United States Patent [19]

Case

[11] **3,869,861**

[45] **Mar. 11, 1975**

[54] **COMBINATION HYDRAULIC CYLINDER AND ACCUMULATOR**

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[73] Assignee: **Hesston Corporation,** Hesston, Kans.

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[52] **U.S. Cl.** ..... **60/413,** 60/469, 267/64 R, 280/124 F

[51] **Int. Cl.** **F15b 1/02**

[58] **Field of Search** ..... 60/413, 414, 469, 480; 91/390; 92/83, 84; 267/64 R, 64 A, 64 B, 65 D; 280/124 F

[56] **References Cited**

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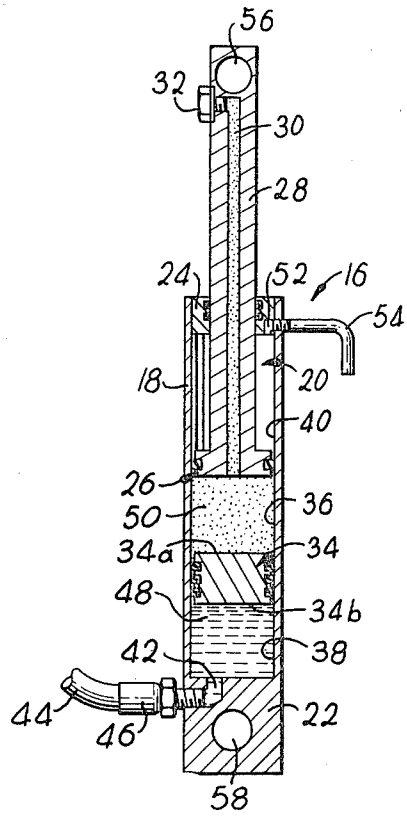
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Primary Examiner—Edgar W. Geoghegan

[57] **ABSTRACT**

A combination accumulator and hydraulic fluid pressure actuated power unit has a pair of pistons, one of which is extensible and is adapted for connection to an object to be controlled, and the other of which is free-floating within the cylinder of the unit to define an extra gas subchamber between the floating piston and the extensible piston. Thus, when a fixed volume of hydraulic fluid is supplied to the side of the floating piston opposite the gas subchamber, the gas is firmly supported by the noncompressible hydraulic fluid and the load is floatingly supported by the gas. By varying the volume of hydraulic fluid, the floating piston can be reciprocated within the cylinder with the compressed gas functioning substantially as a noncompressible fluid to thus reciprocate the extensible piston. The unit can be readily adapted for single or double acting use.

