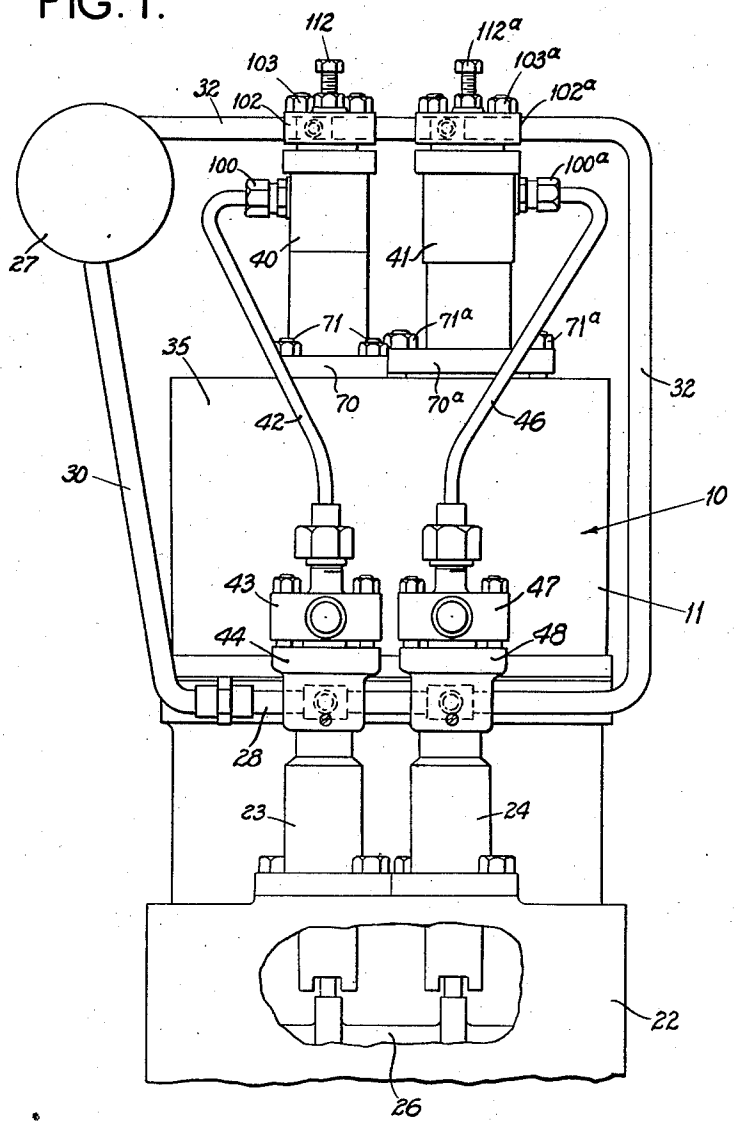
Sept. 11, 1945. H. SCHRECK 2,384,701

HYDRAULIC OPERATING UNIT

Filed May 8, 1943 2 Sheets-Sheet 1

FIG. 1.



