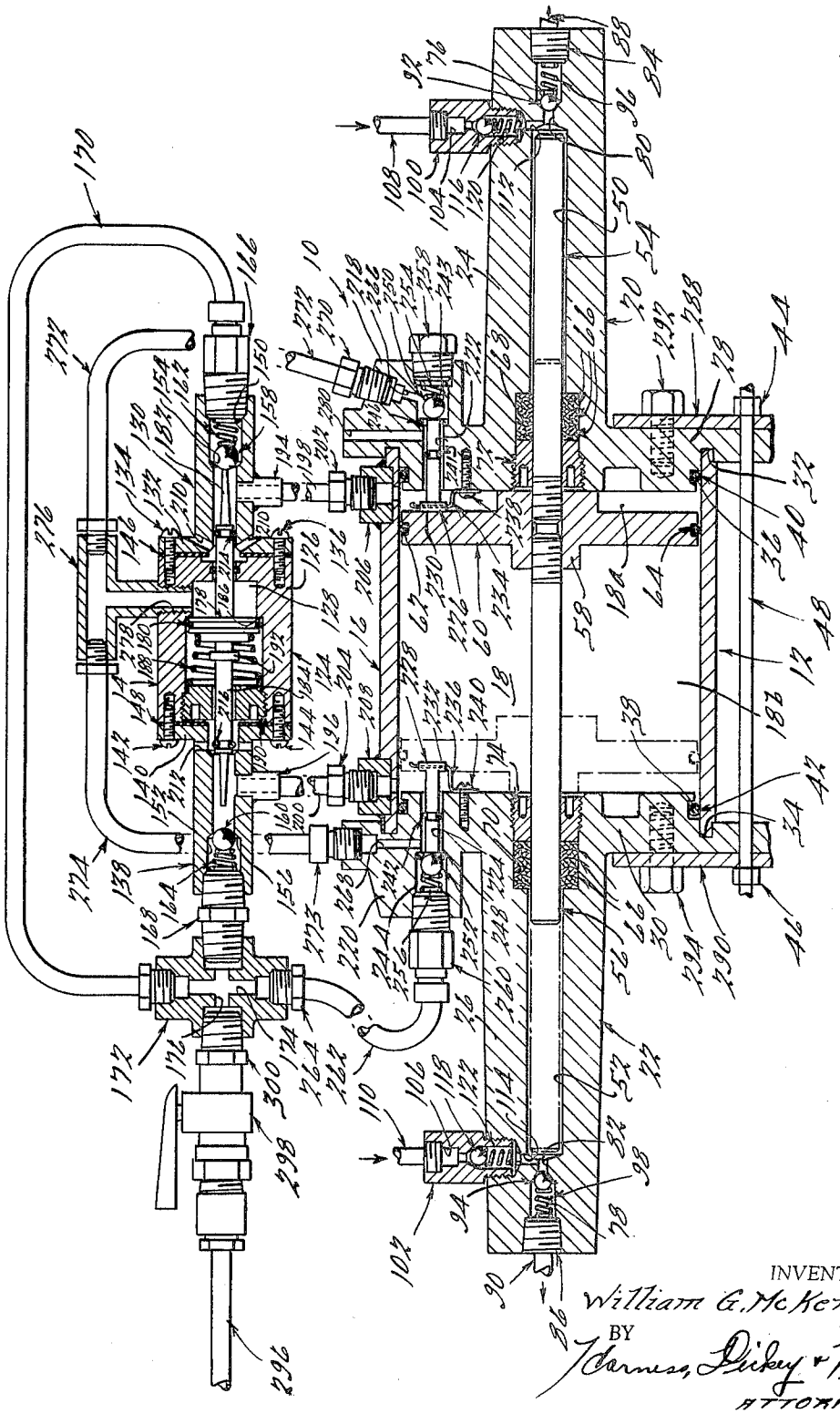
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RECIPROCATING FLUID MOTOR

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RECIPROCATING FLUID MOTOR

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This invention relates generally to fluid pumping means and, more particularly, to a combination pneumatic-hydraulic power device which uses compressed air at a relatively low pressure to pump hydraulic fluid at a relatively high pressure.

The power device of the present invention is particularly directed towards use in elevating relatively heavy loads on hydraulic service jacks of the type used in automotive vehicle repair shops and which include a hydraulic pressure-operated load lifting lever that is adapted to be elevated upon oscillation of a manipulating or pumping handle. The power device is adapted to be mounted on the jack handle or frame and use pressurized air from a common compressed air source to pump hydraulic fluid from the jack's fluid reservoir to its load-lifting ram assembly, thereby effecting elevation of the jack's lifting lever without requiring oscillation of the manipulating handle.

