June 5, 1934. F. R. WEST 1,961,918

COMPRESSOR STRUCTURE

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Fig.1.

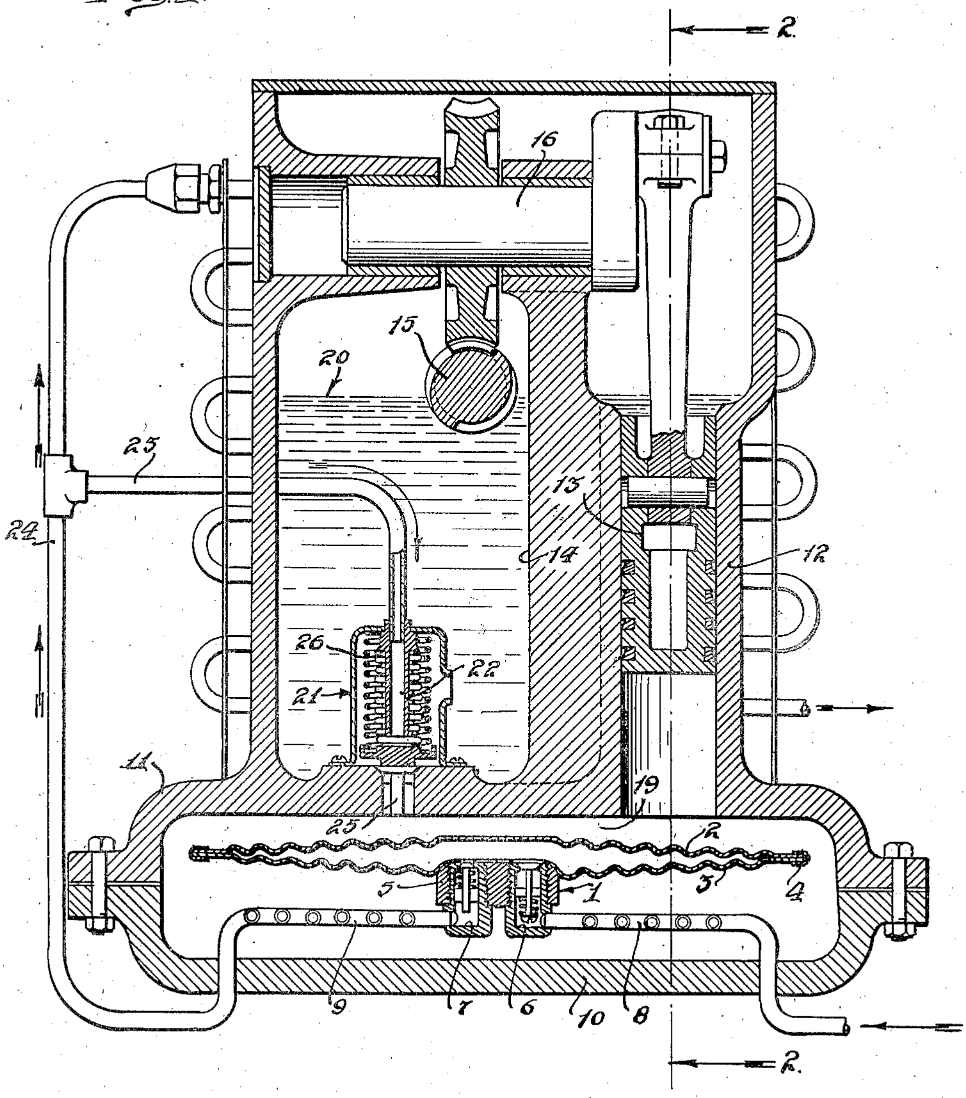

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Fig. 2.

