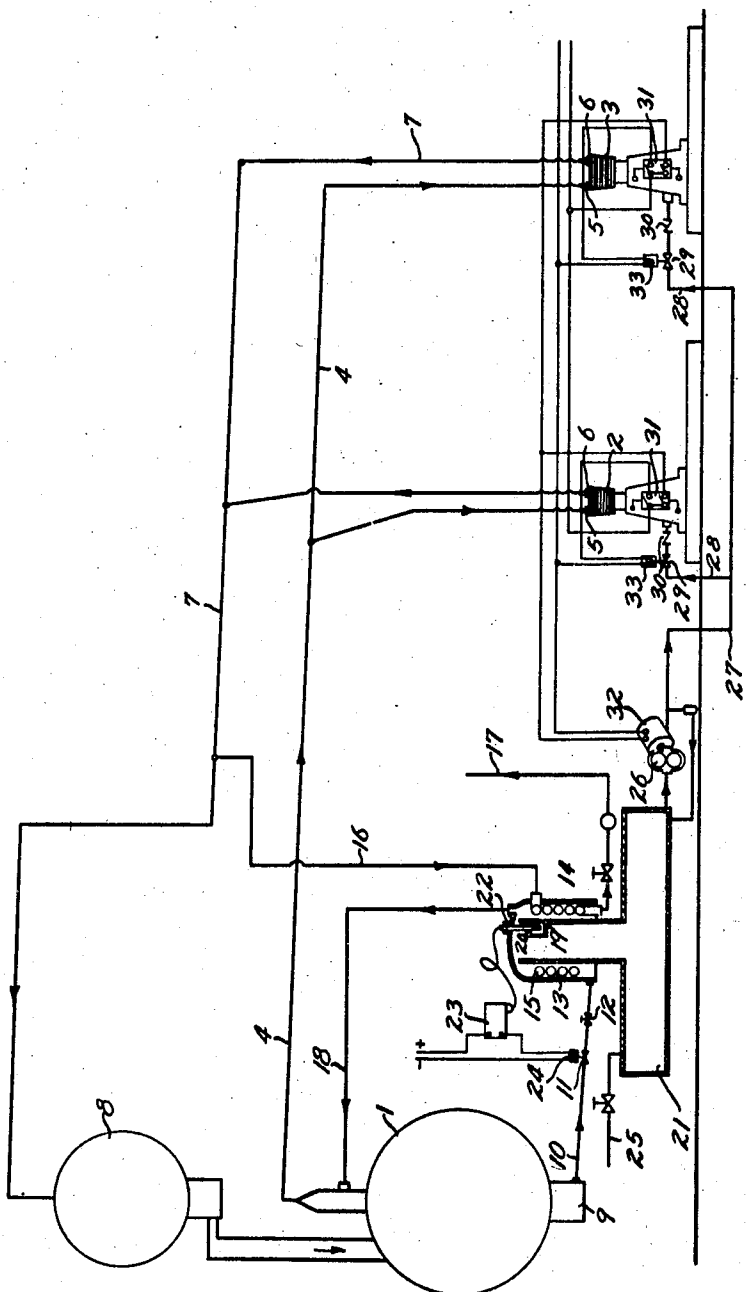
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OIL SEPARATOR IN A REFRIGERATION SYSTEM

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JOSEPH R. ZWICKL
INVENTOR

BY Robert Meyer

ATTORNEY

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OIL SEPARATOR IN REFRIGERATION SYSTEMS

Joseph R. Zwickl, East Orange, N. J., assignor to Worthington Pump and Machinery Corporation, Harrison, N. J., a corporation of Delaware

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This invention relates to refrigerating systems of the closed circuit type utilizing a compressor, condenser, and evaporator or cooler, and in which system a refrigerant such as those of the well known "Freon" types is compressed, condensed, and evaporated to provide the refrigeration or cooling of the medium to be cooled.

