SINGLE ROTARY VALVE FOR HYDRAULIC FLUID AND AIR

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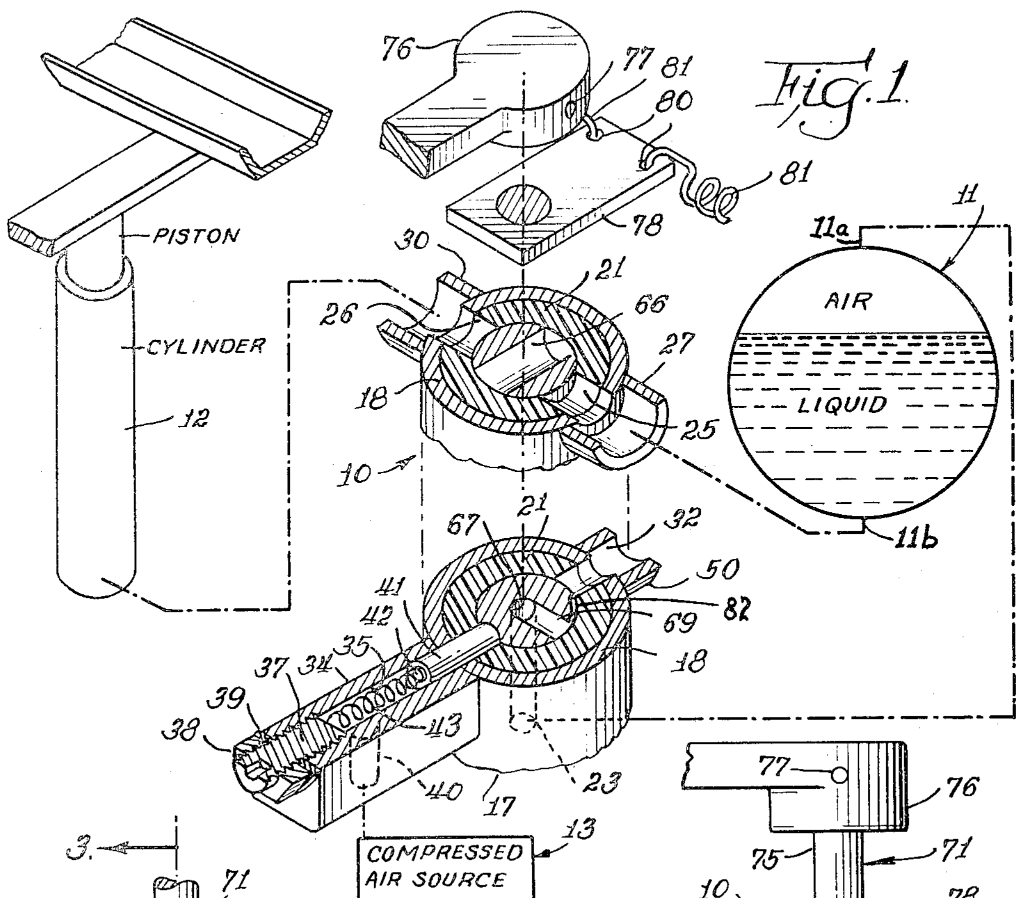