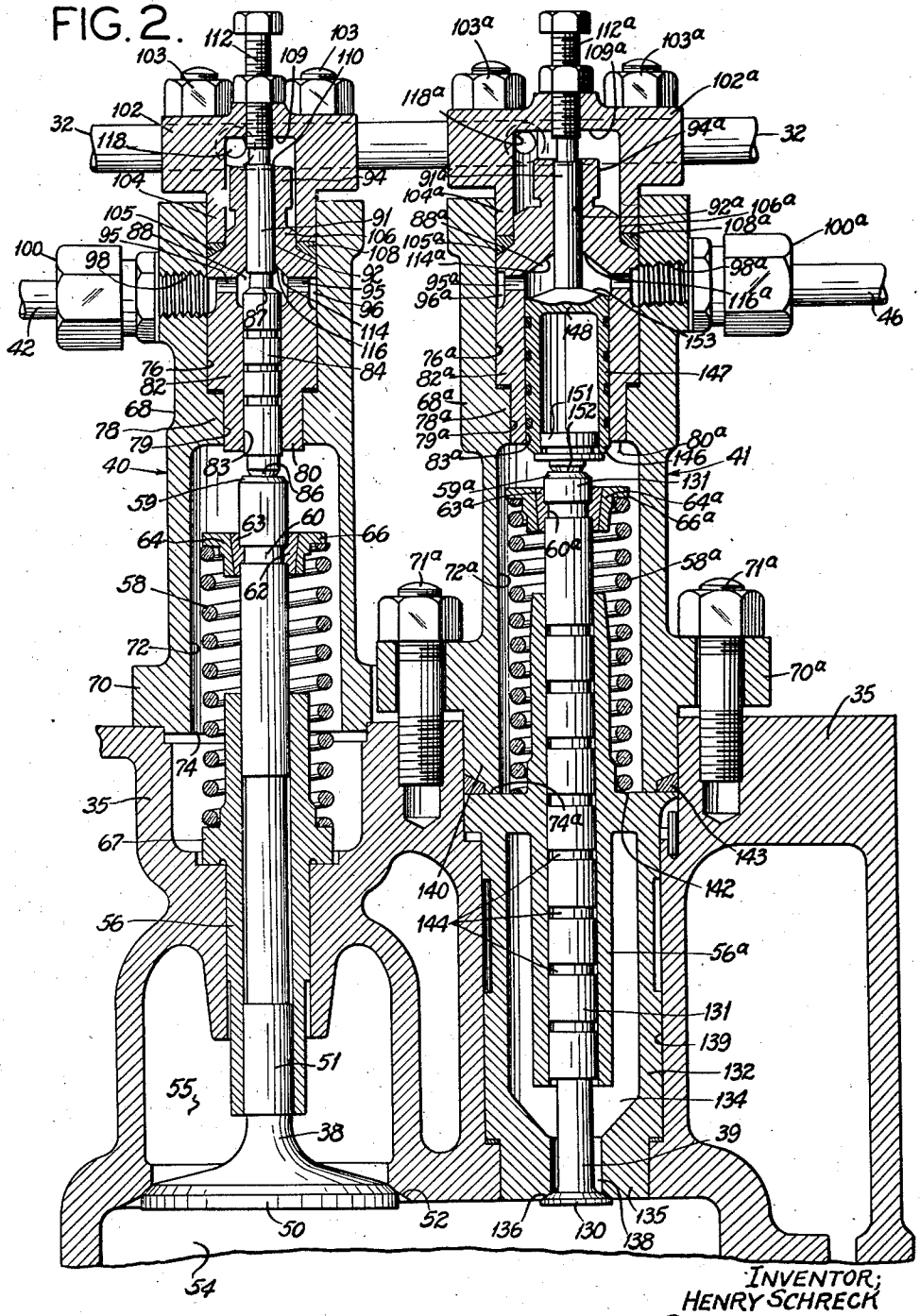
INVENTOR;
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FIG. 2.



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UNITED STATES PATENT OFFICE

2,384,701

HYDRAULIC OPERATING UNIT

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Application May 8, 1943, Serial No. 486,194

1 Claim. (Cl. 123—90)

This invention relates to hydraulic operating units, and more particularly to improvements in fluid pressure actuated devices of a character suitable for use with internal combustion engines, as for effecting periodic movement of valves associated with the engine cylinders.

An object of the present invention resides in the provision of an improved and compact reciprocal motor unit of fluid pressure operated type, which includes certain novel features of construction making for a dependable and uniform actuating movement, and includes provisions for readily adjusting the motor for differing operating conditions.

Another object is to provide a unit of this character, suitable, for example, for engine valve actuation, and which includes provisions effective for removing air and other gases from the actuating fluid delivered to the motor, during pressure operation of the device.

A further object is to provide a hydraulic motor unit as indicated, wherein fluid under pressure is utilized to cause a linear movement in one direction, and mechanical means of yieldable character employed for operating the motor in the opposite direction, and coincidentally therewith, for restoring the fluid motor of the unit to an initial, inoperative condition.

Other objects and advantages of the invention will appear hereinafter in the following description thereof, as exemplified by the accompanying drawings.

Although it is to be understood that the fluid operated means of the present invention is fully susceptible of general utility, it is preferred to illustrate the assembly in a preferred form, in association with an internal combustion engine for causing valve operation events in conjunction with the engine cylinder, and also in association with a hydraulic valve-actuating system of the character fully disclosed by my copending application for Hydraulic operation of mechanism, filed on May 8, 1943, and bearing Serial No. 486,192.

