Nov. 4, 1969 J. J. CZARNECKI ET AL 3,476,053

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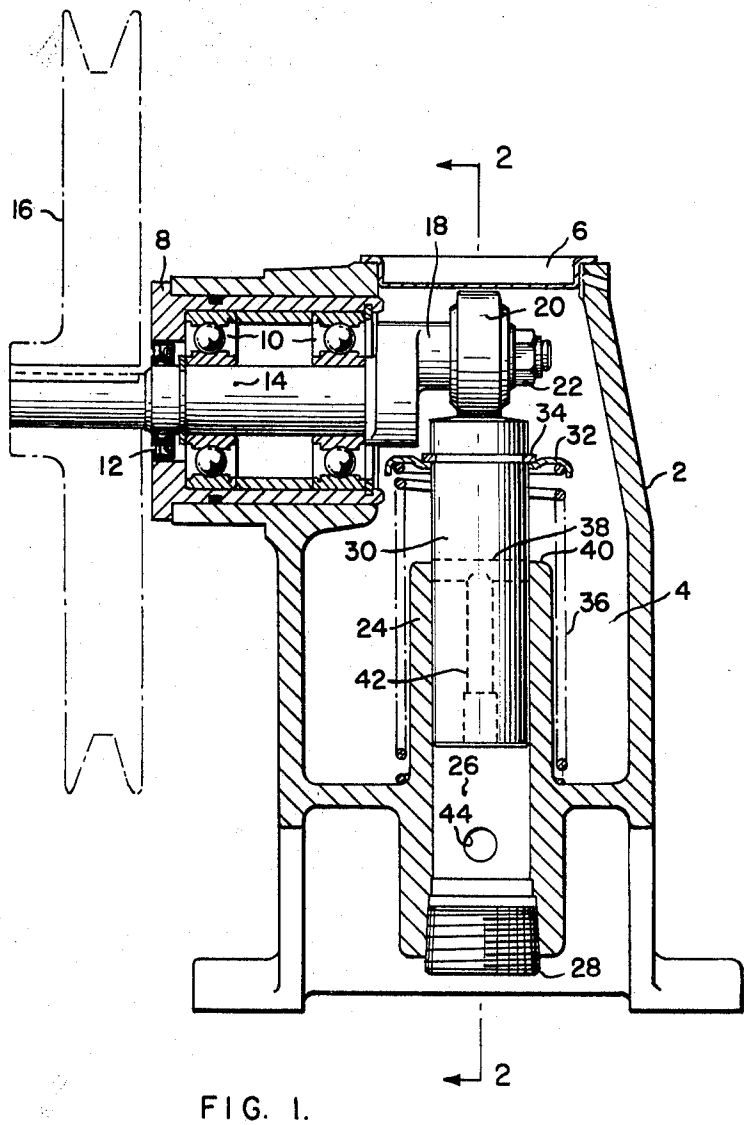

FIG. 1.

INVENTORS
JERZY J. CZARNECKI &
PETER ARKWRIGHT

BY
Brasser, Smith & Harding
ATTORNEYS

Nov. 4, 1969 J. J. CZARNECKI ET AL 3,476,053

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Filed Nov. 1, 1967 3 Sheets-Sheet 2