Fig. 1

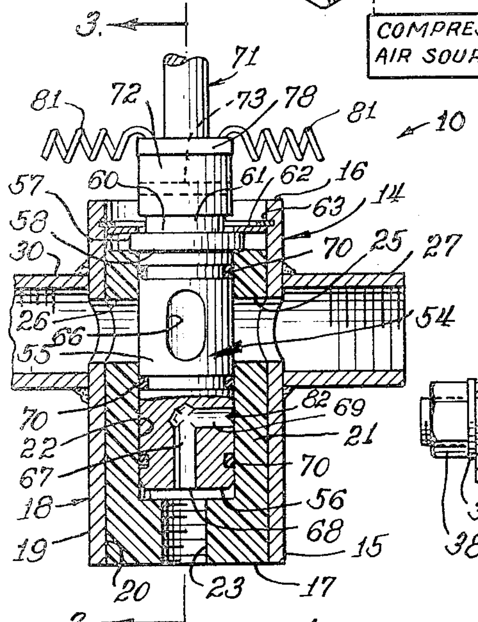

Fig. 2

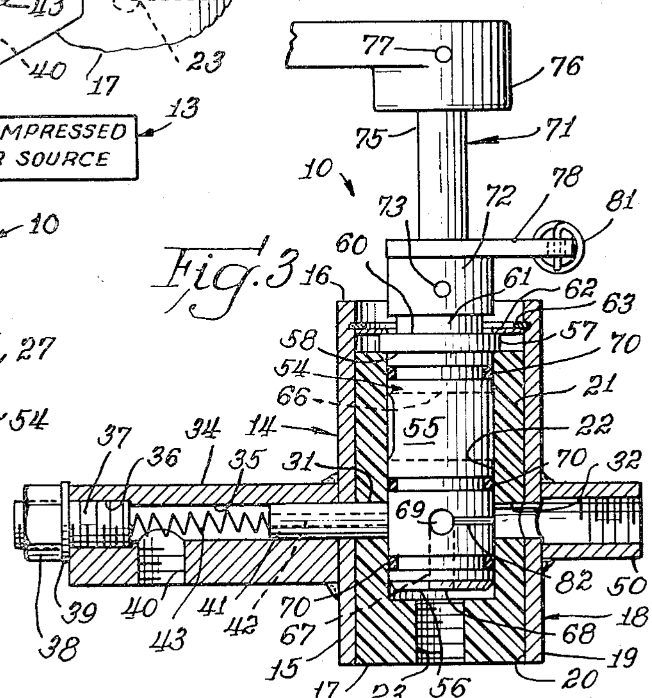

Fig. 3

INVENTOR.
Jesse E. Clarke
BY
Darbo, Robertson & Vandenburgh Att'ys.

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Jesse E. Clarke, Hinsdale, Ill., assignor to Autoquip Corporation, Chicago, Ill., a corporation of Illinois

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ABSTRACT OF THE DISCLOSURE

A unitary two-part control valve is provided for an air-hydraulic system for operating a hydraulic cylinder. The valve comprises a cylindrical valve rotor in a valve body. The valve rotor is biased to an intermediate position and is movable 90 degrees in either direction from the intermediate position to two end positions respectively. At one position along the axis of the rotor there is a hydraulic fluid passage diametrically therethrough. At the same longitudinal position the valve body has diametrically opposed ports, one port being adapted to be connected to the hydraulic cylinder and the other port adapted to be connected to the hydraulic reservoir below the level of the hydraulic fluid therein. At one end of the rotor an air passage extends from the end of the rotor into the interior of the rotor and then radially through the side of the rotor at a second position along the longitudinal axis thereof. At said second position the valve body has two diametrically opposed ports, one being the exhaust port and the second being adapted to be connected to the source of compressed air. At said end of the rotor, the valve body has an air port adapted to be connected to the hydraulic reservoir above the level of the liquid therein. Extending from the radial end of the air passage in the rotor is a small bleed passage about the periphery of the rotor which, when the rotor is in the intermediate position, communicates with the exhaust port. With the rotor in the intermediate position the communication between the cylinder port and reservoir hydraulic port is shut off as is communication between the compressed air port and the air passage in the rotor. When the rotor is moved to one end position the cylinder and the hydraulic reservoir ports are in communication and the air passage of the rotor is in communication with the compressed air port. At the other end position of the rotor the cylinder and the hydraulic reservoir ports are in communication and the air passage of the rotor communicates with the exhaust port.

Background of the invention

One well-known form of hydraulic elevating device uses a single hand-operated valve for controlling the flow of compressed air into and out of a hydraulic fluid reservoir. Movement of the valve to one position permits compressed air to enter and pressurize the hydraulic fluid within the reservoir. The pressurized fluid then flows through an open line to a hydraulic cylinder and raises a platform or the like. To lower the platform the hand operated valve is pivoted to a different position which opens the reservoir to the atmosphere and permits the compressed air therein to exhaust. The platform then lowers accordingly. This type of system is frequently used in automotive garages because of its simplicity and because these garages normally already have a source of compressed air for performing other services such as inflating tires, greasing, etc. A distinct disadvantage of such a system results from the compressible nature of air which gives the lift a generally spongy characteristic making it difficult to accurately position and lock the lift at a height intermediate of its end positions.

