United States Patent

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[73] Assignee **Utility Products, Inc.**

[54] **DOUBLE-ACTING PUMP**
7 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **417/389**
[51] **Int. Cl.** **F04b 35/02**
[50] **Field of Search** 417/389, 533, 900

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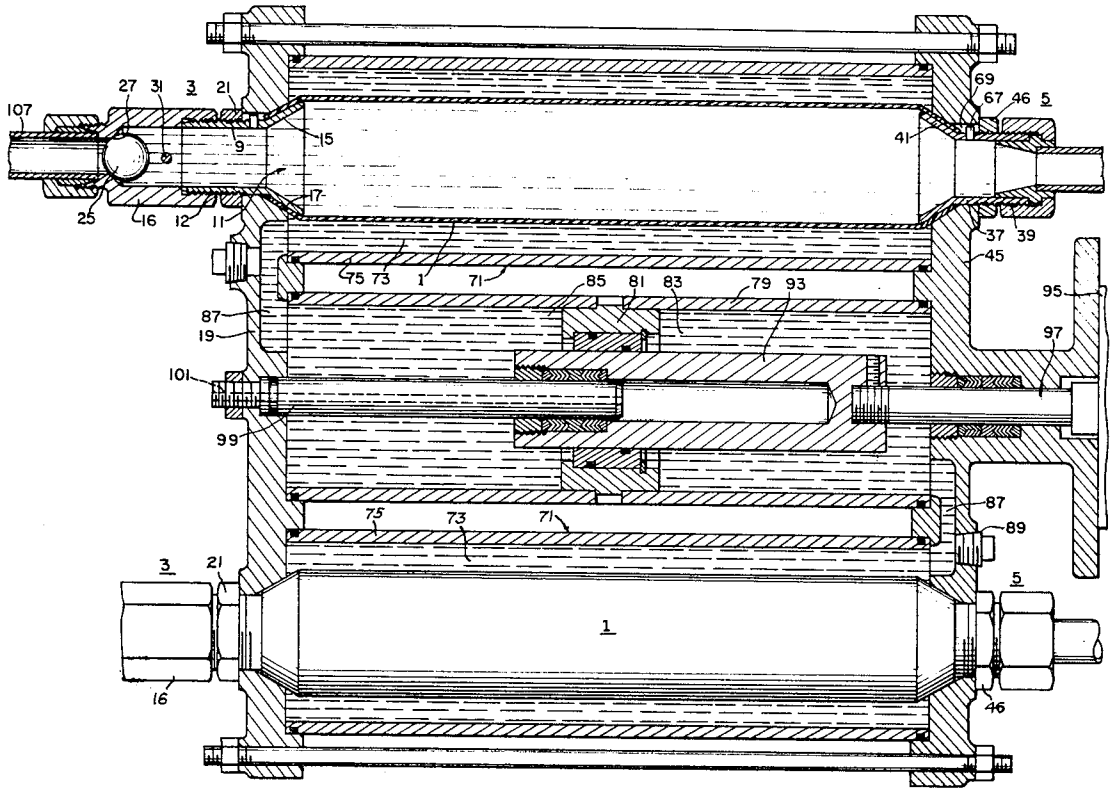
ABSTRACT: A double acting pump for abrasive or like material, involving a pair of flexible tubes, each adapted to be cyclically pulsed by surrounding pump fluid which is flow connected to a pump fluid chamber, the pulsing being alternately accomplished by a reciprocal displacement piston, which, when reciprocated, alternately displaces pump fluid in the pump fluid chambers.



