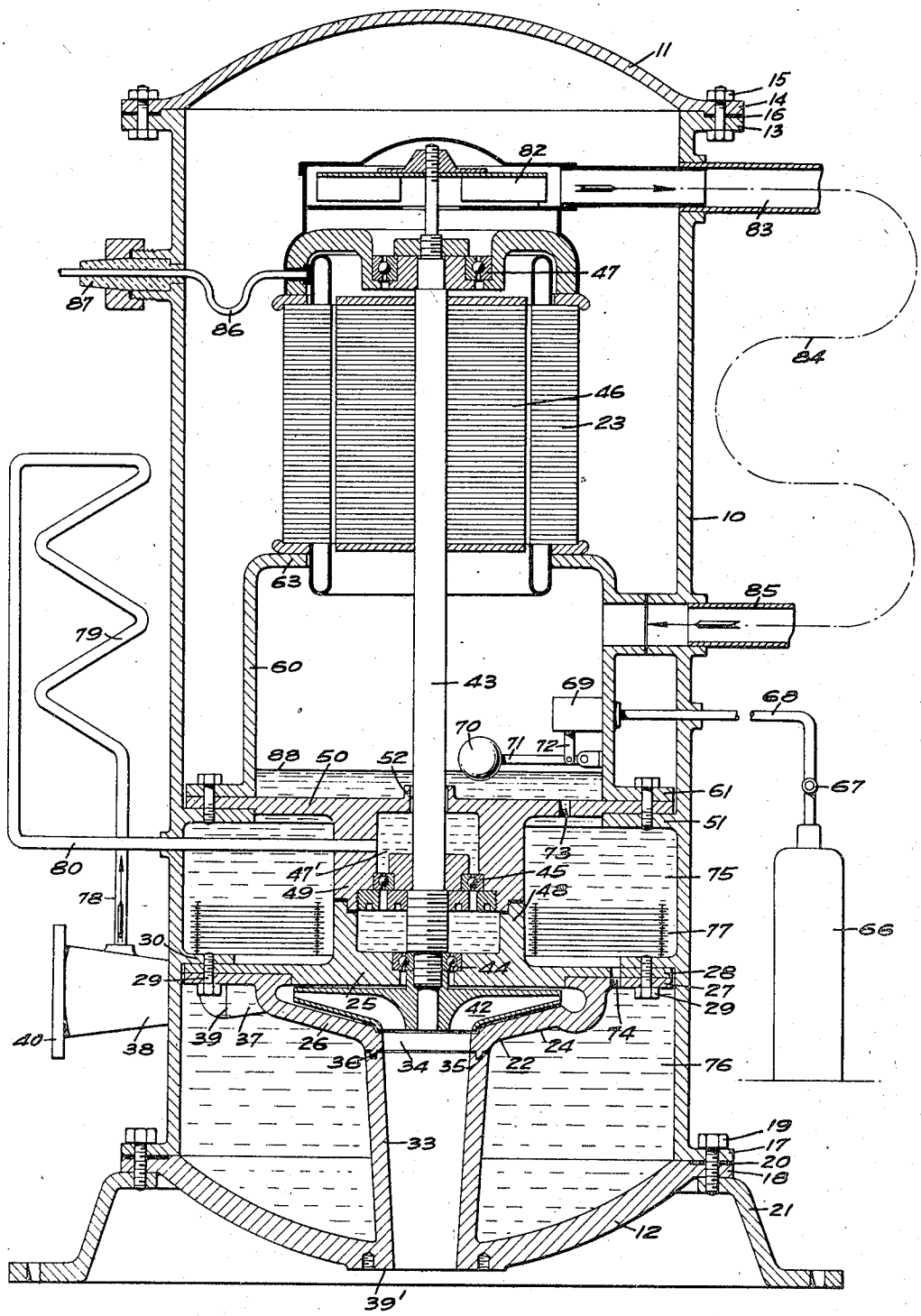
Dec. 6, 1927. 1,651,881

R. E. FRICKEY ET AL

PUMPING SYSTEM

Original Filed Dec. 26, 1925



INVENTORS
Royal E. Frickey
W. Robert Layne
BY White & Frost
THEIR ATTORNEYS

Patented Dec. 6, 1927. 1,651,881

UNITED STATES PATENT OFFICE.

