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OIL RETURN ARRANGEMENT

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FIG. 2

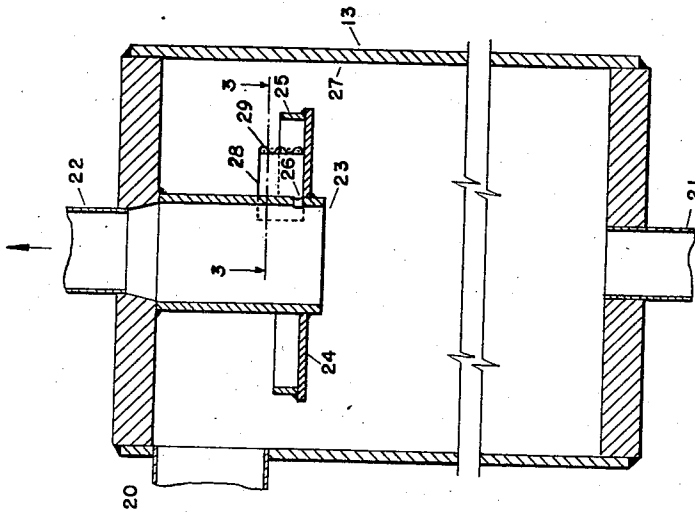


FIG. 3

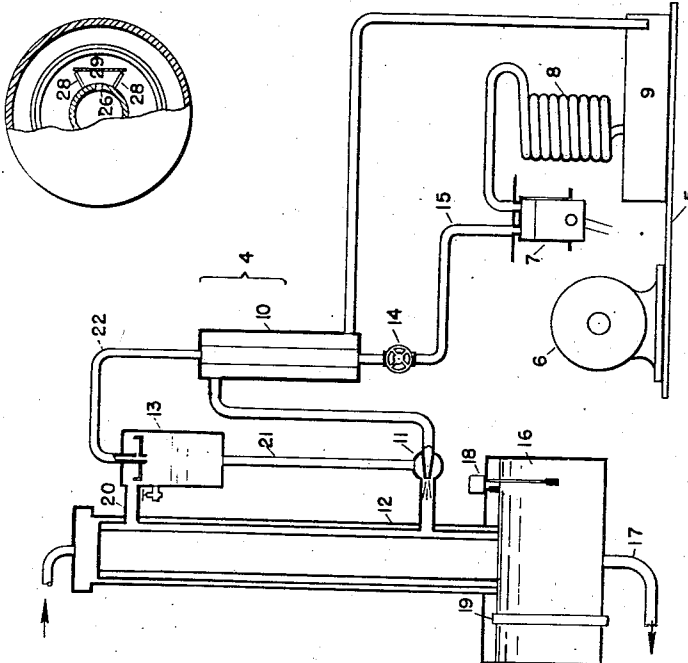


FIG. 1

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OIL RETURN ARRANGEMENT

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10 Claims. (Cl. 62—115)

This invention relates to refrigeration systems and more particularly to an oil return arrangement employed in connection with flooded systems wherein the oil mixes with the refrigerant.

The general object of the invention is to provide for the return of oil to a compressor from the low side of a flooded refrigeration system wherein the efficiency of the system will be substantially impaired if the contamination of refrigerant by oil is allowed to proceed beyond a predetermined maximum. As is well known in connection with the operation of flooded systems, if the oil passing into the system is not returned to the compressor at least as fast or faster than it is lost past the piston rings (or from the compressor), the concentration of oil in the low side will build up to the point where the cooling capacity is reduced to a preponderant degree. Various means have been improvised to return oil from an accumulator, operatively associated with the cooler or evaporator, but such prior practices have not always been satisfactory, especially under varying load conditions, and in some cases, the expedients employed required the use of needle valves, solenoid valves and the like, all of which are eliminated by applicants in their solution of the problem.

