Jan. 13, 1970 D. C. HILL 3,489,100

AIR DRIVEN FLUID PUMP

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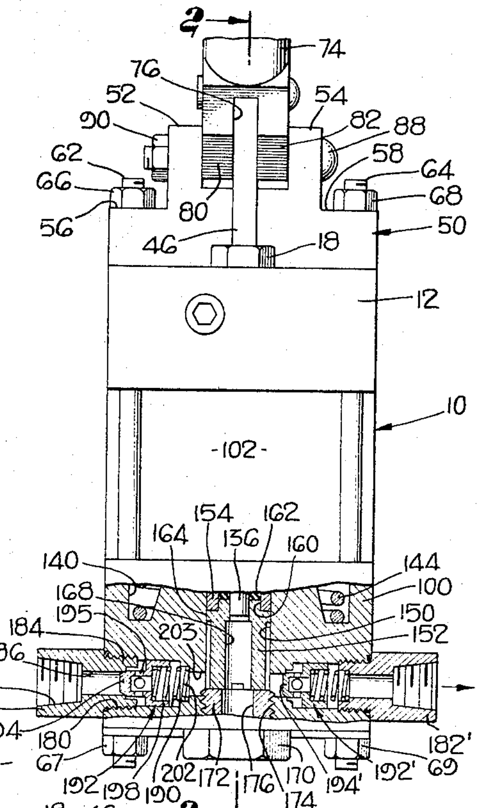

FIG. 1.

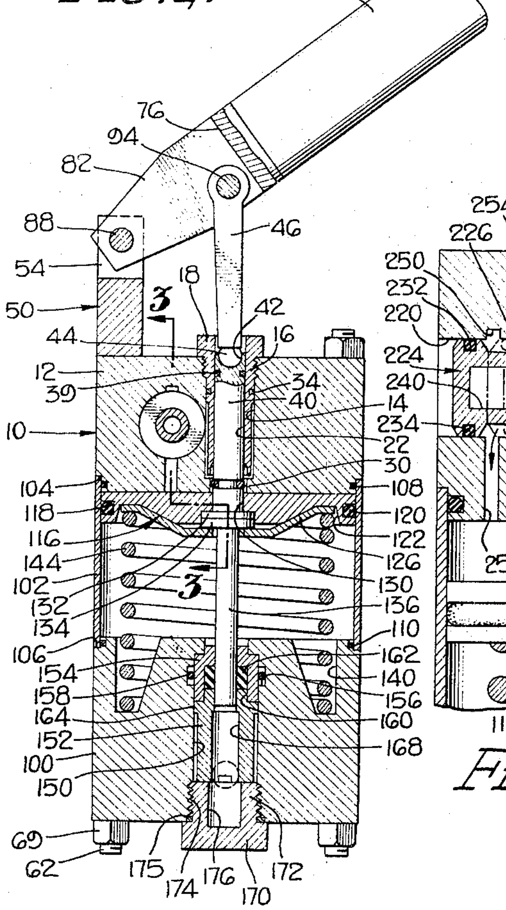

FIG. 2.

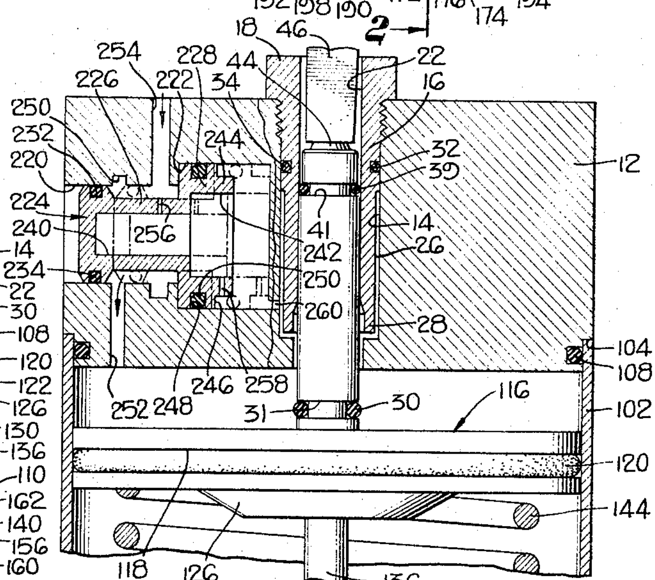

FIG. 3.