ROYAL E. FRICKEY, OF SAN FRANCISCO, AND WILLIAM ROBERT LAYNE, OF OAKLAND, CALIFORNIA.

PUMPING SYSTEM.

Original application filed December 26, 1925, Serial No. 77,699. Divided and this application filed December 1, 1926. Serial No. 151,855.

This invention relates to a system for pumping liquids which it is desired to keep out of contact with air. In the oil refining industry it is often necessary to pump or circulate hot oil at high pressure. The temperature of such oil may be as high as 1000 degrees Fahrenheit and the pressure of the system as high as 1000 pounds per square inch. This is well above the flash point of such oils and if they are exposed to the air through leakage, instantaneous combustion occurs. To successfully pump such liquids a special type of pump is required which will obviate all danger of combustion through leakage between the working parts. The system of this invention has been designed to solve this problem.

It is a further object of this invention to devise a pumping system in which leakage from between the stationary and movable members of the pump is arrested by subjecting these parts to a fluid under pressure to oppose the pressure of the liquid in the system.

It is a further object of this invention to arrest leakage from any part of a pump structure by submerging the entire housing of the pump in a body of liquid which is maintained at sufficient pressure to arrest leakage of liquid from the system in which the pump may be employed.

It is a further object of this invention to devise a pump for handling hot liquids in which the housing of the pump is submerged in a body of liquid and in which means is provided for minimizing transmission of heat from the housing thru the body of liquid.

It is a further object of this invention to devise a pumping system in which a reservoir is provided on the stationary member of the pump to surround the shaft of the same so as to store any leakage occurring around the shaft, and to maintain the level of the liquid in the reservoir constant by subjecting it to the pressure of an inert gas, the pressure of the gas being automatically controlled to maintain the liquid level substantially constant. It is proposed to supply the gas from a source of gas under pressure and to provide a float control valve for automatically controlling the supply of gas to the reservoir.

It is a further object of this invention to devise a pumping system in which an electric motor-pump unit is employed which is entirely enclosed within an air-tight casing and to provide an atmosphere of inert gas within this casing. It is proposed to divide this casing into two parts by means of a partition which serves to insulate the electric motor from the heat of the liquid being pumped.

It is a further object of this invention to lubricate the drive shaft of the pump employed by by-passing a certain portion of the oil being pumped, cooling the same and then circulating it about the drive shaft bearings.

Further objects of the invention will appear from the following description in which there is set forth the preferred embodiment of the invention. It is to be understood that the invention is to be accorded a range of mechanical equivalents consistent with the state of the prior art.

The single figure of the drawing shows a transverse sectional view of the complete pump unit employed with the system of this invention.

The system contemplates generally the use of a motor-pump unit which is entirely enclosed within an air-tight casing. Thus there is preferably provided a cylindrical casing 10 having an upper end member 11 and a lower end member 12. In order to securely clamp these end members to the casing 10, the casing is provided along its upper end with a flange 13 adapted to be secured to the flange 14 of the upper end member 11 by suitable means such as bolts 15. An annular gasket 16 is inserted between the end of casing 10 and the end member 11 to insure an air-tight fit. The lower end of the casing 10 is similarly provided with the flange 17 adapted to be secured to the flange 18 of the end member 12 by suitable means such as bolts 19. A gasket 20 is also inserted between the lower end of casing 10 and the lower end member 12. The bolts 19 also serve to secure the casing 10 to the base 21. By means of this base 21 the casing 10 is normally retained in upright or vertical position. Within the lower portion of the casing there is disposed a liquid pump designated generally as 22 while in the upper portion of the casing there is disposed a motor 23 which is preferably electrical.

