United States Patent [19]

Otto

[11] **3,779,132**

[45] **Dec. 18, 1973**

[54] **COMBINATION AIR AND HYDRAULIC MOTOR**

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[22] Filed: **July 14, 1971**

[21] Appl. No.: **162,549**

[52] **U.S. Cl.** ..... **91/4 A,** 91/331, 91/350, 91/448

[51] **Int. Cl.** **F15b 21/04,** F01l 31/14

[58] **Field of Search** ..... 91/4 A, 4 R, 218, 91/350, 331

[56] **References Cited**

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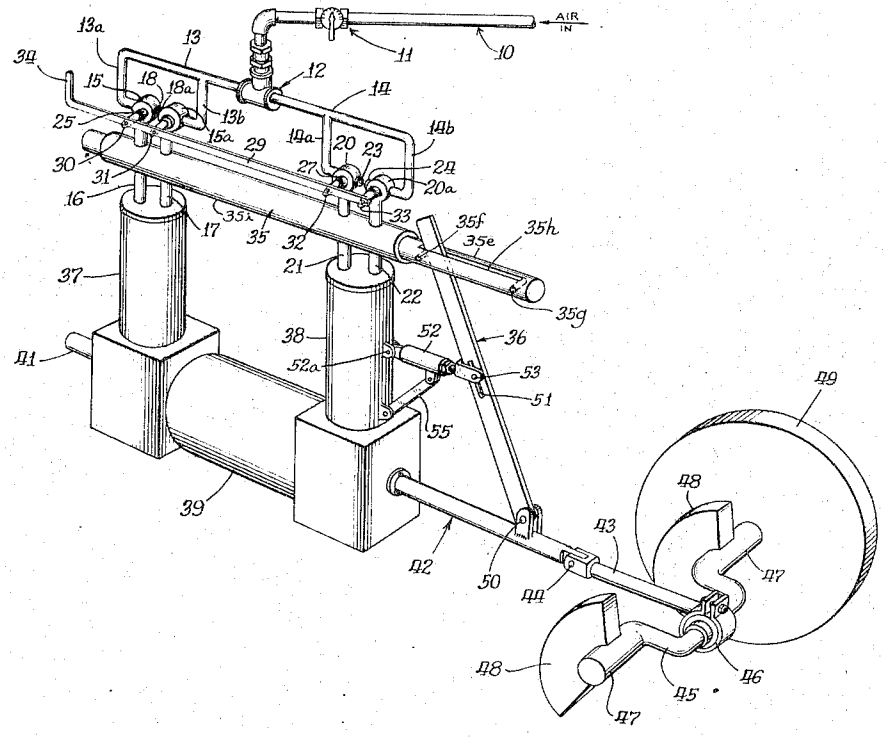
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[57] **ABSTRACT**

A combination air and hydraulic motor in which air under pressure is used as the primary source of power. Hydraulic liquid is used as an intermediate linkage between the air under pressure and a mechanically reciprocating arm. A spherical float acts as a coupling means to separate the air and hydraulic liquid and prevents undesirable admixture of air and liquid. Valve means for the air under pressure determines the direction of movement of the hydraulic liquid. Mechanical linkage joins the reciprocating arm and the valve means whereby the valve means is alternately shifted to move the hydraulic liquid in one direction and then the other in alternating fashion to keep the motor running.