In such systems, lubricating oil lost by the compressor is picked up by the refrigerant liquid, and accumulation of such oil in the refrigerating fluid impairs the efficiency of the heat transfer in the evaporator or cooler, resulting in a lowering of the efficiency of the system.

It is an object of the present invention to provide means for removing or separating such oil out of the refrigerant fluid and returning the oil to the compressor or compressors for re-use as a lubricant.

In such systems employing a number of compressors, each compressor loses a different amount of oil, and, consequently, the demands for returned oil of the different compressors vary; therefore, it is another object of the present invention to provide means whereby the quantity of the re-claimed or released oil delivered to the respective compressors is controlled by the quantity of oil in the compressor which is available for lubricating purposes.

With these and other objects in view, as may appear from the accompanying drawing, the invention consists of various features of construction and combination of parts, which will be first described in connection with the accompanying drawing showing a refrigerating system of the preferred form in diagram with parts in section and partly in diagrammatic elevation, and the features forming the invention will be specifically pointed out in the claims.

Referring more particularly to the drawing, the improved refrigerating system includes an evaporator 1 of any approved type in which the refrigerant is evaporated to provide refrigeration for cooling the medium to be cooled which, as is usual in refrigerating systems, is circulated through the evaporator. The vaporous refrigerant passes from the evaporator to the compressor or compressors. In the drawing, two such compressors 2 and 3 are shown, but it is to be understood that any number of compressors may be employed without departing from the spirit of the present invention and that these compressors may be of the reciprocating type as shown, or of a well known centrifugal type. The vaporized refrigerant which flows from the evaporator 1 through the line 4 into the suctions

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5 of the compressors is compressed and returns from the discharges 6 of the compressors through a suitable line 7 to the condenser 8.

During the operation of the apparatus, oil is lost by the compressors and finds its way through the system into the liquid refrigerant in the evaporator 1. Such oil must be removed so as to prevent any excessive oil accumulation within the sysetem which would impair the efficiency of the heat transfer in the evaporator or cooler, and it is desirable to return such oil to the compressor or compressors.

The oil and non-evaporated refrigerant in the evaporator or cooler 1 falls to the lowest part of the evaporator and into a well or compartment indicated at 9, although the well or compartment 9 may be eliminated if desired, and the contaminated liquid refrigerant may be allowed to collect in the lowermost portion of the evaporator or cooler 1.

From the deepest point of the evaporator or cooler 1, which in the drawing is shown as the well 9, a small stream of the liquid, that is, the refrigerant and oil, is drained through a suitable pipe or conduit 10 in which is located a solenoid operated valve 11 and a needle valve 12. The liquid withdrawn from the evaporator 1 through the pipe 10 is delivered into the annular upper chamber 13 of the oil separator structure 14. A pipe coil 15 is located in the upper annular chamber 13, and it has connection through a suitable pipe 16 with the discharge pipe 7 from the compressors 2 and 3 to the condenser 8 for receiving hot discharge gas from the point in the system where the temperature of the gas is highest. The sensible and latent heat of the high pressure gas delivered to the coil 15 is given off as the gas condenses in the coil 15 during the heating of the liquid delivered to the annular chamber 13 through the pipe 10. The condensate from the lowermost part of the coil 15 is returned through a suitable pipe connection 17 either to the main cooler or evaporator 1, or to any other suitable point in the system wherein the pressure is less than the pressure in the condenser 8.

The liquid refrigerant which is contaminated with oil enters the annular chamber 13 at the bottom of the chamber and rises slowly therein, during which time the liquid refrigerant is evaporated or vaporized by the heat transfer action from the coil 15. The vaporized refrigerant is returned to the evaporator or cooler 1 through a suitable connection 18 which connects with the uppermost part of the annular chamber 13, or rather it is delivered by the pipe

18 into the main suction line 4 from the evaporator to the compressors. As more and more of the refrigerant is vaporized and returned as a gas or vapor to the main suction line 4, the oil concentration in the residue of liquid rises steadily and its temperature increases. As the oil rises in the annular chamber 13, it reaches the overflow opening 19 through which it flows over the weir 20 into the oil storage compartment 21. A temperature bulb 22 extends into the oil separator 14 and it is positioned so that the oil flowing through the opening 19 and over the weir 20 must contact the temperature bulb.