It is an object of the present invention to provide a pneumatic-hydraulic power device of the above character that is of an extremely compact construction.

It is another object of the present invention to provide a pneumatic-hydraulic pumping device of the above character which operates entirely automatically once pressurized air is communicated thereto.

It is still another object of the present invention to provide a power device of the above character that may be easily assembled and economically manufactured.

Other objects and advantages of the present invention will become apparent from the following detailed description taken in conjunction with the accompanying drawing, wherein:

The figure is a longitudinal cross-sectional view of a preferred embodiment of the combined pneumatic-hydraulic power device of the present invention.

Referring now to the drawing, a combination pneumatic-hydraulic power device **10**, in accordance with a preferred embodiment of the present invention, is shown as including a hollow cylindrical pump housing **12** to which pressurized air is selectively transmitted from a pilot valve assembly **14** that is mounted on one (upper) side of the housing **12**. The housing **12** comprises a cylindrical shell **16** which defines a pumping chamber **18** and which is closed on the opposite ends by a pair of substantially identical, combination header-displacement cylinder members **20** and **22**. The members **20** and **22** are respectively formed with axially outwardly extending pumping sections **24** and **26** and with radially outwardly extending header sections **28** and **30**, respectively. A pair of axially aligned annular recesses **32** and **34** are respectively formed on the inner sides of the header sections **28** and **30** within which the opposite ends of the shell **16** are disposed. The header sections **28** and **30** are also formed with radially inwardly extending recesses **36** and **38** circumjacent the recesses **32** and **34**, respectively, within which sealing means in the form of O-rings **40** and **42** are nested. A plurality of bolts, one of which is illustrated herein with suitable nuts **44**, **46**, and is designated by the numeral **48**, are arranged circumferentially around the exterior of the shell **16** and extend axially through suitable aligned apertures in the outer peripheries of the header sections **28** and **30** to rigidly secure the members **20** and **22** to the opposite ends of the shell **16**.

The pumping sections **24** and **26** of the members **20** and **22** are respectively formed with coaxial bores **50** and **52** which are communicable with the opposite sides of the displacement chamber **18**. Slidably disposed within the bores **50** and **52** are elongated cylindrical hydraulic pistons **54** and **56**, respectively. The inner ends of the pistons **54** and **56** are threaded into the opposite sides of a central sleeve section **58** of a double-acting pneumatic piston **60** which is reciprocable within the chamber **18**. The piston **60** lies in a radial plane perpendicular to the longitudinal axis of the housing **12** and is provided with a radially inwardly extending recess **62** around the periphery thereof, within which is disposed sealing means in the form of an O-ring **64** that serves to provide a slidable but air-tight seal between the shell **18** and the piston **60**. The piston **60** divides the pumping chamber **18** into two adjacent chambers **18***a* and **18***b*, the first of which is adjacent the member **20** (on the right side of the piston **60**), and the second of which is adjacent the member **22** (on the left side of the piston **60**). To prevent hydraulic leakage from the interior of the bores **50** and **52** into the chambers **18***a* and **18***b*, a plurality of packing rings, generally designated **66**, are disposed circumjacent the pistons **54** and **56** and are operatively maintained within a pair of annular recesses **68** and **70** that are formed in the inner sides of the header sections **28** and **30** by gland nuts **72** and **74**.

A pair of identical valve bores **76** and **78** are formed in the outer ends of the pumping sections **24** and **26** of the members **20** and **22** and are communicable through fluid passages **80** and **82** with the outer ends of the bores **50** and **52**, respectively. Hydraulic fittings **84** and **86** are threaded within and communicate a pair of hydraulic conduits **88** and **90** with the valve bores **76** and **78**, respectively. A pair of ball-type check valves **92** and **94** are resiliently seated within the bores **76** and **78** by suitable valve springs **96** and **98** and are adapted to control the flow of hydraulic pumping fluid between the bores **76**, **78** and the conduits **80**, **82**, respectively, as will be described.

A pair of check valve fittings **100** and **102** are threaded within appropriate radially outwardly extending bores formed in the outer ends of the pumping sections **24** and **26**, respectively, which fittings are formed with valve bores **104** and **106** that communicate a second pair of hydraulic conduits **108** and **110** with a pair of radially inwardly extending bores **112** and **114** that are formed in the pumping sections **24** and **26**. It will be seen that the bores **112** and **114** are communicable with the bores **80** and **82**, respectively, adjacent the outer end of the bores **50** and **52**, respectively. A pair of ball-type check valves **116** and **118** are resiliently seated within the fittings **100** and **102** by springs **120** and **122**, respectively, and are adapted to control the flow of hydraulic pumping fluid between the bores **112**, **114** and the conduits **108**, **110**, respectively.

