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MULTIPLE HYDRAULIC COMPRESSOR IN A REFRIGERATION SYSTEM

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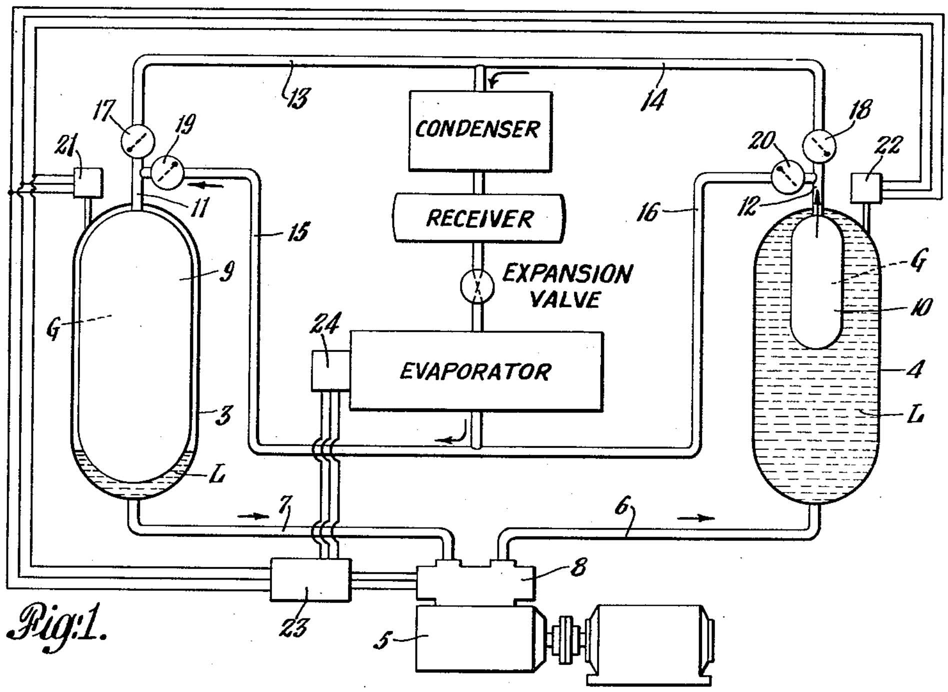

Fig:1.

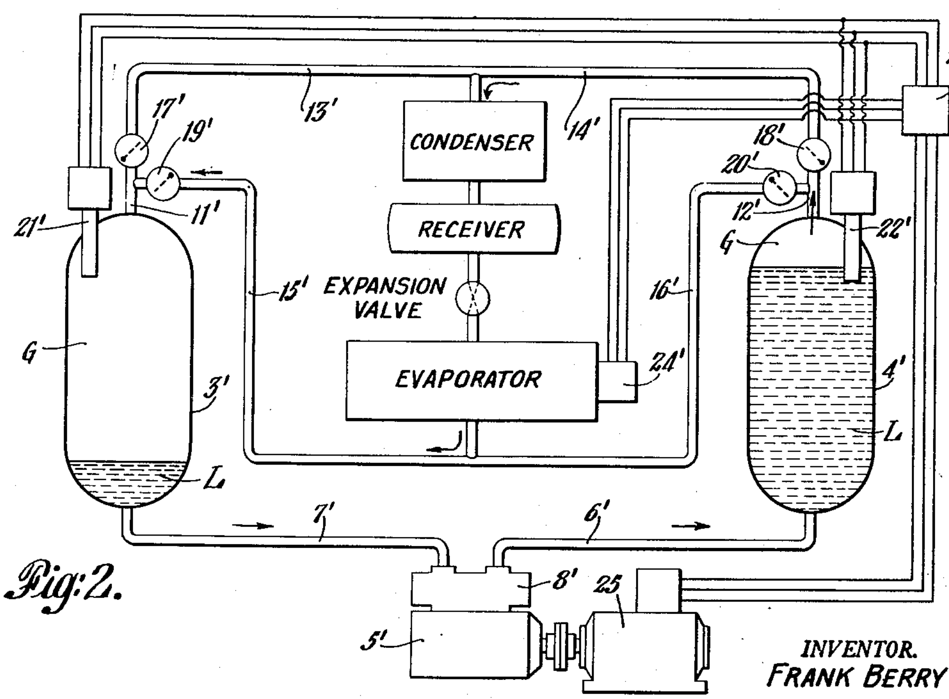

Fig:2.

