A positive displacement pump has a passageway connected between the outlet side of the pump and an intermediate location in the pumping mechanism for supplying liquid under pressure thereto for reducing cavitation in the pump.

3 Claims, 5 Drawing Figures
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POSITIVE DISPLACEMENT LIQUID PUMP

The present invention relates in general to positive displacement pumps, and it relates more particularly to new and improved means for supplying liquid under pressure to an intermediate location in the pumping mechanism to reduce cavitation.

BACKGROUND OF THE INVENTION

Cavitation in positive displacement pumps is undesirable because it is always a source of noise, reduces volumetric efficiency, and in extreme cases reduces pump life. It results when the negative pressure developed by the pump is insufficient to fill the pumping cavities whereby voids are carried to the discharge side of the pump and result in turbulence in the pressure line. Accordingly, cavitation is most pronounced where the pumping means is operated at high speeds or where the pump is located at a substantial distance above the supply tank.

In the oil burner industry where high lift applications are commonplace, it has been the practice to employ two-stage pumps, the first set of pumping members being used to lift the oil from the tank and the other set being used to deliver the oil under pressure to the burner nozzle. While such pumps minimize cavitation, they are expensive to manufacture and increase the inventory of manufacturers and distributors.

Attempts have been made to reduce cavitation in internal gear pumps by machining off a small section of the crescent face at the outlet side of the pump. This has not, however, been a satisfactory solution to the problem, because, I believe, the oil being fed across the face of the crescent in a turbulent condition.

OBJECTS OF THE INVENTION

An object, therefore, of the present invention is to provide a new and improved single-stage pump construction for minimizing cavitation therein.

Another object of this invention is to provide a new and improved gear pump having means for supercharging the pump at a location between the internal intake and discharge ports.

A further object of this invention is to provide a new and improved single-stage oil burner pump.

SUMMARY OF THE INVENTION

Briefly, the above and further objects may be realized in accordance with the present invention by providing a restricted, relatively long passageway between the discharge side of a positive displacement pump and a location in the pumping mechanism intermediate the inlet and discharge sides thereof, and a pressure regulator connected to said passageway downstream of the orifice for setting the pressure of the fluid supplied to the intermediate location in the pumping mechanism at a predetermined value below the operating pressure of the pump. The liquid flow to the intermediate pump location is thus laminar and free from turbulence and cavitation itself, whereby cavitation is substantially completely eliminated.

BRIEF DESCRIPTION OF THE DRAWINGS

Further objects and advantages and a better understanding of the invention may be had from the following detailed description taken in connection with the accompanying drawings, wherein:

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FIG. 1 is a cross-sectional view of a single-stage internal gear pump embodying the present invention;

FIG. 2 is a cross-sectional view taken along the line 2-2 of FIG. 1;

FIG. 3 is a cross-sectional view taken along the line 3-3 of FIG. 1;

FIG. 4 is a schematic flow diagram of the pump of FIG. 1; and

FIG. 5 is a sectional view of an alternative embodiment of the present invention.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring now to the drawings and particularly to FIG. 1 thereof, a single-stage, internal gear pump particularly suited for oil burner applications is identified by the number 10 and includes a main housing 11 in which is journalled a driving shaft 12. The shaft 12 is suitably sealed in the housing 11 by conventional means and is keyed to a pinion 13 forming part of the pumping mechanism. As best shown in FIG. 3, the pinion 13 is eccentrically positioned in mating engagement with an internal ring gear 14 rotatably mounted in a cylindrical recess 15 in a block 16 fixedly mounted in the housing 11 over a port plate 17. Integral with the block 16 is a crescent shaped blocking member 18 disposed between the lower half of the pinion 13 and the corresponding portion of the ring gear 14.

As the shaft 12 is rotated, a vacuum is created in the portion of the pumping chamber in proximity to the righthand tip of the crescent 18 and liquid is thus drawn into the tooth spaces in the pinion and ring gears through an arcuate inlet port 19 (FIG. 2) milled in the block 16. Liquid is thus carried in the tooth spaces to the portion of the pumping chamber in proximity with the left-hand tip of the crescent and exits the pumping chamber under pressure through an arcuate port 20 milled in the block 16. This type of pumping mechanism is described in U. S. Pat. No. 2,159,720.

In order to eliminate cavitation in this pumping assembly by filling any voids in those spaces in the pinion and ring gears passing from the inlet to the outlet side of the pump, there is provided in accordance with the present invention means for supercharging the pumping chamber by supplying liquid under pressure at a reduced flow rate to the tooth spaces as they pass the central part of the crescent. As best shown in FIG. 3, a small bleed orifice 23 is drilled through the plate 17 just above the left-hand tip of the crescent 18 opposite the outlet port 20 to connect the discharge side of the pumping chamber to an annular chamber 24 formed by a recess in the housing 11. The right-hand face of the crescent 18 is provided with a centrally disposed vertical slot 25 which is connected to the chamber 24 by means of a hole 26 in the plate 17. The slot 25 extends across the full width of the crescent 18 so as to open onto both the pinion and ring gears to supply liquid under pressure to fill any voids which may exist therein.