A feature of the invention resides in the provision of a simple accumulator structure operatively associated with a cooler for effectively feeding oil back to the compressor, the amount of oil fed to the suction line of the compressor being proportional to the suction velocity or speed of the machine. Thus, under heavy loads, when the compressor operates at higher velocity, more oil will be led back than under low load conditions when the compressor speeds are lower. In effect, the amount of oil returned always meets the requirements of operation despite varying load conditions.

A further feature of the invention resides in the provision of an oil return arrangement wherein the return of oil to a compressor automatically terminates when the compressor becomes inoperative, thus eliminating the dangers of rupture as might occur from a continuation of bleeding back of liquid to a compressor, especially of the reciprocating type.

Further features making for efficient operation, simplicity and economy in construction, and substantial freedom from service troubles, will be apparent from the following description of one form of the invention to be read in connection with the accompanying drawing, drawn to different scales, in which:

Fig. 1 illustrates a flooded system incorporating an accumulator in which applicant's oil return arrangement is employed, and

Fig. 2 is a sectional view diagrammatically illustrating that portion of the accumulator in which the oil return structure is provided, and

Fig. 3 is a fragmentary plan view illustrating certain features of the accumulator structure.

Referring to the drawing, similar designations referring to similar parts, numeral 4 generally designates a refrigeration system of the flooded type utilized, for example, for the cooling of water. A compressor-condenser assembly is diagrammatically illustrated and includes compressor base 5 on which is mounted motor 6 for driving compressor 7, which is shown to be of the reciprocating, although it may be of any other, type. Although one cylinder is diagrammatically shown, it will be understood that the machine may be a multi-cylinder structure, the construction of which is well-known in the art, and the details of which are eliminated, since they form no part of the invention. Condenser 8 and receiver 9 are also positioned on base 5, and such arrangement is also well understood by those skilled in the art, forming no part of the invention. The liquid refrigerant plus such oil as is lost past the piston rings or is otherwise in the system, passes under high pressure from receiver 9 to heat exchanger 10, then through injector 11 into cooler 12. From the cooler, the evaporated refrigerant plus liquid refrigerant plus such oil as is carried over enters accumulator 13 and the evaporated refrigerant (including a portion of such oil) is then returned to the compressor through heat exchanger 10, back pressure regulator valve 14, and suction line 15, to complete the cycle. The cooler or evaporator 12 serves a cold storage tank 16 from which water may be fed through cold water discharge line 17 for any desired purpose, the cold water tank being equipped with a level control 18, and overflow pipe 19 to provide a practical cold water supply system.

Considering the accumulator arrangement 13, a mixture of liquid and gaseous refrigerant in practice enters accumulator 13 from the evaporator through line 20. This mixture also contains a portion of oil which has been carried over into the system. The purpose of the accumulator is to cause a separation of the liquid from the gaseous refrigerant so that the liquid may be returned to promote further refrigerating effect and the gas returned to the compressor.

With applicant's accumulator structure, the liquid will settle to the bottom of accumulator 13 and will return through liquid leg 21 to injector 11 for recirculation to cooler 12. The gaseous refrigerant is sucked from the accumulator through return line 22 which is actually part of suction line 15.

To prevent excessive liquid refrigerant from being sucked into line 22 at the entrance point 23, a baffle 24 is positioned about line 22 at the entrance end thereof. A flange or lip 25 is provided at the periphery of baffle 24 to form a cup or shallow receptacle. Access from the cup to line 22 is through an orifice 26.

In practice, a rush of liquid and gaseous refrigerant, containing a small amount of oil, enters the accumulator through line 20. Such liquid as is routed between the cup and the inner wall 27 of the accumulator drops to the bottom thereof for return to the injector through leg 21. Gaseous refrigerant above the liquid level in the accumulator is sucked into line 22 for return to the machine.

It may here be noted that if gaseous refrigerant were alone taken into the suction line 22, with the oil remaining behind in the low side of the system, the result would be an increasing concentration of oil, with consequent foaming to raise the liquid level in the accumulator so that it reaches point 23. This would bring about objectionable return of liquid refrigerant to the compressor in a form which would not result in proper feeding of the oil thereto, since to be useful, it must be fed in small quantities and substantially free of liquid refrigerant. Also, such return of liquid would result in possible damage to the compressor and hence, soon necessitate stopping operations.