Accordingly, in the drawings:

Fig. 1 is an assembly view in elevation, of an engine shown in part only, incorporating a hydraulic valve actuating system of the type disclosed and claimed in the aforesaid application, and the hydraulic actuator assembly forming the subject of the present invention; and

Fig. 2 is an enlarged vertical section through the valves and valve actuator assemblies of improved construction, in which the valves shown, serve as fuel and air control agencies of the engine.

Referring first to Fig. 1 of the drawings, there is illustrated an internal combustion engine generally designated by the numeral 10, including in the portion thereof shown, a single cylinder assembly 11 extending above the engine crankcase (not shown). The engine includes a camshaft 26, for which a suitable housing 22 may be provided, and on which are mounted a pair of fluid pumps 23 and 24 of reciprocating plunger type, each of which is cam-actuated preferably from the camshaft 26 shown fragmentarily in Fig. 1, within the casing 22. All of the pumps are supplied with a suitable hydraulic operating fluid, from a common source provided either by a tank or a suitable fluid pump, as indicated at 27, through a supply header 28 connected to each of the pumps. A feed pipe 30 connects the source 27 to one end of the header 28, while the opposite end of header 28 is connected to source 27 by a return pipe 32. In the event a tank is employed to provide the fluid source 27, it may be somewhat elevated relative to the header 28, in order to provide a desired initial fluid-pressure head in the header. There is thus provided a closed fluid system with fluid circulation therein maintained during engine operation, through the pressure flow function of the source 27 when constituted by a fluid pump, or by the suction and fluid by-pass functions of the several pumps 23—24, as fully described in my said copending application.

Within the cylinder head 35 of the cylinder 11 are a pair of valves 38 and 39 (Fig. 2) the valve 38 serving as an air valve in conjunction with the cylinder, while the adjacent valve 39 controls fuel admission. These valves are actuated respectively, by hydraulic valve-motors 40 and 41 suitably mounted on the cylinder head as shown. Actuating fluid is delivered to the valve operating motor 40 by the pump 23 through a conduit connection 42 and a control valve device 43 arranged by preference, at the discharge end 44 of the pump. In a similar manner, actuating fluid for the fuel valve operating motor 41, is delivered by pump 24 through a conduit connection 46 and a valve device 47 similar to the valve device 43, at the discharge end 48 of the pump. These valve and motor units 38—40 and 39—41 which incorporate the features of improvement constituting the subject of the present invention, will be now described in detail, in association with the engine cylinder head. The valve devices 43 and 47 are or may be of the general type and function disclosed in the aforesaid copending application, and claimed in a further copending application Serial No.

486,193, filed May 8, 1943, by this applicant and entitled Fluid flow control device.

Fig. 2 illustrates in vertical section, two of the valves of the engine, and the hydraulic actuating motors therefor, as provided for the cylinder shown, and similarly provided for each cylinder of a multi-cylinder engine. Describing first the valve 38 and its operating motor 40, this structure includes a valve head 50 and vertically extending valve stem 51, and is arranged in the cylinder head 35 so that the valve head 50 controls the opening and closing of a port 52 between the cylinder chamber shown in its upper portion at 54, and a chamber 55 formed in the cylinder head. The valve stem 51 is guided for vertical reciprocable movement, by a sleeve member 56 fixed in the cylinder head 35, the valve stem projecting upwardly therebeyond for operative association with the motor 40 and a valve-closure spring 58. As appears, the valve stem below its upper end 59, is circumferentially recessed at 60, for the reception of the internal flange 62 of a tapered split collar 63. The split collar in turn, is engaged by an internally tapered annular ring 64 having an outstanding circular flange 66. Through the collar 63 and the wedged connection of the ring 64 therewith, the ring is thus fixed to the valve stem. The spring 58 has its upper end bearing against the ring flange 66, and its lower end abutting a flanged portion 67 of the sleeve member 56, being thus arranged to load or bias the valve stem 51 in the upward direction for seating the valve head 50 to close the port 52.

Although for convenience of description certain of the elements are herein referred to as of vertical disposition, and hence reference made to upward or downward portions or movements, such terminology is not to be taken in any sense of limiting possibilities of location or arrangement.

