

[54] **HYDRAULIC FLOTATION FOR
IMPLEMENT HEADER**

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[57] **ABSTRACT**

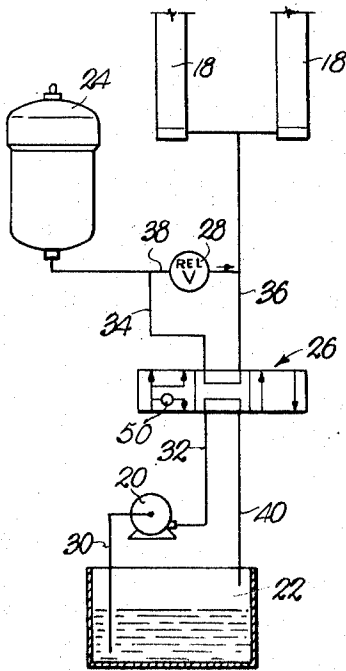
A hydraulic flotation system for an implement header or the like utilizes a pressure sensitive relief valve in cooperation with a special arrangement of hydraulic flow lines to prevent a gas and liquid, header-supporting accumulator, during lowering of the header from a raised, over-the-road position, from exhausting pressurized liquid below that level needed to support the header in a flotation condition at a preselected, lowered operating position.

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[51] Int. Cl.F15b 1/02
[58] Field of Search60/51, 52 HE

[56] **References Cited**
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7 Claims, 11 Drawing Figures



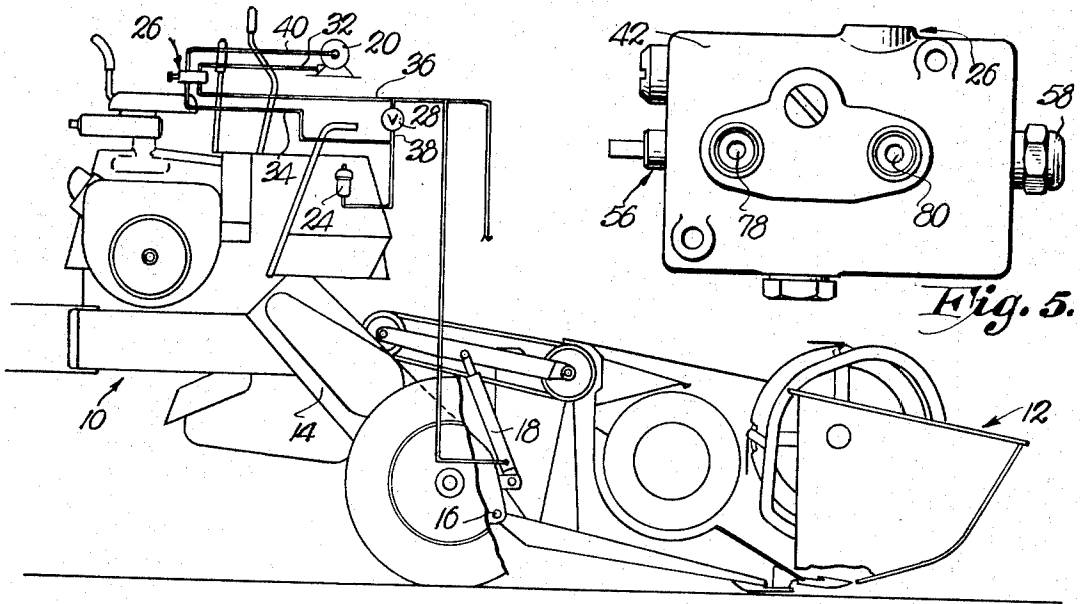


Fig. 1.