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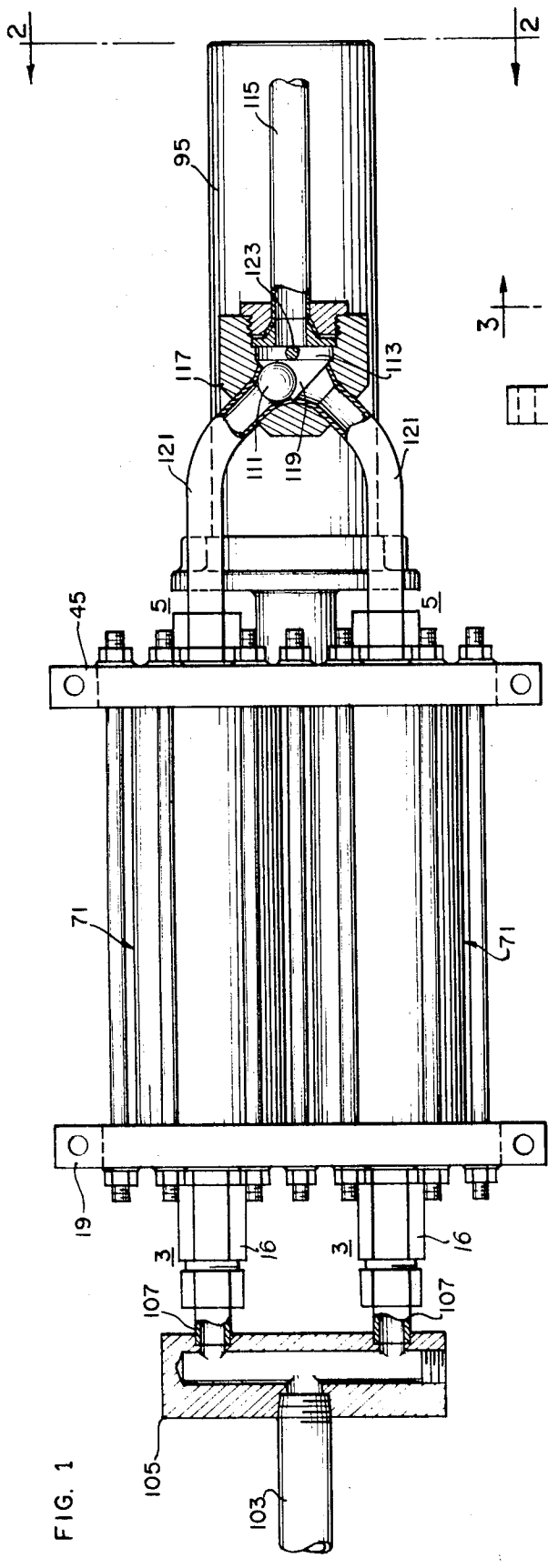