7 Claims, 3 Drawing Figures



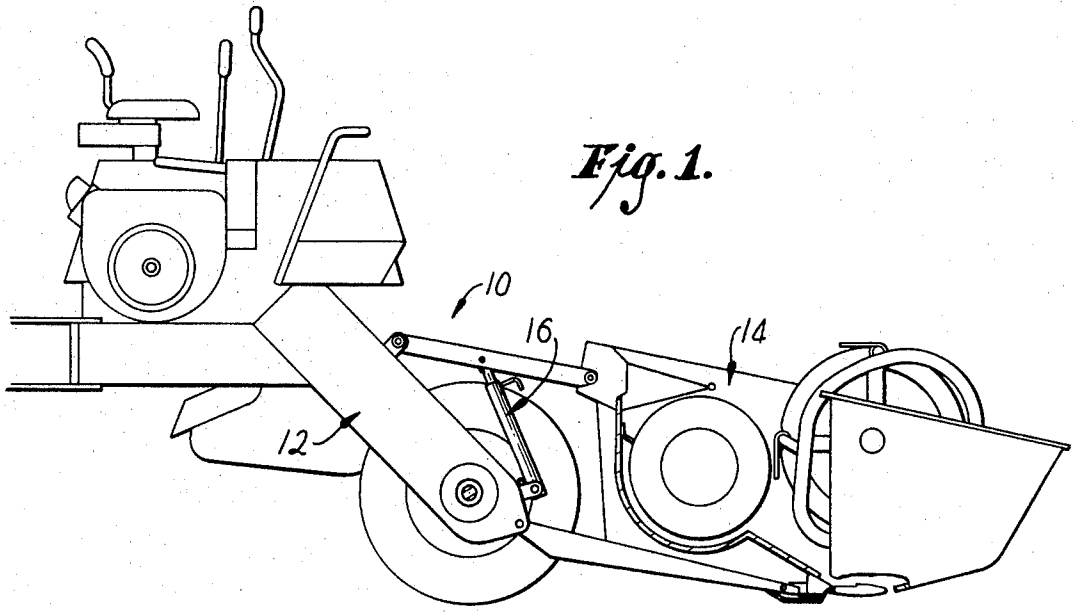


Fig. 1.

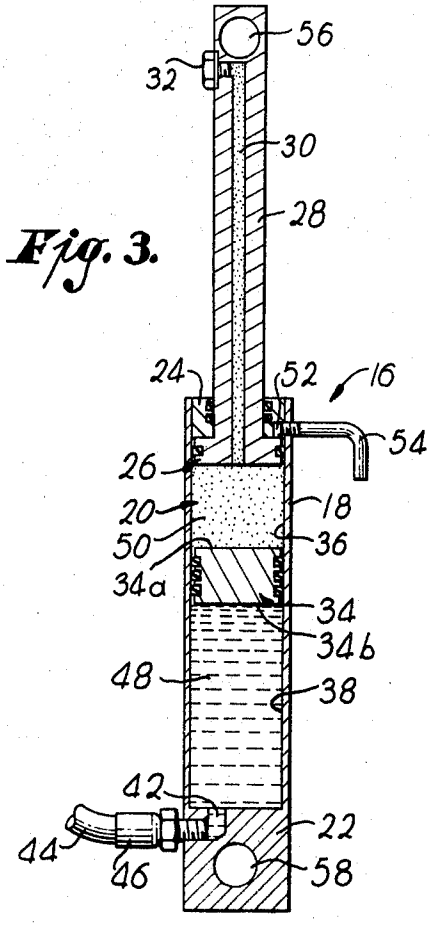


Fig. 3.

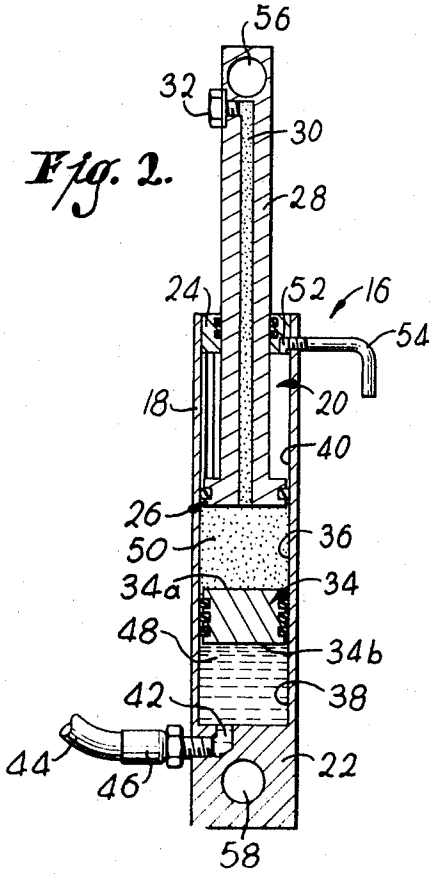


Fig. 2.

COMBINATION HYDRAULIC CYLINDER AND ACCUMULATOR

This invention relates to the field of fluid pressure control for various shiftable structures and articles requiring power for support or operation, and has as an important object to provide a special fluid pressure actuated power unit that doubles as a source of "floating" support.

Another important object of the invention is to provide a combination accumulator and power unit wherein floating or shock-absorbing action is obtained by a compressible fluid in the unit while positive, power supplying action is obtained by noncompressible fluid in the unit.