INVENTOR,
DAVID C. HILL

BY

Herzig, Walsh & Blackham

ATTORNEYS

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AIR DRIVEN FLUID PUMP
David C. Hill, Pasadena, Calif., assignor to Haskel Engineering & Supply Co., Burbank, Calif., a corporation of California
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ABSTRACT OF THE DISCLOSURE

The invention is a reciprocating piston for driving a pump that is powered by fluid such as air as well as by hand. It can be operated by power and manually simultaneously. The power operation may be by way of an air cylinder with a manual operating lever attached to the stem of the air cylinder. The pump is useful for many applications but particularly for jacking operations wherein ordinarily it is necessary to have a separate hand pump in the event of an air compressor failure or in the event no compressed air power is available. The herein invention makes it unnnecessary to have two different pumps, thus realizing economy in equipment and space, together with simplifying maintenance over that required for two separate units.

When the pump is driven by air it can be cycled at a desired higher rate, which is not possible manually, thus producing the required flow. On the other hand, manual operation gives more precise control of volume and/or pressure. In using both power and manual drive simultaneously air power can relieve the operator of much of the total load required, giving him even more precise control.

The invention relates to the field of fluid pumps and the improvement of the invention is a combination comprising a fluid pump provided with power drive along with manual drive or manual operating means. In a preferred form of the invention as described herein a fluid pump is power driven by means of an air cylinder although other power means might be used.

The fluid pump is a reciprocating piston pump which, with the combination of the invention, is powered by air or by hand or both simultaneously.

The combination of the invention has many advantages as will be made clear hereinafter. Realization of these advantages constitutes objects of the invention.

The invention is adapted to various different applications among which an important one is that in the field of jacking. In most jacking operations employing power drive such as an air driven pump, it is necessary to have a separate hand pump in the event of an air compressor failure, or in the event the area or location has no compressed air power available. The herein invention avoids the necessity of having two different pumps thus realizing economy in equipment and space, in addition to simplifying maintenance which is, of course greater where two separate units are required. The realization of these advantages constitutes primary object of the invention.

Among other typical applications of the invention are static or burst testing. Power drive by way of a cylinder can be used for filling, bleeding and initial pressurization. Manual drive or power, with or without the air assist provides for precise control of final pressure, and further manual control prevents pump "runaway" when and if burst occurs. The realization of these advantages constitutes further objects of the invention.

Additional typical applications of the invention, in addition to jacking previously referred to, are in the areas of pressing, stretching, clamping or forming. Operations

of this type require a large volume of air at low pressure for initial "daylight closing" or the equivalent followed by a low volume at high pressure for the final portion of the operation. The combination of the herein invention permits use of a relatively large plunger giving high volume. The final high pressure can advantageously be obtained by using air and manual power simultaneously.

Other typical applications of the invention are applications or operations requiring precise positioning. Some of the operations referred to in the foregoing are the type which frequently require "inching," or precise positioning at the end of the operation. By means of the hand pump as described herein, with or without air assist, precise control can be achieved. The realization of this advantage constitutes a further object of the invention.

Further objects and additional advantages of the invention will become apparent from the following detailed description and the annexed drawings wherein:

FIGURE 1 is a view partly in section of a preferred form of the invention;

FIGURE 2 is a sectional view of the form of the invention shown in FIGURE 1;

FIGURE 3 is a diagramatic view illustrating the automatic operation of the air cylinder of the equipment.

Referring now more particularly to FIGURES 1 and 2 of the drawings the equipment comprises a generally upright cylindrical body **10**. The fluid pump and its valves are in the lower part of this body; the air cylinder is in the intermediate part of it; and the manually actuated stem is in the upper part of the body. Numeral **12** designates a cylindrical mmeber at the upper part of the body **10**. The cylindrical member **12** has a central bore **14** which is a cylinder or a sleeve **16** having a head **18** and the upper part of which adjacent to the head is threaded into the upper end of the bore **14**. The sleeve **16** has a bore **22**. The lower part of the sleeve **16** is of slightly smaller diameter so as to be spaced from the sidewalls of the bore **14** as may be seen at **26**. The sleeve **16** has a skirt **28** at the lower end of a diameter which is intermediate to that of the bore **22** and the bore **14**. Below the end of the sleeve **16** is a sealing O-ring **30** in annular groove **31** in cylindrical stem **40**. On the outside of sleeve **16** is an annular groove below the threaded portion **20** and received in this groove is a sealing O-ring **34**.

Fitting within the bore **22** of sleeve **16** is the cylindrical stem **40** which connects to the air cylinder as will be described. At the upper end of the stem **40** is a socket **42** which receives a ball **44** on the end of a link **46** which connects to the manual operating handle, as will be described. Stem **40** is sealed in bore **22** by O-ring **39** in annular groove **41**.