The valve motor 40 includes a casing 68 having a mounting flange 70 engaging the cylinder head 35 and secured thereto, as by the studs 71 (Fig. 1), the casing providing a lower chamber 72 open at its lower end 74, for receiving the upper portions of the valve stem 51 and spring 58. The chamber 72 may be open to the atmosphere, in order to prevent air entrapment in the chamber, as through any suitable venting passage (not shown). Casing 68 further has an upper chamber 76 open at the top, and separated from the lower casing chamber 72 by a transverse wall 78. The wall 78 is apertured centrally thereof at 79, to receive therethrough the lower end portion 80 of a cylinder member 82 seated in the upper chamber 76. The member 82 provides a cylinder bore 83 for a vertically movable piston 84 in axial alignment with the valve 38 and having its lower end 86 normally engaging the upper end 59 of the valve stem 51. The piston has a pressure head 87 exposed in an enlarged cylinder pressure chamber 88 at the upper end of the bore 83, and is provided with a stop element or pin-like member 91 extending beyond the head 87 and through a pin bore 92 formed in the head section 94 of the cylinder member 82. Fluid-pressure admission to the cylinder chamber 88, is effected through radial passages 95 in the cylinder member, communicating with an external annular channel 96 therein, which in the assembly positionment of the cylinder, aligns with a threaded passage 98 through the wall of the casing 68. Communicating with the passage 98 is the fluid conduit 42 leading from the pump unit 23 (Fig. 1), connection of the conduit in fluid flow association with the passage 98 being made in a fluid-tight manner by a detachable coupling element 100 threadedly received in passage 98, as shown.

The cylinder 82 is retained in assembly with the casing 68 by a removable cap element 102 suitably secured to the upper end of the casing, as by the bolts 103, the lower end 104 of the cap projecting within the upper casing chamber 76 for assembly abutment with an annular shoulder 105 on the cylinder head portion 94, formed by reducing the cylinder head as shown at 106. A suitable gasket 108 of a compressible character is, by preference, interposed between the cap and cylinder shoulder 105 to effect a fluid-tight seal at this zone.

The reduced cylinder head portion 106 is thereby adapted for reception in the cap 102, to cooperate therewith in defining a chamber 109 within the cap 102 for a purpose which will appear. The upper end 110 of piston stop pin 91 is exposed in chamber 109 for abutment with an adjusting screw 112 extending through the top of the cap 102. It will now appear that through the screw 112 and pin 91, the upward extent of piston movement and hence of the valve stem 51, may be controlled to any desired degree, as for effecting a condition wherein, when the valve 50 is fully closed, the valve stem 51 and piston 84 will be in substantial engagement as illustrated, whereby to avoid, or at most have but an irreducible minimum of initial lost motion of the piston relative to the valve stem.

In the operation of the valve as thus far described, admission of fluid under pressure into the pressure chamber 88, will effect a downward displacement of piston 84 and a corresponding downward movement of the valve stem 51 and valve head 50, to open the port 52 into the engine cylinder chamber 54. Upon release of fluid pressure in motor chamber 88, the valve return spring 58 then restores the valve 50 to port-closing position and coincidentally therewith, returns the piston 84 and stop element 91 to an initial position wherein the stop pin 91 is substantially in abutment with the adjusting screw 112.

An important feature of the presently improved hydraulic operator assembly is found in the provisions for removing air and other gases from the motor actuating fluid, upon its admission under pressure to the motor chamber 88. The piston stop pin 91 which extends through cylinder head bore 92, is given a predetermined degree of clearance therein sufficient to permit pressure-flow of gases and a minimum quantity of fluid entrapping such gases, from the pressure chamber 88, between and along the opposed surfaces of the bore 92 and pin 91 therein, and into the upper chamber 109 heretofore described, for ultimate discharge therefrom. In order to assure delivery of gases into the vent passage or gas bleed duct through bore 92 as above described, the uppermost or top wall 114 of the pressure chamber 88, is inclined upwardly and convergently toward the vertical axis of the cylinder head bore 92, to terminate in the circular margin 116 defining the lower open end of the bore 92. By reason of the predetermined clearance of the pin 91 in bore 92, the margin 116 cooperates with the adjacent opposed surface of the pin to form an inlet port opening for the leakage passage or bleed duct through the bore 92. Thus as air and any other gases or vapors in the fluid under pressure in chamber 88, collect in the upper zone of the chamber, such air and gases will be concentrated at the leakage port by reason of the

upward convergence or umbrella-like formation of the chamber top wall 114, for pressure discharge into and along the clearance passage in bore 92.