Referring now to the pilot valve assembly **14**, there is provided a pilot valve housing, generally designated **124**, that includes a hollow cylindrical shell **126** which defines a metering chamber **128**. Extending axially outward from one (right) end of the shell **126** is an elongated cylindrical valve housing **130** that is formed with an outwardly extending flange section **132** which is attached to the end of the shell **126** by screws **134** and **136**. Another valve housing **138**, which is similar in construction to the housing **130**, extends axially outward from the opposite (left) end of the shell **126** and is formed with an annular flange section **140** which is attached to the end of the shell **126** with screws **142** and **144**. Flat annular gaskets **146** and **148** are respectively interposed between the flange sections **132** and **140**, and the opposite ends of the shell **126** to assure an air-tight seal therebetween. The valve housings **130** and **138** are respectively formed with axially extending valve bores **150** and **152** which communicate with the interior of the metering chamber **128** at the op-

posite ends of the shell **126**. The valve bores **150** and **152** respectively define annular valve seats **154** and **156** against which ball-type check valves **158** and **160** are resiliently seated by valve springs **162** and **164**, respectively. A pair of fittings **166** and **168** are respectively threaded within the outer ends of the bores **150** and **152** and respectively communicate the bores **150** and **152** with an air conduit **170** and a cross fitting **172**, the latter of which is formed with intersecting air passages **174** and **176**. As illustrated, the outer ends of the valve springs **162** and **164** bear against the inner ends of the fittings **166** and **168** to resiliently seat the valves **158** and **160**, respectively.

A flat annular piston **178**, around which is disposed an O-ring sealing member **180**, is reciprocable within the metering chamber **128**. Formed on the opposite sides of the piston **178** is a pair of outwardly extending valve stems **182** and **184** which extend coaxially of and are slidable within the valve bores **150** and **152**, respectively. The metering chamber **128** is formed with an annular shoulder **186** against which the piston **178** is resiliently urged by a coil spring **188** that extends within the chamber **128** circumjacent the valve stem **184**. The outer (left) end of the spring **188** bears against a gland nut **190** which is threaded within the (left) end of the shell **126**. A radially outwardly extending shoulder or stop **192** is formed on the valve stem **184** and is adapted to engage the inner end of the gland nut **190** to limit the reciprocal movement of the piston **178** within the chamber **128**.

It will be seen that as the piston **178** reciprocates within the metering chamber **128**, the valve stems **182** and **184** will respectively reciprocate within the valve bores **150** and **152**. The lengths of the valve stems **182** and **184** are designed such that when the piston **178** moves to the left, the valve stem **184** will unseat the ball valve **160**, and conversely, when the piston **178** is in the position illustrated in the figure (at the far right hand end of its stroke), the valve stem **182** will unseat the ball valve **158**. Thus, as the piston **178** reciprocates within the chamber **128**, the ball valves **158** and **160** will be alternately unseated by the valve stems **182** and **184**, and reseated by the springs **162** and **164**.

A pair of fittings **194** and **196** are mounted within suitable apertures in the lower sides of the housings **130** and **138**, respectively, and communicate a pair of air conduits **198** and **200** with the interior of the valve bores **150** and **152**, respectively. The opposite ends of the conduits **198** and **200** are communicable through a pair of fittings **202** and **204**, and a pair of annular sleeves **206** and **208** which are disposed in the top and at the opposite ends of the shell **16**, with the interior of the chambers **18***a* and **18***b*, respectively. It will thus be seen that the valve bores **150** and **152** are always communicable with the opposite sides of the piston **60** during its reciprocation within the housing **12**.

