Sept. 1, 1942. O. J. NELSON 2,294,798

PUMPING EQUIPMENT

Filed March 8, 1939

Fig. 1.

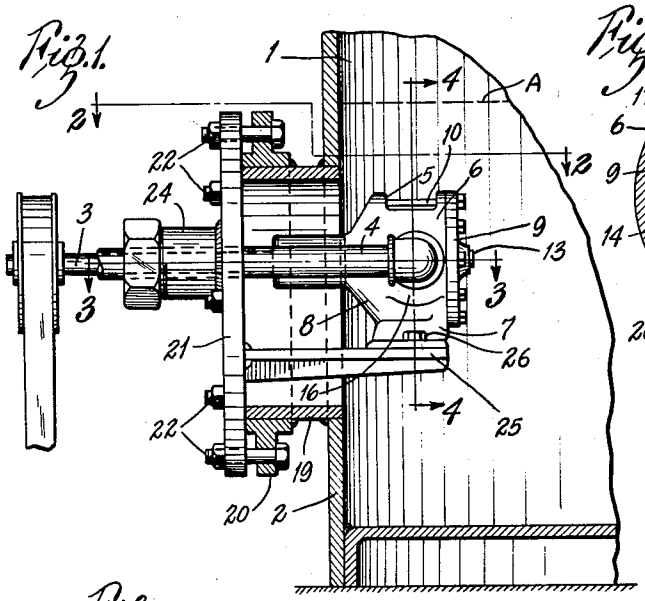


Fig. 2.

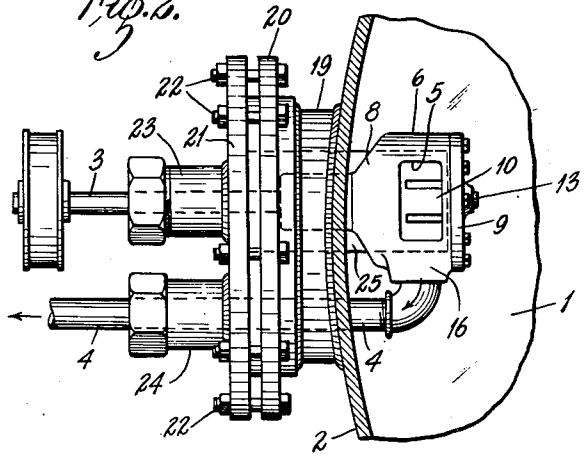


Fig. 3.

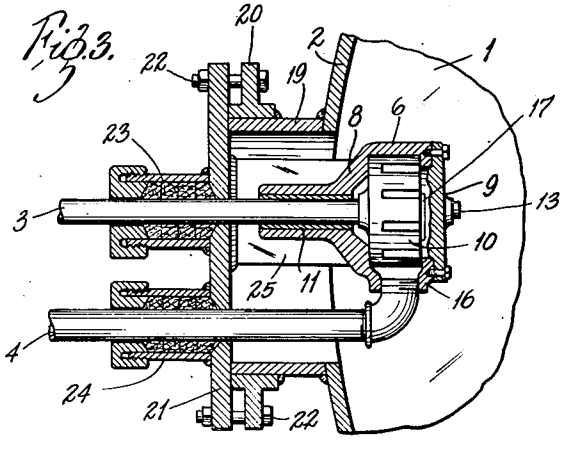


Fig. 4.

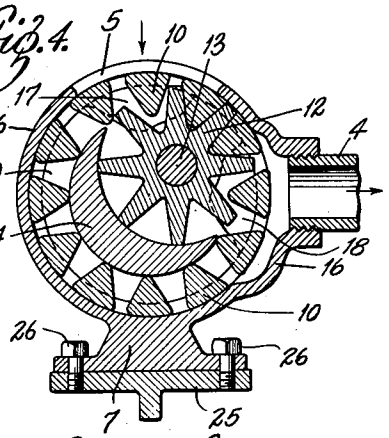


Fig. 5.

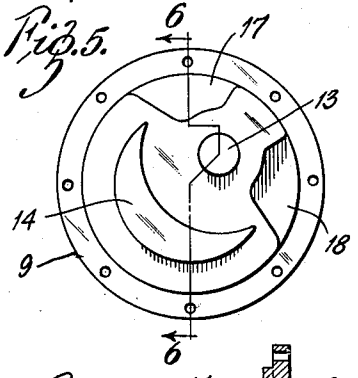


Fig. 6.

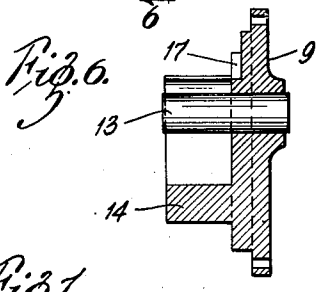
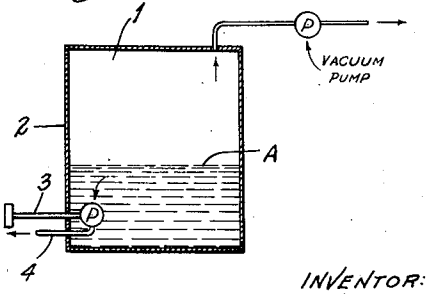


Fig. 7.



