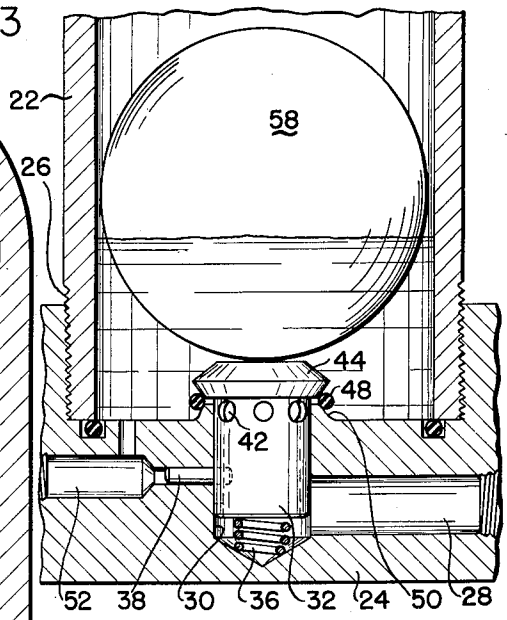
Jan. 17, 1956 H. M. PURCELL 2,731,038

HYDRAULIC ACCUMULATOR

Filed Jan. 26, 1953

FIG-3



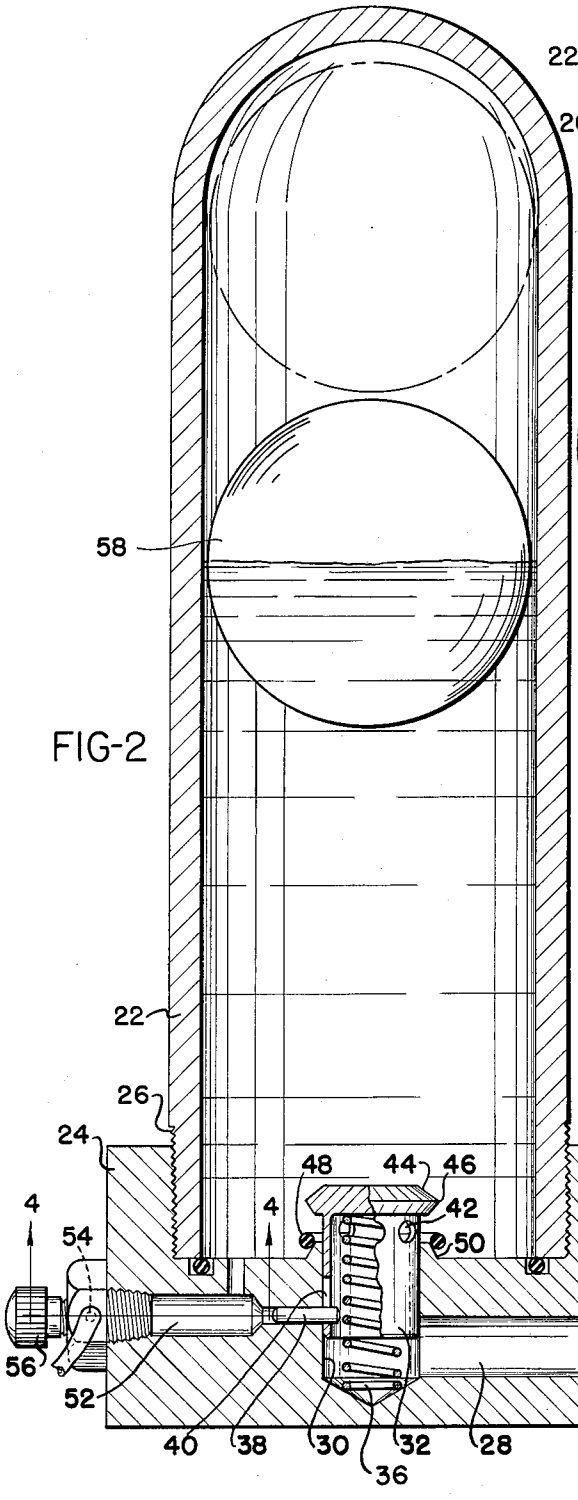


FIG-2

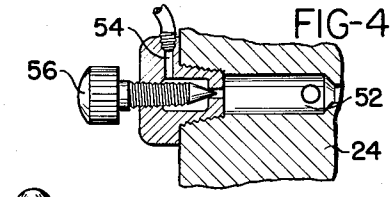


FIG-4

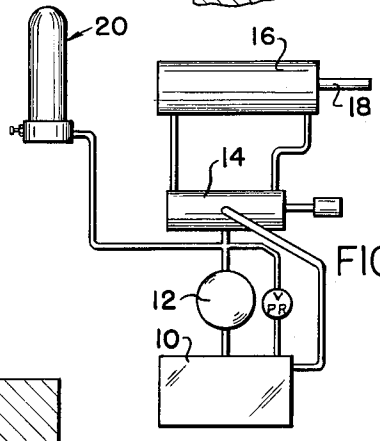


FIG-1

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HYDRAULIC ACCUMULATOR

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3 Claims. (Cl. 138—30)

This invention relates to a hydraulic accumulator and a method of operation thereof.