A pair of exhaust vents **210** and **212** are formed in the pilot valve assembly housings **130** and **138**, respectively, and are adapted to be communicable with the chambers **18***a* and **18***b* through the valve bores **150**, **152** and the conduits **198**, **200**. Around the medial sections of the valve stems **182** and **184** are provided O-ring sealing means **214** and **216**, respectively, which are adapted to reciprocate with the valve stems **182** and **184** and provide an air-tight seal between the interior of the chamber **128** and the valve bores **150** and **152**, respectively. It will be seen that when the piston **178** is at the far right hand end of its stroke, as illustrated in the figure, the valve stem **184** is substantially retracted from the valve bore **152** and, accordingly, the O-ring **216** is disengaged from the inner periphery of the bore **152** and the exhaust vent **212** is in communication through the valve bore **152** and the conduit **200** with the interior of the chamber **18***b*. With the piston **178** in this position, the O-ring **214** is disposed in the valve bore **150** in a position such that it blocks communication between the exhaust vent **210** and the interior of the chamber **18***a*. Conversely, when the piston **178** is at the far and left hand end of its stroke, the O-ring **216**, together with the valve stem **184** is disposed within the valve bore **152**, thereby blocking communication between the exhaust vent **212** and the interior of the chamber **18***b* and the O-ring **214** is retracted from the bore **150** and thus the exhaust vent **210** is in communication with the chamber **18***a*.

Referring again to the pump housing **12**, it will be seen that the header sections **28** and **30** of the members **20** and **22** are respectively formed with enlarged valve sections **218** and **220**. A pair of substantially axially aligned bores **222** and **224** are formed in the sections **218** and **220**, which bores lie along a line substantially parallel to the longitudinal axis of the aforediscussed bores **50** and **52**. Slidably disposed within the bores **222** and **224** are a pair of cylindrical probes **226** and **228**, respectively. Piston engaging head sections **230** and **232** are respectively formed on the probes **226** and **228** and extend into the interior of the chambers **18***a* and **18***b* from the inner sides of the header sections **28** and **30**, respectively. A pair of leaf springs **234** and **236**, which are respectively attached to the inner sides of the header sections **28** and **30** by suitable screws **238** and **240**, extend through the head sections **230** and **232** of the probes **226** and **228** and resiliently maintain the probes **226** and **228** in a position where their head sections **230** and **232** extend into the chambers **18***a* and **18***b*, respectively. O-rings **241** and **242** are mounted on the probes **226** and **228**, respectively, and provide slidable but air-tight seals between the probes **226**, **228** and the bores **222**, **224**. The bores **222** and **224** are respectively formed with enlarged outer sections **243** and **244** within which are respectively disposed O-ring valve seats **246** and **248**. A pair of ball-type check valves **250** and **252** are resiliently biased against the seats **246** and **248** by valve springs **254** and **256**, respectively. The outer ends of the springs **254** and **256** respectively bear against fittings **258** and **260** which are threaded in the outer ends of the sections **243** and **244**, and the latter of which communicates the section **244** with the passage **174** of the cross fitting **172** through a conduit **262** and a fitting **264**.

The probes **226** and **228** are arranged within their respective valve bores **222** and **224** such that when the piston **60** is at the far right hand end of its stroke, as illustrated by the solid lines in the figure, the probe **226** will be engaged by the piston and thereby be biased inwardly to unseat the ball valve **250**. When the piston **60** is disengaged from the probe **228**, the leaf spring **236** maintains this probe in the position illustrated, and the valve spring **256** resiliently seats the ball valve **252**. In a similar manner, when the piston **60** is at the far left hand end of its stroke, as indicated by the phantom lines in the figure, the probe **228** is biased outwardly (to the left), thereby unseating the ball valve **252**, during which time the probe **226** is also biased inwardly (to the left) by the spring **234**, thereby permitting the spring **254** to seat the ball valve **250**.

The valve sections **218** and **220** of the members **20** and **22** are further formed with upwardly extending passages **266** and **268**, respectively, which are communicable with the bore section **243** and bore **224**, respectively. Within the outer ends of the passages **266** and **268** are threaded fittings **270** and **273**, which respectively communicate a pair of air conduits **272** and **274** with the passages **266** and **268**. The opposite ends of the conduits **272** and **274** are communicable with the opposite sides of a T-fitting **276** which is threaded within a passage **278** formed in the top of the shell **126** and communicating with the interior of the metering chamber **128**. An air vent **280** is also formed in the section **218** which communicates the bore **222** with the exterior of the housing **12**.

In operation, the power device **10** is preferably mounted on the jack frame or manipulating handle by a pair of mounting brackets **288** and **290** which are respectively secured to the members **20** and **22** by bolts **292** and **294**. The conduits **88** and **90** are communicated with the jack's

ram cylinder and the conduits 108 and 110 are communicated with the jack's fluid reservoir. Pressurized air is communicated to the device 10 through a suitable air conduit 296 and may be controlled by a manually operated air valve 298. The valve 298 may be directly connected through a fitting 300 to the cross fitting 172 or alternatively, may be remotely communicated with the fitting 172 through a suitable conduit (not shown).