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PUMPING EQUIPMENT

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Application March 8, 1939, Serial No. 260,484

2 Claims. (Cl. 103—6)

This invention relates to pumping equipment.

An object of this invention is to provide pumping equipment which will be efficient to pump hot and hazardous liquids from a condition of low subatmospheric pressure to a condition of high pressure. More specifically, an object of the invention is to provide pumping equipment which will take liquids from a chamber under subatmospheric pressure near zero absolute without the use of a stand pipe or head.

Another object of the invention is to provide pumping equipment which will be so arranged and constructed as to have its efficiency unimpaired by temperatures up to 800° F.

A further object of the invention is to provide pumping equipment which, when pumping volatile liquid, will be substantially unaffected by vapor lock.

A further object of the invention is to provide an improvement in pumping equipment which will give increased capacity when pumping viscous fluids.

Another object of the invention is to provide pump equipment suitable for pumping hazardous liquids so arranged as to avoid leakage through shaft bearings on the high pressure side.

Other and specific objects will appear from the following detail description, taken in connection with the accompanying drawing.

Fig. 1 is an elevation of the pumping equipment partly in section;

Fig. 2 is a plan view partly in section, approximately on line 2—2, Fig. 1;

Fig. 3 is a horizontal section on line 3—3, Fig. 1;

Fig. 4 is a vertical section of the pump on line 4—4, Fig. 1;

Fig. 5 is an elevation of a pump cover plate;

Fig. 6 is a section of the cover plate on line 6—6, Fig. 5; and

Fig. 7 is a diagram showing the pump equipment in a preferred installation.

Pumping equipment embodying the invention and improvements described and claimed herein has been developed primarily for pumping a hot residue or oil from a vacuum flash chamber in oil refinery equipment, where a subatmospheric pressure approaching 29 inches of mercury is maintained in the chamber and where the residue has a temperature as high as, and sometimes somewhat exceeding, 800° F. For this purpose it has been found that the pump operates satisfactorily, that it may be manufactured and installed at a less cost than any other pumping equipment for this purpose on the market, and that the necessity of a stand pipe depending from the flash drum is eliminated. While the pumping equipment has been developed particularly for the purpose intended, its utility is not limited thereto but some or all of its advantages may be obtained when used for other purposes and in a different environment.

As specifically shown, a chamber 1 has an opening in its side wall 2 through which the pump is inserted and through which its driving shaft 3 and discharge line 4 extends, the pump being located within the chamber 1, with its intake port 5 below the level A of liquid in the chamber. As shown diagrammatically in Fig. 7, the chamber may be under suction to a high degree. It is not unusual in flash drums to have a subatmospheric pressure of 29 inches in the drum.

The pump has a casing with a circular wall 6, a base 7 and an end wall 8, all integral and usually constructed of a single casting. A head or end plate 9 closes the casing and forms a cylindrical chamber fitted to receive a rotor 10. The rotor 10 is keyed to the shaft 3, which extends through a bearing 11 on the end wall 8 of the casing. This bearing may be packed by a gland or not, depending upon the use to which it is put, no packing being shown on the accompanying drawings since those skilled in the art are familiar with packing glands for this type of equipment. The rotor is cut to form an internal gear, with the grooves between its teeth cut through to its periphery.

A pinion 12 meshing with the gear on the rotor is carried by a stud shaft 13 on the head. The arrangement is such that a crescent shaped space is left between the pinion and the gear and this space is occupied by a crescent shaped lug 14 cast integral with and extending inwardly from the head plate. As described, the rotor 10 is positively driven by the shaft 3 while the pinion 12 is floating. The pump, however, may be driven through the pinion 12. Both methods of driving are understood in the art and are known to be, in part at least, equivalents of each other.

A novel inlet port 5 is formed in the circular wall 6 of the casing and its peculiar arrangement and importance will be described presently. An outlet or discharge port is formed by means of a boss 16 approximately 90° removed from the center of the inlet port 5 also in the circular wall 6 of the casing. The discharge line 4 is connected in the boss 16. The pump head plate 9 has a recess 17, adjacent the inlet port 5, and a recess 18 adjacent the boss 16, providing proper ingress and egress for liquid at these points to the impellers, which comprise the rotor 10 and pinion 12.

The pump per se as shown, apart from the novel intake port and, of course, apart from the arrangement and combination described, is old in the art. It may be understood that as the shaft 3 turns the rotor 10 in a counterclockwise direction, Fig. 4, the liquid to be pumped is picked up at the intake port 5 by the rotor and the pinion and is carried about in the spaces between the teeth on the rotor and between the teeth on the pinion to a point adjacent the boss 16 where the meshing of the teeth of the rotor

10 and the teeth of the pinion 12 forces the liquid out of the discharge port under pressure.