The temperature bulb 22 is of the usual type of thermostat bulb which when subjected to a predetermined temperature degree will operate the thermostat 23 of any approved construction to close the electrical circuit of the solenoid 24 of the solenoid valve 11, opening the valve and allowing the liquid to flow from the evaporator 1 into the annular chamber 13. The rate of flow of the liquid into the annular chamber 13 is regulated by means of the needle valve 12. At such time that the temperature of liquid in contact with the bulb 22, is below a predetermined degree, due to the presence of too much liquid refrigerant in the mixture the thermostat 23 operates to close the solenoid-actuated valve 11.

If the flow of the liquid refrigerant, contaminated with oil, to the chamber 13 is too fast, insufficient refrigerant will be vaporized in the chamber 13 and the temperature of the mixed oil and refrigerant will fall, insufficiently heating the bulb 22 to cause operation of the thermostat 23 and thus stopping the flow to the annular chamber 13 by the closing of the solenoid valve 11. However, when the heat supplied from the coil 15 causes the liquid refrigerant to vaporize and consequently a temperature rise, the bulb 22 will again operate the thermostat 23 and energize the solenoid 24 for opening the valve 11. If it is so desired, suitable means may be provided for heating the oil receiver or storage member 21 so as to evaporate out any refrigerant which might flow over the weir 20 into this tank, and prevent reabsorption of any refrigerant vapor by the oil.

The tank 21 is provided with suitable inlet 25 to permit a make up supply of oil thereto when necessary. The oil in the storage tank or receiver 21 is utilized as a lubricant in the compressors 2 and 3 and it is drawn from the storage tank by any suitable type of small pump, preferably a small gear pump indicated at 26 which discharges the oil into the compressor supply line 27. Branch lines 28 lead from the supply line 27 to the compressors 2 and 3, and these supply lines have solenoid actuated valves 29 located therein as well as check valves 30. The check valves 30 prevent a back flow of oil from the compressors into the line when the pump 26 is not operating. Float-actuated electric switch structures 31, of any approved type which may be purchased upon the open market and as shown diagrammatically in the drawing, are connected to the compressors, and, as is usual in this type of float-operated switch, variations in the level of oil in the compressor operate the switches 31 to make or break an electric circuit through the motor 32 employed to drive the pump 26.

The quantity of oil in the different compressors will not be uniformly varied, that is, one compressor may lose more oil than the other; therefore, to prevent flooding of the compressor and supply to each compressor only the amount of oil required by it, the solenoid valves 29 are provided. The solenoids 33 of these valves 29 are connected in the electrical circuit with the float-actuated switches 31.

When the oil level in any one of the compressors falls to a predetermined level, that is, to a point where the compressor needs an additional supply of oil, its switch 31 will be closed which will cause energization of the motor 32 and the starting of the pump 26. At the same time, the solenoid 33 of the valve 29, which is in the supply line 28 to the compressor needing oil, will be energized which will open the valve and allow oil to flow into that compressor until such time as the level of oil in the compressor reaches a height to open the switch 31 and break the electrical circuit through the motor 32 and the solenoid 33. If the other compressor in the system does not need oil at the same time as the closing of the electrical circuit of the motor 32 by another of the compressors, its solenoid-actuated valve will remain closed which will prevent the delivery of oil to the compressor not needing oil. Thus oil is delivered to the compressors only as and when needed thereby.

It will be understood that the invention is not to be limited to the specific construction or arrangement of parts shown, but that they may be widely modified within the invention defined by the claims.

What is claimed is:

1. In a refrigerating system including a compressor and an evaporator and a condenser and wherein a refrigerant is evaporated compressed and condensed to provide refrigeration, an oil separator, means for delivering mixed refrigerant liquid and oil from the evaporator to said separator, and means controlled by the temperature of the mixture of separated oil and residual refrigerant in the separator for controlling the delivery of mixed refrigerant and oil to the separator.