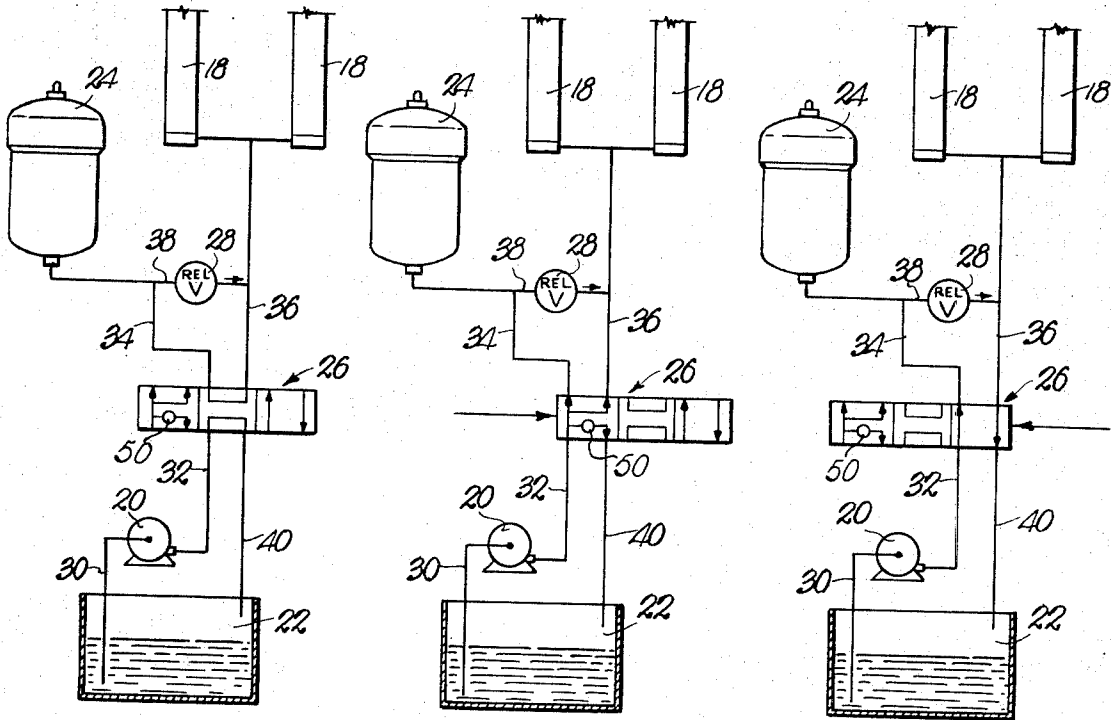


Fig. 2.

Fig. 3.

Fig. 4.

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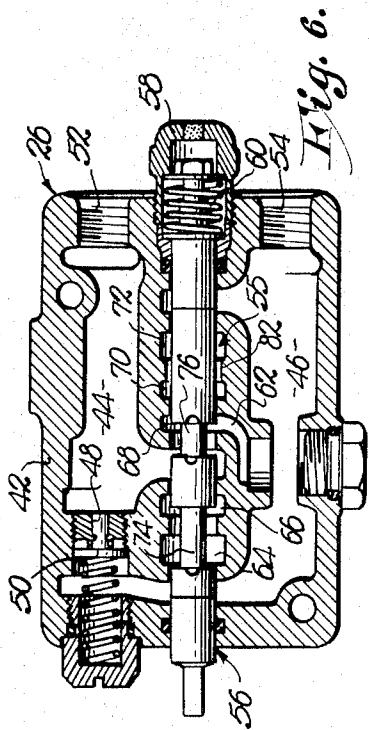


Fig. 6.

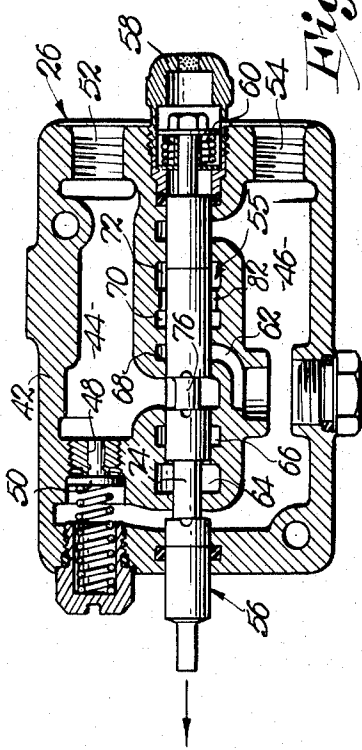


Fig. 8.

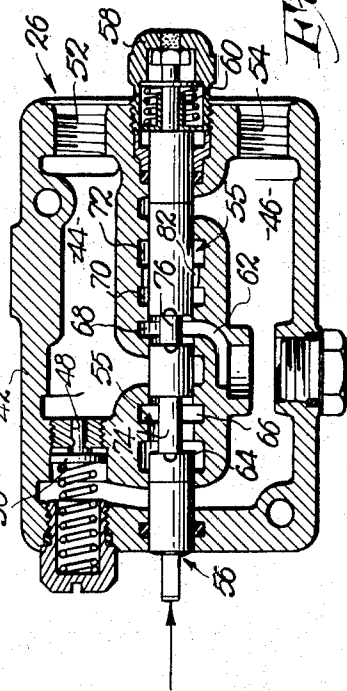


Fig. 10.