Where more accurate control of the vertical positioning lift is required, a second control valve is frequently interposed in the hydraulic fluid line which extends between the reservoir and the hydraulic cylinder. After pressurizing the reservoir by means of the first or compressed air valve, the second valve is opened to control the flow of fluid into the hydraulic cylinder, thus substantially eliminating the spongy effect of the compressed air. Of course, if the lift operator overshoots the desired platform height, he must depressurize the reservoir with the first valve in order to permit drainage from the cylinder to the reservoir by means of the second valve. For this reason, many experienced lift operators save time in accurately controlling the vertical positioning of the platform by endeavoring to simultaneously manipulate both valves, each with a different hand. Until the lift operator is thoroughly experienced in the use of this two-valve system, he is likely to waste time adjusting the platform to the desired height, and more importantly, the confusion resulting from the novice's attempt to use two handles simultaneously could cause injury to objects or people in the path of movement of the platform.

It is therefore a general object of this invention to provide a single control for a pneumatically powered hydraulic lift system which both controls the flow of compressed air into and out of the hydraulic fluid reservoir as well as accurately metering the flow of hydraulic fluid into or out of the lift cylinder.

An advantage and feature of the invention resides in the provision of means by which the reservoir is inherently depressurized after being elevated, thereby eliminating the task of depressurizing the reservoir before lowering the platform.

Other objects, advantages and features will become apparent upon a reading of the following description when taken in conjunction with the following drawings, wherein:

FIGURE 1 is a schematic diagram of a sample form of hydraulic elevating system including a separated and broken away view of the valve assembly which incorporates the principles of one preferred form of the present invention;

FIGURE 2 is a cross-sectional view of the valve assembly shown in FIGURE 1; and

FIGURE 3 is a cross-sectional view of the valve assembly shown in FIGURES 1 and 2 taken substantailly along the lines **3—3** of FIGURE 2.

Although the following disclosure offered for public dissemination is detailed to ensure adequacy and aid understanding, this is not intended to prejudice that purpose of a patent which is to cover each new inventive concept therein no matter how others may later disguise it by variations in form or additions or further improvements. The claims at the end hereof are intended as the chief aid toward this purpose; as it is these that meet the requirement of pointing out the parts, improvements, or combinations in which the inventive concepts are found.

Referring now to the drawings in more detail, control valve assembly generally **10** forms a portion of a hydraulic lift system which also includes a hydraulic fluid reservoir **11** and a hydraulic cylinder **12**. Reservoir **11** has an air connection **11*a*** above the liquid level and a liquid connection **11*b*** below the liquid level. cylinder **12** may be conventionally connected to a vertically movable platform or the like for raising a load. A source of compressed air, as at **13**, is used to power the lift system, this source taking any conventional and convenient form.

Control valve assembly **10** includes a main valve body **14** having an elongate cylindrical portion **15** defining a first end **16** and a second end **17**. Elongate cylindrical portion **15** consists essentially of an outer shell or casing **18** having an outer surface **19** and an inner surface **20**, and a bearing **21** carried therein and bonded to the inner surface **20** of outer casing **18**. Bearing **21** has an elongate cylindrical hole **22** extending axially therein from the first end **16**. Extending between cylindrical hole **22** and the second end **17** of the valve body is an air passage or port **23** threaded internally to adapt it for connection with the air connection **11***a* of the hydraulic fluid reservoir **11**.

Extending transversely through cylindrical portion **15** is a first pair of axially aligned and diametrically opposed ports or holes **25** and **26** forming two separated portions of a hydraulic fluid passage. Hole **25** communicates with fluid connection **11***b* of reservoir **11** by means of an internally threaded connector **27** welded to and forming another portion of the main valve body **14**. Similarly, hole **26** is adapted for fluid communication with cylinder **12** by means of an internally threaded connector **30**, also welded to the outer surface **19** of main valve body **14** and forming a portion thereof.