The liquid pump 22 comprises the usual

stationary and movable members and is preferably of the centrifugal type. Accordingly, the pump 22 includes a pump housing 24 which may be split circumferentially to form an upper portion 25 and a lower portion 26. The lower portion 26 is provided with a peripheral flange 27 which is securely clamped to the flange 28 of the upper housing portion 25 by suitable means such as bolts 29. These bolts 29 also serve to secure the pump housing 24 to the casing 10 by means of an internal peripheral flange 30 which projects from the interior wall of the casing 10 and is preferably spaced from the lower end of the casing 10. The lower portion 26 of the pump housing is provided with suitable liquid intake and outlet passages which communicate with the exterior of the casing 10. Thus there is provided an intake pipe 33 which communicates with the intake opening 34 in the lower portion 26. The pipe 33 is preferably formed as an integral continuation of the end member 12 and is provided with a suitable fluid-tight connection with the lower portion 26. This connection may be in the form of an annular groove 35 into which is fitted the annular tongue 36 extending from the end of the lower side portion of the pump housing. The outlet pipe 37 is formed upon the periphery of the pump housing and registers with an exterior outlet pipe 38 which may either be bolted to the side of the casing 10 or may be formed integral therewith. The junction between pipes 37 and 38 need not be fluid-tight and may be merely a butt joint as indicated at 39 from which fluid may leak into the lower portion of the casing. The pipes 33 and 38 are provided with suitable faces 39′ and 40 for connection with any devised system of external piping.

Within the hollow pump housing there is arranged a rotary impeller 42 which is mounted upon a rotatable shaft 43. The shaft 43 is arranged to extend vertically within the casing 10 and is suitably journaled adjacent its lower end as by bearings 44 and 45. Within the upper portion of the casing 10 the motor 23 preferably has its armature 46 directly mounted upon the shaft 43 to drive the same. The upper end of the shaft 43 is also provided with a suitable bearing 47 mounted adjacent the motor armature 46.

Means has also been provided for submerging the entire pump housing in a body of liquid. By maintaining this body of liquid under a pressure corresponding to the pressure within the pump, stresses on the pump housing caused by internal pressure are minimized. Thus it is possible to employ a relatively light pump housing of cheap construction in a high pressure system, as the walls of the housing need only withstand compressional stresses caused by the opposed internal and external pressures. Another important function for this arrangement is to arrest leakage of liquid from the system. By confining the immersing body of liquid under pressure to prevent its volume from increasing above a given maximum, all leakage from the pump is arrested and any leakage that may occur from the pump is returned into the system. When inflammable liquids such as hot oil are pumped, the body of immersing liquid is kept under pressure by an inert gas.

With the specific type of pump which has been illustrated, leakage will tend to occur between the parts of the housing, between the housing and the outlet pipe 38 and between the shaft 43 and the housing. When the pump is initially operated leakage will fill the lower portion of the casing to entirely submerge the pump. When the level of the immersing body of liquid rises to a certain predetermined level it is placed under pressure by suitable means such as an inert gas under pressure to arrest further leakage. As it is preferable to protect the motor from hot vapors from the immersing liquid, means is provided for maintaining the upper surface of the immersing liquid at a relatively low temperature. Also provision is made for lubricating the lower bearings for the shaft 43 with relatively cool oil. Thus the lower portion of the shaft 43 is enclosed by a reservoir 47′ formed by an upstanding annular flange 48 secured to the housing portion 25 connecting with a depending annular flange 49 formed on the transverse plate 50. The plate 50 is suitably secured to an internal casing flange 51 and is provided with an aperture 52 which closely fits the shaft 43. The stationary parts of the bearing 45 may be mounted upon the flange 49.

In order to confine the upper surface of the immersing liquid there is preferably provided a shell 60 which is suitably mounted upon the transverse plate 50 as by means of flange 61. The upper end of the shell 60 is provided with an inturned portion 63 which serves as a mounting for the motor 23. The shell 60 has a relatively large cross-sectional area so that a relatively small fluctuation of the level of any liquid within this shell will cause a relatively large amount of gas above the liquid to be displaced. It will be noted that the arrangement of the shell 60 provides a partition for the casing 10 which divides the casing 10 into a lower portion and an upper portion. Since the pump is adapted to be used in pumping liquid at high temperature this partition is of material advantage in protecting the windings of the motor from the heat of the liquid being pumped.

In order to maintain the immersing liquid under pressure there is provided an external storage tank 66 of inert gas such

as nitrogen gas under pressure. This tank is provided with a suitable control valve 67 and is in communication with the interior of the shell 60 by means of a pipe 68. Within the casing there is provided a device for automatically controlling the supply of inert gas in accordance with the level of the liquid within the shell 60. The particular mechanism employed includes a valve 69 which is operated by means of a float 70. The float 70 is carried upon the end of a pivoted arm 71 which is linked to the valve 69 by means of lever 72. This float control device will prevent the level of the liquid in the shell 60 from rising above a given maximum irrespective of the pressure of the liquid being pumped.