To avoid the possibility of such undesirable operation, the accumulator is so designed that only gaseous refrigerant plus a desired metered quantity of oil is allowed to pass to the compressor. The baffle arrangement within accumulator 13 catches oil and refrigerant to form a small source of supply to the compressor. In effect, only that small amount of liquid refrigerant, containing oil, which passes through orifice 26, is sucked into line 22. When this reaches heat exchanger 10 and comes in indirect contact with the hot liquid flowing therethrough from the high side of the machine, the refrigerant will in effect be "boiled out" and will reach the compressor, after leaving the heat exchanger, in gaseous superheated condition. The oil, in liquid form, carried over into the compressor, with the gaseous refrigerant, is free of liquid refrigerant, and in a form to be accepted by the compressor for return to the crankcase.

Thus, applicants have provided a safe method of feeding a small amount of liquid containing oil to a compressor, but have assured the gasification of the liquid refrigerant in its course to the compressor so that the oil free of liquid reaches the compressor with the refrigerant fed to the compressor in gaseous form. The cup construction provides an adequate reservoir for continuous flow of liquid containing oil through a fixed orifice. The projecting lips 28 on each side of orifice 26 form a pocket within which liquid is collected for continuous flow through the orifice while the system is in operation. The lips prevent sweeping away of liquid from the orifice. Interruption in the continuity of flow through the orifice is thus avoided. Screen 29 serves to keep the orifice free from possible clogging due to particles car-

ried into the system. The amount of liquid drawn into the suction line through the orifice is necessarily proportional to the suction velocity and hence, more liquid will be fed back under heavier load conditions than when the compressor speed is lower under lower load conditions. Thus, the rate of return increases and decreases responsive to increases and decreases of load conditions and assures a check on contamination in the system regardless of variations in load.

When the compressor shuts down, it will be impossible for the liquid to be returned to the compressor. The bleeding back automatically ceases since the only place the small amount of accumulated liquid can go is downwardly from the cup through the orifice 26 into the bottom of the accumulator. This eliminates any possibility of feeding liquid back to the compressor which might cause blowing of a cylinder head or other damage.

It may be noted that no valves are employed to throttle the flow of liquid to the suction line, as is customary in some prior arrangements; nor do applicants require a solenoid valve or similar arrangement, often employed in such systems for stopping flow of liquid when the compressor stops.

It is apparent that applicants' system of oil return is applicable to all types of flooded systems and hence, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

We claim:

1. In a flooded refrigeration system, a compressor, a condenser, and an evaporator, operatively associated together, an accumulator, means for admitting refrigerant having oil entrained therein to the accumulator from the evaporator, means for draining refrigerant from the accumulator to the evaporator, means leading from a point above the liquid level in the accumulator for returning responsive to the operation of the compressor a quantity of refrigerant and oil entrained therewith from the accumulator to the compressor substantially continuously while said compressor is in operation.

2. In a system of the character described, a compressor, a condenser and an evaporator, operatively associated in a refrigeration cycle, an accumulator, means for admitting refrigerant having oil to entrained therein to the accumulator from the evaporator, a heat exchanger, means for withdrawing liquid refrigerant from the accumulator for return to the evaporator, means subjected to variations in suction pressure for withdrawing from the accumulator a varying quantity of refrigerant and oil and admitting the same to the heat exchanger, said refrigerant being gasified in the heat exchanger, and means for returning the gaseous refrigerant and oil entrained therewith to the compressor from the heat exchanger.

3. In a compression refrigeration system containing a refrigerant and a supply of oil, an accumulator, means for feeding a portion of said refrigerant with a portion of said oil entrained therein to the accumulator, means for withdrawing refrigerant with entrained oil from the accumulator consisting of a line having an inlet below the liquid level in the accumulator, a second line leading from within the accumulator, said second line having an inlet above the liquid level in the accumulator, means for admitting a measured quantity of refrigerant with entrained oil from the accumulator into said second line, the

quantity being varied responsive to variations in suction pressure exerted upon the second line, means for gasifying the refrigerant fed through the second line and means for removing the resultant gas and oil entrained therewith from said gasifying means for further use in the system.