2. In a refrigerating system including a compressor and an evaporator and a condenser and wherein a refrigerant is evaporated compressed and condensed to provide refrigeration, an oil separator, means for delivering mixed refrigerant liquid and oil from the evaporator to said separator, means controlled by the temperature of separated oil in the separator for controlling the delivery of mixed refrigerant and oil to the separator, means for delivering oil from the separator to the compressor, and means controlled by variances in the level of the oil in the compressor for controlling the delivery of oil from the separator to the compressor.

3. In a refrigerating system including a compressor and an evaporator and a condenser and wherein a refrigerant is evaporated compressed and condensed to provide refrigeration, an oil separator, means for delivering mixed refrigerant liquid and oil from the evaporator to said separator, heat exchange means in said separator for evaporating the refrigerant in the separator to separate the oil therefrom, and means controlled by the temperature of separated oil in the separator for controlling the delivery of mixed refrigerant and oil to the separator.

4. In a refrigerating system including a compressor and an evaporator and a condenser and wherein a refrigerant is evaporated compressed and condensed to provide refrigeration, an oil separator, means for delivering mixed refrigerant liquid and oil from the evaporator to said separator, heat exchange means in said separator for

evaporating the refrigerant in the separator to separate the oil therefrom, means controlled by the temperature of separated oil in the separator for controlling the delivery of mixed refrigerant and oil to the separator, and means for delivering gaseous refrigerant to said heat exchange means from a point in the system where the temperature of the evaporated gas is sufficient that the hot gaseous refrigerant circulating through the heat exchange means will provide heat for evaporation of the refrigerant in the refrigerant and gas mixture delivered to the separator.

5. In a refrigerating system including a compressor and an evaporator and a condenser and wherein a refrigerant is evaporated compressed and condensed to provide refrigeration, an oil separator, means for delivering mixed refrigerant liquid and oil from the evaporator to said separator, heat exchange means in said separator for evaporating the refrigerant in the separator to separate the oil therefrom, means for delivering gaseous refrigerant to said heat exchange means from a point in the system where the temperature of the evaporated gas is sufficient to provide heat for evaporation of the refrigerant in the mixture of refrigerant and oil delivered to the separator, means controlled by the temperature of separated oil in the separator for controlling the delivery of mixed refrigerant and oil to the separator, means for delivering oil from the separator to the compressor, and means controlled by variances in the level of the oil in the compressor for controlling the delivery of oil from the separator to the compressor.

6. In a refrigerating system including a compressor and an evaporator and a condenser and wherein a refrigerant is evaporated compressed and condensed to provide refrigeration, an oil separator, means for delivering mixed refrigerant liquid and oil from the evaporator to said separator, heat exchange means in said separator for

evaporating the refrigerant in the separator to separate the oil therefrom, means for delivering gaseous refrigerant to said heat exchange means from a point in the system where the temperature of the evaporated gas is sufficient to provide heat for evaporation of the refrigerant in the mixture of refrigerant and oil delivered to the separator, means controlled by the temperature of separated oil in the separator for controlling the delivery of mixed refrigerant and oil to the separator, an oil storage receptacle for receiving oil from said separator, means for delivering oil from the storage receptacle to the compressor, and means controlled by variances in the level of the quantity of oil in the compressor for controlling the delivery of oil from said receptacle to the compressor.

7. In a refrigerating system including a plurality of compressors; an evaporator and a condenser and wherein a refrigerant is evaporated, compressed and condensed to provide refrigerant; an oil separator; means for delivering mixed liquid refrigerant and oil from the evaporator to said oil separator; means for delivering separated out oil from the separator to said compressors; means controlled by the level of oil in each compressor for independently controlling the delivery of oil from the separator to each compressor; and means controlled by the temperature of separated oil in the separator for controlling the delivery of mixed refrigerant and oil to the separator.

JOSEPH R. ZWICKL.

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