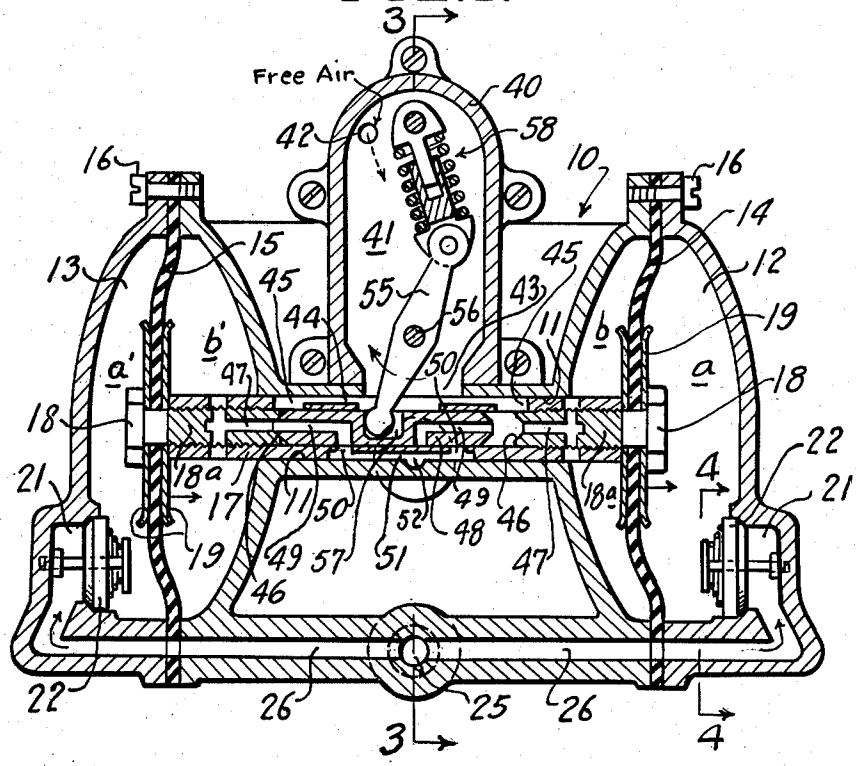
July 9, 1957 E. A. HALL 2,798,440

FUEL FEED PUMP

Filed Feb. 26, 1954 2 Sheets-Sheet 1

FIG. 1.



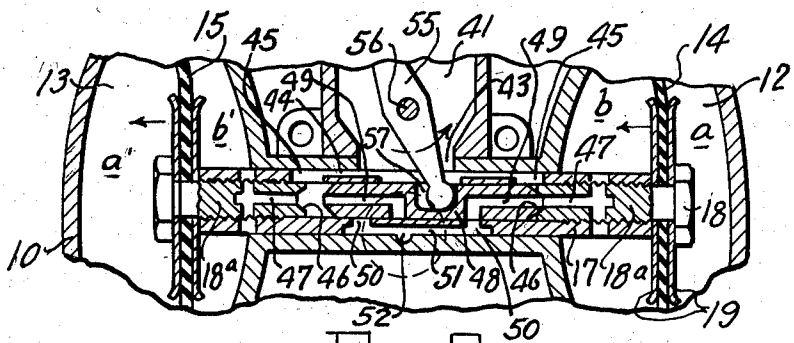


FIG. 2.

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July 9, 1957 E. A. HALL 2,798,440

FUEL FEED PUMP

Filed Feb. 26, 1954 2 Sheets-Sheet 2

FIG. 3.