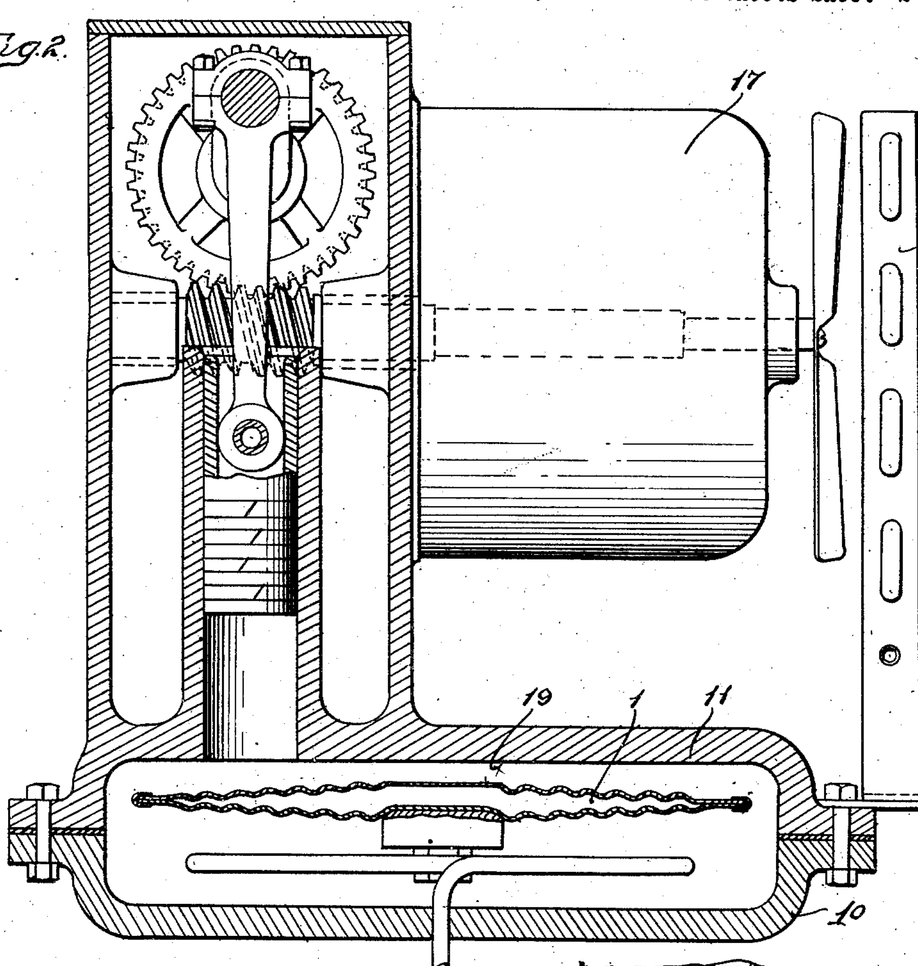
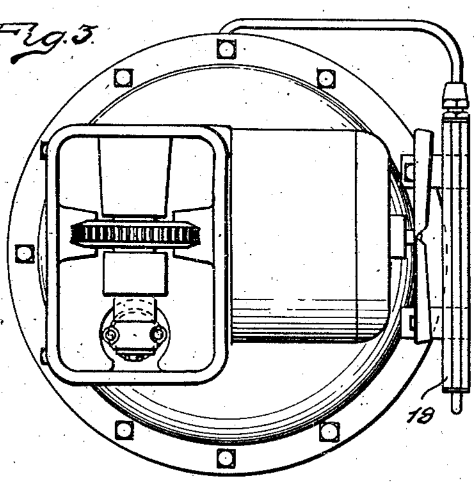


Fig. 3.



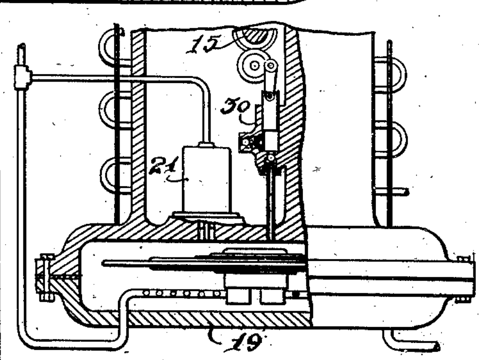


Fig. 4.

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COMPRESSOR STRUCTURE

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Application June 24, 1930, Serial No. 463,503

11 Claims. (Cl. 230—49)

This invention relates to compressor structure and more particularly to a membrane pump of the type actuated externally by varying fluid pressures.

The present invention is particularly adaptable to refrigerating systems in that it permits of the pumping of refrigerant under relatively high pressure, while maintaining complete sealing of the refrigerant at all times. Membrane pumps have heretofore been designed for use as compressors in connection with refrigerating systems, and such compressors have embodied both the single diaphragm principle such as shown in the patent to Nixon #1,650,377 and a double diaphragm principle as exemplified by Patents Nos. 225,930 of March 30, 1880 and 1,489,143 of April 1, 1924.

The present invention is designed to overcome various inefficiencies of structure and operation, such as have been met with in the past, by the provision of a complementally formed free floating membrane pump. Such floating membrane pump embodies several novel features of construction which renders its use very efficacious as to volumetric efficiency as well as permanency.

Another feature of the present invention resides in the novel manner of maintaining a constant body of actuating fluid together with the manner of supplying the said actuating fluid to maintain said body and the manner of relieving the same in proportion to the pressure in the high side of the system.

Other features of the invention reside in the details of construction of the membrane pump, the piston actuator and compressor structure in general, as will be more clearly brought out in the specification and claims.

Fig. 1 is a vertical sectional view of a complete compressor unit embodying the present invention, and illustrating in particular the arrangement of the floating membrane pump, the fluid actuating means, and the relief valve structure.