8 Claims, 2 Drawing Figures

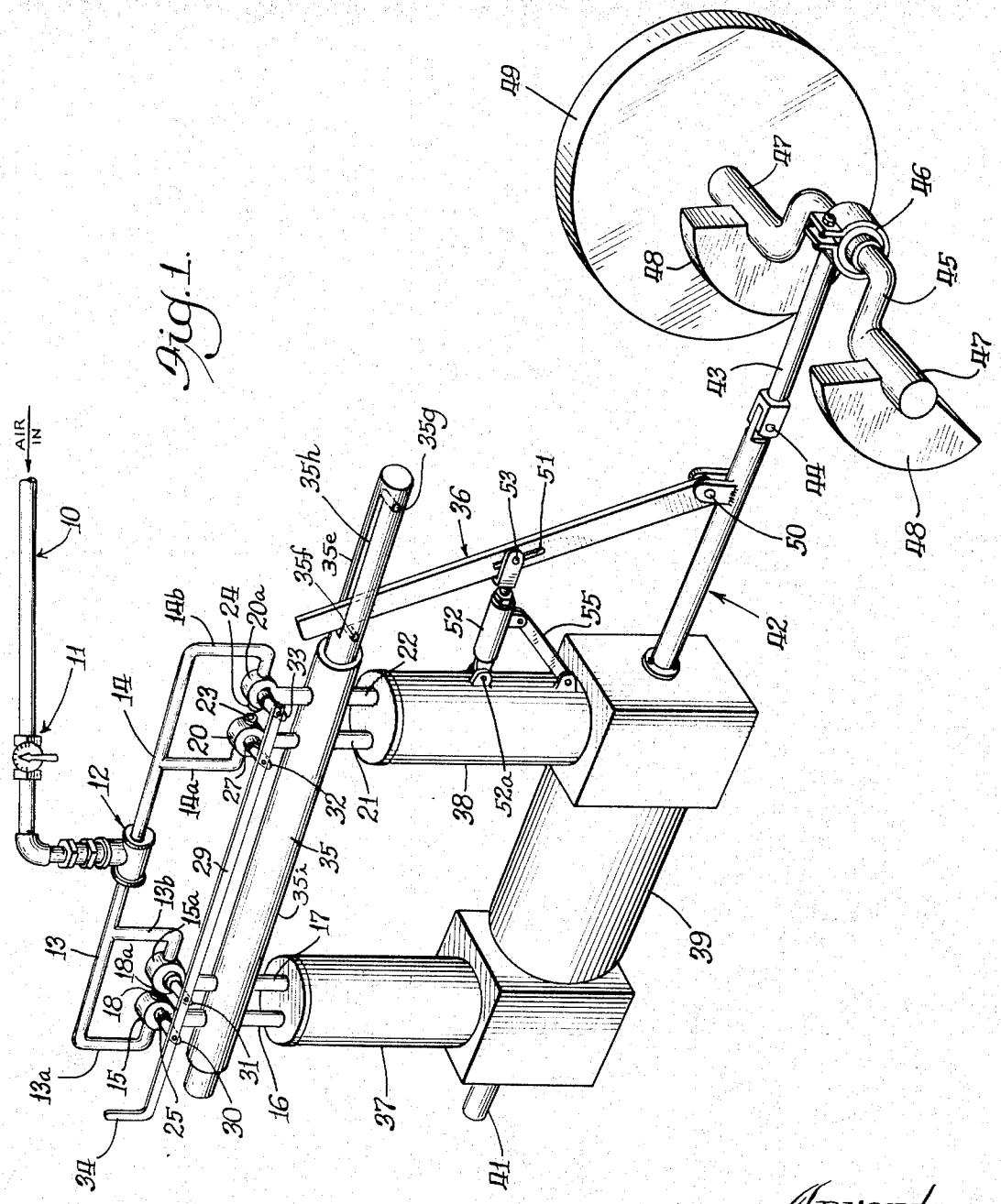


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SHEET 1 OF 2

Fig. 1.