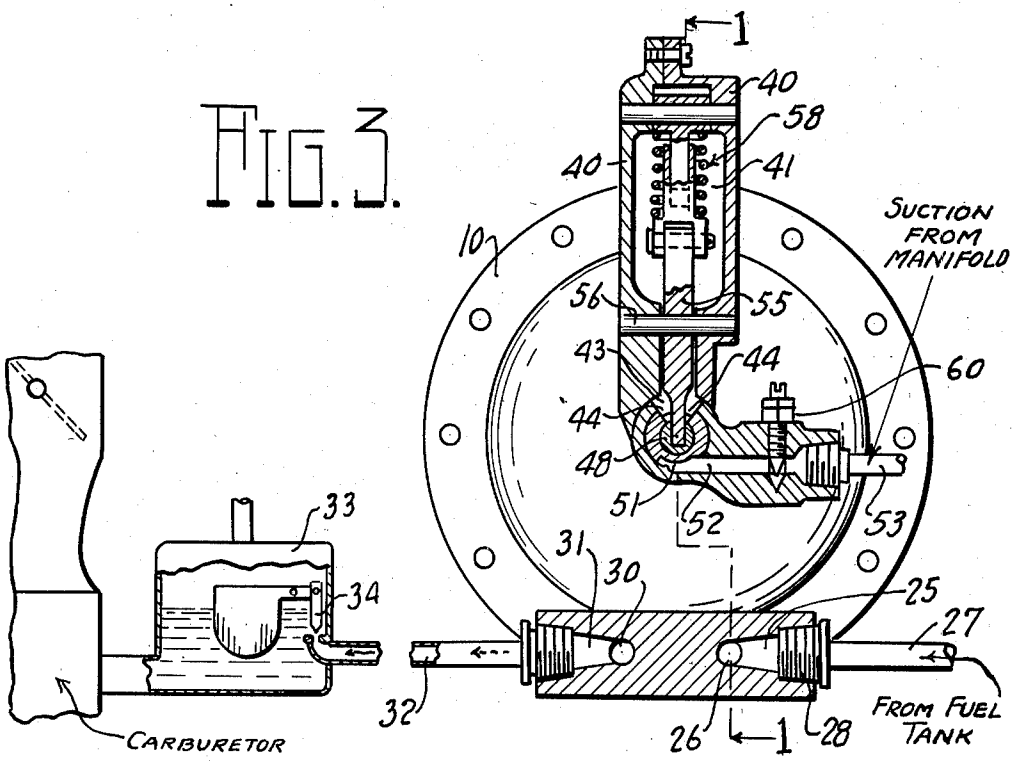
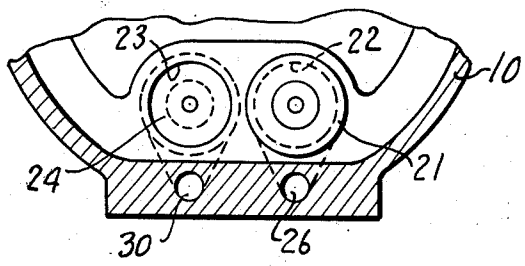


FIG. 4.



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2,798,440

FUEL FEED PUMP

Ernest A. Hall, Fort Lauderdale, Fla.

Application February 26, 1954, Serial No. 412,914

8 Claims. (Cl. 103—152)

This invention relates to fuel feed pumps for use in connection with internal combustion engines, and particularly to such a pump that will operate under engine suction action such as is present in the fuel intake manifold of an engine when running.

The primary object of the present invention is the provision of a fuel pump wherein the operation of the fuel inlet and outlet valves are not operated at a speed corresponding to or proportional to the operating engine cam shaft speed, but at a very much reduced speed which is dependent on the call of the associated carburetor for fuel to supply the engine demand in accordance with the engine operating speed and its load.

A further object of the invention is the provision of a fuel pump having diaphragms or pistons alternately operated by suction impulses from the associated engine to draw fuel from a supply source and supply it to the carburetor float chamber and at the same time to control the automatic action of said diaphragms or pistons to take care of the fuel feed to the carburetor in accordance with the engine demand for fuel.

Further objects and advantages of the invention will be apparent from the following detailed description, and from the accompanying drawings illustrating one embodiment thereof, and in which—

Fig. 1 is a central vertical longitudinal sectional view of the feed pump embodying the invention, taken on the line 1—1 in Fig. 3;

Fig. 2 is a fragmentary section of the valve portion of Fig. 1, with the valve shown in the opposite position from that in such figure;

Fig. 3 is a section on the line 3—3 in Fig. 1, with associated connections shown, and

Fig. 4 is an enlarged section on the line 4—4 in Fig. 1.

Referring to the drawings, 10 designates the pump body or casing which has a straight bore or hole 11 therethrough connecting two spaced chambers 12 and 13 in which displacement members 14 and 15, in the present instance in the form of flexible diaphragms, are respectively disposed and which divide the chambers into respective fuel pumping and power sections which in one chamber are designated *a* and *b*, respectively, and in the other chamber *a'* and *b'*, respectively. The opposing sides of each of said chambers, in the present instance, are outwardly bulged so that the chambers are substantially ellipsoidal in cross-section, as shown in Fig. 1. The outer side of each chamber is separable from the body 10 and is secured to the body by screws 16 with the edges of the respective diaphragm clamped therebetween to prevent any communication between the associated compartments or sections or with the atmosphere.