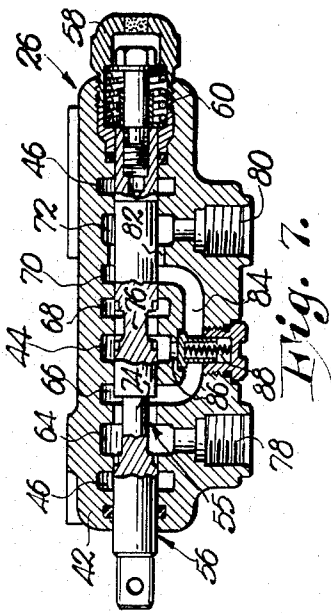


Fig. 7.

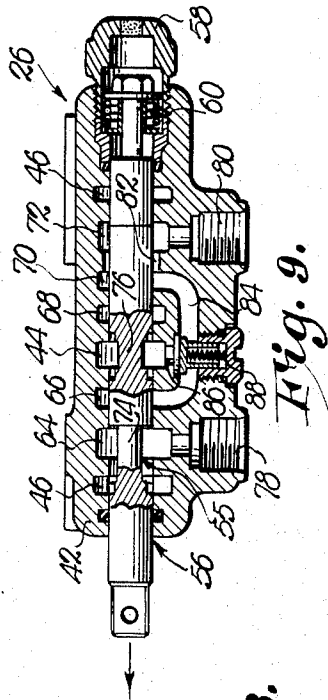


Fig. 9.

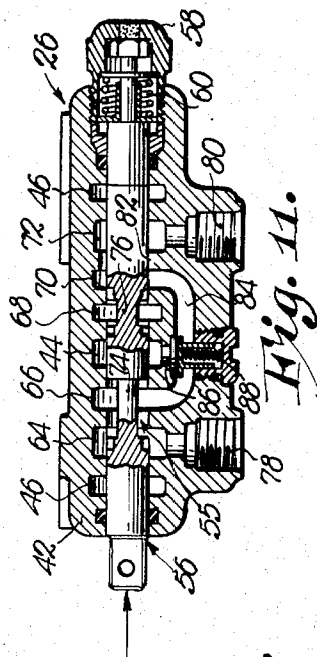


Fig. 11.

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HYDRAULIC FLotation FOR IMPLEMENT HEADER

The primary aim of the present invention is to provide a flotation system for the header of farm implements or the like which eliminates certain problems inherent in previous flotation systems, particularly those problems associated with re-establishing flotation pressure within the system when the latter has been temporarily removed from the flotation condition, such as when the header has been raised to facilitate maneuverability after completing a pass along a crop row. Once the header has been removed from its flotation condition, re-establishment of such condition is difficult with present systems because of the need to drain both the piston and cylinder lifting assembly and the header-cushioning accumulator in order to return the header to its lowered, working position. Thus, after lowering the header, it is usually necessary to resupply the accumulator and the assembly with just the right amount of pressurized fluid to raise the header to the proper working height and flotation condition. Manifestly, this trial-and-error maneuvering is time-consuming and exasperating, particularly when it is realized that the process must be repeated after raising the header at the end of each row in order to prepare for travel down the next succeeding row.

Accordingly, it is an important object of the present invention to provide a specially arranged network of hydraulic flow lines having a pressure-sensitive relief valve associated therewith which prevents the fluid pressure level within the accumulator from falling below a preselected level during exhausting of the accumulator and piston and cylinder assembly to lower the header, thereby assuring that sufficient pressurized fluid is contained within the accumulator to immediately place the header in a floating condition upon cessation of the lowering action.

A further important object of the instant invention is to render the header floatable in any one of a number of selected positions above the ground as a result of the adjustable nature of the relief valve and its relationship with the remainder of the system.

In the drawings:

FIG. 1 is a fragmentary, schematic, side elevational view of a windrower showing schematically the flotation system of the present invention in use thereon;

FIG. 2 is an enlarged schematic representation of the system showing the main control valve in a neutral, bypass position for the header;

FIG. 3 is a schematic representation similar to FIG. 2 showing the main control valve shifted into a position for raising the header;

FIG. 4 is a representation similar to FIGS. 2 and 3, but showing the main control valve in a third position for lowering the header;

FIG. 5 is an enlarged elevational view of the main control valve of the system;

FIGS. 6 and 7 are enlarged, vertical and horizontal cross-sectional views respectively through the main control valve when the latter is in its neutral position corresponding to FIG. 2;

FIGS. 8 and 9 are cross-sectional views of the control valve similar to FIGS. 6 and 7, but taken with the valve in position to lower the header corresponding to FIG. 4; and

FIGS. 10 and 11 are cross-sectional views similar to FIGS. 6-9, illustrating the valve in a position for raising the header corresponding to FIG. 3.