Such air and other gases together with a small amount of fluid, which thus attain and accumulate in the cap chamber 109, may be readily removed therefrom in any suitable manner. As presently preferred, a discharge opening 118 is provided through a wall portion of the cap element 102 near the upper zone of the chamber 109, and is connected to the return conduit 32 of the fluid circulatory system hereinbefore described, by a suitable conduit connection (not shown). Thus fluid and gases received under pressure in the cap chamber 109, may readily pass into conduit 32 for delivery to the tank or pump unit 27, wherein the gases may be vented to atmosphere in any suitable manner not presently illustrated.

The valve and actuating motor assembly 39—41 controlling fuel admission to the engine cylinder is in all important respects as to structure and function, substantially similar to the above described assembly 38—40. Hence in the following description thereof, those parts which correspond to the similar parts of the first-described valve and operating assembly, will be designated by the same reference numerals, differentiated however, by the letter suffix "a."

Valve 39 includes a valve head 130 and vertically extending valve stem 131, the latter being guided in a sleeve 56a which is here formed as a part of a cylinder head insert member 132 providing a fuel-receiving chamber 134 and having its lower end 135 exposed to the engine cylinder chamber or clearance 54. A port opening 136 and port passage 138 formed in the lower end portion of member 132, serve to communicate the fuel supply chamber 134 with the cylinder chamber 54, and the valve head 130 as shown, is arranged to control the port 136. The engine cylinder head 35 is recessed as at 139, for receiving the insert member 132, and the latter is retained therein through the lower projecting end 140 of the valve motor casing 68a which engages the upper end 142 of member 132 through a sealing gasket 143, the casing 68a in turn being secured to the cylinder head 35 as by the casing flange 70a and studs 71a. The valve stem 131 vertically movable in sleeve 56a, is sealed against fuel leakage upwardly therealong by a plurality of ring grooves 144 of suitable character, and supports at its upper portion 59a a split collar 63a engaged in the stem groove 60a. The collar is tapered on its external surface as shown, and supports thereon the correspondingly tapered ring 64a. A flange 66a on ring 64a provides a bearing abutment for the upper end of valve-closing spring 58a, the spring thus loading the valve stem 131 for urging the same upwardly to seat the valve head 130 at the fuel inlet port 136.

The casing 68a for the valve motor 41, provides the lower chamber 72a open at its lower end 74a, for receiving the upper portions of the valve stem 131 and spring 58a, and open to the atmosphere near its upper end, as through a vent opening (not shown). An upper chamber 76a formed by the casing 68a and separated from the lower chamber therein by the transverse wall 78a, has mounted therein a cylinder member 82a which differs from the cylinder member 82 of valve motor 40, in that the diameter of the cylinder bore 83a is somewhat greater. The lower end 80a of cylinder 82a is projected downwardly through an opening 79a in the casing wall 78a, in order that the lower end 146 of a piston 147 may be exposed in the lower casing chamber 72a, for abutting engagement with the upper end 59a of the valve stem 131. The piston 147 being larger in diameter than the piston 84 of valve motor 40, is preferably of hollow construction providing an integral piston head 148, and being open at its lower end 146. The latter open end of the piston is closed by a wall insert 151 which is formed to provide an abutment projection 152 for engaging the valve stem 131, as shown. The piston head 148 has its external pressure surface 153 exposed in an enlarged cylinder pressure chamber 88a, and is provided with a stop pin 91a which projects therebeyond through a bore 92a in the cylinder head 94a. As in the instance of valve motor 40, fluid-pressure communication with the cylinder chamber 88a, is effected through radial passages 95a in cylinder 82a, external annular cylinder wall channel 96a, and casing passage 98a in communication with the fluid conduit 46 leading from pump unit 24 (Fig. 1). Assembly connection of the fluid conduit 46 may be made as by a fluid-tight coupling 100a.

