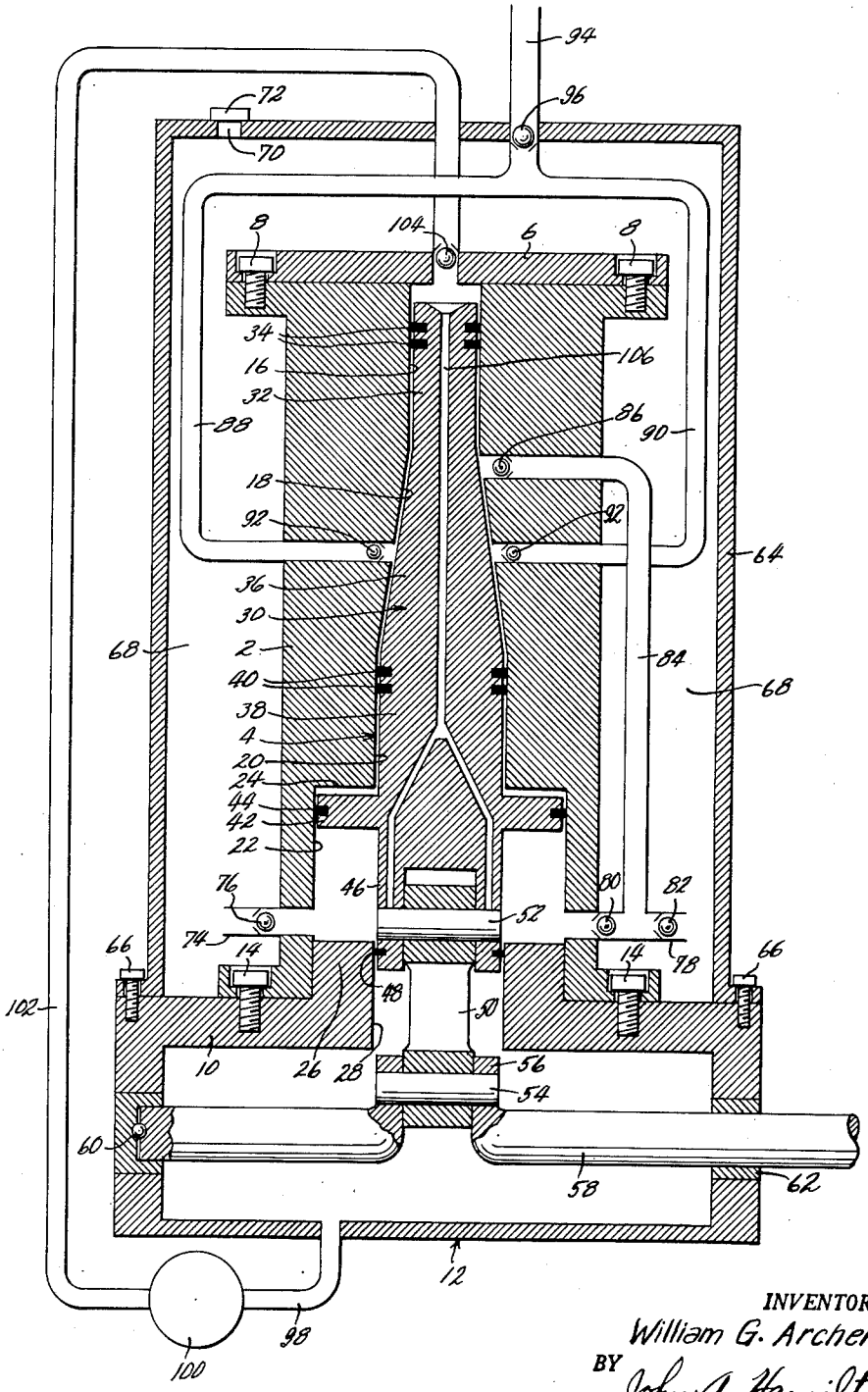
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PUMP

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This invention relates to new and useful improvements in pumps, and has particular reference to pumps peculiarly adapted to handle cold, extremely volatile materials such as liquid oxygen, liquid nitrogen, and the like.

The principal object of the present invention is the provision of a pump of the general character described having several novel provisions for reducing the possibility of "gassing-off" or vaporization of the volatile material being pumped, such vaporization producing gas pockets often referred to as "cavitation," which not only is undesirable in the fluid being delivered, but also reduces the efficiency of the pump and its pumping capacity. The provisions for the prevention of cavitation include a special configuration of the pumping piston whereby the piston never engages the cylinder walls in the immediate vicinity of the inlet and outlet ports, so as to reduce frictional heat which could cause vaporization, and which reduces the unit pressure on the piston so as to minimize the heat of compression. Other features are the pressurizing of the pump intake so as to prevent cavitation by excessive suction or pressure reduction at said intake, and the provision of an intake reservoir connected to the pump intake and surrounding the operating pump parts, whereby the pump is kept cooled to proper operating temperature without necessity for any auxiliary pre-cooling apparatus.

Another object is the provision of a pump of the general character described which is self-lubricating, that is, it contains an auxiliary pump for delivering oil under pressure to its operating parts.