FIG. 1 shows a farm implement 10 in the nature of a windrower having a header 12 which is pivoted to the main frame 14 of implement 10 at point 16 for vertical swinging movement about a horizontal axis through pivot point 16. The hydraulic system for floating header 12 includes a pair of fluid pressure piston and cylinder assemblies 18 which operably interconnect the frame 14 and header 12 to effect powered raising and lowering of the latter; a pump 20 on implement 10 which draws fluid from a reservoir 22 (FIGS. 2-4) to supply fluid under pressure to assemblies 18; an accumulator 24 interposed within the flow path of the system and having a diaphragm or bladder interiorly thereof (not shown) which divides accumulator 24 into an upper chamber for a compressible gas such as nitrogen and a lower chamber for hydraulic fluid entering the accumulator 24 in opposition to the gas chamber; a main control valve 26 stationed near the operator on implement 10 for regulating the direction of fluid flow within the system; and a relief valve 28 within the system which is designed to control the pressure level of the two separated fluids within the accumulator 24. In lieu of a bladder, accumulator 24 may be provided with a free floating separating piston. The system also includes a number of flow lines which interconnect the various components of the system. These include a supply line 30 leading from the reservoir 22 to pump 20, a fluid input line 32 interconnecting the pump 20 and control valve 26, a line 34 between valve 26 and accumulator 24, a line 36 between the piston and cylinder assemblies 18 and valve 26, a bridging line 38 interconnecting flow lines 34 and 36 and with which the relief valve 28 is coupled, and a return line 40 leading from main valve 26 to reservoir 22.

Relief valve 28 may comprise any suitable commercially available relief valve which is adjustable (from the operator's station, or otherwise) to open and close at selected pressure levels, while control valve 26 is a special spool-type valve which is shown in detail in FIGS. 6-11 and performs three separate valving functions represented by FIGS. 2, 3, and 4 and the corresponding sets of FIGS. 6-7, 10-11, and 8-9. Valve 26 has a body 42 provided with a pair of main chambers 44 and 46 which are interconnected by a passage 48, the latter normally being maintained in a closed condition by an adjustable, spring biased main relief valve 50. An inlet port 52 at one end of chamber 44 communicates with the input line 32 from pump 20, while an outlet port 54 communicates with the return line 40 to the reservoir 22.

Body 42 is also provided with a central bore 55 therethrough which shiftably receives spool 56 extending the full length of bore 55 and outwardly beyond the opposed ends thereof. The spool 56 is shiftable longitudinally of bore 55 within a stationary head 58 threaded into body 42 and containing a coil spring 60 which normally biases spool 56 into the neutral position illustrated in FIGS. 6 and 7.

Chambers 44 and 46 are also interconnected by means of a laterally extending, curved passage 62 which leads from bore 55 to the chamber 46 and is opened and closed in response to the shifting of spool

56 as will hereinafter be described in detail. The bore 55 is provided with a number of longitudinally spaced, enlarged cavities 64, 66, 68, 70 and 72, the cavities 64 and 66 being periodically placed in fluid communication by means of the reduced neck portion 74 of spool 56 while a second reduced neck portion 76 of the latter serves to selectively communicate the chamber 44 with cavity 68 via bore 55. As shown in FIGS. 5, 7, 9 and 11, body 42 has a port 78 which communicates with cavity 64 and line 36 leading to assemblies 18, and a port 80 communicating with cavity 72 and line 34 which leads to the accumulator 24. Cavity 72 is maintained in constant fluid communication with cavity 70 by means of an annular opening 82, while the cavities 66 and 70 are maintained in constant communication by means of a U-shaped channel 84 which is intersected by a flow opening 86 leading to cavity 44 and normally maintained in a closed condition by spring-loaded check valve 88.