Longitudinally spaced from holes **25** and **26** are a second pair of axially aligned and diametrically opposed ports or holes **31** and **32** extending through the side walls of main valve body **14**. Holes **31** and **32** are not only spaced from holes **25** and **26** longitudinally along cylindrical portion **15**, but are also rotated 90 degrees relative thereto. Alhough the valve assembly **10** could be designed to work equally well regardless of the angle between the first and second pair of holes, it will be understood that the alignment shown permits the longitudinal distance therebetween to be held to a minimum, thereby minimizing the length of cylindrical portion **15**. Also, this 90 degree offset separates the connections to facilitate the attachment of various fluid lines into the main valve body. Hole **31** comprises one portion of a compressed air inlet passage and hole **32** comprises one portion of an air exhaust passage.

Welded to the outside surface **19** of main valve body **14**, so as to form an integral part thereof, is a laterally extending portion **34** having an elongate guide hole **35** extending therethrough of the same diameter as air inlet hole **31** and in axial alignment therewith. The outermost end of guide hole **35** is threaded as at **36** to receive a spring preload adjusting screw **37** which is threaded over its entire length, a portion of which projects outwardly beyond the outermost end of extension **34**. Screw **37** is locked in place by means of a nut **38** drawn up thereon, and air leakage between screw **37** and threads **36** is prevented by means of a sealing washer **39**. Compressed air gains entry into the central portions of guide hole **35** by way of a transverse passage **40**. Passage **40** is threaded to facilitate connection with compressed air source **13**.

Slideably carried within axially aligned holes **31** and **35** is an elongate and cylindrical sealing member **41** having a central hole **42** extending longitudinally therethrough. Sealing member **41** is preferably constructed of a resilient material such as rubber tubing. A compression spring **43** is interposed in guide hole **35** between adjusting screw **37** and sealing member **41** to bias sealing member **41** towards cylindrical hole **22** in the main valve body **14**. Also welded to the outer surface **19** of main valve body **14**, and in axial alignment with exhaust hole **32**, is an internally threaded connector **50** forming a part of the main valve body **14** and adapting exhaust hole **32** for connection with an air exhaust line. Obviously, main valve body **14** could be fabricated in other ways, as by casting, and less expensive forms might eliminate the use of bearing **19** as a separate element.

Pivotally carried within cylindrical hole **22** of the main valve body **14** are means for selectively permitting and restraining fluid flow through the control valve assembly **10**. Herein these means comprise movable closure means in the form of a valve rotor **54** having an elongate and generally cylindrical portion **55** extending into cylindrical hole **22** from the first end **16** of the main valve body. Innermost end **56** of the valve rotor lies adjacent the second end **17** of the main valve body. The diameter of cylindrical portion **55** is slightly less than the diameter of cylindrical hole **22** to permit relative rotation but prevent fluid leakage therebetween. Valve rotor **54** also has an increased diameter portion **57** lying adjacent the outer end of bearing **21** and forming an inwardly facing shoulder **58** and an outwardly facing shoulder **60**. A reduced diameter portion **61** of rotor **54** extends further outwardly from the first end **16** of the main valve body **14**.

Cylindrical portion **55** is restrained from appreciable axial movement relative to the main valve body. Herein these restraining means include a washer **62** resting against outwardly facing shoulder **60** and held in place by means of a C-ring **63** snapped in place within an internal annular groove provided therefor in the casing **18**, thus preventing withdrawal of the valve rotor. Shoulder **58** rests on the first end portions of bearing **21** thereby preventing further entry of the valve rotor **54** into the cylindrical hole **22**.

Extending transversely through cylindrical portion **55** of the valve rotor is a hydraulic fluid passage **66** positioned longitudinally relative to valve body cylindrical portion **15** between holes **25** and **26** therein. When valve rotor **54** is pivoted such that passage **66** is aligned with holes **25** and **26**, hydraulic fluid can flow therebetween; and when passage **66** is pivoted out of alignment with these holes, hydraulic fluid flow is prevented.