Secured to the cylindrical member **12** is a frame member **50** having an upstanding intermediate part forming a yoke having legs **52** and **54** adjacent to square shoulders **56** and **58**. The member **50** is attached to the member **12** by stud bolts **62** and **64** having nuts **66** and **68** at one end and nuts **67** and **69** at the lower ends.

Numeral **74** designates the manual operating handle, which preferably is round, with the end bifurcated to provide a slot **76** between two legs **80** and **82**. These legs fit between the legs **52** and **54** and are pivotally secured thereto by the transverse pivot bolt **88** having a nut **90**. The link **46** extends in between the legs **80** and **82** and is pivotally secured thereto by means of the pivot pin **94**.

The pilot valve mechanism for operating the air cylinder is embodied in the member **12** as will be described.

Numeral **100** designates a cylindrical member at the lower part of the body **10**, this member being of the same diameter as the member **12**. Between the member **12** and **100** is a cylinder **102**. The upper end of this cylinder fits into an annular shoulder **104** at the lower part of the member **12** and the lower end of the cylinder **102** fits into an annular shoulder **106** at the upper end of the cylindrical part **100**. The upper end of the cylinder **102** is sealed to the part **12** by way of O-ring **108** and the lower end of the cylinder **102** is sealed to the member **100** by O-ring **110**.

The air cylinder piston is designated at **116** and reciprocates within the cylinder **102**. At its periphery there is an annular groove **118** in which is a sealing O-ring **120**. An annular recess or depression **122** is provided in the lower side of the piston **116** and fitting in this depression is a disc **126** configurated to complementarily engage the recess **122**. The piston **116** has a central bore **130** through which the stem **40** extends. On the end of this stem is a disc **132** which is secured to a similar disc **134** on the upper end of the stem **136** of the fluid piston, that is the piston of the pump. The lower cylindrical member **100** has in its upper end an annular groove **140** the outer wall of which is parallel to the axis of the assembly and the inner wall which tapers inwardly as shown. Within the cylinder **102** is a coil spring **144**, the upper end of which bears against the disc **126** and the lower end of which is seated in the bottom of the annular groove **140**. When the piston **116** moves down it moves against the force of this spring.

In the center of the lower cylindrical member **100** is an axial bore **150**. In this bore is the fluid pump cylinder **152**. The stem **136** moves through a cylindrical yoke member **154** which is in the bore **150**. Numeral **156** designates an annular groove in the sidewall of the bore **150** adjacent to the yoke **154** and in this annular groove is a sealing O-ring **158**. The cylindrical yoke **154** itself has a bore **160** and in this bore is a sealing gasket **162**. The pump cylinder **152** has an annular flange **164** spaced from its end forming a square shoulder, and the yoke **154** engages this cylinder, its lower end fitting against the square shoulder at the upper end of the piston. The pump cylinder **152** has a cylindrical bore **168** in which piston **136** moves. The end of the pump cylinder bore **150** is closed by the plug **170** having a threaded part **172** threaded into a threaded part **174** at the end of the bore **150** of a slightly larger diameter, the part **170** having a bore **176**. Plug **170** is sealed by O-ring **175** and it bears against cylinder **152** holding the parts in position.

The fluid pump is provided with inlet and outlet check valves so that fluid which may be gas or liquid is drawn in on the suction stroke and compressed and forced out on the pressure stroke. In one side of the cylindrical member **100** there is a threaded bore **180** which receives a threaded nipple **182** having a threaded part **184**. The nipple **182** has an outer tapered threaded bore **185** communicating with cylindrical bore **186**. Spaced inwardly from the inner end of the nipple **182** is a bore **190** having in it a member **192** having a valve part **194** having orifices **195** and having a skirt part **198** forming a spring retainer for a biasing spring **202**, the other end of which is positioned against a bore **203** of smaller diameter at the end of the bore **190**. The bore **203** communicates with the bore **150** in which the piston **152** operates.

On the opposite side of the cylindrical member **100** there is a similar nipple, **182'**, which is similar to the nipple **182** in construction. There is a similar valve member **192'–194'** positioned so that this check valve operates as an outlet valve. Valve **194'** communicates with bore **150**, the parts of this assembly being similar to the corresponding parts on the opposite side but being arranged to form an outlet or exhaust check valve.