In the hydraulic art the necessity or desirability often arises of providing a supply of fluid for driving a work member at a high rate of speed during a short interval of time. Normally it is uneconomical to provide pumping capacity sufficiently large for this purpose because the pumping capacity would be operating idle most of the time and thus would represent loss of energy and excess investment.

To provide such a supply of fluid it has been more or less common practice to use a hydraulic accumulator which will store the desired quantity of fluid under pressure and release the fluid at the proper time during the work cycle, the accumulator being charged by the pump during the idle period thereof.

In general, such accumulators are of either the diaphragm type or the piston type. In the diaphragm type a chamber is provided that is divided by a flexible diaphragm and gas under pressure is supplied to the chamber on one side of the diaphragm and hydraulic fluid is supplied to the chamber on the other side of the diaphragm. That type of accumulator is relatively effective but involves the disadvantages of embodying a diaphragm member which is subject to wear and rupturing and which is relatively expensive when it is constructed with sufficient strength to withstand the stress imposed thereon. Further, a diaphragm accumulator of any substantial capacity, must necessarily be of relatively large diameter.

With a piston type of accumulator a cylinder is provided in which a piston is reciprocably mounted with gas being supplied to one side of the fluid and the hydraulic fluid which is to be stored under pressure being supplied to the other side thereof. With an accumulator of this type the disadvantage arises of the necessity of providing an accurately machined bore and piston, and packing for the piston, all of which involves expense with the packing having a tendency to wear out and with the friction presented by the piston in its movements in the accumulator representing a substantial energy loss.

Still another type of accumulator employs a container closed at the top and to which a gas is supplied. A supply of hydraulic fluid to the bottom of the accumulator will cause the gas to be compressed and in this manner the fluid is stored under pressure. This type of accumulator has the very serious fault that the gas will be dissolved to a certain extent in the hydraulic fluid and this tendency will increase as the pressure within the accumulator increases.

Having the foregoing in mind it is a primary object of the present invention to provide a hydraulic accumulator which eliminates these faults and which is also inexpensive to construct and which has improved operating characteristics.

A still further object is the provision of an accumulator of substantial capacity which can be constructed so as to

be of relatively small diameter thus lending itself well to being utilized in factories where space is at a premium.

A still further object of this invention is the provision of a hydraulic accumulator having the simplicity and efficiency of a simple gas type accumulator but in which the difficulties attendant to that type of accumulator are eliminated.

Another particular object of this invention is the provision of an accumulator in which a predetermined minimum liquid level is maintained at all times thereby preventing any loss of gas therefrom.

These and other objects and advantages of the invention will appear more clearly in the following specification in connection with the accompanying drawings, in which:

Figure 1 is a schematic view showing a hydraulic system employing an accumulator;

Figure 2 is a vertical sectional view through a hydraulic accumulator according to my invention;

Figure 3 is a fragmentary sectional view showing the lower part of the accumulator with the discharge valve in closed position; and

Figure 4 is a sectional view indicated by line 4—4 on Figure 2 showing a gas admitting valve forming a part of the accumulator structure.

Referring to the drawings somewhat more in detail the circuit of Figure 1 comprises a reservoir **10** from which fluid is drawn by a pump **12** to be discharged under pressure to the inlet of a four-way control valve **14** which has service ports connected with opposite ends of a hydraulic motor **16** having a reciprocable ram **18**.

The hydraulic accumulator of the present invention, indicated generally at **20** is connected to the conduit leading from pump **12** to valve **14**. By this arrangement, whenever the pump **12** is discharging in excess of what is required by motor **16**, the accumulator **20** will be charged with fluid under pressure and then, when the requirements of motor **16** are in excess of the discharge capacity of pump **12**, fluid will be discharged from the accumulator and add to the pump discharge and actuate motor **16** at the desired rate.

It will be understood that the Figure 1 illustration is only exemplary of the several manners in which an accumulator of the nature with which this invention is concerned can be employed.

Turning now to Figures 2, 3 and 4, the accumulator **20** comprises a cylindrical container part **22** closed at the top and open at the bottom and connected to base member **24** as by threads **26** and which base member comprises a flow passage **28** through which the accumulator is filled and through which the accumulator discharges. Flow passage **28** comprises a cylindrical portion **30** on the axis of container **22** and in which is reciprocably mounted valve member **32** that is bored upwardly from the bottom and which is closed at the top. A spring **34** urges valve member **32** towards its Figure 2 position and a pin **38** fixed in base **24** and extending into slot **40** limits the said upward movement of the valve member.

When the valve member is in its upper position the radial bores **42** therein communicate the interior of container **22** with the inside of valve member **32** and thus with the flow passage **28**.

The extreme upper end of valve member **32** comprises an outwardly projecting portion **44** having at least its underside beveled as at **46**.