Upon appropriate actuation of the valve 298, pressurized air is communicated into the cross fitting 172 where it is allowed to go in three different directions. Assuming the pistons 60 and 178 are in their respective positions illustrated in the figure, the air may flow through the passage 176 and pass into the valve bore 152 where its flow is stopped by the ball valve 160. Alternatively, air may also flow downward through the passage 174 and the conduit 262 into the bore section 244 where its flow is stopped by the ball valve 252. The air in the fitting 172 may, however, flow through the conduit 170 and into the valve bore 150, past the ball valve 158 and then downward through the passage 198 into the chamber 18*a*. The air entering the chamber 18*a* through the conduit 198 forces the air piston 60 to the left until it engages the head section 232 of the probe 228, thereby unseating the ball valve 252. As the ball valve 252 thus becomes unseated, pressurized air is communicated through the conduit 262 from the T-fitting 172 and into the passage 268 and the conduit 274. The pressurized air within the conduit 274 flows into the T-fitting 276 and downward through the passage 278 in the sheel 124 into the metering chamber 128. It will be noted that at the time the piston 60 moves to the left, the probe 226 also moves to the left through the action of the leaf spring 234, thereby allowing the ball valve 250 to seat against the O-ring 246 to block communication between the valve bore 222 and the bore section 243. With the ball valve 50 thus seated, it will be seen that the pressurized air flowing from the cross fitting 172, around the ball valve 252 and upward into the conduit 174, will flow downward from the T-fitting 276 and into the cavity 128, thereby moving the piston 178 and the valve stems 182 and 184 to the left. As the valve stem 184 moves to the left within the valve bore 152, it engages and unseats the ball valve 160 while at the same time, the ball valve 158 is seated within the bore 150 by the spring 162. It will be noted that as the piston 178 moves to the left, the O-ring seal 214 is retracted from the bore 150, thereby opening a passage from the chamber 18*a*, through the conduit 198 and bore 150, to the exhaust vent 210.

It will be seen that once the piston 178 has moved to the left, thereby unseating the ball valve 160 and concurrently allowing the ball valve 158 to be seated within the bore 150, the flow of pressurized air from the cross fitting 172 will pass through the fitting 168 and into the cylinder 138, from where it will flow downward through the conduit 200 into the interior of the chamber ber 18*a*, it engages the probe 226 thereby unseating the ball piston 60 leaves the left hand side of the housing 12 (that position indicated by the phantom lines), the probe 228 will be biased inwardly (to the right) by the spring 236, thereby allowing the ball valve 252 to seat within the bore section 244. During the time the air piston 60 moves from left to right, it will be seen that the air pressure within the conduit 272 and the chamber 128 is trapped so that the piston 178 cannot move. When the air piston 60 reaches the far right side of the chamber 18*a*, it engages the probe 226 thereby unseating the ball valve 250 and permitting air trapped within the conduit 272 and the chamber 128 to exhaust through the bore section 243 and air vent 280. As the air exhausts from the chamber 128, the spring 188 resiliently biases the piston 178 to the right, thereby engaging and unseating the ball valve 158 with the valve stem 182 and biasing the O-ring 214 into the bore 150 to block communication between the exhaust vent 210 and the interior of the chamber 18*a*. Also, movement of the piston 178 to the right withdraws the O-ring 216 from the bore 152, thereby allowing pressurized air to flow from the chamber 18*b* through the conduit 200 and exhaust vent 212. It will be apparent, of course, that as the valve stem 182 unseats the ball valve 158, the entire pumping device 10 will begin its next successive cycle, identical to that hereinbefore described.

As the air piston 60 reciprocates within the pump housing 12, the hydraulic pistons 54 and 56, which are attached to the opposite sides of the air piston 60, reciprocate within the cylinders 24 and 26. As the piston 56 moves to the right within the bore 52, hydraulic fluid communicated to the fitting 102 from the jack's fluid reservoir through the conduit 110 will unseat the ball valve 118 and flow into the bore 52. At such time as the piston 56 moves outward within the bore 52, the hydraulic fluid within the bore 52 will seat the valve 118 and unseat the ball valve 94, and thus be pumped through the conduit 90 to the load-lifting ram cylinder of the jack. In a similar manner, as the piston 54 reciprocates within the bore 50, hydraulic fluid is pumped into the cylinder 24 through the conduit 108 and past the ball valve 116, and is pumped from the cylinder 24 through the conduit 88 past the ball valve 92. It will thus be seen that as the air cylinder 60 reciprocates within the pump housing 12, the piston 54 will draw hydraulic fluid into the bore 50 while the piston 56 simultaneously discharges fluid from the bore 52, and conversely, as the piston 56 draws fluid into the bore 52, the piston 54 simultaneously discharges fluid from the bore 50. It will thus be apparent that a continuous flow of hydraulic fluid will be pumped to the jack during the entire time pressurized air is communicated to the power device 10.