Longitudinally spaced from passage **66** is an internal air conducting passage **67**. One end **68** of air conducting passage **67** opens outwardly at the innermost end **56** of cylindrical portion **55** where it is in fluid communication with air passage **23** in the main body. The other end **69** of passage **67** opens outwardly through the side wall of rotor cylindrical portion **55** at a longitudinal position on the valve body corresponding to the longitudinal posion of holes **31** and **32** in the main valve body. Side opening **69** of air conducting passage **67** is generally 90 degrees displaced from each of the side openings of the hydraulic fluid passage **66**. It can thus be seen that selective pivoting of the valve rotor permits fluid (air) communication between passage **23** and hole **31** or between passage **23** and hole **32**, or alternatively, prevents fluid communication when side opening **69** is not aligned with either of the holes **31** and **32**.

Three O-ring seals **70** are mounted on rotor cylindrical portion **55** to prevent the escape of fluid out of the valve body or between the air conducting passages and hydraulic fluid conducting passage. One is positioned between shoulder **58** and passage **66**; another is positioned between passages **66** and **67**; and the third is positioned between side opening **69** and innermost end **56** of valve rotor **54**.

Means are provided for permitting selective pivotal movement of the valve rotor, and herein these means include a member **71** having end portion **72** mounted over reduced diameter portion **61** of the valve rotor and rigidly affixed thereto by means of a pin **73**. The other end **75** of member **71** carries a handle **76** pinned thereto as at **77**. Member **71** also includes a transversely protruding arm **78** having a pair of holes **80** therein in which are mounted a pair of tension springs **81** for biasing the valve rotor **54** to the angular position shown in FIGURES 1 and 2, thereby normally maintaining the fluid passages in a closed condition.

Reservoir pressure relief means are also provided, and herein these means comprise a small bleed passage in the form of a surface indentation or scratch **82** extending peripherally around rotor **54** generally 90 degrees between the side opening **69** of air conducting passage **67** to a position exposed to hole **32** when the valve rotor is in its biased closed position. This indentation is relatively small to permit a relatively slow depressurization of the reservoir, the reasoning for which will be discussed in greater detail later.

In operation, and assuming the valve rotor **54** is biased closed, hole **35** is at a high pressure because it is connected by way of an open line to the compressed air source **13.** This pressure is exerted through central hole **42** in the sealing member **41**, but is unable to escape to exhaust hole **32** between the outer surface of cylindrical rotor portion **55** and the inner surface of bearing **21** because of an air-tight seal formed between resilient sealing member **41** and cylindrical portion **55** under the bias of compression spring **43.**

When it is desired to raise the lift platform or the like, handle **76** is pivoted approximately 90 degrees in a clockwise direction (FIGURE 1) from its biased closed position to align the side opening **69** of air conducting passage **67** with hole **42** in the sealing member **41.** Generally concurrently therewith, hydraulic fluid conducting passage **66** in the valve rotor becomes aligned with holes **25** and **26** in the main valve body. As compressed air passes through rotor passage **67** and bearing passage **23** into the hydraulic fluid reservoir, the pressure in the reservoir increases and forces hydraulic fluid from the reservoir through passage **66** in the valve rotor and into the hydraulic cylinder **12.** As the platform approaches its desired height, its rate of ascent can be diminished by pivoting the handle **76** and closing down the opening formed by hydraulic fluid passage **66.** When the exact height is reached the valve is manually pivoted to close off hydraulic fluid passage **66** and the platform is fixed.

In the well known systems using two separately controlled valves, it is necessary to exhaust the air pressure from the reservoir before lowering the platform in order to permit the fluid to flow back into the reservoir. However, the system herein disclosed eliminates the necessity of first exhausting this air pressure prior to lowering the lift platform. The small passage or indentation **82** permits this pressure to bleed off and exhaust through **82** after the lift has been elevated and the valve rotor **54** has been biased to its closed position. This bleeding off provides a safety feature to ensure that the residual pressure in the reservoir does not cause the lift platform to unexpectedly raise prior to lowering when the valve rotor is rotated in the direction permitting lowering of the platform.