Cylinder 82a is retained in casing 68a by removable cap member 102a which in turn is suitably secured to the upper end of the casing by studs 103a. The lower end 104a of cap 102a projects within the upper casing chamber 76a for assembly engagement with the annular shoulder 105a on the cylinder head 94a, the shoulder being formed by reducing the cylinder head as at 106a. A suitable gasket 108a interposed between the cap end 104a and the cylinder shoulder 105a, serves to effect a fluid-tight seal in this zone. The reduced head 106a of the cylinder cooperates with the cap 102a to form a chamber 109a within the cap, for receiving gases and leakage fluid from the pressure chamber 88a in the manner heretofore described in connection with the valve motor 40. As before, the stop pin 91a is exposed at its upper end, in the cap chamber 109a for engagement with a positioning screw 112a threaded in the cap. For the purposes heretofore described, the pin 91a is given a predetermined clearance in the pin bore 92a, and the upper wall 114a of pressure chamber 88a is inclined upwardly and convergently toward the axis of the bore 92a, to terminate in the margin 116a defining the lower open end of the pin bore. The margin 116a in cooperation with the adjacent surface of pin 91a, forms the inlet port for the leakage passage or bleed duct through the bore 92a. Discharge of gases and fluid collecting in the head chamber 109a is as before, effected through the return conduit 32.

Each of the pump units 23 and 24 is of a fluid impulse delivery character controlled in its fluid pressure output in the manner fully described in my copending application Serial No. 486,192 first hereinbefore referred to, for example, a governor (not shown).

In the operation of the improved valve and actuator assemblies as now described, fluid pressure delivery by the pumps 23 and 24 to the respective valve motors 40 and 41 of valves 38 and 39, will establish fluid pressure in the motor chambers 88 and 88a to cause downward displacement of the respective motor pistons 84 and 147. As a result, the valves 38 and 39 will be similarly downwardly displaced to open the ports 52 and 136 for the control, for example, of air and fuel communication with engine cylinder chamber 54. The extent and duration of valve opening in each

case, is dependent of course, upon the continuance of pump pressure by the pumps 23 and 24 as regulated. Also during fluid pressure actuation of the valves, such air and other gases as may be entrapped in the fluid delivered into the motor chambers 88 and 88a, will be vented in the manner described herein, to the upper chambers 109 and 109a, for ultimate discharge to the atmosphere, for example, as through the return conduit 32 and the fluid source 27.

Upon pump release of fluid pressure application on the respective valves 38 and 39 in the cycle of pump operation, the valve springs 58 and 58a become effective to seat the valves 38 and 39 on the ports 52 and 136 respectively, and coincidentally in each assembly, to restore the motor pistons 84 and 147 to their initial inoperative positions as shown by Fig. 2. During the spring-effected return displacement of the motor pistons, the pressure exerted thereby upon the fluid in the chambers 88 and 88a will be sufficient to cause a return flow of fluid through the pumps and into the header 28, the rate and conditions of such return flow however being regulated by the control devices 43 and 47 in the manner fully described in each of the copending applications hereinabove referred to. Control of the rate and conditions of return flow from the motor chambers 88 and 88a thus affords determination of the rate of valve closure under the urge of the return springs 58 and 58a, and hence permits a desirable degree of valve cushioning in the closing displacement of the cylinder valves. This provision also avoids objectionable surges in the fluid return flow through the pumps, which otherwise might tend to produce a fluid hammering effect upon the valves and motor parts, with attendant excessive wear and sometimes ineffective valve closure.

The foregoing now fully describes the improved valve mechanism of the present invention, as illustrated by the accompanying drawings. Although only preferred embodiments thereof are herein disclosed in detail, it will be understood of course, that certain alterations in or modifications of the several parts and arrangement thereof may be made without departing from the spirit and full intended scope of the invention as defined by the hereunto appended claim.

I claim as my invention:

A hydraulically actuated valve assembly of the character described, in association with means providing a fluid port, comprising a valve member controlling said port, yieldable means serving to bias said valve member toward port-closing position, a housing providing a fluid chamber therein, a piston in said chamber movable from an initial position responsively to fluid-pressure in the chamber, for actuating said valve member to a port-opening position, said piston upon release of fluid-pressure in the chamber, being returned to said initial position responsively to port-closing movement of said valve member as effected by said yieldable means, and abutment means extending from and in a direction coaxially of said piston, for determining the initial position of said piston in the chamber, said abutment means including an element movable by said piston and an adjusting member therefor, located exteriorly of said fluid chamber, said element cooperating with an adjacent portion of said housing to define a vent passage for said chamber.

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