In carrying out the preceding objects an important aim of the present invention is the provision of a special free-floating piston within the unit that is displaced by noncompressible fluid on one side thereof while acting against compressible fluid on the opposite side.

A further important object is to provide such a unit wherein its ability to cushion loads in no way interferes with or impairs its ability to positively shift the loads.

An additional important object of this invention is to provide a special unit as aforesaid which can be easily rendered single or double acting.

In the drawing:

FIG. 1 is a schematic side elevational view of a farm implement showing one representative manner in which the combination accumulator and pressure-actuated power unit of the present invention may be utilized;

FIG. 2 is an enlarged, vertical cross-sectional view of the unit when the latter is in condition to floatingly support an object such as the header of the implement in FIG. 1; and

FIG. 3 is a view of the unit similar to FIG. 2, but showing the condition of the unit when the supported object is raised to the fullest limit of the unit.

The implement **10** has a frame structure **12** and a header structure **14** swingably supported thereon for vertical shifting movement between a fully lowered and a fully raised position. As illustrated, the unit **16** of the present invention may be interposed between the frame **12** and the header **14** in order to control such swinging of header **14**, and also to floatingly support the latter during advancement of the implement **10** over a field. It will be readily recognized from the description which follows, however, that the principles of the present invention are not limited to the specific use of unit **16** illustrated in FIG. **1**. and that such representative illustration is made only for the purpose of rendering the manner of use of unit **16** fully and clearly understandable.

It is also important to point out at this juncture that the frequent reference herein made to "compressible" and "noncompressible" fluids is done with a view to contrasting the relative compressive abilities of the fluids selected for use in unit **16.** Although liquids are capable of being compressed to a degree, such compression is so slight as to be negligible for practically all applications, including those contemplated by the present invention. Therefore, it is to be understood that, in the interest of conciseness and expediency, noncompressible as herein used includes not capable of being compressed within all practical limits of load application.

The unit **16** has a hollow cylinder **18** provided with a chamber **20** extending from one end **22** of cylinder **18**

to the opposite end **24** thereof. A piston **26** having an elongated stem **28** is reciprocable longitudinally of chamber **20** in sealing engagement with the interior thereof for extension and retraction of the stem **28** through end **24.** A passage **30** through stem **28** longitudinally thereof is open at one end to the chamber **20** and is closed at the opposite end thereof by a suitable component such as a plug **32.**

A special free-floating piston **34** is also located within chamber **20** between the piston **26** and end **22** of cylinder **18.** Piston **34** thus subdivides chamber **20** into a pair of subchambers **36** and **38** on opposite sides of piston **34,** and the piston **26** also operates to effectively subdivide chamber **20** into yet a third subchamber **40** between piston **26** and end **24.**

A port **42** in end **22** communicates subchamber **38** with a line **44** through a fitting **46** for supplying subchamber **38** with a noncompressible hydraulic fluid denoted by the numeral **48.** On the other hand, the passage **30,** upon removal of plug **32,** may be used to charge the subchamber **36** with a suitable compressible fluid denoted by the numeral **50,** such fluid **50** preferably taking the form of nitrogen gas. A second port **52** in end **24** communicates subchamber **40** with the atmosphere and may be used to vent subchamber **40** when unit **16** is placed in a situation requiring only single-acting operation, or port **52** may be provided with a suitable fitting such as **54** to enable hydraulic fluid to be supplied to subchamber **40** for double-acting applications.