The pressure of the liquid being pumped into the slot 25 must be below pump pressure and for that purpose a pressure regulating check valve 27 is connected between the chamber 24 and a liquid return or bypass port 28. More particularly, a passageway 29 is drilled between the chamber 24 and a valve seat against which a ball valve member 30 is biased by means of a spring 31 seated against a ball 32 press-fitted into the housing. The constant force exerted by the spring 31 thus main-
tains the supercharging pressure below a predetermined value below pump pressure. In an oil burner pump designed to operate between 75 and 150 p.s.i., a supercharging pressure of between about 2 p.s.i. and 70 p.s.i., is desirable. With this arrangement, supercharging is effective with both head pressure and suction installations.

Considering the remainder of the pump 10 in greater detail, liquid enters the housing 11 through an inlet port 35 and flows through a hole 36 to a chamber 37 surrounding a filter screen 38. After passing through the screen 38, the oil flows through a hole 39 into an annular chamber 40 partially formed by an annular recess in a plate 41 secured to the housing 11 by means of a nut 42. As best shown in FIG. 2, a hole 43 is angularly drilled through the block 16 between the chamber 40 and the arcuate inlet port 19 thereby to supply liquid to the inlet side of the pumping chamber. Liquid under pressure from the arcuate discharge port 20 flows through a hole 44 into an annular chamber 45 surrounding a dual ported valve seat 46 mounted in alignment with the shaft 12. A diaphragm 47 is mounted between the plate 41 and the opposing portion of the housing and is held against the valve seat by means of a spring 48 and a disc 49. When the pressure in the chamber is great enough to move the diaphragm 47 away from the valve seat, the liquid is supplied to an outlet port 50 via a passageway including drilled holes 51, 52, and 53. Bypass liquid flows to the bypass or return port 28 via a passageway including holes 54, 55, and 56.

Referring to FIG. 4, an understanding of the operation of the pump 10 may be facilitated. As there illustrated, liquid from the discharge side of the pump is returned at a reduced flow rate through the metering orifice 23 to the pump chamber to minimize cavitation therein, and the pressure of the returned liquid is maintained below a predetermined value by the pressure regulator 27.

Referring to FIG. 5, a pump 60 is shown in schematic form and includes an inlet port 61 opening into a pumping chamber 62 in which a pair of mating gears 63 and 64 are rotatably mounted. An outlet port 65 is provided opposite the inlet port and a metering orifice 66 connects a supercharging passageway 67 thereto. The passageway 67 opens into locations 68 and 69 in the pumping chamber midway between the inlet and outlet ports 61 and 65 to return liquid thereto under pressure. A pressure regulator 70 is connected to the passageway 67 to maintain the supercharging pressure below a predetermined value below the pump pressure. The valve 70 includes a ball 71 biased by a spring 72 located in a hole 73 connected to a bypass or return port 74. A passageway 75 connects the chamber 73 to the inlet side of the pumping chamber whereby return oil from the valve 73 may be made to enter the pump without returning to the sump by closing off the port 74.

The present invention thus provides a supercharged, single-stage pump wherein a portion of the liquid from the outlet side of the pump is internally returned at a reduced pressure and controlled flow rate to the central portion of the pumping chamber to substantially eliminate cavitation. Where desired, the restricted orifice may be a long passageway of somewhat greater cross-sectional area to minimize the possibility of plugging thereof by impurities in the liquid.

While the present invention has been described in connection with a particular embodiment thereof, it will be understood that those skilled in the art may make many changes and modifications without departing from the true spirit and scope thereof. Accordingly, the appended claims are intended to cover all such changes and modifications as fall within the true spirit and scope of the present invention.

What is claimed is:
1. A positive displacement liquid pump, comprising a housing having a pumping chamber therein, an inlet to one side of said chamber and an outlet from the other side of said chamber, motor driven pumping means mounted in said chamber between said inlet and said outlet, a supercharging passageway extending through said housing between the outlet side of said chamber and a location in said chamber intermediate said inlet and said outlet, a restricted metering means of fixed cross-sectional area disposed in said passageway to provide a constant rate of flow through said passageway for any given pump speed, and pressure relief means connected downstream of said restricted metering means and between said restricted metering means and said inlet to regulate the pressure of the liquid in the passageway between said restricted metering means and said intermediate location in said metering chamber.
2. A positive displacement liquid pump according to claim 1 wherein said pumping means is a pair of intermeshing gears.
3. A pump according to claim 1 for use with an oil burner, wherein said metering means has a flow rate of about 2 to 3 gallons per hour at a pump discharge pressure of about 100 p.s.i.