FIGURE 3 illustrates schematically a preferred arrangement for automatically operating the air cylinder piston **116**. It should be pointed out, however, that other arrangements may be utilized for driving this piston and such arrangements may be made like that in Patent No. 3,174,409 wherein a spool-type of pilot valve mechanism is utilized for controlling an air cylinder. In FIGURE 3 in the part **12** of the assembly there is provided a transverse bore **220** communicating with a larger bore **222**. Positioned in these bores is a shuttle valve **224** having a smaller part **226** in the smaller bore and a larger **228** in the larger bore. The end part of the smaller portion **226** is of larger diameter having in it an annular groove **232** in which is a sealing O-ring **234**. This part of the shuttle valve **224** has an internal bore **240** connecting with a larger internal bore **242** in the part **228** of the shuttle valve of larger diameter. The shuttle valve at the right end looking at FIGURE 3 has an extending part **244** of smaller diameter forming a square annular shoulder **246**. In the part of larger diameter there is an annular groove **248** in which is a sealing O-ring **250**.

Formed in the bore **220** is a groove **251** communicating with a channel **252** in the portion **12** which connects with the interior of the cylinder **102**. Numeral **254** designates a channel formed in the part **12** which communicates with the bore **220** as shown. In the sidewall of the smaller part of the shuttle valve **226** is a channel **256** allowing communication to bore **240** within the shuttle valve. Formed in the extending end **244** of the shuttle valve is a channel **258** which allows communication from the bore **242** within the shuttle valve to the annular space formed between the annular shoulder **246** of the shuttle valve and the bore **222**.

The operation of the shuttle valve in automatically controlling the operation of the piston **116** will now be described. Pressure from any suitable source is provided by channel **254** to the shuttle valve. The interior of the bore **222** is referred to herein as the control chamber. The shuttle valve moves between two positions as shown in FIGURE 3 in full lines and broken lines. At all times in mid stroke of the piston **116**, that is, whenever it is between its extreme positions, the control chamber, that is the space within the bore **222** communicates with the space within the cylinder **102** above the piston **116**. This communication is by way of channel **260** into the space around the lower part **26** of the sleeve **18** which has a diameter smaller than the bore **14**. The stem **40** is of smaller diameter than the bore **262** so that air from the control chamber passes down into the space above the piston **116**. The sequence of operation is as follows: The solid line position of the shuttle valve is the pump stroke position. The high pressure enters through the channel **254** and passes around the part **226** of the shuttle valve of smaller diameter through the channel **252** into the chamber above the piston **16** forcing it down in its pump stroke. Stem **40** moves down and when O-ring **39** passes below the end of bore **14** the air in the control chamber is exhausted through the bore **22** in sleeve **18** above O-ring seal **39**. The pressure in bore **220** around the part of shuttle valve **227** of smaller diameter acting against the part of the shuttle valve of larger diameter shifts it to the right to the dotted line position which is the suction stroke position. In this position the interior of cylinder **102** above the piston **116** is open to exhaust through the channel **252** to atmosphere. The stem **40** in moving up causes the O-ring to seal the channel adjacent the end of the skirt **28** on the stem **18**. Incoming pressure through channel **254** leads through the channel **256** into the control chamber within the shuttle valve and causes the shuttle valve to again be shifted to the left into the full line position to repeat the action.

From the foregoing those who are skilled in the art will fully understand the nature and construction of the invention, its operation, and the manner in which it achieves and realizes all of the objects as set forth in the foregoing.

The foregoing disclosure is representative of a preferred form of the invention and is to be interpreted within an illustrative rather than a limiting manner and the invention to be accorded the full scope of the claims appended hereto.

I claim:

1. Pump means comprising a cylinder having a piston therein, said piston having a stem, power means for operating the pump comprising a cylinder having a piston therein and means for supplying fluid pressure for operating said piston, and for releasing fluid pressure, spring means for moving said fluid operated piston in one direction, and additional manually operated means cooperable with said fluid operated piston whereby said fluid operated piston and manual operating means may be moved in one direction against the said spring and the fluid operated piston and manual operating means can be moved in the other direction by the spring whereby fluid power, and manual power can be selectively applied simultaneously or separately for purposes of precise control of the actuation of the pump.

2. Pump means as in claim **1** wherein the fluid supplied is air pressure, the supply means comprising a reciprocatable control valve which is shifted by air pressure controlling the supply and release of air pressure, and further valve means actuatable by the fluid piston controlling said reciprocatable valve.

3. Pump means as in claim **2** wherein said further valve comprises a stem extending from the fluid operated piston associated with ports whereby to control pressure for positioning said reciprocatable control valve.

4. Pump means as in claim **2** wherein said reciprocatable control valve comprises a spool member having areas of different diameters one of which is within a chamber in which pressure is controlled by said further valve means for causing fluid pressure to be applied to and released from said spool member.

5. Pump means as in claim **4** wherein said further valve means comprises a stem extending from the fluid operated piston associated with ports whereby to control pressure in said chamber.

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ROBERT M. WALKER, Primary Examiner

U.S. Cl. X.R.

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