4. In a system of the character described, a compressor, a condenser and an evaporator operatively associated to carry on a refrigeration cycle, an accumulator, means for admitting refrigerant having oil entrained therein to the accumulator from the evaporator, an injector for feeding liquid refrigerant supplied from the condenser to the evaporator, means for feeding liquid refrigerant from the accumulator to said injector, a collecting device within the accumulator, a measuring device through which liquid from said collecting device may be withdrawn, a suction line leading from a point above the liquid level in the accumulator and connecting said measuring device to the suction intake of the compressor, liquid refrigerant and oil entrained therewith being fed from said measuring device into said line responsive to suction pressure exerted on the line by said compressor.

5. In a system of the character described, a compressor, a condenser, an evaporator, a heat interchanger, means for feeding refrigerant from the condenser to the interchanger, a line connecting the interchanger and evaporator for feeding refrigerant to the latter, an accumulator, means for feeding refrigerant with entrained oil to the accumulator from the evaporator, means for returning a portion of said refrigerant with entrained oil from the accumulator to the line connecting the interchanger and evaporator, means for feeding another portion of refrigerant with entrained oil from a point above the liquid level in the accumulator to the interchanger responsive to suction pressure and means for admitting said last portion of refrigerant, converted into gaseous form, and oil entrained therewith, from the interchanger into the compressor.

6. In a system of the character described, an evaporator, a compressor, an accumulator, means for supplying refrigerant having oil entrained therein from the evaporator to the accumulator through an inlet to the accumulator, a receptacle in the form of a cup positioned within and spaced from the walls of the accumulator, a suction line connected to the receptacle and leading to the compressor said receptacle being so related to the inlet of the accumulator and to the walls of the accumulator that some of the refrigerant and entrained oil discharged into the accumulator forms a shallow pool of liquid in the receptacle and some of the refrigerant and entrained oil forms a

body of liquid below the receptacle, means responsive to suction pressure in said line for feeding a measured quantity of the liquid from said receptacle into said line.

7. In a system of the character described, an accumulator, means for feeding refrigerant with entrained oil into the accumulator, a suction line leading from within the accumulator to a compressor, a cup-shaped receptacle within the accumulator, said line passing through the receptacle, an orifice connecting the receptacle to said line, gaseous refrigerant being fed into said line from the accumulator, liquid refrigerant with entrained oil being fed into said line through the orifice.

8. In an accumulator arrangement according to claim 7, said cup forming a reservoir surrounding said line, and a plurality of lips within said cup forming a pocket about said orifice to prevent liquid adjacent said orifice from being swept away.

9. In combination for use in a flooded system of the character described, a casing, a first line for supplying refrigerant from a point of evaporation to said casing, a second line leading from the casing, a third line leading from the casing, a receptacle positioned about the third line proximate the point of entrance of the refrigerant into the casing from the first line, means for withdrawing liquid from the casing through the second line, means for withdrawing refrigerant in gaseous condition from the casing through the third line and means for feeding a measured quantity of liquid refrigerant containing oil from the receptacle into the third line.

10. In a system of the character described including a compressor, a condenser, an evaporator, an accumulator, a heat interchanger, means for feeding liquid refrigerant from the condenser to the interchanger, and then to the evaporator, means for admitting refrigerant from the evaporator to the accumulator, means for draining refrigerant from the accumulator to the evaporator, some of the refrigerant admitted to the accumulator being collected within the bottom of the accumulator, means for returning gaseous refrigerant from a point above the liquid level in the accumulator to the interchanger, means for admitting from the accumulator a quantity of liquid refrigerant with entrained oil into the gaseous refrigerant fed to the interchanger, and a suction line for returning gaseous refrigerant plus oil from the interchanger to the compressor.

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