In order to insure equal distribution of the pressure throughout the immersing liquid the plate 50 is suitably apertured as at 73 and the pump housing is apertured as at 74 so that communication is established between the liquid in the shell 60 and the liquid in the spaces 75 and 76. To prevent transmission of heat from the upper surface of the pump housing 24 thru the liquid in the space 75, a series of spaced lateral baffles 77 are provided. These baffles are in the form of plates closely spaced together so as to retain thin heat insulating layers of liquid between the same. They also serve to minimize convection currents in the space 75. These baffles aid in maintaining the upper surface of the liquid at a relatively low temperature.

Since the bearings 44 and 45 for the shaft 43 are submerged directly in the immersing liquid from the pump 22 it is necessary to provide some means for cooling the oil in the reservoir 47′ in order to prevent injury to these bearings when the device is used to pump oil at high temperatures. Means has accordingly been provided for by-passing a certain amount of the oil from the system and then circulating this oil down through the reservoir 47′. However, before introducing this oil into this portion of the reservoir the oil is passed through a cooling system. Thus there is provided a pipe 78 connected with the outlet pipe 38 of the pump 22 which by-passes a certain amount of oil from the outlet pipe 37. This outlet pipe communicates with a system of cooling coils 79 which in turn communicates with the pipe 80 which introduces the cooled oil into the upper part of the reservoir 47′. Therefore a downward current is produced and the bearings 45 and 44 are maintained at a relatively low temperature compared to the temperature of the oil being pumped.

Provision has also been made for cooling the windings of the electric motor drive. Since the upper portion of the casing 10 is in communication with the shell 60 the motor will be subjected to an atmosphere of inert gas. This gas is preferably circulated over the motor windings to more effectively conduct away the heat. Thus the motor 23 is preferably provided with a small blower 82 which serves to blow the inert gas out of the interior of the upper portion of the casing 10 through the pipe 83. The pipe 83 communicates with a system of cooling pipes represented diagrammatically by the dash and dot line 84 and from which the gas is again introduced into the casing 10 through the pipe 85. Thus the motor will be maintained at a sufficiently low operating temperature to prevent injury to the windings. The electrical conductors 86 for the electric motor 23 preferably extend through the side of the casing 10 to suitable air-tight fittings 87.

In operation if the liquid being pumped is hot oil under high pressure, the oil will initially leak between the shaft 43 and the upper portion 25 of the pump housing 24 until it fills the shell 60 to the liquid level indicated at 88. Leakage will also occur between the pump housing portions and between the pump housing and casing 10 to fill spaces 75 and 76, or these spaces may be initially filled with oil. However, when the liquid reaches this level the float 70 is lifted to automatically cause the introduction of an inert gas from the storage reservoir 66 to the valve 69. This gas will then press down upon the surface 88 of the liquid and will arrest further leakage by opposing the pressure of the liquid being pumped. The float controlled valve 69 will automatically regulate the supply of inert gas so as to prevent the liquid level from rising above a given maximum irrespective of the pressure of liquid tending to leak from the pump. Circulation of oil through the pipes 78, 79 and 80 will cause a downward current of the liquid in the reservoir 47′ to keep the bearings 44 and 45 cool and properly lubricated. The cooling of the electric motor 23 is effected by circulating the inert gases through the pipes 83, 84 and 85 by means of the blower 82. Stresses within the pump housing caused by internal pressure will be substantially balanced by the opposing external pressure of the immersing liquid.

This case is a continuation of certain subject matter taken from our copending application No. 77,699, filed Dec. 26, 1925 and entitled "Pumping system".

We claim:

1. In a pumping system, a liquid pump having relatively movable and stationary members between which leakage tends to occur, means for subjecting all portions of said members to an external fluid pressure, and means for automatically increasing said external pressure in accordance with an increase in the amount of said leakage.

2. In a pumping system, a liquid pump

having relatively movable and stationary members, means for subjecting all portions of said members to an external fluid pressure, and means for automatically maintaining said external fluid at a pressure at least as great as the maximum pressure of the fluid tending to leak from the system.