This projecting portion of the valve member is availed of for interrupting communication between container **22** and flow passage **28** when the valve member is moved downwardly to its Figure 3 position by engagement of the said bevel **46**, with an annular resilient O ring **48**

that is mounted on the slightly raised portion 50 surrounding the upper end of cylindrical portion 30.

The base 24 is also provided with a gas supply passage 52, best seen in Figure 4, adapted for being supplied with gas or air under pressure through an opening 54 and with there being a valve 56 provided for closing passage 52 during normal operations.

An important feature of my invention resides in the float element 58 which, in the preferred form of my invention takes the shape of a ball but could, conceivably, be of other shapes if so desired. The float element 58 has the important characteristic of floating about half in and half out of the liquid in container 22 and is of about the same diameter as container 22. The float element 58 has sufficient clearance within the container 22 that it will freely rise and fall within the container with the liquid level but greatly reduces the area of contact between the gas entrapped in the upper end of the container and the hydraulic fluid in the bottom of the container. The float element 58 therefore serves to eliminate the principal drawback of a gas type accumulator because the gas will have very little tendency to pass into the hydraulic fluid over the extremely limited area of contact between the gas and fluid.

The float element can be constructed of any suitable material having the proper strength to withstand collapsing from the pressure to which it will be subjected and which material is resistant to attack by the hydraulic fluid and can be either solid or hollow as desired so long as it will float on the hydraulic fluid and effect a substantially complete separation thereof from the gas in the container.

An important function of float element 58 is illustrated in Figure 3 wherein it will be seen that when the liquid level in container 22 reaches a predetermined lower level the float element will engage and close valve member 32 thus interrupting communication between container 22 and flow passage 28 and thereby preventing further discharge of liquid from the accumulator. In this manner any loss of gas from the container is prevented and likewise the entrance of gas into the hydraulic system to which the accumulator is connected and which would be objectionable is also prevented.

However, it will be evident that upon the supply of fluid to passage 28 at a pressure greater than exists in the accumulator, the valve member 32 will be forced upwardly and permit the said fluid to enter the accumulator for storage therein.

In the foregoing it will be evident that the accumulator structure which I have provided by this invention and the method of operation thereof offers the several advantages over what is now available that were enumerated above, namely, low cost, elimination of diaphragms and pistons, substantial elimination of gas absorption by the hydraulic fluid in the accumulator, high operating efficiency, and the prevention of loss of gas from the accumulator.

It will be understood that this invention is susceptible to modification in order to adapt it to different usages and conditions, and, accordingly, it is desired to comprehend such modifications within this invention as may fall within the scope of the appended claims.

I claim

1. In a hydraulic accumulator; a cylindrical container having a bottom wall with a liquid flow passage therein opening axially into the container, a valve member in the passage having limited vertical reciprocatory movement therein between an upper flow passage open position and a lower flow passage closed position and spring urged upwardly, said valve member having channel means extending upwardly therealong and opening from the side thereof outwardly into the container adjacent the upper end of the valve member, a head on the valve member, a resilient seal ring surrounding the valve member under the head, and a ball shaped element in the container floating on the liquid therein adapted for engaging said valve member and moving it downwardly until the head thereon presses the seal ring against the said bottom wall whereby discharge from said accumulator will be interrupted when the liquid level drops to a predetermined level therein, said ball-shaped element when located on the axis of said container having a small clearance therefrom completely around the element.

2. In a hydraulic accumulator; a cylindrical container having a bottom wall with a liquid flow passage therein opening axially into the container, a valve member in the passage having limited vertical reciprocatory movement therein between an upper position wherein the flow passage is open and a lower position wherein the flow passage is closed and spring urged upwardly, said valve member having channel means extending upwardly therealong and opening from the side thereof outwardly into the container adjacent the upper end of the valve member, a head on the valve member, a resilient seal ring surrounding the valve member under the head, and a spherical element fitting in the container with a small clearance between it and the container and floating on the liquid therein adapted for engaging said valve member and moving it downwardly until the head thereon presses the seal ring against the said bottom wall whereby discharge from said accumulator will be interrupted when the liquid level drops to a predetermined level therein, said bottom wall and the bottom of said head comprising outwardly divergent bevels which engage said ring.

3. In a hydraulic accumulator; a container having a bottom wall, a liquid flow passage in said wall comprising a portion opening axially into said container, a valve member reciprocable in said portion having an axial slot, a stationary pin extending into said slot to limit the reciprocatory movement of the valve member, said valve member being bored upwardly from the bottom and there being radial ports opening outwardly from said bore at the upper end of the valve member, a spring urging the valve member upwardly so said ports normally open into said container, a head on the valve member having its under side beveled, a boss upstanding about the end of said portion of the passage also beveled, a resilient seal ring disposed between said bevels to be engaged thereby in sealing relation, and an element fitting in said container to float on the liquid therein and adapted to engage and move said valve member downwardly when the liquid in the container falls to a predetermined level.

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