Other objects are simplicity and economy of construction, efficiency and dependability of operation, and adaptability to handle various other types of fluids.

With these objects in view, as well as other objects which will appear in the course of the specification, reference will be had to the drawing, which is a vertical sectional view, partially diagrammatic in character, of a pump embodying the present invention.

In said drawing, the numeral 2 applies to the pump body, which may be a solid metal block, and which has a cylinder 4 formed vertically therethrough. Said cylinder is closed at its upper end by a cover plate 6 secured to the body by screws 8, and the body is secured at its lower end to the top wall 10 of a crank case 12 by screws 14. Cylinder 4 is of irregular contour, having a top section 16 of cylindrical form, a frustro-conical section 18 having its upper minimum diameter merging with the lower end of section 16, a larger cylindrical section 20 merging with the lower end of section 18, and a substantially larger cylindrical bottom section 22 connected at its upper end to section 20 by an offset shoulder 24. All of said sections are concentric with each other. Top wall 10 of the crank case is provided with a raised cylindrical boss 26 which fits snugly into the lower portion of cylinder section 22 and said boss is cylindrically apertured at 28, concentrically with cylinder 4, to provide access to the crank case.

Operable in cylinder 4 is a piston indicated generally by the numeral 30. Said piston is of the same general contour as the cylinder, having a top cylindrical section 32 operable in cylinder section 16 and having seals 34 engaging the wall thereof, a next frustro-conical section 36 operable in cylinder section 18, a next cylindrical section 38 operable in cylinder section 20 and having seals

40 engaging the walls thereof, and a next enlarged cylindrical section 42 operable in cylinder section 22 and having a seal 44 engaging the wall thereof. Depending from section 42, the piston is provided with a cylindrical extension 46 which operates in aperture 28 of the crank case, and is provided with a seal 48 engaging the wall of said aperture to prevent leakage of fluid between cylinder section 22 and the crank case. A connecting rod 50 is pivoted in extension 46 by means of a horizontal pin 52, and the lower end of said connecting rod is pivoted by means of pin 54 to the crank portion 56 of a horizontal crank shaft 58 extending through the crank case and journalled therein by bearings 60 and 62. Said crank shaft extends externally of the crank case, and may be driven rotatably by any suitable power unit, not shown, such as a motor or engine. It will be apparent that as shaft 58 is turned, it will cause piston 30 to be reciprocated vertically in cylinder 4.

A box-like housing 64 surrounds the pump body 2, being secured at its lower end to the crank case by screws 66, so as to form a jacketing chamber 68 surrounding the pump body. The housing walls may be heavily insulated. The liquid to be pumped is introduced into chamber 68 through a filling opening 70 at the top of the housing. Said opening may be provided with a removable cap 72, or a liquid supply conduit may be attached thereto. Chamber 68 should be maintained substantially full of liquid at all times so as to thoroughly pre-cool the pump. The pump body is provided with an inlet conduit 74 interconnecting chamber 68 with the lower portion of cylinder section 22. Said conduit is provided with a check valve 76 which allows liquid to enter the cylinder, but prevents reverse flow. Cylinder section 22 is also provided with an outlet conduit 78 which discharges into chamber 68, and in which are disposed, in series, a check valve 80 operable to permit outward flow but to prevent flow in a reverse direction, and a pressure relief check valve 82 operable to permit outward flow when the fluid pressure thereagainst exceeds a pre-determined level. Interconnected into conduit 78 intermediate valves 80 and 82 is a conduit 84, conduit 84 being interconnected to conical cylinder section 18, said conduit having therein a check valve 86 operable to permit flow into the cylinder, but to prevent flow in a reverse direction. Cylinder section 18 is also provided with a plurality of outlet conduits 88 and 90 each having therein a check valve 92 operable to permit outward flow but to prevent reverse flow. Said outlet conduits are joined in a single outlet conduit 94 which extends outwardly through the wall of housing 64, and which also is provided with a check valve 96 permitting outward flow only. The conduits and valving is indicated diagrammatically.

Crank case 12 is connected by conduit 98 to the intake side of an oil pump 100, the delivery conduit 102 being interconnected to the top end of cylinder section 16 through cover plate 6, and being provided with a check valve 104 which permits oil flow only in a direction toward the cylinder. The piston 30 is provided with an axial bore 106 which opens through the upper end of the piston, and which is branched at its lower end to communicate with the bearings of pin 52. It will be evident that as the piston moves downwardly during the operation of the pump, oil from crank case 12 will be impelled by pump 100, and by the suction of cylinder 30, to enter cylinder section 16 above piston 30, passing through check valve 104. When the piston moves upwardly, check valve 104 closes and oil in the cylinder is forced downwardly through piston bore 106 to lubricate pin 52, from whence it will return by gravity to the crank case for recirculation. The lubricant used must be compatible with the fluid being pumped.