A valve tube or hollow shaft 17 is slidingly fitted in the bore 11 with its opposite ends projecting from the bore ends and into the respective chambers 12, 13, and attached to the centers of the diaphragms 14, 15 therein, in the present instance by screws 18. These screws are headed at the outer sides of the diaphragms and after passing therethrough are threaded into the respective ends of the

valve tube to form fixed plug parts 18a therein. It is preferable to provide washers 19 at opposite sides of each diaphragm between the screw head and valve tube ends to stiffen the central portions of the diaphragms and to facilitate firm clamping of the diaphragms to the valve tube. It is apparent that the diaphragms 14 and 15 and valve tube 17 are tied together to move in unison, one diaphragm moving inward when the other is moving outward, and vice versa.

The fuel pumping side *a*, *a'* of each diaphragm chamber 12, 13, has a fuel inlet 21 controlled by a respective inwardly seating check valve 22. Each of said chamber sections *a*, *a'* also has a fuel outlet port 23 normally closed by a respective outwardly opening check valve 24. In the lower portion of the casing 10 at one side is provided an inlet port 25 (Fig. 1) that communicates through oppositely extending passages 26 with both inlet ports 21 opening into the fuel pumping sides *a*, *a'* of the two diaphragms. The port 25 is connected with a source of fuel supply in the present instance through a flexible tube 27 (Fig. 3) having a nipple 28 at its ends threaded into the port.

Each outlet port 23 is connected by a passage 30, in the lower portion of the casing, to an opening 31 with which a tube 32 is connected. This tube leads to the float bowl 33 of the associated carburetor, and the fuel discharge therefrom into the bowl is controlled by the associated float valve 34 in the usual manner.

The inner or power compartment *b*, *b'* of the respective chambers 12, 13 has controlled communication in the present instance with the inlet manifold (not shown) of the associated engine at a point between the engine and carburetor whereby suction impulses of the engine are communicated to one compartment and then the other to serve as power means to draw the respective pump diaphragm inward to create a fuel pumping suction in the companion compartment *a*, *a'*. During the time either compartment *b*, *b'* is in communiction with the engine suction force, the other of such compartments is opened to the atmosphere to relieve the suction force therein.

On the top of the casing 10 over the part in which the valve bore 11 is provided is a casing part 40 forming an air chamber 41 which has unrestricted communication with the atmosphere through an opening 42 in its wall, and which has at its bottom or inner end an opening 43 that is elongated lengthwise of the bore 11 and registers with an elongated passage 44 formed by a lengthwise extending groove in the adjacent side of the valve tube 17. This passage at each end has a side passage or port 45 in communication with each end of the bore of the valve tube 17 adjacent to the inner end of the plug 18a which forms a fixed part of and closes the respective end of the tube. Each plug part 18a is formed at its inner end with a valve seat 46 from which leads a passage 47 outwardly through the plug 18a. This passage is angled at its outer end and continues through the valve tube 17 into communication with the section *b* or *b'* of the respective diaphragm chamber. The chamber end of the passage 47 is so positioned and of such dimension lengthwise of the valve tube that it is always open to the respective compartment *b*, *b'* irrespective of the stroke movements of the valve tube and connected diaphragms.

Mounted in the valve tube 17 for limited lengthwise movement therein between the two valve seats 46 is a valve member 48 of plug form adapted to have complemental seating engagement at its ends with the respective valve seats 46 when the member is moved thereagainst, as hereinafter described. This member 48 has an angled or L-shaped passage 49 in each end portion at opposite sides of its longitudinal center with one end open at the respective end of the member to register with the adjacent end of the valve seat passage 47 and

with its other end adapted to register with a respective side port 50 in a side of the valve tube 17 when the plug member is in engagement with the seat 46 at such end. The ports 50 are at opposite sides of the center of movement of the plug valve 48 so that when such member is at one end of its movement the passage 49 at such end will be in register with its port 50, and when the valve plug is at the other end of its movement and the first-mentioned port registry will be closed and the passage 49 at the other end will be open to its port 50.