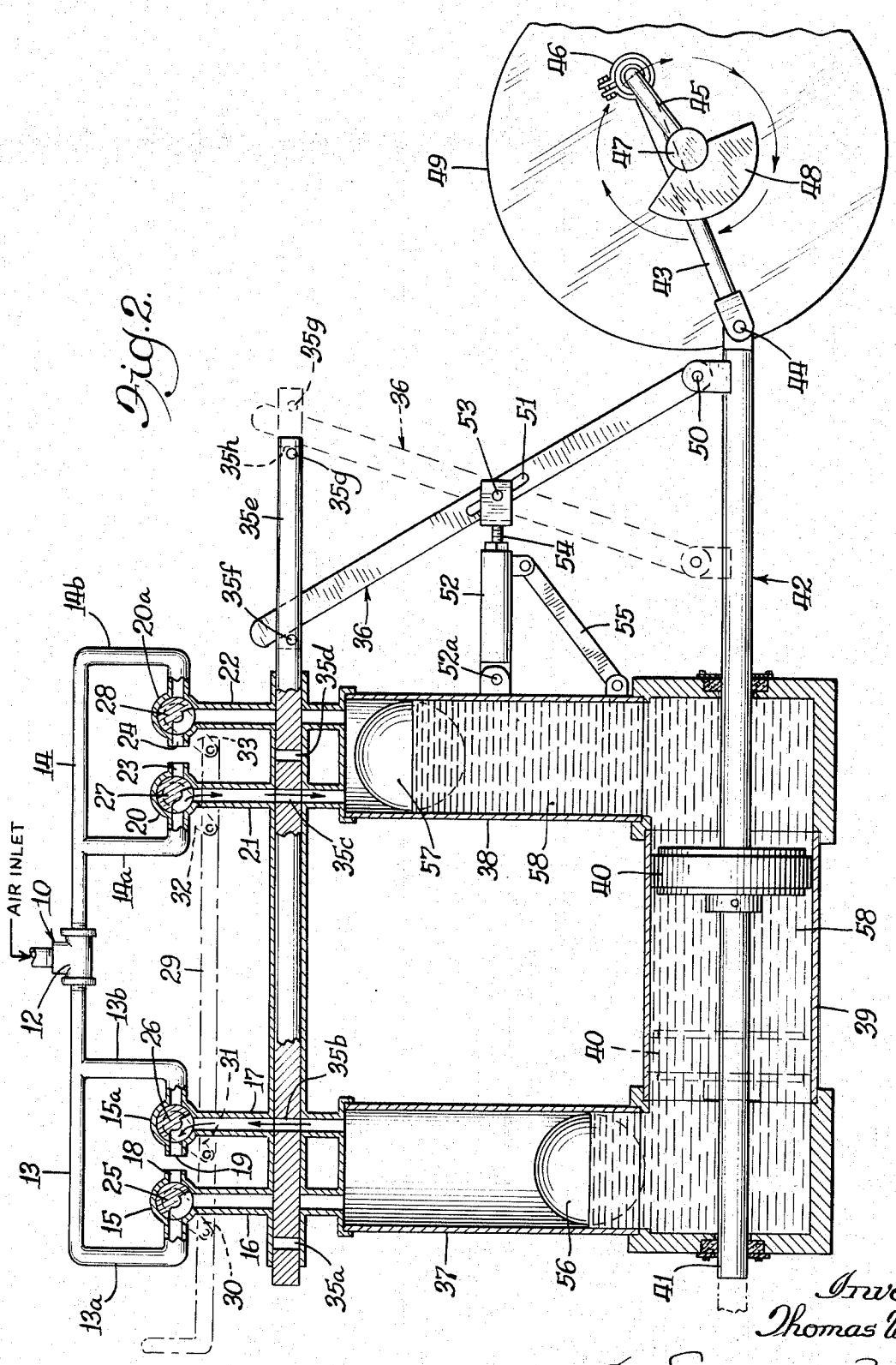


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Fig. 2.



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COMBINATION AIR AND HYDRAULIC MOTOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The particular type of motor best suited for any given device depends to a great extent on the power available. If air is readily available, one might select an air motor as the driving means for a particular device; especially if combustion, heat or noise must be eliminated. Also, air power is desirable where pollution must be reduced or eliminated. The present invention is concerned with a combination air and hydraulic motor — taking the best features of each. The present invention is concerned with the utilization of compressed air as the basic source of energy while the hydraulic means is employed to give stability to the motor drive means and to provide a means for producing a mechanical advantage. Further, it is the coupling of the air and hydraulic means with floating spheres that differs from the prior art.

2. Description of the Prior Art

A preliminary search has been made and the following are brief resumes of the pertinent disclosures.

Blackburn Pat. No. 3,100,965 utilizes gas under pressure to actuate a hydraulic system. A concerted effort is made by Blackburn to prevent contamination of the gas with the liquid by sealing pistons between the different fluids.

Stelzer Pat. No. 2,151,998 describes a steering booster in which engine gases are used directly on a hydraulic liquid to cause actuation of the device. Also, this Stelzer patent shows a linkage from the steering mechanism to control valving.

Aber Pat. No. 3,234,854 actuates a hydraulic device by the direct application of air under pressure to either of two vertical columns of liquid. Further, baffle means are provided at the inlet ports to prevent splashing and entrapment of air in the liquid.

