Accordingly, the invention described herein has numerous advantages over prior devices. The invention requires little power to operate, as only an air compressor or other source of compressed gas is used to operate it. No large, unsightly apparatus must be located on the surface above the well bore, as the source of compressed gas need be neither large nor unsightly. The source of compressed gas does not have to be placed directly above the well bore, and can be located a distance from the well bore if need be. The present invention has fewer moving parts than previous devices, resulting in less frequent repairs, ease of repair when such repairs are required, and a reduction in the number of parts which must be produced to meet close manufacturing tolerances.

It will thus be seen that the present invention provides an improved pump with an improved pumping operation, reduced energy requirements, and more reliable operation than previous pumps.

The foregoing description of the invention is illustrative and explanatory thereof, and various changes in the size, shape, and materials as well as in the details of the illustrated construction may be made within the scope of the appended claims without departing from the scope and spirit of the invention.

I claim:

1. A device for elevating a subsurface liquid comprising:
- housing means for being placed in a well bore and submerged in the liquid;
- supply means connected between said housing means and the well surface for supplying pressurized gas to said housing means;
- exhaust conduit means connected to said housing means for conducting the liquid to the well surface;
- elastic cylindrical diaphragm means disposed in said housing means and in fluid communication with said exhaust conduit means, said diaphragm means being movable in response to pressure exerted by pressurized gas supplied by said supply means to the area between said diaphragm means and said pump body means for substantially collapsing said diaphragm means towards its axis for displacing liquid in said diaphragm means; and
- spring means disposed in said housing means outside said diaphragm means for expanding said diaphragm means to its expanded position after the liquid is displaced.

2. The device in claim 1 wherein:
- a piston means is slidably disposed in said housing means and couples said diaphragm means to said spring means; and
- a plurality of coil springs are longitudinally embedded in said diaphragm means and expand said diaphragm means to its expanded position after the liquid is displaced.

3. The device in claim 1 wherein a small gap separates said diaphragm means from said housing means when the pressure in said pump body means is lower than the pressure in said diaphragm means and said diaphragm means is in an expanded position.

4. The device in claim 1 wherein said diaphragm means occupies substantially less than the volume of said pump body means when the pressure in said pump body means is greater than the pressure in said diaphragm means, and said diaphragm means is in a collapsed position.

5. The device in claim 1 and further comprising one-way valve means disposed between said diaphragm means and said exhaust conduit means.

6. The device in claim 1 and further comprising:
- one-way valve means disposed between said diaphragm means and the well bore; and
- tail pipe means connected to said housing means for conducting the submerged liquid into said housing means.

7. The device in claim 1 and further comprising conducting means disposed about the longitudinal axis of said housing means and inside said diaphragm means, for conducting the liquid within said diaphragm means to said exhaust conduit means.

8. The device in claim 1 wherein a plurality of longitudinally placed springs are molded in said diaphragm means and expand said diaphragm means to its expanded position when the liquid is displaced.

9. A down hole pump for pumping a liquid in a well bore comprising:
- pump body means for being placed in the well bore and submerged in the liquid;
- gas pressure conduit means connected between said pump body means and the well surface for supplying pressurized gas to said pump body means;
- exhaust means connected to said pump body means for conducting the liquid to the well surface;
- elastic cylindrical diaphragm means disposed in said pump body means, said diaphragm means substantially collapsing towards its axis in response to pressure exerted by pressurized gas supplied by said gas pressure conduit means to the area between said diaphragm means and said pump body means for displacing the liquid from said diaphragm means when the pressure in said pump body means is greater than that in said diaphragm means and for expanding to fill substantially said pump body means when filling with the liquid when the pressure in said pump body means is lower than that in said diaphragm means;
- first one-way valve means connected between said diaphragm means and said exhaust means for permitting the fluid to flow only out of said diaphragm means;
- perforated, hollow limit tube means having a length less than said pump body means for conducting liquid in said diaphragm means to said exhaust conduit means;
- piston means slidably disposed in said pump body means, supporting said diaphragm means and having an aperture therein providing fluid communication between said diaphragm means and the well bore;
- spring means secured to said piston means and said pump body means for supporting and expanding said diaphragm means after the liquid is pumped; and
- second one-way valve means attached to said piston means and permitting the liquid in the well bore to flow only into said diaphragm means.

10. The pump in claim 9 wherein a plurality of longitudinally placed coil springs are embedded in said diaphragm means and expand said diaphragm means to its expanded position when the liquid is displaced.

11. The pump in claim 9 and further comprising a cylindrical tail pipe means connected to said pump body means for conducting liquid into said diaphragm means.

12. The pump in claim 9 wherein said perforated hollow limit tube means is disposed about the longitudinal axis of said pump body means.

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