The two ports 50 open at their outer ends into a longitudinal groove or passage 51 in the outer peripheral surface of the valve tube 17 at the opposite side thereof to the passage 44. The groove 51 connects at its center through a passage 52 (Fig. 3) and tube 53 with the intake manifold of the associated engine whereby each suction impulse in the manifold that takes place during operation of the engine is communicated to said groove 51, which groove serves as a vacuum distributing passage for the pump. At approximately the end of each stroke of the plug valve member 48, and while seated against the respective end plug 18a, the passage 49 in the seating end registers with the respective port 50 in the valve tube 17 and opens communication between the suction distributing passage 51 and the suction compartment *b* or *b'* through the passage 47 in the plug 18a against which the member 48 is seated. The induced vacuum which then takes place in said compartment *b* or *b'* draws the associated diaphragm 14 or 15 inward, thus creating a suction in the pumping side *a* or *a'* of the respective diaphragm to draw a charge of gasoline or other liquid fuel therein through the passage 26 from the connected supply tank or other source of supply.

The rigid connection of the two diaphragms 14, 15 by the valve tube 17 causes movement of the two diaphragms in unison, so that when one is pumping in a fuel charge the other is expelling its previously pumped-in charge. The expelled charge is directed to the associated carburetor bowl 33 through connecting passages 30, 31 and 32.

The valve plug 48 is intended to have an initial movement with the valve tube 17 at each stroke of the latter due to the thrust coaction of the plug member 18a against which the plug valve is seated. When the valve plug has been moved a predetermined extent in this manner, it is caused to move quickly by snap action to seat against the plug seat 46 at the opposite end of the valve tube. For this purpose, a lever 55 is fulcrumed in the air chamber 41 to its side walls, as at 56, for rocking movements in a plane lengthwise of the valve tube 17 and parallel to its axis. The inner end of this lever projects through the air chamber opening 43 and a bottom opening in the valve tube groove 44 and into a socket 57 in the central portion of the plug valve 48. The lever has a knob end working freely in the socket 57 and preferably has a short lost motion action therein lengthwise of the valve. When the lever has been moved past center a spring pressed expandable connection 58 at its outer end imparts a snap action thereto for the remainder of its movement, thus quickly moving the plug valve in the valve tube in the direction of its movement to unseat the then seated end and seat its other end in the companion tube seat 46 and at the same time assist in the completion of the stroke movement of the tube and connected diaphragms.

In use, the feed pump may be mounted in a suitable position on or near the engine with which associated with its fuel inlet tube connected to the fuel tank or other source of fuel supply, with its fuel discharge line 32 in supply connection with the float bowl of the engine carburetor, and with its suction line 52, 53 in connection with the engine intake manifold at some point between the carburetor and engine. Upon a running of the engine, the suction impulses in the intake manifold are communicated to the pump through the suction connection 52, 53, leading to the suction distributing passage 51 in the valve tube 17. Let it now be assumed that the movable pump parts are in the positions indicated in Fig. 1 with the diaphragms 14 and 15 and the connecting valve tube 17 at the limits of their movements to the left. In this position, the plug valve 48 is seated at its left end against the left plug seat 46, thus closing the communication of the air supply chamber 41 with the vacuum compartment *b'* of the diaphragm chamber 13 and opening the communication of said compartment *b'* with the engine intake manifold. At the same time, the right hand passage 49 in the valve plug 48 is out of register with its vacuum port 50, the valve plug is unseated from the right hand plug seat 46 and the intervening space between the unseated parts 48 and 18a is open to the air supply chamber 41. This closes the vacuum source communication with the power side *b* of the diaphragm 14 and opens it to the air supply chamber 41 to release the power at said side of the diaphragm. This relief of pressure from the compartment *b* and the presence of power in the left compartment *b'* moves the two diaphragms and connecting valve means to the right, causing a charge of fuel to be drawn into the pumping side *a'* of the left chamber 13 from its inlet port 21 and the expulsion from the pumping side *a* of the right chamber 12, through its outlet port 23, of the fuel drawn therein on the last preceding stroke of the diaphragms. During a predetermined initial portion of each stroke movement of the diaphragms, the valve tube 17 and valve plug 48 move together in undisturbed relation until the lever 55 has been moved past center and the lever spring connection 58 causes the lever to complete its movement with a snap and quickly move the valve plug 48 to uncover the last closed valve seat 46 and close the other, and at the same time assisting the power action to complete the then stroke of the connected diaphragms.