In use, the unit **16** may be installed as illustrated in FIG. **1** wherein the outermost apertured end **56** of piston stem **28** is secured to the header **14** while the remote end **22** of cylinder **18** is secured to frame **12** through aperture **58.** Height control and floating support of header **14** is thereby provided through controlled extension and retraction of the piston **26** while the cylinder **18** remains stationary. It is within the scope of the present invention, however, to reverse this procedure so that the piston **26** remains stationary and cylinder **18** is reciprocated relative thereto. Such an arrangement requires only that the unit **16** be inverted from its orientation illustrated in FIG. **1** and hydraulic fluid **48** supplied to subchamber **36** while compressible gas **50** is supplied to subchamber **38.** Passage **30** could be used to carry hydraulic fluid **48** to subchamber **36,** and port **42** could be used to charge subchamber **38** with gas **48.**

It is also within the scope of the present invention to maintain the orientation of unit **16** as illustrated and simply supply subchamber **36** with hydraulic fluid **48** while charging subchamber **38** with gas **50.** Once again, a convenient manner of carrying out this arrangement is simply to use passage **30** for hydraulic fluid **48** and port **42** for gas **50.**

Assuming for purposes of illustration that the unit **16** is to be utilized as illustrated in FIG. **1** wherein piston **26** is reciprocated and only a single-acting arrangement is required because of the fact that header **14** can return to its lowermost position by gravity, charging of the subchamber **36** with the gas **50** causes the subchamber **36** in cooperation with the topside **34***a* of piston **34** to function as an accumulator in floatingly supporting header **14.** Introduction of hydraulic fluid **48** into subchamber **38** through port **42** and against the lower side **34b** of piston **34,** causes the latter to move upwardly against gas **50,** compressing the later until the

header **14** just begins to lift from the ground. This condition is illustrated in FIG. **2** and thus represents the situation wherein header **14** only lightly engages the ground, its load being borne by the gas **50** backed up by the "solid" fluid **48** within subchamber **38.**

Therefore, as the implement **10** is advanced over a field, the unit **16** operates to effectively float header **14** so that should abrupt rises in the terrain be encountered, for example, header **14** can immediately respond and easily ride up and over such rises because of the assistance imparted thereto by the compressed gas **50.** On the other hand, should an abrupt depression be encountered, the header **14** does not slam downwardly against the bottom of the depression, but instead, very gently settles therewithin to accommodate such deviation in surface contour.

When it is necessary to raise the header **14** to an above-ground position, it is only necessary to pump an additional volume of hydraulic fluid **48** into subchamber **38** which causes the piston **34** to be shifted upwardly, such as shown in FIG. **3,** to extend piston stem **28.** Inasmuch as the header **14** has previously compressed gas **50** almost to the fullest extent possible for the particular weight of header **14** in order to floatingly support the same, very little further compression of gas **50** is experienced during the positive lifting process. Because the header **14** has already expended its compressive force, gas **50** in effect acts as a noncompressible fluid at this time to push piston **26** upwardly in response to the similar displacement of piston **34.**

Lowering of header **14** may be carried out simply by allowing an appropriate portion of the hydraulic fluid **48** to escape from subchamber **38** through port **42,** whereupon the floating piston **34** gradually drops toward end **22** to allow the weight of header **14** to push stem **28** back into chamber **20.**

During such single-acting operation of unit **16** the port **52** serves only as a vent for the subchamber **40** behind piston **26,** allowing air to escape therefrom when piston **26** is moved toward end **24** and allowing ambient air to be drawn into subchamber **40** when piston **26** is moved in the opposite direction toward end **22.** Of course, unit **16** can be easily made double-acting by simply attaching the fitting **54** to port **52** and coupling a suitable hydraulic line (not shown) therewith for introducing hydraulic fluid into subchamber **50.** Thus, instead of allowing piston **26** to retract on its own accord, hydraulic fluid may be supplied to subchamber **40** through port **52** in order to forcibly move piston **26** toward end **22** to retract stem **28.** Thus, the piston **26** is rendered positively displaceable in opposite directions, making it suitable for application requiring such double-acting capability.