FIG. 1

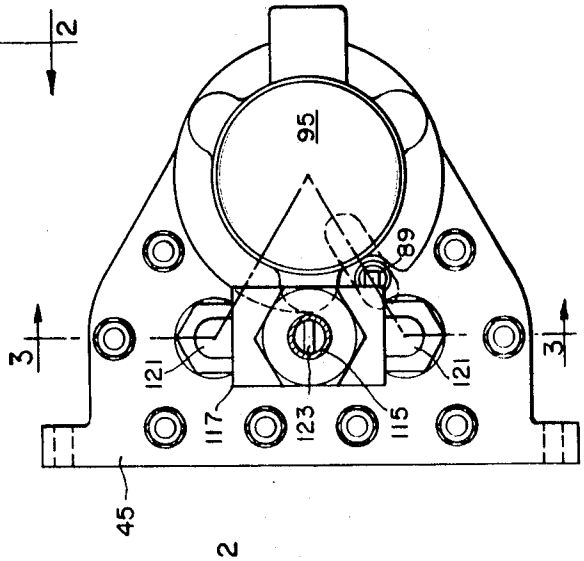

FIG. 2

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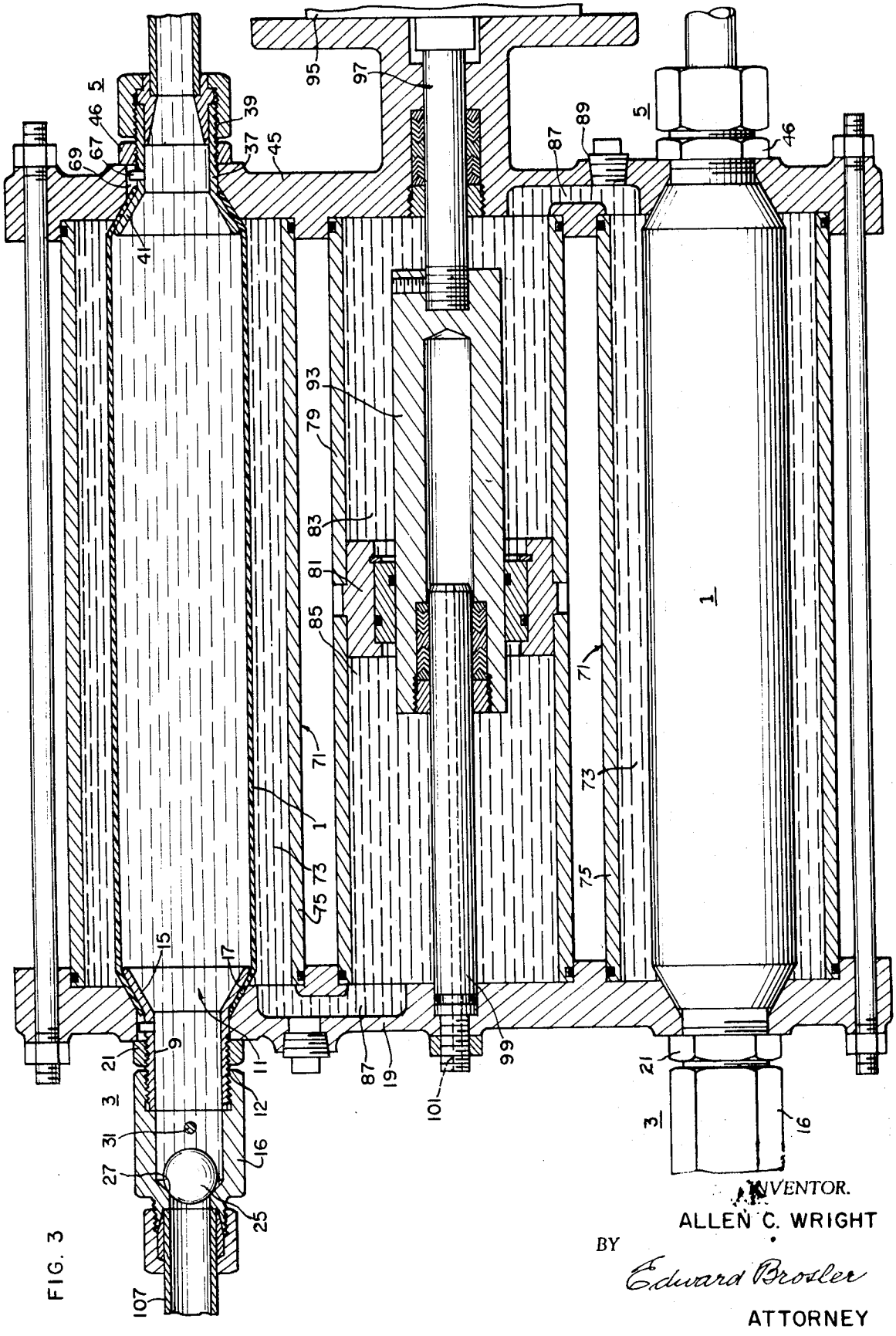

FIG. 3

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DOUBLE-ACTING PUMP

My invention relates to pumps and more particularly to pumps for handling material of an abrasive character.

Among the objects of my invention are:

(1) To provide a novel and improved pump adapted for pumping the material having abrasive characteristics;

(2) To provide a novel and improved pump of the double acting type capable of long life expectancy when pumping material having abrasive characteristics;

(3) To provide a novel and improved double acting pump of the aforementioned character, which can supply a common discharge line and with a minimum of seal exposure to atmospheric contaminants.

Additional objects of my invention will be brought out in the description of the same in its preferred form, taken in conjunction with the accompanying drawings wherein;

FIG. 1 is a plan view, partly in section, of a double acting pump of the present invention;

FIG. 2 is an end view of the pump of the present invention, taken in the plane 2—2 of FIG. 1;

FIG. 3 is a developed view, in section, taken in the planes 3—3 of FIG. 2.

Referring to the drawings for details of my invention in its preferred form, I provide a pair of tubes 1 of flexible material, each tube being closed at one end by a valve controlled inlet coupling assembly 3, and at its other end by a discharge coupling assembly 5. Only one tube and its end assemblies have been illustrated in section, in that all tubes involved in the pump, will be of similar construction, and a description of one will suffice for the others.

The tube may be of any suitable flexible material, namely a material which is impervious to liquids and is capable of withstanding pulsations. Rubber or plastic are examples of such materials, with Teflon or other "memory plastic" being preferred where usable, because of their heat shrinkable properties.

The intake coupling assembly provides for connecting the tube to a source of liquid to be pumped. Such assembly includes a body component 9, having a flow passageway 11 therethrough, said body component including a threaded neck section 12, connecting with an enlarged or flared end or head 15, and to the threaded end is secured a valve housing 16.

Over the enlarged end, is stretched an end of the tube 1, the enclosing portion of the tube, if of Teflon or other heat-shrinkable material, being heat-shrunk into tighter fitting engagement therewith.

The enlarged end is preferably frustoconical in shape to be received in a correspondingly shaped recess 17 in approximate end plate 19, whereby the enclosing portion of the tube 1 may be effectively clamped between them by a nut 21 applied to the neck station of the body component.

Within the valve housing is a ball check valve 25 adapted to seat against a valve seat 27 formed therein.