The Patent to Holub No. 199,978 discloses a motor driven slide valve E with a preceding diverter valve A in a dual fluid system of steam and water.

The Patent of Elmes No. 486,095 discloses a dual fluid motor which includes a liquid reservoir **17** and **18** for the motor **1** and an air valve **6** driven between motor shaft **3** through the linkage **42, 43** and **45.**

Jackman, Jr. Pat. No. 2,239,893 is of interest because it employs mechanical linkage from a piston rod in a cylinder to actuate an adjacent slide valve.

SUMMARY OF THE INVENTION

A principal object of the present invention is to provide a novel air and hydraulic motor.

An important object of this invention is to provide a novel spherical floating coupling means situated between the air and hydraulic fluid.

Another important object of this invention is to provide novel parallel columns of liquid joined by a cylinder disposed at right angles to the columns and means for alternately imposing air under pressure on each column to cause a mechanical reciprocation of a piston in the cylinder.

Another and further important object of this invention is to provide a novel arrangement of elements as defined in the preceding object and having slide valve means movable by the reciprocating piston to effect an alternating of the admission of air under pressure from one column to the other.

Still another important object of this invention is to provide a novel combination air and hydraulic motor with manually operable valve means to effect reversal of direction of the output of the motor.

Other and further important objects and advantages will become apparent from the disclosures in the following specification and accompanying drawings.

IN THE DRAWINGS

FIG. **1** is a perspective view of the combination air and hydraulic motor of this invention.

FIG. **2** is a vertical sectional view taken through the device of FIG. **1** and showing the operating interior.

AS SHOWN IN THE DRAWINGS

The reference numeral **10** indicates generally an input pipe for a source of air under pressure. A manual control valve **11** is in the line **10** and the operator may turn the system on or off with the valve **11.** A T-fitting **12** joins the input pipe **10** and divides the incoming air under pressure into two passageways **13** and **14.**

The passageway **13** is further divided into two passageways **13*a*** and **13*b***. The extension passageway **13*a*** joins a fixed housing **15** and similarly the extension **13*b*** joins a spaced apart fixed housing **15*a***. Downwardly extending passages **16** and **17** join the housings **15** and **15*a*** respectively. Each housing **15** and **15*a*** is provided with an exhaust port **18** and **19** as best shown in FIG. **2.** Similarly the passageway **14** is further divided into two passageways **14*a*** and **14*b***. The extension passageway **14*a*** joins a fixed housing **20** while the extension passageway **14*b*** joins a spaced apart fixed housing **20*a***. Downwardly extending passages **21** and **22** join the housings **20** and **20*a*** respectively. Each housing **20** and **20*a*** is provided with an exhaust port **23** and **24.**

A 3-way valve **25** disposed in the housing **15** is adapted to control the opening and closing of communication from passage **13*a*** to passage **16** and to either open or close the passage **16** to the exhaust port **18.** As shown in FIG. **2** the valve **25** permits communication between passages **13*a*** and **16** but bars communication between the passage **16** and the exhaust port **18.** A second 3-way valve **26** disposed in the housing **15*a*** acts to control communication from the passage **13*b*** to the passage **17** as well as either opening or closing the passage **17** to the exhaust post **19.** As shown in FIG. **2** air under pressure is barred from passing through the valve **26** to the passage **17** while communication of the passageway **17** to the exhaust post **19** is open.

On the other side of the device a 3-way valve **27** is provided in the housing **20** to control communication between the passage **14*a*** and the passage **21** and also between the passage **21** and the exhaust port **23.** Similarly a 3-way valve **28** is disposed in the housing **20*a*** and controls communication between the passages **14*b*** and **22** and between the passage **22** and the exhaust post **24.** As presently set in FIG. **2** air under pressure moves through the passage **14*a***, through the open valve **27** and thence into the passage **21.** The exhaust port **23** is closed. Air under pressure is barred by a closed valve **28** between the passages **14*b*** and **22.** However, the passage **22** is open to the exhaust port **24.**

An elongated valve operating member **29** is positioned laterally across and adjacent the passages **16, 17, 21** and **22** and by means of short control links **30, 31, 32** and **33** the member **29** is joined to the valves **25, 26, 27** and **28.** A handle **34** at one end of the operating

rod member **29** permits an operator to pull or push the rod member **29** and thereby control in unison all of the 3-way control valves **25, 26, 27** and **28.** It should be understood electrical controls could be employed to operate the valving used to direct the passage of air and hydraulic liquid in the device of this invention.