In operation, the gas chamber of accumulator 24 should be initially charged with a supply of nitrogen or other compressible gas to approximately 350-450 p.s.i. at 70° F. This will properly prepare accumulator 24 for cushioning at slightly above ground level a header 12 which, for example, requires 1200 p.s.i. within the hydraulic system in order to float at that level. A header 12 requiring this amount of pressure to float slightly above the ground might require, for example, approximately 1800 p.s.i. pressure in the hydraulic system in order to be held in a raised, over-the-road condition and, accordingly, for purposes of explanation only, these figures will be used throughout the description of operation as representative of the pressure levels needed to operate header 12 in its two extreme positions. Initially then, the main relief valve 50 should be set to open at 1800 p.s.i. to relieve the system once header 12 is in a completely raised condition, and the relief valve 28 (which is spring-loaded toward its closed position) should be adjusted to open against the action of its spring by fluid from line 38 at 1200 p.s.i., the pressure level selected to float header 12.

When spool 56 is shifted to the right viewing FIGS. 3, 10 and 11, lines 34 and 36 are placed in direct communication with line 32 from pump 20 to charge accumulator 24 and assemblies 18 with pressurized fluid at the 1800 p.s.i. level. Thus, the header 12 is raised to its uppermost position against a stop (not shown) at which time relief valve 50 opens and header 12 remains in such raised condition as long as the spool 56 is held in its rightmost position or is allowed to shift into its neutral position of FIGS. 2, 6 and 7, in which latter position the fluid is trapped in lines 34 and 36 at 1800 p.s.i., while fluid from pump 20 by-passes from line 32 past relief valve 50 through line 40 to reservoir 22. Equal pressure on both sides of valve 28 at 1800 p.s.i., plus the action of the spring of valve 28, causes valve 28 to remain closed in the positions of valve 26 shown in FIGS. 2 and 3.

This process may be seen in more detail viewing initially FIGS. 10 and 11 wherein it may be seen that with spool 56 shifted to the right, fluid entering port 52 from line 32 travels into chamber 44 and laterally toward bore 55. Because of the spool position, entry of the fluid into cavity 68 is blocked and the fluid is forced to flow into opening 86 against check valve 88, depressing

the latter to allow fluid to enter channel 84 wherein it divides and flows in opposite directions into cavities 64 and 72 and thence out ports 78 and 80 to accumulator 24 and assemblies 18. Then, when spool 56 is allowed to return to its neutral position of FIGS. 6 and 7, the fluid entering chamber 44 is allowed to pass around neck 76 into cavity 68, thence through passage 62 into chamber 46 and out port 54 to return to reservoir 22. Simultaneously, the fluid trapped in the upper part of the system between accumulator 24 and assemblies 18 is disposed in a path extending from port 78 around neck 74, into channel 84, through opening 82 into cavity 72 and out port 80. At this time, therefore, because of the substantially equal fluid pressure on opposite sides of relief valve 28, the latter remains in a closed condition, in spite of the fact that the pressure level within lines 34 and 36 is in excess of 1200 p.s.i.

Once implement 10 is in position for advancement along the crop row or, in the present instance, along the windrow, header 12 may be lowered to its flotation position by shifting spool 56 to the exhaust position illustrated schematically in FIG. 4. At this time line 34 to accumulator 24 is disposed in direct communication with input line 32, while the line 36 from assemblies 18 communicates directly with return line 40 to bleed fluid from assemblies 18 and hence lower the header 12 as the weight of the latter forces the fluid from assemblies 18 to reservoir 22 via lines 36 and 40 until header 12 comes to rest on the ground.

At this time the pressure level within line 36 drops substantially below the 1200 p.s.i. level, causing relief valve 28 to open due to the presence of more than 1200 p.s.i. pressure in lines 34 and 38. This causes fluid previously trapped within accumulator 24 to bleed through line 38 and valve 28 to line 36 and hence to reservoir 22, although the presence of hydraulic fluid in accumulator 24 is not permitted to fall below 1200 p.s.i. in view of the fact that valve 28 will close when the pressure level has dropped to that point. Therefore, during the period that the header 12 swings toward the ground with negligible pressure in line 36, pump 20 continuously supplies fluid to line 34 which is allowed to pass through line 38 and valve 28 to merge with fluid bleeding through line 36 while the pressure level in accumulator 24 remains equal to or in excess of 1200 p.s.i. Should it tend to fall below this level, valve 28 closes to direct fluid into accumulator 24 until the 1200 p.s.i. level has again been reached, at which time valve 28 reopens.