In the operation of the pump, it will be seen that as the piston moves upwardly, piston section **42** tends to create a vacuum therebeneath in cylinder section **22**, so that fluid from chamber **68** flows into cylinder section through conduit **74**. When the piston is driven downwardly, check valve **76** closes, and fluid is forced outwardly through conduit **78**, past check valve **80**, and through conduit **84** and check valve **86** into cylinder section **18**, which at this time has an increasing volume due to the downward movement of the piston. Since piston section **42** has a substantially greater displacement than piston section **36**, the former tends to deliver more fluid to cylinder section **18** than it can hold, so that the intake fluid of the latter is pressurized to the setting of relief valve **82**. When valve **82** is opened by pressure thereagainst, the excess fluid flows therethrough and is returned to chamber **68**. This pressurization of the intake of cylinder section **18** greatly reduces the vaporization or "gassing-off" of the volatile fluid being pumped which would otherwise occur due to suction or pressure reduction at the intake. It will be noted further that conduit **84** is disposed within chamber **68** and therefore surrounded by the fluid in said chamber. By heat transfer through the walls of said conduit, most of any heat introduced into the fluid by pressure or friction in cylinder section **22** and valve **80** is dissipated. When the piston is again raised, conical section **36** thereof exerts pressure on the fluid in cylinder section **18**, causing intake check valve **86** to close and outlet valves **92** to open, whereby fluid is forced through conduits **88** and **90**, check valve **96**, and conduit **94** to its place of eventual usage, which forms no part of the present invention and is not shown. During this operative stroke of piston section **36**, piston section **42** is of course drawing a new charge of fluid into cylinder section **22**, and the cycle is repeated continuously.

The specific arrangement and configuration of the cylinder and piston are believed to possess certain novel advantages. Firstly, it will be seen that there is no contact at any time between piston section **36** and cylinder section **18**, particularly in the immediate zones of the intake and delivery conduits **84**, **88** and **99**, since the piston is supported and guided only by seals **34** and **40** carried by the piston at points remote from a conical section **36** thereof. Friction and consequent heat which would otherwise be generated in the pumping zone are thereby eliminated, along with the tendency of such heat to cause vaporization of the volatile fluid being pumped. "Gassing off" and cavitation are therefore reduced. The conical shape of piston and cylinder sections **36** and **18** has the concurrent function of permitting full utilization of the cylinder volume without concurrent contact of the cylinder and piston walls in the pumping zone. The conical shape of the operative section **36** of the piston also has the advantage that since it has a much greater area than a flat-faced piston of comparable effective area, the unit fluid pressure thereon is greatly reduced as compared to a flat-faced piston. This tends to reduce the compressional heat generated by the delivery stroke of the piston, and provides a much greater area for the dissipation of any such heat into the pump and piston bodies.

While I have shown and described a specific embodiment of my invention, it will be readily apparent that many minor changes of structure and operation could be made without departing from the spirit of the invention as defined by the scope of the appended claims.

What I claim as new and desire to protect by Letters Patent is:

1. A pump comprising a body member defining a cylinder having a section of frusto-conical shape, a fluid inlet conduit interconnected with the frusto-conical section of said cylinder, means in said inlet conduit for preventing reverse fluid flow therein, an outlet conduit interconnected with the frusto-conical section of said cylinder, means in said outlet conduit for preventing reverse fluid flow therein, a piston operably disposed in said cylinder and having a frusto-conical section cooperating with the correspondingly shaped section of said cylinder to form a pump chamber, guide means maintaining said piston in coaxial spaced relation to said cylinder, means for reciprocating said piston axially in said cylinder, said cylinder and piston being provided with cooperating enlarged sections constituting an auxiliary pump of greater capacity than the pump chamber formed by said frusto-conical sections thereof, said auxiliary pump having an inlet and an outlet each provided with a check valve preventing reverse fluid flow, said auxiliary pump outlet being interconnected to said inlet conduit, the delivery stroke of said auxiliary pump corresponding to the intake stroke of the frusto-conical section of said piston, and means for by-passing fluid from said inlet conduit back to said auxiliary pump inlet whenever fluid pressure in said inlet conduit exceeds a pre-determined level.

2. A pump as recited in claim 1 with the addition of a housing forming a reservoir chamber surrounding said body member, said chamber being interconnected with the inlet of said auxiliary pump.

3. A pump as recited in claim 1 with the addition of a housing having a reservoir chamber surrounding said body member, said chamber being interconnected with the inlet of said auxiliary pump, and wherein said inlet conduit is enclosed within said chamber.

4. A pump as recited in claim 1 with the addition of a housing forming a reservoir chamber surrounding said body member, said chamber being interconnected with the inlet of said auxiliary pump, wherein said inlet conduit is enclosed within said chamber, and wherein said by-pass means comprises a pressure relief valve disposed in said inlet conduit and operable to release fluid from said conduit to said chamber whenever pressure in said conduit exceeds a pre-determined level.

References Cited in the file of this patent

UNITED STATES PATENTS

1,261,061	Seymour	Apr. 2, 1918
1,467,489	Nordberg	Sept. 11, 1923
2,018,144	Mesinger	Oct. 22, 1935
2,054,710	Okada	Sept. 15, 1936
2,640,432	Chappelle	June 2, 1953
2,831,325	White	Apr. 22, 1958

FOREIGN PATENTS

317,179	Great Britain	Aug. 15, 1929