A reciprocating slide valve **35** passes through the passages **16, 17, 21** and **22** and depending on the position thereof either opens or closes these passageways. The slide member **35** is equipped with spaced apart cross ports **35***a*, **35***b*, **35***c* and **35***d*. As shown in FIG. **2** the port **35***b* is in alignment with the passage **17** and thus that passage is open. The port **35***a* is offset from the passage **16** and thus that passage is closed. The port **35**c is aligned with the passage **21** and therefore that passageway is open. The port **35**d is not in alignment with the passage **22** to thereby close that passageway. The slide valve **35** is provided with an axial extension **35***e*. On this extension **35***e* there is provided spaced apart stop members **35***f* and **35***g* defining the ends of an elongated slot **35***h*. The slide valve **35** further includes a stationary sleeve housing **35***i* throughout the area of the passageways that the slide valve controls. It is between the two stop members and within the elongated slot **35***h* that a valve actuating lever **36** swings to move the slide valve **35** in a reciprocating manner.

A first vertically disposed cylindrical column **37** is disposed directly beneath the passages **16** and **17.** These passages communicatingly join the top of the column **37.** A second vertically disposed cylindrical column **38** is disposed beneath the passages **21** and **22.** These passages enter the top of the clyinder **38** in the same manner as the passages **16** and **17** enter the top of the cylinder **37.** The cylinders or columns **37** and **38** lie parallel to one another.

A generally horizontally disposed cylinder **39** spans the space between the parallel vertical columns **37** and **38.** The bottom of the column **37** is joined to and communicates with one end of the horizontal cylinder **39** while the bottom of the column **38** is joined to and communicates with the other end of the horizontal cylinder **39.** A piston **40** is arranged for sliding reciprocation in the cylinder **39.** A piston rod **41** on one side of the piston **40** is slidably journaled in the end thereof adjacent the first vertical column **37.** An axially aligned piston rod **42** is located on the other side of the piston **40** and is slidably journaled in the other end of the cylinder **39** adjacent the second vertical column **38.** The piston rod **42** in the present invention is used as the drive shaft of the motor. By having a piston rod extend out both ends of the cylinder **39** either or both ends may be used as a driving means. Also, there is no differential in effective piston areas on either side thereof because of the utilization of piston rods of equal diameter on both sides of the piston.

The diameters of the parallel columns **37** and **38** are shown smaller than the larger diameter connecting cylinder **39.** This differential in diameters of the cylinders in the air-hydraulic system creates a mechanical advantage in the driving output. This is accomplished by the returning of hydraulic liquid to a smaller diameter column or cylinder from the large diameter connecting cylinder. Depending on the sizes of the cylinders employed the air-hydraulic motor of this invention can be made to operate with more speed or more power or may be made to operate in one direction differently from the other direction by having the parallel vertically disposed columns made of different diameters.

As best shown in FIGS. **1** and **2** a pitman **43** pivotally joins the end of the drive shaft **42** at **44.** The other end of the pitman **43** joins a crank **45** at **46.** A shaft **47** has the crank **45** on one side and at a diametrically opposite position there is provided a counterbalance **48.** For purposes of completing the drive a flywheel **49** is mounted on the shaft **47** and is the mechanical element driven by the motor of this invention. It is preferable that the flywheel shaft be offset from the plane through the drive shaft to avoid difficulties in starting that might occur if the pitman were in axial alignment with the drive shaft. A dead center position could be possible if the flywheel shaft were not offset.

The lower end of the valve actuating lever **36** is pivotally joined to the drive shaft **42** at **50.** An intermediate portion of the valve actuating lever **36** is equipped with an elongated slot **51.** A horizontal post **52** carried in a clevis on the second vertical column at **52***a* or on any other stationary part of the device has a pivot pin **53** as part of a clevis at the lateral outer end thereof. The pivot pin **53** is adjustable for in and out movement by means of a screw **54** threadedly cooperating with the post **52.** A brace **55** is provided to give rigidity to the pivot pin **53.** The screw means permits the proper positioning of the pivot for timing of the motor.