With this fuel feed pump, the speed of movement of the diaphragm should not exceed 80 strokes per minute at full engine speeds, and when idling or when the carburetor demand for fuel is very low, the pump speed would be approximately three or four strokes per minute. The pressure of fuel at the float chamber needle valve of the carburetor also remains more constant at all operating speeds than is possible, so far as I am aware, by the use of present type fuel feed pumps. Any irregularity of fuel feed to the carburetor can be corrected and made constant by adjustment of the permissible amount of power applied to the pump, as for instance by regulation of the size of the power line passage by the regulation of a needle valve disposed at a convenient point in such line or in any other suitable manner. In the drawings, such a valve is shown at 60 in Fig. 3.

I wish it understood that my invention is not limited to any specific construction, arrangement or form of the parts, as it is capable of numerous modifications and changes without departing from the spirit of the claims.

I claim:

1. In a fuel feed pump, a body having two spaced chambers and a passage for connection to a power source, a displacement unit movably mounted in each chamber and dividing it into a fuel pumping side and a power side, the pumping side of each chamber having a fuel inlet for connection to a source of fuel supply and a fuel outlet, an inwardly opening check valve for each inlet and an outwardly opening check valve for each outlet, means connecting said units to move together in said chambers to alternately draw fuel into the pumping side of one chamber and expel fuel from the corresponding side of the other chamber at one stroke of the units and to have a reverse action on the next stroke in the opposite direction of the units, said connecting means including a valve tube movable with said units and having its interior in restricted communication at each end with the power side of each chamber, and having two power ports spaced

lengthwise of the tube and in communication with said passage, a valve member movable longitudinally in one direction in said valve tube to open one of said ports to one chamber through said tube and close the other port and movable in the opposite direction in said tube to open the port communication with the other chamber through said tube and to close the port communication with the first-mentioned chamber, and means operable at a predetermined point in each stroke movement of the valve tube to quickly move said member to open one of said ports to the chamber toward which the valve tube is moving and close the other.

2. A pump for feeding fuel to the carburetor float bowl of an internal combustion engine and having a suction passage for connection to the intake manifold of the engine at the engine side of the associated carburetor, and also having a fuel feed supply passage and a fuel feed discharge passage, the latter passage for connection to the carburetor float bowl, the provision of a body having two spaced chambers, a displacement unit movably mounted in each chamber and dividing the chamber into a fuel pumping side and a power suction side, each pumping side having a respective inlet and outlet check valve controlled connection with said fuel supply and discharge passages, and said power suction sides having connection with said suction passage, a rigid hollow shaft connection between the units to cause them to move together, said connection having ports therein, some for communication with said power suction passage and others for communication with the power side of each of said chambers, and valve means in said shaft movable therewith and relative thereto and operable during successive stroke movements thereof to alternately open and close the connection between the suction sides of said chambers and the suction passage, whereby each unit operates during alternate strokes and in alternate relation to the other unit to draw in and expel fuel charges.

3. In a pump structure having laterally spaced chambers, and a piston member in each chamber dividing it into a power side and a pump side, the provision of valve guide means between said chambers having both a port for communication with a fluid power source and a relief passage, a valve tube guided for axial movement by said guide means and rigidly connecting said piston members to cause them to move in unison, with one at the inner end of its stroke when the other is at the outer end of its stroke, said valve tube having its ends closed with a valve space therebetween and with opposed inwardly facing valve seats in said closed ends and each valve seat having a passage connecting the respective end of said valve space to the power side of the adjacent chamber, said valve space having communication with said relief passage and also communication with a power source through said port, a valve reciprocably movable in said valve tube space to alternately seat at opposite ends against said seats and having separate passages at opposite ends, each of which separate passages cooperate with a valve tube end passage when seated at such end and with said port to open communication between the power source and the power side of the respective chamber, said valve also at the same time being spaced from the seat at its opposite end and opening communication at such end between the power side of the other chamber and said relief passage, and means operable at each stroke of the valve tube to relatively move said valve to unseat its trailing end and seat its other end.

4. In a pump structure having laterally spaced chambers, and a piston member in each chamber dividing it into a power side and a pump side, the provision of valve guide means between said chambers having both a port for communication with a fluid power source and a relief passage, a valve tube guided for axial movement by said guide means and rigidly connecting said piston members to cause them to move in unison with one at the inner end of its stroke when the other is at the outer end of its stroke, said valve tube having its ends closed with a valve space therebetween and with opposed inwardly facing valve seats in said closed ends and each valve seat having a passage connecting the respective end of said valve space to the power side of adjacent chamber, said valve space having communication with said relief passage and also communication with a power source through said port, a valve reciprocably movable in said valve tube space to alternately seat at opposite ends against said seats and having separate passages at opposite ends, each of which separate passages cooperates with a valve tube end passage when seated at such end and with said port to open communication between the power source and the power side of the respective chamber, said valve also at the same time being spaced from the seat at its opposite end and opening communication at such end between the power side of the other chamber and said relief passage, snap action means acting on the said valve to quickly move it from seated position at its trailing end to seated position at its forward end of movement with said valve tube when such tube has reached a predetermined point in its advancing movement and yieldingly hold it in such advanced seated position until the valve tube has reached a predetermined position in its next stroke.