3. In a pumping system, a liquid pump having relatively movable and stationary members and provided with inlet and outlet passages, means for immersing adjacent exterior portions of said members in a mass of liquid, means containing a gaseous medium for exerting pressure on the surface of said liquid, and means for automatically controlling said pressure in accordance with the level of the liquid immersing said members.

4. In a pumping system, a liquid pump including a housing, means for completely submerging said pump in liquid under pressure, and means for varying the pressure of said liquid in accordance with variations in the pressure of the liquid within the system.

5. In a pumping system, a liquid pump including a housing, means for completely submerging said pump in liquid under pressure, and means for automatically varying the pressure of said liquid in accordance with variations in the pressure of the oil within the system.

6. In a liquid pumping system, a pump having relatively movable members, an enclosure for external portions of said members containing a gaseous medium, and means for automatically increasing the pressure of said gaseous medium in accordance with the amount of liquid leakage tending to occur from the pump between said members.

7. In an oil pumping system for pumping oil above atmospheric pressure, a liquid pump having relatively stationary and movable members and provided with inlet and outlet passages, said movable member including a rotatable shaft extending into said member, a bearing for said shaft adjacent said stationary member, a reservoir secured to said stationary member to surround said bearing, means for by-passing oil from said outlet thru said reservoir to lubricate said bearing, and means for exerting a pressure above atmospheric upon the liquid in said reservoir whereby loss of oil from the system is arrested.

8. In a pumping system, a pump adapted to receive relatively hot liquid, means for immersing certain exterior portions of said pump in a mass of liquid to form a liquid seal, and baffle means for minimizing convection currents in said mass of liquid.

9. In a pumping system, a pump adapted to receive relatively hot liquid, means for immersing certain exterior portions of said pump in a mass of liquid to form a liquid seal, and heat insulating means within said mass of liquid to maintain the upper surface of the liquid at a relatively low temperature.

10. A pumping system comprising a casing, a centrifugal pump including a housing mounted in said casing and having its inlet and outlet extending outside said casing, said pump having a vertical shaft, means comprising a reservoir having a liquid therein for immersing certain exterior portions of said pump, an external source of gas under pressure communicating with said reservoir, and means responsive to the level of the liquid in said reservoir to control the flow of gas from said source to said reservoir in order to maintain said level substantially constant.

11. A pumping device comprising a vertical casing, a centrifugal pump including a housing mounted in the lower portion of said casing and having inlet and outlet openings extending outside said casing, said pump having a vertical shaft, an immersing liquid in the lower portion of the casing to submerge the pump housing, a reservoir disposed above said pump housing, a bearing for said shaft within said reservoir, a source of gas under pressure external of said casing and communicating with said casing, float means within said casing for controlling the supply of gas to said casing from said source, said gas supplied tending to prevent liquid from escaping from said pump housing.

12. In a pumping system, a liquid pump having relatively movable and stationary members and provided with inlet and outlet passages, means including a reservoir for immersing adjacent exterior portions of said members in a mass of liquid, means containing a gaseous medium for exerting pressure on the surface of said last named liquid, means supplying the gaseous medium under pressure to said last mentioned means, and means responsive to the level of the liquid in said reservoir to control the supplying of said gaseous medium to said second named means.

13. In a high pressure pumping system, a liquid pump having relatively movable and stationary members between which leakage tends to occur, means surrounding said members for storing accumulated leakage, means for subjecting said members to an external gaseous pressure, and means for automatically increasing said pressure in response to an increase in the quantity of accumulated leakage.

14. In a high pressure liquid pumping system, a liquid pump having relatively movable and stationary members, means for enclosing adjacent portions of said members and for storing liquid leakage tending to occur between said members, an external tank containing gas under pressure relative-

ly high compared to the pressure of liquid within the system, means connecting said tank and enclosing means for introducing gas into said enclosing means, and means for controlling the introduction of gas into the enclosing means from said tank whereby said adjacent portions of said members may be opposed by a pressure approximating the pressure of liquid within the pump at the point of leakage.

In testimony whereof we have hereunto set our hands.

ROYAL E. FRICKEY.
WILLIAM ROBERT LAYNE.