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MULTIPLE HYDRAULIC COMPRESSOR IN A REFRIGERATION SYSTEM

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1 Claim. (Cl. 62—115)

The invention relates to refrigeration systems.

Summary

Conventional types of refrigeration systems as employed commonly today require the use of gas compressors which act directly on the gas to compress it. According to my invention the gas is compressed hydraulically through the use of an hydraulic pump, doing away entirely with a "compressor" in the usual sense of the word. This I have accomplished by providing in a refrigeration system a gas compressing apparatus comprising two containers each arranged for confining both a liquid and a gas under pressure, and an hydraulic pump connected by conduits to each of these containers. Liquid is pumped into one of the containers to reduce the volume of the space available for gas within it. The pump receives liquid from the other container to increase the volume of the space available for gas in this other container. Means are provided for stopping the flow of liquid, and also for reversing the flow so that each container acts alternately as a compressor and as an expander, compressing while the other container is expanding, and vice versa.

In my preferred construction each container consists of a rigid outer vessel and a flexible inner vessel, the pump conduit being connected to discharge liquid into the rigid outer vessel and the flexible inner vessel being connected to the discharge conduit for compressed gas, this latter conduit being the one which leads to the condenser intake.

By eliminating the need for the usual gas compressor, many advantages are realized. For one thing, a tiny hydraulic pump when employed in my system will displace a sizeable compressor, with resultant decrease in both weight and cost. The reduction in weight is a particularly important factor in refrigeration equipment for railroad cars, trucks, automobiles and airplanes. Also my system makes it possible to utilize the high volumetric efficiency of an hydraulic pump in place of the relatively low volumetric efficiency of the ordinary compressor. Moreover, the efficiency of the hydraulic pump remains high over a wide range of operating speeds which is particularly important in refrigeration for automotive vehicles as it permits the use of a direct drive from the prime mover or from a simple jack shaft. Another advantage of my system is that the freon gas or other refrigerant does not come in contact with mechanical elements of the pump as they are required to do in a compressor. This permits the use of lower cost construction as it is not necessary to employ the high priced materials now utilized in compressors for air conditioning systems.

Description

In the drawings, I have illustrated two embodiments which represent the best mode known to me for carrying out my invention.

Fig. 1 is a diagrammatic view of a refrigeration system utilizing my invention.

Fig. 2 is a similar view showing a modified construction.

Referring first to Fig. 1, my apparatus has been shown in its relation to the condenser, receiver, expansion valve and evaporator of a typical freon gas refrigeration system. These elements may be of any well known type and may be arranged in the usual manner for any desired purpose or application. My invention comprises apparatus for compressing a gas in such a refrigeration system, including two containers 3, 4 each arranged for confining both a liquid L and a gas G under pressure, an hydraulic pump 5 driven from any suitable power source, conduits 6, 7 connecting the pump to the respective containers, means such as the control valve 8 for stopping the flow of fluid through the conduits, and means such as the control valve 8 for reversing said flow so that each container acts alternately as a compressor and as an expander, compressing while the other container is expanding, and vice versa.

In the particular construction here shown, container 3 consits of a rigid outer vessel and a flexible inner vessel 9 of neoprene or other suitable material. Vessel 9 is shown in its expanded condition. A similar vessel 10 which forms a part of container 4 is shown in contracted condition. Conduits 6 and 7 connect the pump to the rigid outer vessels 4 and 3, respectively, and the flexible inner vessels 9 and 10 are connected to the discharge conduits 11 and 12 for compressed gas and for return of the low pressure gas from the evaporator. Conduits 11 and 12 are connected by conduits 13 and 14 to the condenser intake, and by conduits 15 and 16 to the evaporator discharge. Check valves 17, 18, 19 and 20 permit unidirectional flow of gas into the condenser and from the evaporator discharge, alternately as determined by pressure conditions.