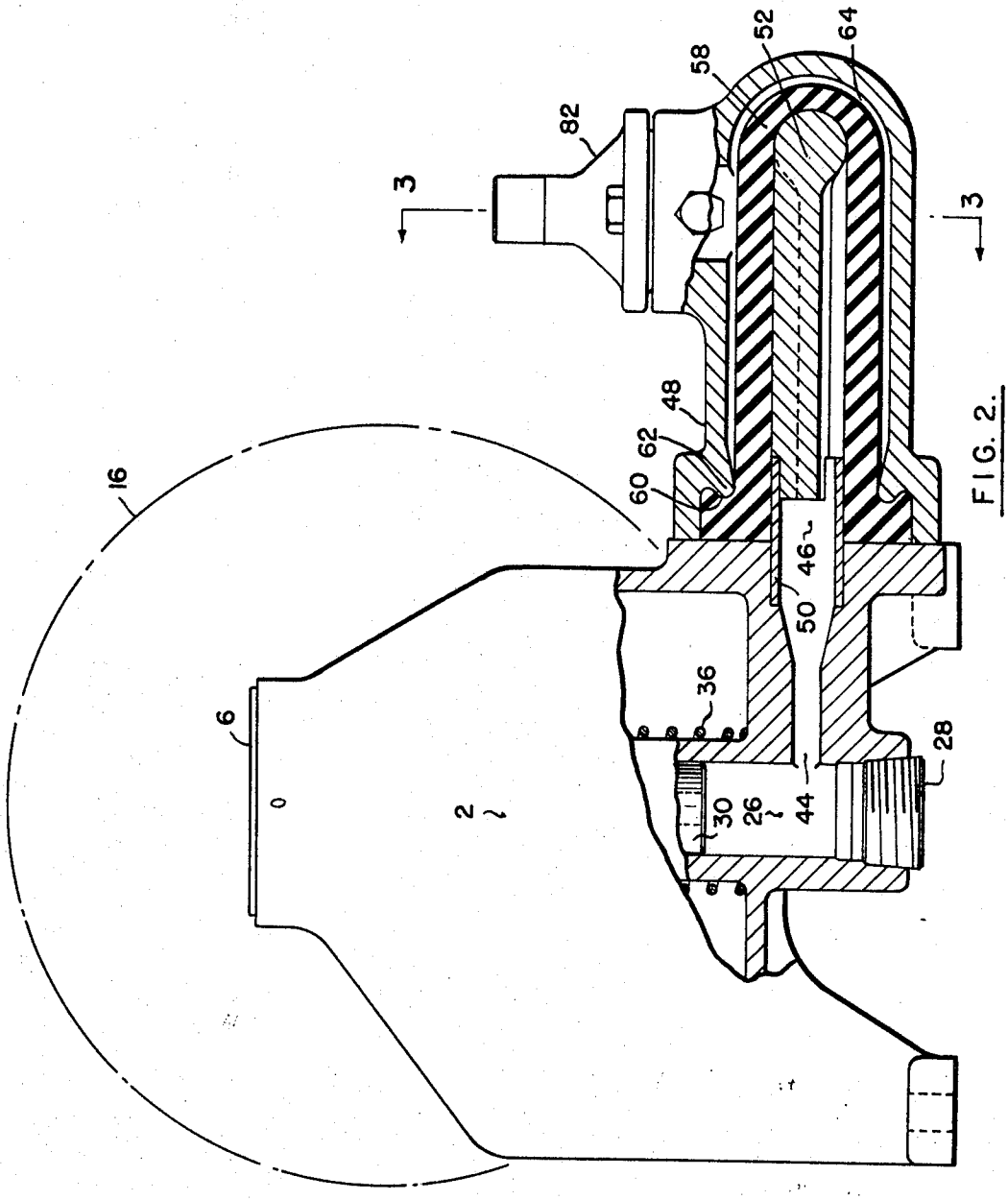

FIG. 2.

INVENTORS
JERZY J. CZARNECKI &
PETER ARKWRIGHT

BY

Brisco, Smith & Harding

ATTORNEYS

Nov. 4, 1969 J. J. CZARNECKI ET AL 3,476,053

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Filed Nov. 1, 1967 3 Sheets-Sheet 3