It should now be apparent from the foregoing that the unit **16** fills a need heretofore wanting in this field and does so in a non-complex, highly efficient manner. In order to provide floating support in combination with the ability to positively raise and lower an object such as an implement header, it has heretofore been the common practice to use a relatively complex hydraulic system requiring a multitude of hydraulic flow lines and valves, not to mention the separate accumulators and fluid-actuated piston and cylinder assemblies necessary. By virtue of the present invention, such complex systems are no longer required inasmuch as the role of the cushioning and shock-absorbing accumulator has now been combined with the function of a fluid pressure actuated power device, all within the same unit. The key to such highly desirable combination is, of course, the floating piston **34** which enables noncompressible hydraulic fluid to be supplied to one side thereof while compressible cushioning gas is supplied to the opposite side thereof within the same major chamber. By virture of the floating piston **34,** the ability of unit **16** to function as a floating support device does not impair its ability to function as a device for supplying positive shifting or lifting power. Moreover, when the unit **16** is used in single-acting arrangements, the hydraulic pressure in the system can be dropped to zero without the accumulator pressure dropping to zero. This permits hydraulic lines of the system to be connected and disconnected while maintaining shock-absorbing capabilities.

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

1. A combination accumulator and pressure-actuated power unit comprising:

a hollow cylinder having a working chamber therewithin and adapted for connection to one of two relatively shiftable structures;

a first piston within said chamber and dividing the latter into a pair of subchanbers on opposite sides of said piston;

a compressible fluid in one of said subchambers filling the same;

means for introducing a noncompressible fluid into the other of said subchambers; and

a second imperforate piston reciprocable within said chamber and adapted for connection to the other of said relatively shiftable structures,

said first piston being free-floating within said chamber whereby to permit cushioning of said structures against said compressible fluid when a fixed volume of said noncompressible fluid is maintained, yet to permit powered relative shifting of the structures when the volume of said noncompressible fluid is varied,

said second piston being reciprocable within said one subchamber against said compressible fluid.

2. A combination accumulator and pressure-actuated power unit as claimed in claim **1,** wherein said means for introducing noncompressible fluid is disposed on the side of said first piston remote from said second piston.

3. A combination accumulator and pressure-actuated power unit as claimed in claim **1,** wherein said second piston has a sealable passage therethrough for initially charging said one subchamber with said compressible fluid.

4. A combination accumulator and pressure-actuated power unit comprising:

a hollow cylinder having a working chamber therewithin and adapted for connection to one of two relatively shiftable structures;

a first piston within said chamber and dividing the latter into a pair of subchambers on opposite sides of said piston;

a compressible fluid in one of said subchambers filling the same;

means for introducing a noncompressible fluid into the other of said subchambers; and

a second imperforate piston reciprocable within said chamber and adapted for connection to the other of said relatively shiftable structures,

said first pistion being free-floating within said chamber whereby to permit cushioning of said structures against said compressible fluid when a fixed volume of said noncompressible fluid is maintained, yet to permit powered relative shifting of the structure when the volume of said non-compressible fluid is varied,

said second piston being operable to define a third subchamber on a side thereof opposite the remaining subchambers, said third subchamber having a port therein for venting the same during powered relative displacement of the cylinder and second piston in a single direction.

5. A combination accumulator and pressure-actuated power unit as claimed in claim **4,** wherein said one subchamber is disposed between said other and said third subchambers.

6. A combination accumulator and pressure-actuated power unit comprising:

a hollow cylinder having a working chamber therewithin and adapted for connection to one of two relatively shiftable structures;

a first piston within said chamber and dividing the latter into a pair of subchambers on opposite sides of said piston;

a compressible fluid in one of said subchambers filling the same;

means for introducing a noncompressible fluid into the other of said subchambers; and

a second imperforate piston reciprocable within said chamber and adapted for connection to the other of said relatively shiftable structures,

said first piston being free-floating within said chamber whereby to permit cushioning of said structures against said compressible fluid when a fixed volume of said noncompressible fluid is maintained, yet to permit powered relative shifting of the structures when the volume of said noncompressible fluid is varied,

said second piston being operable to define a third subchamber on a side thereof opposite the remaining subchambers, said third subchamber having a port therein and means coupled with said port for introducing noncompressible fluid to said third subchamber for powered relative displacement of the cylinder and second piston in double directions.

7. A combination accumulator and pressure-actuated power unit as claimed in claim **6,** wherein said one subchamber is disposed between said other and said third subchambers.

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