Therefore, when it is desired to lower the platform, handle **76** is merely rotated 90 degrees in the opposite direction from that required to raise the platform. The hydraulic fluid is then free to flow from the cylinder **12** through passage **66** in the valve rotor and back to the hydraulic fluid reservoir **11.**

It can thus be seen that the control valve assembly permits single handle control of a hydraulic lift platform, and also eliminates the necessity of exhausting air pressure from the reservoir prior to lowering the platform.

I claim:

1. In a gas-liquid hydraulic system for use with a source of compressed gas and comprising a fluid reservoir having a gas connection above the fluid level therein and a liquid connection below the fluid level therein, a fluid operated cylinder normally urged to the retracted position, a valve means connected to the cylinder, the source, the gas and fluid connections and to a gas exhaust to control the flow of gas between the source, the exhaust and the reservoir and to control the flow of liquid between the reservoir and the cylinder, the improvement comprising: said valve means being a unitary two-part valve including a valve body with a valve member movable therein between three positions to wit, a first end position, an intermediate position and a second end position, one part of said valve means comprising a first portion of said member defining a first fluid passage and a first portion of the body defining a cylinder port and a liquid connected reservoir port, said first fluid passage communicating with both ports when the member is in the first and second positions and blocking communication between the ports when the member is in the intermediate position, the second part of the valve means comprising a second portion of said member defining a second fluid passage, a second portion of the body defining a gas source port, an exhaust port and a gas connected reservoir port, said second fluid passage communicating with said source port and with said gas connected reservoir port when said member is in the first position and with said exhaust and said gas connected reservoir port when the member is in the second position, whereby when said member is in the first position gas will be fed from said source to said reservoir and liquid will flow from the reservoir to the cylinder and when said member is in the second position gas will flow from the reservoir to exhaust and liquid will flow from the cylinder to the reservoir.

2. In a system as set forth in claim **1**, wherein said second portion of said member defines a bleed passage of smaller gas transmitting capacity than said second fluid passage, said bleed passage being in communication with said gas connected reservoir port and with the exhaust port when the member is in the intermediate position.

3. In a system as set forth in claim **2**, including resilient means connected to said member to resiliently urge said member to said intermediate position.

4. In a system as set forth in claim **3**, wherein said valve member is a solid of revolution about an axis, said first fluid passage extending radially through said member, said second fluid passage extending from the interior of the member to one side and from the interior of the member to the adjacent end of the member, said body defining an interior opening of substantially the same configuration as the exterior of the member to fit closely thereabout, said cylinder port and said liquid connected reservoir port being diametrically opposite each other in the body and in the same position along the axis as the ends of said first passage, said gas source port and said exhaust port being diametrically opposite each other in the body and in the same position along the axis as the side end of the second fluid passage, said gas connected reservoir port being in the end of the body corresponding to said adjacent end of the member and in communication with the second fluid passage at said adjacent end; and including O-ring seals between the body and the member at each side of said two passages.

5. In a system as set forth in claim **4**, wherein said member is cylindrical and said bleed passage is a groove at the exterior of the member.

6. In a system as set forth in claim **1**, wherein said valve member is a solid of revolution about an axis, said first fluid passage extending radially through said member, said second fluid passage extending from the interior of the member to one side and from the interior of the member to the adjacent end of the member, said body defining an interior opening of substantially the same configuration as the exterior of the member to fit closely thereabout, said cylinder port and said liquid connected reservoir port being diametrically opposite each other in the body and in the same position along the axis as the ends of said first passage, said gas source port and said exhaust port being diametrically opposite each other in the body and in the same position along the axis as the side end of the second fluid passage, said gas connected reservoir port being in the end of the body corresponding to said adjacent end of the member and in communication with the second fluid passage at said adjacent end; and including O-ring seals between the body and the member at each side of said two passages.

7. In a system as set forth in claim **6**, including resilient means connected to said member to resiliently urge said member to said intermediate position.

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MARTIN P. SCHWADRON, *Primary Examiner.*

B. L. ADAMS, *Assistant Examiner.*