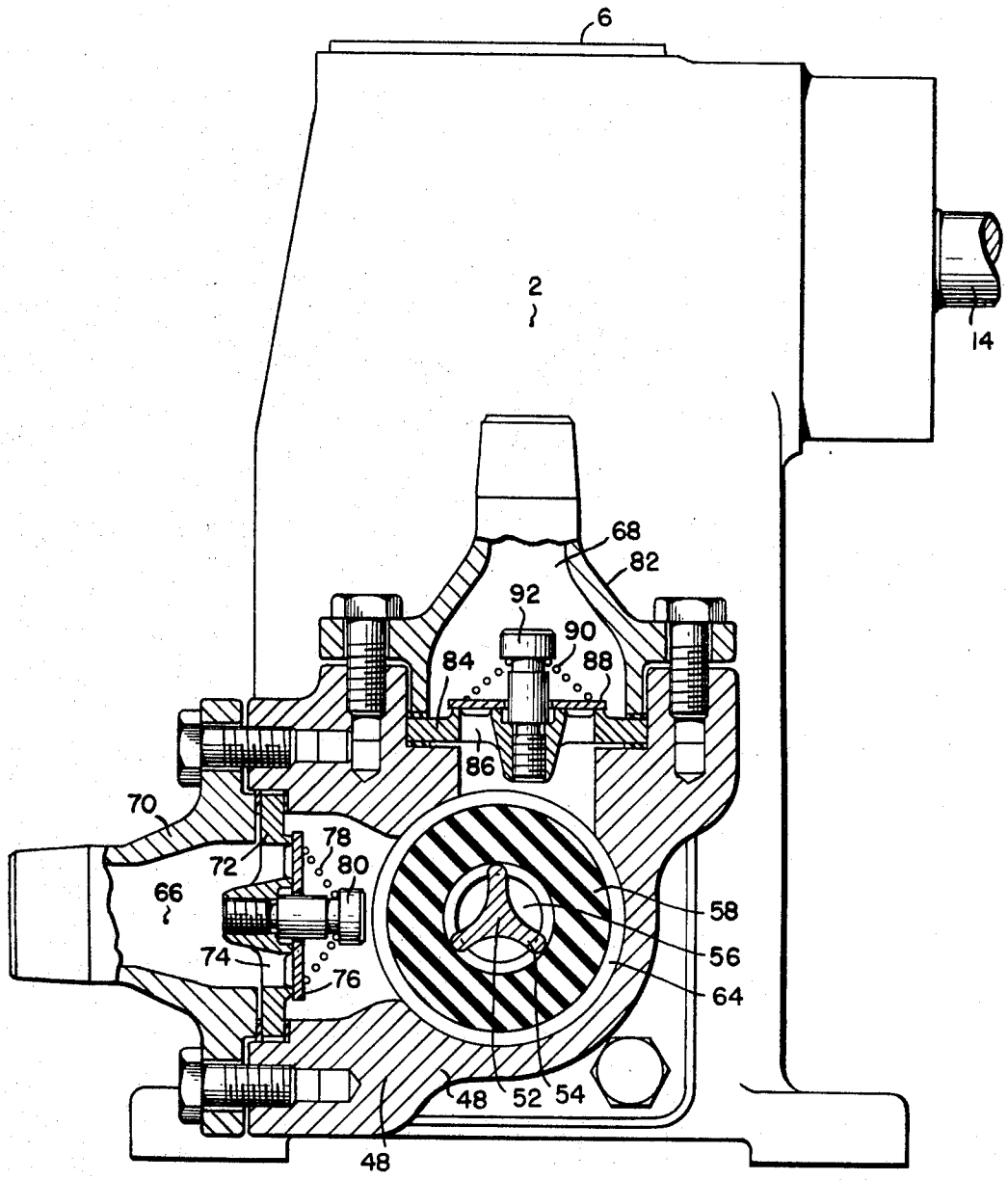

FIG. 3.

INVENTORS
JERZY J. CZARNECKI &
PETER ARKWRIGHT
BY
Brisen, Smith & Harding
ATTORNEYS

United States Patent Office

3,476,053

Patented Nov. 4, 1969

3,476,053

PUMP

Jerzy J. Czarnecki, Princeton, and Peter Arkwright, Pennington, N.J., assignors to De Laval Turbine Inc., Trenton, N.J., a corporation of Delaware

Filed Nov. 1, 1967, Ser. No. 679,803
Int. Cl. F04b 9/10, 43/00; F01b 19/04
U.S. Cl. 103—44 1 Claim

ABSTRACT OF THE DISCLOSURE

A pump of the pulsator type is provided with a vertical cylinder in which a piston is reciprocated by a crank carrying a needle bearing engaging the top of the piston to move it downwardly against spring action. The cylinder is submerged in a liquid and the piston is provided with ports communicating with the space below the piston and arranged to be cut off as the ports move below the top of the cylinder, thereby to trap a definite quantity of liquid which is driven into a pulsator in the form of an elastic thimble to provide displacement in a chamber for pumped liquid, the last chamber being provided with inlet and outlet valves offering low resistance to flow. A simplified clamping assembly for the pulsator provides sealing. The interior of the pulsator contains a fluted core limiting its collapse.

BACKGROUND OF THE INVENTION

This invention relates to pumps of the pulsator type and particularly relates to improvements in the type of pump disclosed in Browne Patent 2,738,731, dated Mar. 20, 1956.

Pumps of this type are designed particularly for the complete isolation of a driving liquid from a pumped liquid under usual conditions of working at quite high pressures. The special type of problem which is involved is exemplified by the utilization of the particular pump herein described in a refrigerating system in which liquid ammonia is the pumped liquid and in which the driving liquid may be either an oil or another liquid which has relatively low viscosity at the low temperatures to which it may be subjected.

The pumped liquid in such a case is in a closed and sealed system and reliable operation must be maintained over long periods. Operation must be satisfactory over the transitions between shut-downs of the refrigeration system and normal active operation. Without the exercise of special precautions the pulsator, of a suitable elastomeric or rubber-like material, may be subjected to rupture as the result of abnormal expansion or collapse.