The opening in the wall 2 has a collar 19 to which is welded or otherwise secured a circumferential attaching flange 20. A cover plate 21 for the opening is clamped by bolts 22 to the flange 20. The shaft 3 extends through an opening in the cover plate 21, such opening being packed by a gland 23. The pipe or line 4 also extends through an opening in the cover plate 21 and may be packed by a gland 24. It will be obvious from the description that for all purposes the packing gland 24 is not necessary since the connection between the plate 21 and the pipe 4 may be otherwise sealed as by welding. However, the packing gland is preferred where high temperatures are encountered, because it allows for expansion and contraction of the pipe without setting up stresses in the pump itself.

A bracket 25 welded or otherwise rigidly secured to the cover plate 21, supports the pump, the base 7 thereof being fastened to the bracket by screws 26. It will be seen, therefore, that the entire pump structure and connections extending inside the chamber 1 form a unit with the plate 21 and may be removed readily for repair or replacement through the opening in the chamber formed by the collar 19.

The intake opening 5 is formed by cutting away the circular wall 6 of the casing for a distance of approximately 60° so that the entire effective intake area of the rotor 10 will be wholly exposed. By this improvement it has been found possible to use the pump when submerged in the liquid even though that liquid be somewhat viscous, and even though the liquid be subjected at its level to an extreme subatmospheric pressure. It also materially increases the capacity of the pump when used for viscous fluids. Heretofore the intake port of a pump of this character has been formed by a boss similar in form and relationship to the boss 16, as best shown in Fig. 4. The improvement which eliminates the boss that has heretofore been used and exposes the entire effective area to the rotor on the suction side to liquid in which the pump is immersed results in making the pump adapted for pumping from low atmospheric pressures and improves its capacity and efficiency in pumping viscous liquids.

The immersion of the pump in a hot liquid to be pumped provides for even heating of its several parts corresponding to the temperature of the liquid in which it is immersed, thus eliminating stresses and strains from uneven expansion and makes the pump adapted to handling the liquids which have a temperature at least twice as great as that for which the pump might otherwise be adapted. When using the pump for high temperature work, the housing and working parts of the pump should all be made from the same material (e. g. cast iron) so that all the parts will have the same coefficiency of thermal expansion.

The inclusion of the pump in a sealed chamber from which the liquids are pumped, obviates leakage from the shaft bearings of the pump 11 which invariably occurs to some extent regardless of the care that is taken in packing the bearing. The leakage that occurs through the bearing merely passes to the body of liquid being pumped, and since the difference between the pressure inside the chamber 1 and atmospheric pressure is comparatively small, the packing gland 23 is adequate to completely protect against leakage at this point. This feature is important when handling hazardous liquids because, while the amount of liquid which leaks and is therefore wasted might not amount to much in the loss itself, the liquid may be such as to cause an extreme hazard, for example when liquid hydrocarbons under high temperatures are being handled. It may be understood that the packing gland 23 is under a pressure equivalent to that of the difference between atmospheric pressure and the pressure in the chamber 1, while the bearing 11 is under the discharge pressure of the pump, which may be as high as 250 pounds per square inch, or higher.

Another important advantage of this invention is that no vapor lock will occur when volatile liquids are handled. The liquid flows quickly through the slots in the rotor and no opportunity is given for vaporization due to suction.

The pumping equipment can be used as a combination liquid level regulator and pressure pump, and will remove the liquid uniformly to the desired level irrespective of the pressure in the vessel. For such a use the pump is driven at a speed slightly in excess of that which will ordinarily be required to remove the liquid and no harm results if the intake port is uncovered, since the pump will not be damaged if it runs dry and the chamber will not be unsealed, and neither will a substantial amount of vapor be removed because the pump is a positive displacement one.

It will be obvious from the foregoing description and from the detailed statement of its advantages that this pumping equipment is adapted for many efficient uses, especially where the liquids to be handled are viscous, hazardous, volatile or under high temperatures, or where the pumping is to be done from a vessel under subatmospheric pressure. Various changes may be made in the details of construction, within the scope of the appended claims without departing from the spirit of this invention, and parts of the improvement may be used to advantage without the whole.

I claim:

1. In and in combination with a chamber containing a liquid and having suction means for producing a low sub-atmospheric pressure in said chamber, the improvement comprising a rotary pump in said chamber below a level of the liquid in the chamber to be pumped, said pump comprising a circular casing, a rotor fitting within the casing and having an internal gear, a pinion meshing with said gear, and an intake port consisting of an unrestricted opening in said casing of such extent as to expose approximately 60° of the periphery of the rotor to a body of liquid in which said port may be immersed.

2. In and in combination with a chamber containing a liquid and having suction means for producing a low sub-atmospheric pressure in said chamber, the improvement comprising a rotary pump in said chamber below a level of the liquid in the chamber to be pumped, said pump comprising a circular casing, a rotor fitting within the casing and having an internal gear, a pinion meshing with said gear, and an intake port consisting of an unrestricted opening in said casing of such extent as to expose approximately the entire part of the circumferential area of the rotor effective for intake to a body of liquid in which said port may be immersed.

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