Pressure responsive electric switches 21 and 22 are mounted in the containers 3 and 4 and are connected in parallel to a relay 23 arranged to operate a solenoid to control the position of valve 8. A thermostatic control 24 is connected to relay 23 to activate the relay when additional cooling is required. These pressure responsive switches, thermostatic control and relay may be of the kinds commonly employed for analogous purposes.

Operation

The condition illustrated in Fig. 1 is that which obtains when flow of the oil, or other hydraulic liquid, is in the direction indicated by the arrows superimposed on conduits 6 and 7. Under this condition container 4 is acting as a compressor, and container 3 is acting as an expander. As the oil enters container 4, the flexible inner vessel 10 contracts, and as the oil leaves container 3, the flexible inner vessel 9 expands. Thus the volume of the space available for gas within container 4 is reduced, and the volume of the space available for gas within container 3 is increased. Compressed gas flows from container 4 past check valve 18 as needed to meet refrigeration requirements, while low pressure gas from the evaporator discharge is drawn into container 3 as the suction oil leaves that container.

As soon as all the gas in high pressure container 4 has been forced out, the pressure will increase to a point which actuates the pressure responsive switch 22. This in turn actuates relay 23 and the solenoid to place valve 8 in its neutral position, blocking off the flow of oil in conduits 6 and 7. When additional cooling is required, relay 23 is again actuated, this time by the thermostatic control 24, placing valve 8 in position to produce flow of oil in the direction opposite to that previously described, pumping oil into container 3 and out of container 10. Thus container 3 now becomes the high pressure unit, or compressor, and container 4 the low pressure unit, or expander. Upon completion of a cycle, the pressure responsive switch 21 will actuate relay 23 to place valve 8 again in its neutral position. Any pressure remaining in either container will be added to the suction side of the pump, reducing such power losses as otherwise would be expected to occur.

The modified construction shown in Fig. 2 is the same as the construction shown in Fig. 1 except as follows: The containers 3′ and 4′ are used without flexible inner vessels so that the hydraulic liquid comes into direct contact with the refrigerant gas. The hydraulic fluid should be one in which the gas will not dissolve. For use with freon gas, I suggest glycerin as the hydraulic liquid. The controls 21′ and 22′ may be liquid level switches. Relay 23′, instead of actuating the valve 8′ through a solenoid, controls the starting, stopping and reverse starting of a reversible motor 25. Valve 8′ is pressure-actuated by operation of the pump 5′ in either direction. When pumping stops, this valve is spring-actuated to return it to a neutral position, cutting off flow in both directions. This apparatus operates in the same manner as that of Fig. 1 insofar as concerns the cycle of compression and expansion of the refrigerant gas in containers 3′ and 4′.

If desired, the reversible motor 25 can be replaced by another power source and the solenoid valve 8 of Fig. 1 substituted for the arrangement here shown. Also it may be possible to employ just one of the containers 3, 4, 3′, 4′ in a system where it is used alternately as a compressor and an expander.

The terms and expressions which I have employed are used in a descriptive and not a limiting sense, and I have no intention of excluding such equivalents of the invention described, or of portions thereof, as fall within the purview of the claim.

I claim:

In a refrigeration system, two reservoirs for expanded refrigerant, said reservoirs being directly connected to a condenser and evaporating system, a hydraulic pump connected to said reservoirs for pumping liquid out of one of said reservoirs through the pump and directly into the other of said reservoirs and alternately to return liquid from said other reservoir to the first reservoir, each reservoir arranged to receive expanded refrigerant from the condenser and evaporating system when said hydraulic pump is removing liquid from said reservoir and transferring said liquid into the other reservoir, and each reservoir further arranged to deliver compressed refrigerant to the condenser and evaporating system when said hydraulic pump is forcing liquid from said other reservoir back into the first reservoir.

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