The pivot pin **53** is arranged and constructed to engage the elongated slot **51** in the valve actuating lever **36.** Thus as the drive shaft **42** is reciprocated by movement of the piston **40** in the cylinder **39** the valve actuating lever is rocked about the pivot pin **53.** The upper end of the rocking lever swings in the elongated slot **35***h* between the ends **35***f* and **35***g* and acts to axially move the slide valve **35** as the lever abuts first one end and then the other.

Located in the first vertical column **37** there is provided a floating ball or sphere **56** which substantially fills the cross sectional area of the column. Similarly a like ball **57** substantially fills the cross sectional area of the column **38.** The balls act as floating couplings between the air under pressure and the hydraulic liquid. The couplings prevent direct impingement of the air on the liquid and entrapment of air in the liquid is substantially eliminated. The spheres **56** and **57** are not intended to seal off air from liquid entirely but are free floating in the columns and generally keep the fluids separated.

OPERATION OF THE DEVICE

Air under pressure is admitted to the system through the inlet pipe **10** and an open manual valve **11.** With the slide valve **35** in the position as shown in FIG. **2** air under pressure is admitted down through the open passageway **21** and impinges directly on the ball **57** which acts as a coupling between the air and the hydraulic liquid **58.** The liquid used in the hydraulic system of this invention should preferably be a free flowing liquid or one with a very light viscosity. The ball is moved downwardly by the air under pressure causing the liquid therebeneath to move downwardly and into the horizontal cylinder **39** to thereupon move the piston **40** axially within the cylinder. At the other end of the cylinder hydraulic liquid is moved upwardly against the ball **56.** This upward movement of the ball **56** causes air above the ball to exhaust through the port **35***b* and thence out the exhaust port **19.** When the piston **40** finishes its

stroke in one direction the slide valve **35** automatically shifts its position thus bringing the out of register ports **35***a* and **35***d* into register with the passages **16** and **22** respectively and the ports **35***b* and **35***c* out of registration with the passages **17** and **21.** The air under pressure will now push the ball **56** downwardly and reverse the drive shaft **42.** Without any change in the system or any manual control imposed thereover the motor will continue to operate in a manner to reciprocate the drive shaft **42** and rotate tbe flywheel **48.**

If it is now desired to reverse the direction of rotation of the flywheel **48** the elongated operating member **29** is manually moved to shift the positions of the auxiliary 3-way valves and thus change the direction of the combined air and hydraulic fluid intermediate its stroke ends and thus immediately reverse the direction of movement of the flywheel. The operation of the 3-way valves causes admission of air to a different passage and exhausting of air at a different location.

I am aware that numerous details of construction may be varied throughout a wide range and it should be understood the embodiment as disclosed herein is only one acceptable embodiment.

What is claimed is:

1. A combination air and hydraulic motor comprising a source of air under pressure, a pair of parallel cylindrical columns of liquid, a hydraulic cylinder disposed at substantially right angles to said pair of cylindrical columns of liquid and means directly joining continuous communicating one end of said hydraulic cylinder to one end of one of said pair of cylindrical columns of liquid for full liquid communication therebetween, means directly joining and continuously communicating the other end of said hydraulic cylinder to the corresponding one end of the other of said pair of cylindrical columns of liquid for full liquid communication therebetween, a piston in said hydraulic cylinder, a piston rod on said piston and extending out through both ends of said hydraulic cylinder, conduit means joining said air under pressure to the non-joined other ends of said pair of parallel cylindrical columns of liquid, floating sphere coupling means positioned in said parallel cylindrical columns intermediate said air under pressure and said liquid, separate valve means interposed in said conduit means between said source of air under pressure and the non-joined other ends of said pair of parallel cylindrical columns of liquid, linkage means extending between said piston rod and said separate valve means whereby movement of said piston rod causes a reversal of positioning of the separate valve means whereby air under pressure is first admitted to one of the pair of parallel cylindrical columns of liquid and exhausted from the other of the pair of parallel cylindrical columns of liquid and then secondly alternating for admitting air under pressure to the other of the pair of parallel cylindrical columns of liquid and exhausting it from the one of the pair of cylindrical columns of liquid by reason of movement of said piston rod.

