

of the gas chamber being stretched toward an outer wall of the liquid chamber to squeeze the liquid chamber and thus expell liquid. When air is released from the air chamber, the movable wall of the air chamber retracts and draws the movable wall of the liquid chamber outwardly by vacuum pressure to pull liquid into the liquid chamber.

As can be understood from the above description, the gas-operated positive displacement pump of this invention has several advantages such as: (1) it is simple in construction, containing few movable parts; (2) it is capable of high rates of pumping; (3) it is durable with few wearing parts; (4) it is capable of pumping without a large hydrostatic pressure since it is capable of drawing liquid into the liquid cylinder as well as forcing liquid out of the liquid cylinder; and (5) the liquid cylinder may be composed of inert materials such as stainless steel or polyfluoroethylene.

Although a preferred embodiment of the invention has been described with some particularity, many modifications and variations may be made in the preferred embodiment without deviating from the invention. Therefore, it is to be understood that, within the scope of the appended claims, the invention may be practiced other than as specifically described.

What is claimed is:

1. A gas-operated positive displacement pump comprising:

liquid inlet means for receiving liquid into said pump;
liquid outlet means permitting liquid to be pumped from said pump;

gas communication means for permitting the entering and exiting of gas from said pump, whereby said pump may be actuated to pump liquid into said inlet and out of said outlet;

liquid chamber means having walls confining a liquid; one of the walls of said liquid confining means being movable;

first gas chamber means having walls for confining gas;

at least one wall of said first gas chamber means being movable and biased away from the other wall whereby said at least one wall of said gas chamber may be moved by gas pressure toward said one of the walls of said liquid confining means and permitted to move away from said one of the walls of said liquid confining means;

second gas chamber means for receiving gas from between said one of the walls of said liquid confining means and one wall of said first gas chamber; means connecting said second gas chamber and a space between said one of the walls of said liquid confining means and one wall of said first gas chamber for permitting gas to move only from said space to said second gas chamber;

means connecting said second and first gas chambers for permitting gas to move only from said second gas chamber to said first gas chamber; and means for causing the movement of said at least one wall of said first gas chamber to move said movable wall of said liquid chamber in a direction that expands said liquid chamber.

2. A method of pumping comprising the steps of: immersing a liquid inlet means of a pump in a liquid to be pumped; connecting one end of a hose to a liquid outlet means of said pump;

placing the other end of said hose at a location to which the liquid is to be pumped;

connecting a hose to a gas communication means for permitting the entering and exiting of gas from first gas chamber means in said pump having walls confining a liquid, wherein at least one of the walls of a gas chamber and said liquid confining means are movable;

moving the movable wall of the liquid chamber toward the other wall by moving said gas chamber wall in the direction of the movable wall of liquid chamber whereby the movement of said gas chamber wall moves said movable wall of said liquid chamber;

permitting air between the movable walls of said gas chamber and liquid chamber to move into a second gas chamber but not back between the movable walls; and

permitting the air in said second gas chamber to move into said first gas chamber but not back to the second gas chamber.

3. A gas-operated positive displacement pump comprising:

liquid inlet means for receiving liquid into said pump;
liquid outlet means permitting liquid to be pumped from said pump;

gas communication means for permitting the entering and exiting of gas from said pump, whereby said pump may be actuated to pump liquid into said inlet and out of said outlet;

liquid chamber means having walls confining a liquid; one of the walls of said liquid confining means being movable;

gas chamber means having walls for confining gas; at least one wall of said gas chamber means being movable and biased to retract whereby said at least one wall of said gas chamber means may be moved by gas pressure and permitted to retract with a peak force of at least 5 ounces;

means for causing the movement of said at least one wall of said gas chamber to move said movable wall of said liquid chamber in a direction that expands said liquid chamber;

said at least one wall of said gas chamber being an elastomeric wall having greater elasticity than said movable wall;

means for providing communication between the space between said movable wall and said elastomeric wall while said elastomeric wall is expanding, whereby air between said movable wall and elastomeric wall may enter said air chamber and for preventing communication of the space between said elastomeric wall and movable wall while said elastomeric wall is contracting, whereby said movable wall is pulled with said elastomeric wall to expand said liquid chamber.

4. A pump in accordance with claim 3 in which said movable wall is capable of moving a predetermined distance within the range of 1 millimeter to 5 centimeters.

5. A gas-operated positive displacement pump comprising:

liquid inlet means for receiving liquid into said pump;
liquid outlet means permitting liquid to be pumped from said pump;

gas communication means for permitting the entering and exiting of gas from said pump, whereby said