It wil be evident from the aforegoing construction that the power device 10 of the present invention provides an extremely compact unit which is adapted to be easily installed or mounted on a hydraulic service jack and operate to efficiently pump hydraulic fluid to the jack's ram cylinder to effect elevation of the jack's lifting lever, without requiring any effort on the part of the jack operator other than actuating the valve 298. Moreover, by virtue of the relatively simple construction of the power device 10, it will be apparent that the unit will be both dependable in operation and economical to commercially produce.

While it will be apparent that the preferred embodiment herein illustrated is well calculated to fulfill the objects above stated, it will be appreciated that the invention is susceptible to modification, variation and change without departing from the proper scope or fair meaning of the subjoined claims.

What is claimed is:

1. In a combination pneumatic-hydraulic pumping device,

a pump housing comprising an annular shell and header means closing the opposite ends of said shell,

said header means defining hydraulic pumping chambers communicable with the interior of said shell,

a pneumatically actuated piston reciprocable within said shell,

hydraulic pumping means attached to the opposite sides of said piston and reciprocable within said hydraulic pumping chambers upon reciprocation of said piston in said shell,

valve means for selectively metering predetermined quantities of pressurized air into said shell on the opposite sides of said piston to effect the movement of said piston and said hydraulic pumping means,

said valve means comprising a valve housing and a pressure responsive piston reciprocable within said housing,

conduit means communicating said valve housing with said pump housing,

check valve means in said valve housing and being selectively engageable by said piston means in said valve housing to communicate pressurized air from said valve housing into said conduit means, and

means including probe means slidably mounted in said pump housing and engageable by said pneumatically actuated piston to effect the actuation of said valve means.

2. In a fluid pumping device,

a pump housing,

a pumping chamber in said housing,

a piston reciprocable in said housing,

at least a portion of said piston being reciprocable in said pumping chamber,

fluid inlet and outlet means communicable with said pumping chamber,

valve means for selectively metering predetermined quantities of an actuating fluid into said pump housing to effect the movement of said piston,

said valve means including a valve housing which comprises a central section and check valve sections on the opposite sides of said central section,

said valve means further including a piston reciprocable within said central section and having valve stems reciprocable within said check valve sections upon reciprocation of said last mentioned piston in said central section,

check valve means in each of said check valve sections of said valve housing, and

conduit means communicating said valve housing with said pump housing,

said piston in said valve housing being movable therein in response to movement of said piston in said pump housing thereby effecting movement of said valve stems to unseat said check valve means and communicate pressurized air to said pump housing.

3. In a fluid pumping device,

a pump housing comprising a central section and a pair of pumping chambers,

a piston having an actuating section and a pair of pumping sections respectively reciprocable within said central section and said pumping sections,

fluid inlet and outlet means communicating pumping fluid to and from said pumping chambers,

valve means for selectively metering predetermined quantities of pressurized air into said central section of said pump housing on the opposite sides of said actuating section of said piston to effect the movement of said piston,

said valve means comprising a valve housing and a pressure responsive piston reciprocable within said valve housing,

conduit means communicating said valve housing with said pump housing,

check valve means in said valve housing and being selectively engageable by said piston means in said valve housing to communicate pressurized air from said valve housing into said conduit means, and

means including probe means slidably mounted in said pump housing and engageable by said piston in said pump housing to effect the acuation of said valve means.

4. In a combination pneumatic-hydraulic pumping device,

a pump housing comprising a pneumatic pumping chamber and a pair of hydraulic pumping chambers,

a piston reciprocable within said pneumatic pumping chamber,

hydraulic pumping means reciprocable within said hydraulic pumping chambers,

hydraulic fluid inlet and outlet means communicating hydraulic fluid to and from said hydraulic pumping chambers,

valve means for selectively metering predetermined quantites of pressurized air into said pneumatic pumping chamber on the opposite sides of said piston to effect the movement of said piston and said hydraulic pumping means,

said valve means comprising a valve housing and a pressure responsive piston reciprocable within said valve housing,

conduit means communicating said valve housing with said pump housing,

check valve means in said valve housing and being selectively engageable by said piston means in said valve housing to communicate pressurized air from said valve housing into said conduit means, and

means including probe means slidably mounted in said pump housing and engageable by said piston in said pump housing to effect the actuation of said valve means.