Forward motion of the ball valve from its seat is limited by a transverse pin 31 across the passageway 11.

At the discharge end of the tube, the coupling assembly involves a somewhat similar body component 37 having a threaded neck section 39 at one end an enlarged or flared head portion 41 of generally frustoconical shape at its other end, over which the proximate end of the tube is stretched, with the enclosing portion of the tube, if of Teflon, being heat shrunk thereabout and the assembly then clamped to an end plate 45 by a nut 46 threaded onto the neck section of the body component.

Rotatable movement of either body component in its installed position is inhibited by a radial pin 67 anchored in the body component and entering a groove 69 provided in the approximate wall of the associated end plate.

The tube and its end couplings, as a unit assembly, is housed in a sealed chamber 71 for holding a supply of pumping fluid 73 about the tube.

The housing is preferably cylindrical, and formed by a cylinder 75 surrounding the tube in spaced relationship

thereto and closed at its ends by the end plates 19 and 45 between which the housing cylinder is clamped.

In the present preferred embodiment of the invention, each end plate of sufficient size to accommodate both tubes and associated cylinders, whereby the resulting pump units will be combined into a unitary pump assembly.

Associated with such pump units are means for cyclically and alternately displacing a fixed volume of fluid in the sealed chambers of the pump units, to cause alternate pulsations of the tubes in such units, whereby to produce a pumping of liquid from the source to which such pump units may be connected.

Such means for cyclically and alternately displacing the fluid in the sealed chambers of the pump units involves a cylinder 79 which like the pump unit cylinders, is also clamped between the end plates, but, in addition, is provided with a partition 81 to define a pair of chambers 83, 85 for holding pump fluid, each of which is flow connected to a different one of the sealed chambers 71 of the individual pump units by a connecting flow passageway 87 formed in the proximate end plate.

A filler plug 89 in each end plate, at the location of the connecting passageway 87 permits of the filling of a pump fluid chamber and that sealed chamber 71 to which it is connected.

Slidably installed in the partition through appropriate sealing, is a double acting or reciprocal displacement piston 93 driven by a suitable motor 95, preferably an air motor, mounted on the one end plate 45 and drive connected to the displacement piston by a piston rod 97 passing through the end plate where it is effectively sealed against leakage.

As the displacement piston reciprocates, it will displace pump fluid alternately in the pump fluid chambers and may be caused to displace equal volumes in the two chambers. The piston rod connected to the displacement piston, will additionally displace fluid in the chamber in which it is located, and to effect an equal and corresponding additional displacement in the other pump fluid chamber when desired, a fixed rod 99 of like diameter is axially installed in the other chamber in alignment with the piston rod, by mounting it with one end bolted in the proximate end plate 19, while the displacement piston is made hollow to reciprocally receive the free end of the fixed rod, with appropriate sealing means provided in the displacement piston to preclude leakage of pump fluid into the displacement piston.

As a precautionary measure in the event of a faulty seal, and to avoid resulting accumulation of such pump fluid in the displacement piston, the rod 99 is provided with an axial passageway 101 therethrough, whereby any leakage of pump fluid to the inside of the displacement piston, cannot accumulate therein, and will be evidenced by resulting telltale leakage from the exposed end of the fixed rod.

Reciprocation of the displacement piston will alternately displace liquid in the pump fluid chamber, each displacement causing a pressure pulse against one of the flexible tubes, causing it to give, in response to such pressure and, if such tube be full of liquid to be pumped, a volume of the contents thereof will be discharged. Return of the displacement piston from its position of displacement, will bring about a withdrawal of fluid from the sealed chamber about the flexible tube under consideration, thereby causing such tube to inflate to its cylindrical form, in the course of which it will draw into itself, a supply of liquid from a source to which the tube may at that time be connected.

Both pump units may be connected to a common source 103 of liquid through a common manifold 105, to which the valve housing 16 of each pump unit may be coupled by a tube 107.

At the discharge end of each pump unit, it is noted that there is no check valve provided to preclude return of pumped liquid, during suction portions of the pumping cycles.

This function is performed by a single check valve 111 in a coupling 113 which flow connects each of the pump units to a common discharge line 115.

Such coupling comprises a housing **117** mounted above the end plate **45** symmetrically with respect to the pump units and providing a valve chamber **119** exposed externally through three wall openings, one of which provides for connection of the common discharge line, while the other two are symmetrically located with respect to the discharge line opening, for flow connection, each to one of the pump units, by a flow line **121**. Each of the latter two wall openings provides a seat for the single ball check valve **111** which is free to roll from one of these two wall openings to the other, and prevented from entering the discharge line by a pin **123** spaning the opening to this line.