Once header 12 has reached the ground, spool 56 may be allowed to return to its neutral position of FIG. 2, at which time fluid at 1200 p.s.i. is immediately available to assemblies 18 because of the fluid which has been trapped within accumulator 24 during the lowering process. Thus, fluid at 1200 p.s.i. is immediately preserved within the upper half of the system in lines 34 and 36 to place header 12 in a flotation condition. At this time the pressurized gas in accumulator 24 acts on the hydraulic fluid in accumulator 24 to raise the pressure in lines 38, 34 and 36, and in assemblies 18 to slightly above 1200 p.s.i. thereby floatingly supporting header 12. Valve 28 will remain closed because the pressure is equalized on both sides thereof.

The flow pattern through valve 26 during the time that header 12 is lowered to its flotation condition may

be seen by viewing FIGS. 8 and 9 which correspond to FIG. 4. With spool 56 shifted to the left, fluid entering chamber 44 from pump 20 is denied entry into cavity 68 because of the location of neck 76 and, instead, the fluid depresses check valve 88 to enter channel 84 through opening 86. The fluid in channel 84 is blocked from entering cavity 64 at this time and therefore flows in one direction only through opening 82 into cavity 72 and out port 80 into line 34. Simultaneously, fluid previously trapped within assemblies 18 enters port 78 and passes around neck 74 into chamber 46 and out port 54 for return to reservoir 22 via line 40. When spool 56 is allowed to return to its neutral position, once again fluid from pump 20 is by-passed into line 40 in the manner earlier described and fluid at 1200 p.s.i. is trapped in the upper part of the system within lines 34 and 36.

Thus, when the end of the windrow is reached and it is necessary to raise the header to facilitate the maneuvering of implement 10, this may be easily performed by simply shifting spool 56 in the proper direction (FIG. 3), after which time header 12 may be immediately returned to its selected flotation condition (FIG. 4 and then FIG. 2) by virtue of the relief valve 28 and its relationship with lines 34, 36 and 38. Further, it is to be pointed out that header 12 may be returned with equal ease to any one of a number of selected flotation positions with respect to the ground by simply adjusting valve 28 to open at a higher or lower pressure level as the case may be.

Therefore, it no longer becomes necessary for the operator to "hunt" for a selected flotation position of header 12 each time it is lowered to ground. Instead, he merely shifts valve 26 or permits it to shift from the position of FIG. 4 to the position of FIG. 2 after header 12 reaches the ground, whereupon header 12 automatically becomes floatingly supported by the pressures of the fluids in accumulator 24 to such extent or height as preadjustment of valve 28 predetermines, all without need for springs to floatingly support header 12 during operation through the field.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. In a flotation system for a unit movable toward and away from the ground, the combination of:
 - a fluid pressure piston and cylinder assembly operably coupled with the unit for raising the latter;
 - an accumulator in fluid communication with said assembly for floatingly supporting the unit;

means for supplying fluid under pressure to the assembly and to the accumulator;

a main control valve associated with said supply means for selectively charging, exhausting, and bypassing the accumulator and the assembly to raise, permit lowering, and floatingly support the unit respectively; and

apparatus associated with the control valve, the accumulator and the assembly for precluding exhaustion of the accumulator below a preselected pressure level while permitting exhaustion of the assembly to cause the unit to lower, thereby assuring the presence of fluid sufficiently pressurized in the accumulator to floatingly support the unit when the control valve is disposed to by-pass the assembly and the accumulator.

2. The system as claimed in claim 1, wherein said apparatus includes a pressure-sensitive relief valve set to exhaust fluid from the accumulator only above said preselected pressure level.

3. The system as claimed in claim 2, wherein said apparatus further includes first fluid conduit means between said control valve and the accumulator; second fluid conduit means between said control valve and the assembly; and third fluid conduit means communicating said first conduit means with said second conduit means, said relief valve being operably coupled with said third conduit means to open and close the latter.

4. The system as claimed in claim 3, wherein is provided a fluid input line and a fluid return line between said control valve and the supply means, said control valve being operable to place said input line in direct communication with said first conduit means and said return line in direct communication with said second conduit means when the control valve is disposed for exhausting the accumulator and the assembly.

5. The system as claimed in claim 4, wherein said control valve is operable to place said input line in direct communication with said first and second conduit means when the control valve is disposed for charging the accumulator and the assembly.

6. The system as claimed in claim 2, wherein is provided a safety valve associated with said control valve for relieving the system at a pressure level substantially beyond said preselected flotation pressure level.

7. The system as claimed in claim 1, wherein said accumulator has a second pressurized fluid trapped therein adapted to act on and to be acted upon by the fluid supplied to the accumulator by said supply means.

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