5. In a combination pneumatic-hydraulic power device,

a pump housing comprising a pneumatic pumping chamber and a pair of hydraulic pumping chambers,

a piston reciprocable within said pneumatic pumping chamber,

hydraulic pumping means reciprocable within said hydraulic pumping chambers,

valve means for selectively metering predetermined quantities of pressurized air into said pneumatic pumping chamber on the opposite sides of said piston to effect the movement of said piston and said hydraulic pumping means,

said valve means comprising a valve housing and a pressure responsive piston reciprocable within said valve housing,

conduit means communicating said valve housing with said pump housing,

check valve means in said valve housing and being selectively engageable by said piston means in said valve housing to communicate pressurized air from said valve housing into said conduit means, and

means in said pneumatic pumping chamber responsive to the movement of said first mentioned piston to communicate pressurized air to said valve housing thereby effecting movement of said pressure responsive piston.

6. In a combination pneumatic-hydraulic power device,

a pump housing comprising a pneumatic pumping chamber and a pair of hydraulic pumping chambers,

a piston reciprocable within said pneumatic pumping chamber,

hydraulic pumping means reciprocable within said hydraulic pumping chambers,

valve means for communicating preselected quantities of an actuating fluid into said pump housing to effect the movement of said piston,

said valve means including a valve housing which comprises a central section and check valve sections on the opposite sides of said central section,

said valve means further including a piston reciprocable within said central section and having valve stems reciprocable within said check valve sections upon reciprocation of said piston in said central section,

check valve means in each of said check valve sections of said valve housing, and

conduit means communicating said valve housing with said pump housing, and

means including probe means slidably mounted in said pump housing and engageable by said pneumatically actuated piston to effect the actuation of said valve means,

said piston in said valve housing being movable therein in response to movement of said piston in said pump housing to effect movement of said valve stems to unseat said check valve means and communicate pressurized air to said pump housing.

7. In a combination pneumatic-hydraulic power device,

a pump housing comprising an annular shell and header means closing the opposite ends of said shell,
said header means defining hydraulic pumping chambers communicable with the interior of said shell,
a pneumatically actuated piston reciprocable within said shell,
hydraulic pumping means attached to the opposite sides of said piston and reciprocable within said hydraulic pumping chambers upon reciprocation of said piston in said shell,
valve means for communicating preselected quantities of pressurized air into said pump housing to effect the movement of said piston,
said valve means including a valve housing which comprises a central section and check valve sections on the opposite sides of said central section,
said valve means further including a piston reciprocable within said central section and having valve stems reciprocable within said check valve sections upon reciprocation of said piston in said central section,
check valve means in each of said check valve sections of said valve housing,
conduit means communicating said valve housing with said pump housing, and
means including probe means slidably mounted in said pump housing and engageable by said pneumatically actuated piston to effect the actuation of said valve means,
said piston in said valve housing being movable therein in response to movement of said piston in said pump housing to effect movement of said valve stems to unseat said check valve means and communicate pressurized air to said pump housing.

8. In a pneumatically powered pumping device,
a pump housing comprising a hollow cylindrical shell,
the opposite ends of said shell being closed by header members each of which defines a hydraulic pumping chamber,
a pneumatically actuated piston reciprocable within said shell,
a hydraulic piston attached to each side of said pneumatically actuated piston and being reciprocable within said hydraulic pumping chambers,
valve means for selectively communicating pressurized air into said pump housing to effect the movement of said pneumatically actuated piston,
said valve means including a valve housing which comprises a central section and check valve sections on the opposite sides of said central section,
said valve means further including a piston reciprocable within said central section and having valve stems reciprocable within said check valve sections upon reciprocation of said piston in said central section,
check valve means in each of said check valve sections of said valve housing,
conduit means communicating said valve housing with said pump housing,
said piston in said valve housing being movable therein in response to movement of said piston in said pump housing to effect movement of said valve stems to unseat said check valve means and communicate pressurized air to said pump housing,
probe means slidably mounted in said header members and being alternately engageable by said pneumatically actuated piston as it reciprocates within said shell, and
conduit means communicating said probe means with said valve housing and communicating pressurized air from said shell to said valve housing upon engagement of said probe means by said pneumatically actuated piston.