SUMMARY OF THE INVENTION

The possibility of rupture of the pulsator is avoided in accordance with the invention by insuring that in each cycle of operation substantially the same volumetric displacement occurs, a correction to prevent cumulative volumetric displacement being automatically made at the end of each cycle.

It will be evident as the description proceeds that the pump may be used for many purposes. The general objects of the invention relate to the accomplishment of the results indicated and will become more apparent from the following description, read in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a vertical section through the driving portion of the pump;

FIGURE 2 is an elevation, partly in section on the plane indicated at 2—2 of FIGURE 1; and

FIGURE 3 is a transverse section taken on the plane indicated at 3—3 in FIGURE 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring first to FIGURE 1, a housing 2 is arranged to provide a chamber 4 for driving liquid which is desirably sealed by a cap 6 and a bearing housing 8 which encloses bearings 10 and a shaft seal 12, the bearings mounting a transverse shaft 14 to which there is keyed a driving pulley 16 which may be belt-driven from an electric motor, though the shaft may be driven otherwise, as through gearing. The shaft carries a crank 18 on the pin of which there is secured by a nut 22 a roller 20 in the form of the outer member of a conventional needle bearing, the roller acting as a cam operating on the upper end of a piston. A tubular portion 24 of the housing 2 has a bore providing a cylinder 26 which is closed at its lower end by a plug 28. Within the cylinder there reciprocates a cylindrical piston 30 which is provided with a collar 32 held by a snap spring 34 engaged in a circumferential groove at the upper end of the piston. A compression spring 36 surrounds the tube 24 and engages the collar 32 to urge the piston upwardly into contact with the roller 20. The area of the piston is sufficient to maintain the rolling contact as the roller goes through its path of movement.

The piston 30 is provided with a transverse opening 38 providing a port arrangement in connection with the upper end 40 of the cylinder tube 24. The chamber 4 contains a liquid the surface of which is substantially above the tube end 40 at all times, and the arrangement is such that when the piston is at the upper end of its stroke the transverse passage 38 is exposed to communication with the submerging liquid, whereas as the piston moves downwardly the effective ports are closed as the passage 38 moves below the end 40. A longitudinal bore 42 provides communication at all times between the transverse passage 38 and the space below the piston.

Additionally referring to FIGURE 2, an opening 44 in the cylinder wall below the lowermost position attained by the piston provides communication with a chamber 46 which, to a major extent, is within a housing portion 48 which is bolted to the housing 2. A sleeve 50 supports a filler member 52 which, as indicated particularly in FIGURE 3, is provided with a plurality of longitudinal extending ribs 54 providing longitudinal flutes 56 throughout most of its length.

A pulsator 58 is in the form of a thimble of a suitable rubber material withstanding chemical action of both the pumping and pumped liquids. At its base it is provided with a flange having an annular groove 60 for the reception of an annular projection 62 of the housing member 48, so that when the latter is bolted in position a tightening action occurs clamping the flange tightly against the wall portion of the housing 2, with the result that the flange provides a tight seal between the driving liquid space and the driven liquid space and between both of these and the atmosphere.

The pulsator has a thick wall and is so formed that its interior will normally hug the ribs of the filler member 52, the result of this being that when interior pressure is relieved the pulsator will collapse to its normal position to provide suction action to draw the pumped liquid into the space 64 surrounding the pulsator and within the housing member 48. By reason of the thick walls, there is considerable resistance to collapse of the pulsator into the flutes 56 of the filler member 52.

Referring next particularly to FIGURE 3, an inlet passage 66 is provided in a member 70 which provides for connection of the inlet passage to suction piping. The member 70 is bolted to the housing member 48 with the

interposition of a plate 72 and suitable packing. Plate 72 is in the form of a spider providing openings 74 and has a seating surface for a valve plate 76 urged thereagainst by a compression spring 78 backed up by the head of a bolt 80 which also serves as a guide for the loose mounting of the plate 76. The spring 78 is desirably a light spring to provide a check valve assembly which is very easily opened when the pressure at its exterior exceeds that at its interior, preventing the existence of any large pressure drop in the opening direction. An outlet passage 68 is similarly provided by a member 82 affording connection to outlet piping and bolted to the housing member 48 with the interposition of a plate 84 associated with suitable packing. The plate 84 is also in the form of a spider having openings 86 and an upper seat engageable by the valve disc or plate 88 which is lightly held downwardly by a spring 90 backed up by the head of a bolt 92 which forms a guide for the plate 88. The arrangement is like that previously described except that the check valve thus provided opens outwardly to pass discharged pumped liquid.