5. In a pump structure having laterally spaced chambers, and a piston member in each chamber dividing it into a power side and a pump side, the provision of valve guide means between said chambers having both a port for communication with a fluid power source and a relief passage, a valve tube guided for axial movement by said guide means and rigidly connecting said piston members to cause them to move in unison with one at the inner end of its stroke when the other is at the outer end of its stroke, said valve tube having its ends closed with a valve space therebetween and with opposed inwardly facing valve seats in said closed ends and each valve seat having a passage connecting the respective end of said valve space to the power side of the adjacent chamber, said valve space having communication with said relief passage and also communication with a power source through said port, a valve reciprocably movable in said valve tube space to alternately seat at opposite ends against said seats and having a passage at each end which when the valve is seated at either end cooperates with the valve seat passage at such end to open communiction between the power side of the adjacent chamber and the power source, and at the same time being spaced at its other end from the companion seat and opening communication at such end between the power side of the respective chamber and the relief passage, and means operable at each stroke of the valve tube to relatively move the valve to unseat its trailing end and seat its other end.

6. In a pump structure having laterally spaced chambers, and a piston member in each chamber dividing it into a power side and a pump side, the provision of valve guide means between said chambers having a port for communication with a fluid power source and a relief passage, a valve tube guided for axial movement by said guide means and rigidly connecting said piston members to cause them to move in unison with one at the inner end of its stroke when the other is at the outer end of its stroke, said valve tube having its ends closed with a valve space therebetween and with opposed inwardly facing valve seats in said closed ends and each valve seat having a passage connecting the respective end of said valve space to the power side of the adjacent chamber, said valve space having communication with said relief passage and also communication with the power source through said port, a valve reciprocably movable in said valve tube space to alternately seat at opposite ends against said seats and having a passage at each end which when the valve is seated at either end cooperates with the valve seat passage at such end to open communication between the power side of the adjacent chamber and the power source, and at the same time being spaced at its other end from the companion seat and opening communication at such

end between the power side of the respective chamber and said relief passage, and snap action means acting on the said valve to quickly move it from seated position at its trailing end to seated position at its forward end of movement with said valve tube when such tube has reached a predetermined point in its advancing movement and yieldingly hold it in such advanced seated position until the valve tube has reached a predetermined position in its next stroke.

7. In a pump structure having laterally spaced chambers, and a piston member in each chamber dividing it into a power side and a pump side, the provision of a valve guide means between said chambers having a port for communication with the fluid power source and a relief passage, a valve member guided for longitudinal movement by said guide means and connecting said piston members to move in unison therewith, said valve member having passages at opposite ends in communication with respective power sides of said chambers and with said relief passage, a second valve member reciprocably movable relative to said first valve member, and means operable during each stroke of said first valve member to move said second valve member in the direction of the concurrent stroke movement of the first valve member to open said power side at the trailing end of the valve stroke to said relief passage and to open the power side at the other end of the stroke to the fluid power source whereby the piston members are moved together by fluid pressure action first in one direction and then the other.

8. In a pump structure having spaced right and left

chambers, and a piston member in each chamber dividing it into a power side and a pump side, each pump side having valve-controlled inlet and outlet passages, and each power side having a passage for communication with a fluid pressure source, the provision of telescoped relatively movable valve members with one rigidly connecting said piston members to cause them to move in unison with one at the inner end of its stroke when the other is at the outer end of its stroke, guide means for the outer of said valve members forming parts of said fluid pressure passages, snap action means connected to said other valve member to quickly move it during each stroke of the piston members to the limit of its movement in stroke direction, said valve members each having passages cooperating with the passages of the other and with the guide means passages to open said fluid pressure source passage to the power side of said right chamber and close it to the left chamber during a right stroke of the piston members, and during their reverse stroke closing the pressure source passage to said right chamber and opening it to said left chamber to actuate its piston member.

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