9. In a pneumatically air-power pumping device,
a pump housing comprising a hollow cylindrical shell,
the opposite ends of said shell being closed by header members each of which defines a hydraulic pumping chamber,
a pneumatically actuated piston reciprocable within said shell,
a hydraulic piston attached to each side of said pneumatically actuated piston and being reciprocable within said hydraulic pumping chambers,
valve means for communicating preselected quantities of an actuating fluid into said pump housing to effect the movement of said pneumatically actuated piston,
said valve means including a valve housing which comprises a central section and check valve sections on the opposite sides of said central section,
said valve means further including a piston reciprocable within said central section and having valve stems reciprocable within said check valve sections upon reciprocation of said piston in said central section,
check valve means in each of said check valve sections of said valve housing,
conduit means communicating said valve housing with said pump housing,
said piston in said valve housing being movable therein in response to movement of said piston in said pump housing to effect movement of said valve stems to unseat said check valve means and communicate pressurized air to said pump housing,
probe means slidably mounted in said header members and being alternately engageable by said pneumatically actuated piston as it reciprocates within said shell,
conduit means communicating said probe means with said valve housing and communicating pressurized air from said shell to said valve housing upon engagement of said probe means by said pneumatically actuated piston,
check valve means in said header members adjacent each of said probe means and selectively blocking communication between said last referred to conduit means and said valve housing,
said last referred to check valve means being unseated upon engagement of said pneumatically actuated piston with the adjacent of said probe means whereby pressurized air is communicated from said shell to said valve housing through said last mentioned conduit means.

10. In a combination pneumatic-hydraulic pumping device,
a pump housing comprising an annular shell and header means closing the opposite ends of said shell,
said header means defining hydraulic pumping chambers communicating with the interior of said shell,
a pneumatically actuated piston reciprocable within said shell,
hydraulic pumping means attached to the opposite sides of said piston and reciprocable within said hydraulic pumping chambers upon reciprocation of said piston in said shell,
a pilot valve assembly comprising a valve housing having a central section and check valve sections on the opposite sides of said central section,
a pilot valve piston reciprocable within said central section of said valve housing and having valve stems attached to the opposite sides thereof that are reciprocable within said check valve sections,
conduit means communicating said check valve sections of said valve housing with said pump housing on the opposite sides of said pneumatically actuated piston, and
check valve means in said check valve sections blocking communication between said central section and said conduit means,
said check valve means being engageable by said valve stems to communicate said central section of said valve housing with said shell through said conduit means.

11. The device as set forth in claim 10 which includes a pressurized air inlet line communicable with each of said check valve sections of said valve housing and wherein said check valve means upon being engaged by said valve stems on said pilot valve piston communicate said air pressurized air inlet line with said shell through said conduit means.

12. In a pneumatically operated device for powering a hydraulic service jack or the like,

a pump housing comprising a hollow annular shell, the opposite ends of said shell being closed by header members each of which defines a hydraulic pumping chamber,

a pneumatically actuated piston recirpocable within said shell,

a hydraulic piston attached to each side of said pneumatically actuated piston and being reciprocable within said hydraulic pumping chambers upon the reciprocation of said pneumatically actuated piston in said shell,

hydraulic inlet and outlet conduits communicating hydraulic fluid to and from said hydraulic pumping chambers,

check valves selectively blocking communication between said inlet and outlet conduits and said hydraulic pumping chambers,

a pilot valve assembly comprising a valve housing having a central section and check valve sections on the opposite sides of said central section,

a pilot valve piston reciprocable within said central section of said valve housing and having valve stems attached to the opposite sides thereof that are reciprocable within said check valve sections,

conduit means communicating said check valve sections of said valve housing with said pump housing on the opposite sides of said pneumatically actuated piston,

check valves in said check valve sections blocking communication between said central section of said valve housing and said last mentioned conduit means,

said last mentioned check valves being engageable by said valve stems to communicate said central section with said last mentioned conduit means,

a pair of probes slidably and resiliently mounted in said header members and being alternately engageable by said pneumatically actuated piston as it reciprocates within said shell,

conduit means communicating said probes with said valve housing and communicating pressurized air to said valve housing upon engagement of said probes by said pneumatically actuated piston,

check valve means in said header members adjacent each of said probes selectively blocking communication between said last referred to conduit means and said valve housing,

said last referred to check valve means being adapted to be unseated upon engagement of said pneumatically actuated piston with the adjacent of said probe means thereby communicating pressurized air to said valve housing through said last mentioned conduit means to effect the movement of said piston in said valve housing.

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