While the pump is functioning, one of the flexible tubes will be exerting pressure upon its contents while the other will be developing suction. Such simultaneous pressure and suction conditions will cooperatively drive the ball check valve **111** to seat and close that wall opening at which the suction is being created, thus permitting discharged liquid to enjoy free access to discharge line.

From the foregoing description of my invention in its preferred form, it will be apparent that a single displacement piston will alternately apply displacement pressure to each of a pair of flexible tubes to produce double action pumping, and because only one displacement piston is required, the entire pump assembly may be formed into a unitary compact assembly, and with a minimum of reciprocating elements requiring seals in the outer walls thereof.

While I have illustrated and described my invention in its preferred form, the same is subject to alteration and modification without departing from the underlying principles involved, and I accordingly do not desire to be limited in my protection to the specific details illustrated and described except as may be necessitated by the appended claims.

I claim:

1. A double-acting pump comprising a pair of tubes of flexible material, means for flow connecting each of said tubes to a source of liquid supply, means for flow connecting each of said tubes to a discharge line, housing means enclosing each of said tubes to form a sealed chamber thereabout independently of the other for holding a supply of pump fluid about each of said tubes, and means for cyclically and alternately displacing a like fixed volume of such fluid to said chambers to cause alternate pulsations of said tubes of flexible material and produce equal volume discharge per pulsation from each tube.

2. A double-acting pump in accordance with claim **1**, characterized by said means for cyclically and alternately displacing a fixed volume of fluid to said chambers, including a pair of pump chambers, one of said pump fluid chambers having flow connection with one of said sealed chambers, the other of said pump fluid chambers having a flow connection with the other of said sealed chambers, a double acting displacement piston having a piston drive rod at one end to reciprocate said piston between said pump fluid chambers, whereby to cyclically and alternately displace a fixed volume of fluid in said fluid chambers, and means for equalizing the fixed volumes so displaced, said equalizing means including a rod associated with the opposite end of said displacement piston and having a variable exposure to surrounding liquid during reciprocation of said piston, corresponding to the variable exposure of said piston drive rod.

3. A double-acting pump in accordance with claim **1**, characterized by said means for cyclically and alternately displacing a fixed volume of fluid to said chambers, including a pair of pump fluid chambers, one of said pump fluid chambers having a flow connection with one of said sealed chambers, the other of said pump fluid chambers having a flow connection with the other of said sealed chambers, and a double acting displacement piston means adapted to reciprocate between said pump fluid chambers and cyclically and alternately displace equal volumes of fluid from said fluid chambers.

4. A double-acting pump in accordance with claim **4**, characterized by said pump fluid chambers being defined by a tubular wall symmetrically disposed with respect to said sealed chambers and sealed at one end to one of said end plates and at its other end to the other of said end plates, and a partition spanning said tubular wall, intermediate the ends thereof to create a pair of pump fluid chambers in end to end relationship, a flow passageway in one of said end plates and flow connecting one of said pump fluid chambers with one of said sealed chambers, and a flow passageway in the other of said end plates and flow connecting the other of said pump fluid chambers with the other of said sealed chambers, and said double-acting displacement piston means including a displacement piston reciprocally mounted in said partition between said pump fluid chambers, a piston drive rod at one end passing through one of said pump fluid chambers for reciprocating said displacement piston to alternately and cyclically alter the effective volume of said pump fluid chambers and a volume equalizer rod extending from the opposite end of said displacement piston for equalizing the discharge per stroke, from each pump fluid chamber.

5. A double-acting pump in accordance with claim **1**, characterized by said means for cyclically and alternately displacing a like fixed volume of fluid to said chambers, including a pair of pump fluid chambers, one of said pump fluid chambers having flow connection with one of said sealed chambers, the other of said pump fluid chambers having a flow connection with the other of said sealed chambers, and a double-acting piston having a piston drive rod at one end whereby to reciprocate said piston between said pump fluid chambers, whereby to cyclically and alternately discharge a fixed volume of fluid from each of said fluid chambers, and means for equalizing the volume of cyclic discharge from one of said fluid chambers with the volume of cyclic discharge from the other.

6. A double-acting pump in accordance with claim **4** characterized by said displacement piston having a axial bore at said other end, and said volume equalizer rod being slidably receivable at one end thereof in said bore and at its other end anchored to a fixed wall of said pump.

7. A double-acting pump in accordance with claim **6** characterized by a leakage passageway through said volume equalizer rod from the interior of the bore of said displacement piston.