2. A device as set forth in claim **1** in which said floating sphere coupling means are of a diameter substantially the same as the internal diameter of the columns, and the direct and full opening liquid communications of the pair of parallel cylindrical columns of liquid with the hydraulic cylinder constitute substantially the full diameter of each of the pair of parallel cylindrical columns of liquid.

3. A device as set forth in claim **2** in which the pair of parallel cylindrical columns have a diameter less than the diameter of the hydraulic cylinder disposed at right angles thereto whereby the resultant drive of the piston rod has an important mechanical advantage.

4. A combination air and hydraulic motor comprising a source of air under pressure, a pair of parallel cylindrical columns of liquid having their one ends joined with a cylinder disposed at substantially right angles thereto, a piston in said cylinder, a piston rod on said piston and extending out through both ends of said cylinder, conduit means joining said air under pressure to the non-joined ends of said pair of parallel cylindrical columns of liquid, floating sphere coupling means positioned in said parallel cylindrical columns intermediate said air under pressure and said liquid, separate valve means interposed in said conduit means between said source of air under pressure and the ends of said pair of parallel cylindrical columns of liquid, linkage means extending between said piston rod and said separate valve means whereby movement of said piston rod causes a reversal of positioning of the separate valve means whereby air under pressure is admitted to one cylindrical column of liquid and exhausted from the other cylindrical column of liquid and this action alternates by reason of movement of said piston rod, said separate valve means having a reciprocating slide member, and said linkage means including a support on one of the parallel cylindrical columns, a link, means pivotally supporting said link intermediate its ends on said support, one end of said link pivotally attached to said piston rod, the other end of said link acting to reciprocate said reciprocating slide member of the separate valve means.

5. A device as set forth in claim **4** in which said means pivotally supporting said link comprises a thread adjustment for varying the timing of the drive as desired.

6. A combination air and hydraulic motor comprising a source of air under pressure, a pair of parallel cylindrical columns of liquid having their one ends joined with a cylinder disposed at substantially right angles thereto, a piston in said cylinder, a piston rod on said piston and extending out through both ends of said cylinder, conduit means joining said air under pressure to the non-joined ends of said pair of parallel cylindrical columns of liquid, floating spher coupling means positioned in said parallel cylindrical columns intermediate said air under pressure and said liquid, separate valve means interposed in said conduit means between said source of air under pressure and the ends of said pair of parallel cylindrical columns of liquid, linkage means extending between said piston rod and said separate valve means whereby movement of said piston rod causes a reversal of positioning of the separate valve means whereby air under pressure is admitted to one cylindrical column of liquid and exhausted from the other cylindrical column of liquid and this action alternates by reason of movement of said piston rod, auxiliary 3-way valves in the conduit means joining the air under pressure to the pair of parallel cylindrical columns of liquid whereby the valves are arranged to admit air under pressure to one cylindrical column and exhaust air from the other cylindrical column and upon operating said valves the path of air may be reversed.

7. A device as set forth in claim **6** in which there is included an elongated operating arm for said auxiliary 3-way valves, and link means joining each of said 3-way

valves to said arm whereby movement of said arm causes operation of said 3-way valves in unison.

8. A combination air and hydraulic motor comprising a source of air under pressure, a pair of parallel cylindrical columns of liquid having their one ends joined with a cylinder disposed at substantially right angles thereto, a piston in said cylinder, a piston rod on said piston and extending out through both ends of said cylinder, conduit means joining said air under pressure to the non-joined ends of said pair of parallel cylindrical columns of liquid, floating sphere coupling means positioned in said parallel cylindrical columns intermediate said air under pressure and said liquid, separate valve means interposed in said conduit means between said source of air under pressure and the ends of said pair of parallel cylindrical columns of liquid, linkage means extending between said piston rod and said separate valve means whereby movement of said piston rod causes a reversal of positioning of the separate valve means whereby air under pressure is admitted to one cylindrical column of liquid and exhausted from the other cylindrical column of liquid and this action alternates by reason of movement of said piston rod, a shaft, a flywheel mounted on said shaft, a crank on said shaft, a pitman joining said piston rod to said crank, and said shaft being in a plane offset from said piston rod.

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