Fig. 2 is a sectional view taken on line 2—2 of Fig. 1.

Fig. 3 is a plan view of the structure shown in Figs. 1 and 2 and illustrating particularly the compactness of the entire refrigerating unit.

Fig. 4 is a fragmentary partially sectional view of a modified means for maintaining a constant body of liquid in the membrane pump chamber.

The efficiency of refrigerating units is usually measured in terms of ice melting capacity. Such efficiency is determined to a great extent by the volumetric efficiency of the compressor, and to ability to maintain this high volumetric efficiency when operating under relatively high pressures.

I have made it possible to obtain maximum efficiency by providing a novel substantially freely floating membrane pump which is generally designated as at 1, in Figs. 1 and 2. This member as a whole consists of two complementally formed diaphragms 2 and 3 secured at their edges as at 4, and suitably corrugated or otherwise formed so that the complemental parts closely fit to make it possible to obtain substantially 100% volumetric efficiency.

One diaphragm, or what is shown in Fig. 1 as a lower diaphragm, may have secured thereto a valve unit 5 containing a suitable intake valve 6, and an exhaust valve 7. This valve unit 5 together with diaphragms 2 and 3 presents a substantially freely floating membrane pump because of the fact that the tubing 8 and 9 leading to and from the valve unit is so arranged as to flexibly carry the entire membrane pump. It will be obvious that such tubing may be formed of any kind and length of convolutions as long as the entire unit is substantially a floating unit.

The most important element to be considered in a pump of this kind has heretofore been found to be the durability of the diaphragm or diaphragms. I have found that if a membrane pump of the type illustrated in Fig. 1 is rigidly held at one point, say for instance, if the valve unit 5 were formed integrally as the casing 10, then varying pressures produced around such membrane pump by a reciprocating piston would cause the diaphragms to be moved bodily downwardly so as to assume substantially a cone shape in one position. The tendency to deteriorate and fatigue under such operations is obvious.

However with the floating arrangement as shown in Figs. 1 and 2, it will be seen that the flexible parts of the membrane unit may bodily move within the casing, if necessary, so that movement of the diaphragms 2 and 3, back and forth, will be substantially about a plane through the periphery 4. Thus the vibration of the relative diaphragms 2 and 3 will be substantially natural so that the life of such floating membrane pump will be commercially permanent.

I prefer to utilize my floating membrane pump in combination with a complete compact refrigerating unit. The casing for this unit may be formed in two parts, one part being the lower half 10 of the diaphragm pump chamber, and the other part 11 completing such chamber, and in addition, preferably forming what might be termed the entire crank case of the compressor in that it forms the cylinder 12 for receiving the reciprocating piston 13, the oil reservoir chamber 14, and also carries and forms bearings for the motor shaft 15 and crank shaft 16. A suitable motor 17 may also be mounted on this unit, and a condenser 18 may be mounted as best shown in Figs. 2 and 3.

The piston 13 preferably has a close fit in the cylinder 12, and while there might be some leakage past this piston if oil rings were not used, I not only use oil rings but preferably utilize oil rings having a slight taper of from one and a half degrees to two degrees, as best shown in Fig. 1. These rings are relatively light and flexible and being tapered in the same direction it will be obvious that the oil on the walls of the cylinder will be scraped downwardly so that upon each downward stroke of the piston, in the arrangement as shown in Fig. 1, a drop or a small amount of oil will be added to the actuating fluid in the chamber 19 which surrounds the pump 1. The chamber 14 is filled with oil up to or above the point 20 so that oil is supplied to all the operating parts, and in addition, this oil covers the upper end of the piston 13 so that there will always be a film of oil on the cylinder wall, and it may be scraped downwardly upon each downward stroke of the piston.

It will thus be obvious that I have taken care of the maintenance of a constant body of fluid, preferably oil, within the chamber 19 and that upon each downward stroke of the piston this oil will completely surround the membrane pump upon all sides thereof and completely collapse the same without placing any undue strain or bending upon any part. The upward stroke of the piston will obviously tend to expand the diaphragms 2 and 3 so as to produce a regular pumping action.

In order to relieve the oil within the chamber 19 in case too much oil is added by the piston, and in order to maintain the pressure of the oil within the chamber 19 comparable to the pressure in the high pressure side of the system, I have provided a relief valve which may be generally designated 21. This relief valve is provided with a metallic bellows 22 which may be connected by means of a conduit 23 with the high pressure side 24 of the system. Thus whatever pressure is maintained in the high pressure side 24 will also be maintained in the sylphon 22 and against the upper end of the valve 25. In addition to this pressure I have provided a spring 26 which supplies the desired pressure over and above that supplied by the pressure on the high side. Thus, if the system is working under seventy-five pounds head pressure and the coil spring 16 is equivalent to ten pounds pressure, then the oil in the chamber 19 surrounding the membrane pump will have to be under a pressure of one eighty-five pounds before pressure in the chamber 19 can be relieved. When so relieved the oil will merely pass into the chamber 14 and again finally pass through this system drop by drop by way of the piston. It will thus be obvious that I have not only provided a relief valve for the fluid pressure chamber, but that this relief valve is automatically regulatable so that the power supplied by the piston is automatically controlled according to the head pressure under which the system is operated.