As will be evident from the foregoing, an assembly is provided which may be permanently sealed as regards both the driving liquid and the pumped liquid. The operation is as follows:

Assuming that the piston is near the upper end of its stroke as illustrated in FIGURE 1, and submerged in the driving liquid, the porting arrangement provided by the passage 38 furnishes free communication between the lower portion of the cylinder 26, and the regions communicating therewith through the opening 44, to the submerging driving liquid in the chamber 4. The pressure above this liquid will be essentially atmospheric, and accordingly there is no possibility at this time of any substantial excess pressure existing within the pulsator which is thus free to assume its collapsed position and, in assuming this position, of drawing pumped liquid into the chamber 64 surrounding the pulsator, the entry of pumped liquid being through the check valve assembly which offers little resistance to flow.

As the piston moves downwardly the ends of the opening 38 are closed off by the upper end 40 of the cylinder tube 24, and as soon as this occurs a definite volume of the driving liquid is trapped within the cylinder 26 and its communicating spaces including the space 46 and the spaces in the flutes within the pulsator.

Downward movement of the piston 30 to the lower end of its stroke drives the essentially incompressible liquid into the pulsator to provide a definite displacement of the pulsator to decrease correspondingly the space in the chamber 64 with resultant drive of the pumped liquid outwardly through the discharge check valve.

As the piston moves upwardly under the action of spring 36, a reversed displacement occurs, and during normal operation the pulsator collapses to its original position causing inflow of the pumped liquid through the check valve assembly associated with the passage 66. When the piston rises to the upper end of its stroke communication is again established between the chamber 4 and the space below the piston to provide equalization of pressures and volumes despite any changes which might have occurred due to temperature variations.

In the event that for any reason the pulsator would be prevented from collapse, as by an arrest of inward flow of the pumped liquid (though this is essentially impossible by reason of any faulty operation of the inlet check valve) the situation is compensated by the fact that the spring 36 exerts a relatively small force as compared with that due to abnormal pressure conditions, and in such case may not rise to its full extent as the roller 20 moves upwardly. Thus the effective displacement downwardly during the next stroke will not be to its normal

full extent and the displacement will not be additive to the previous residual displacement of the pulsator to the extent that the pulsator may be too greatly distended and thereby become subject to rupture.

As a result of the foregoing, safety conditions are assured preventing faulty operation which, in the case of a refrigerating system might lead to escape of a noxious material such as ammonia.

The driven liquid may be of any desired type, and the driving liquid may be an oil or other liquid suitable for the conditions of use; for example, for low temperature conditions an oil may be used which maintains low viscosity at the temperatures possibly encountered. While the driving liquid desirably has some reasonable lubricating properties, to afford lubrication of the piston in its cylinder, the requirements are readily met, and even aqueous solutions of such materials as ethylene glycol may be used, such materials being of antifreeze type.

The rubber material of the pulsator is, of course, chosen to resist chemical or softening action by the driving and pumped liquids. A great variety of artificial rubbers are available to achieve this end.

It will be evident that various changes may be made in the embodiment of the invention without departing from its scope as defined in the following claim.

We claim:

1. A pump comprising a hollow elongated expansible and contractible elastic member having walls of substantial thickness and rigidity, a housing comprising a first part surrounding said elongated member and a second part having a passage extending through it, said passage being in communication with the interior of said elongated member, said elongated member contracting due to its inherent elasticity to create a suction in the space between it and the first part of said housing so as to lie in a definite position of normal repose in the absence of pressure in its interior, inlet and outlet valves controlling flow to and from the space between the first part of the housing and said elongated member, means for intermittently and cyclically forcing the same quantity of liquid through said passage into the interior of said elongated member in each of successive cycles and for releasing the liquid therefrom in each cycle so that said elongated member then returns to said definite position of normal repose in each cycle prior to the next forcing of liquid into its interior, the means for forcing the liquid into the interior of the elongated member and for releasing the liquid therefrom comprising a cylinder communicating through said passage with the interior of said elongated member and submerged in said liquid and a piston reciprocable through one end of the cylinder, wherein the improvement comprises a flange portion of the elastic member having an annular groove, and an annular projection formed in one of said first and second parts of the housing and extending into said groove, said flange being clamped between said first and second parts to provide a seal between the regions inside and outside said elastic member and between both said regions and the exterior of the housing.

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ROBERT M. WALKER, Primary Examiner

U.S. Cl. X.R.

92—98; 103—148