In Fig. 4, I have described a slightly modified structure for maintaining the supply of fluid within the chamber 19. This modified device is in the form of a small pump 30 which is designed to take the place, or at least serve the same function, as the tapered rings in the piston 13. The bore of this small pump 30 is preferably infinitely smaller than the main piston 13. The pump 30 may be provided with any form of piston and is connected to the shaft 14 or any other form of motor power in any manner desired so that the pump may be run at regular speed or any multiple of the regular speed of the shaft 15.

In other words, in Fig. 4, I have provided what may be termed a supplemental pumping means of much smaller displacement than the main pumping means exemplified by the piston 13. This pump 30 is provided with an intake and exhaust valve as shown in Fig. 4, and such pump may be operated so that it injects a certain amount of oil into the chamber 19 at any pressure desired and at any time desired during the cycle. That is, the operation of pump 30 may be timed to inject fluid into the chamber 19 at a certain point during the expansion or contraction of the membrane pump, or may be timed to inject fluid into the chamber 19 irrespective of the operation of the membrane pump. Thus the pump 30 is positive in operation and also permanent.

In using the word floating in the specification and claims, to describe the membrane pump, it will be understood that I am referring to the flexible supporting of the pump within the chamber 19 and not to any buoyant action.

I claim:

1. A refrigerant compressor of the membrane pump type, comprising means for pulsating the membrane, and means flexibly supporting said membrane pump to permit bodily movement of the same during said pulsating action.

2. Compressor structure of the membrane pump type, comprising a flexibly mounted pump unit including opposed diaphragms and valve structure, and pulsating means for effecting actuation of the diaphragm.

3. Compressor structure of the membrane pump type, comprising a fluid chamber surrounding said membrane, pulsating means for variably applying pressure to said fluid, and inlet and outlet conduits connected to said membrane and being of such length and so arranged as to flexibly support said membrane pump.

4. A membrane pump of the type having opposed diaphragms, one of which is supported at the center thereof, comprising valve structure which forms a part of said support, and means for resiliently supporting said support whereby to permit bodily movement of said membrane pump.

5. A compressor unit, comprising a fluid chamber, a membrane pump within said chamber, a reciprocating piston adapted to vary the pressure on the fluid in said chamber and pulsate said membrane, means flexibly supporting said membrane pump to permit bodily movement of same and supplemental means for positively adding a small quantity of fluid to said chamber for maintaining a constant volume of fluid.

6. In a refrigerating system, a compressor unit comprising a fluid chamber, a membrane pump within said chamber, a fluid reservoir pulsating means within and beneath the level of fluid in said reservoir for operatively applying pressure to said fluid, and means in said reservoir for automatically controlling the pressure applied to said membrane pump in accordance with the operating pressure of the system beyond the membrane pump.

7. In a refrigerating system, a fluid pressure chamber, a fluid reservoir a membrane pump within and beneath the level of fluid in said reservoir within said chamber, means for intermittently applying pressure to said fluid to actuate said pump, a relief valve within said reservoir and connected to the high pressure side of said system beyond the membrane pump, and means tending to resist the opening said relief valve with a predetermined pressure in addition to the resistance supplied by said high side pressure.

8. A housing for a compressing unit of the type described formed mainly of two castings, one of said castings forming a cylinder jacket, and an oil reservoir, and the other casting joining with said first casting to form a fluid and membrane pump chamber.

9. A housing for a compressing unit of the type described formed mainly of two castings, one of said castings forming a cylinder jacket and an oil reservoir, crank bearings and a support for the motor, and the other casting cooperating with said first casting for forming a fluid chamber for receiving a membrane pump.

10. In a refrigerating system, a compressor unit comprising a fluid chamber, a membrane pump within said chamber, a fluid reservoir pulsating means within said reservoir for operatively applying the pressure to said fluid, means positioned in said reservoir for automatically controlling the pressure applied to said membrane pump, and separate means in said reservoir for positively adding a small quantity of fluid to said chamber.

11. In a refrigerating system, a compressor unit comprising a fluid chamber, a flexibly supported bodily movable membrane pump positioned within said chamber, pulsating means for operatively applying pressure to said fluid and actuating said pump, and independently operative means for supplying fluid to and exhausting fluid from said chamber.

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