

[54] **REFRIGERANT COOLED
COMPRESSOR**

[75] Inventor: **Erich J. Kocher**, Milwaukee, Wis.

[73] Assignee: **Vilter Manufacturing Corporation**,
Milwaukee, Wis.

[22] Filed: **June 15, 1971**

[21] Appl. No.: **153,230**

[52] U.S. Cl. **62/470, 62/505**

[51] Int. Cl. **F25b 31/00**

[58] Field of Search. 62/196, 84, 469, 470, 505,
62/510, DIG. 2

[56] **References Cited**

UNITED STATES PATENTS

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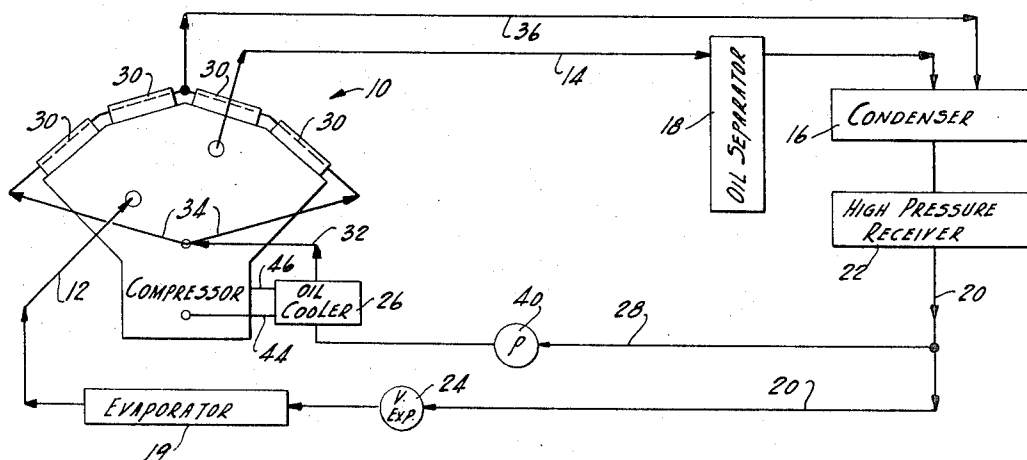
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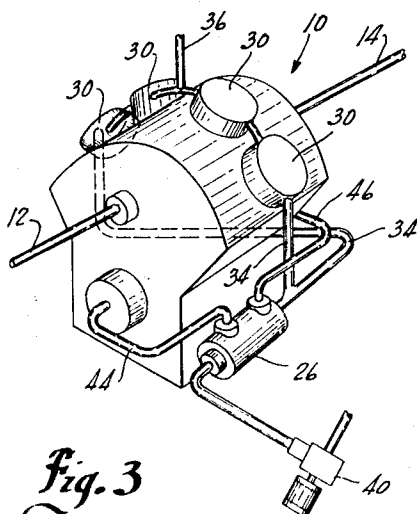
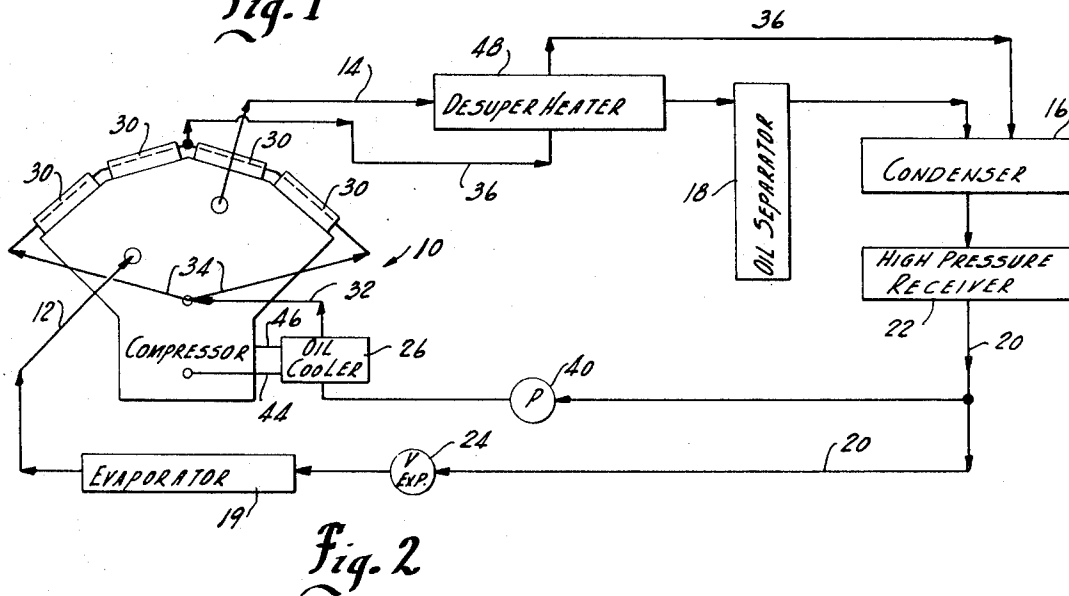
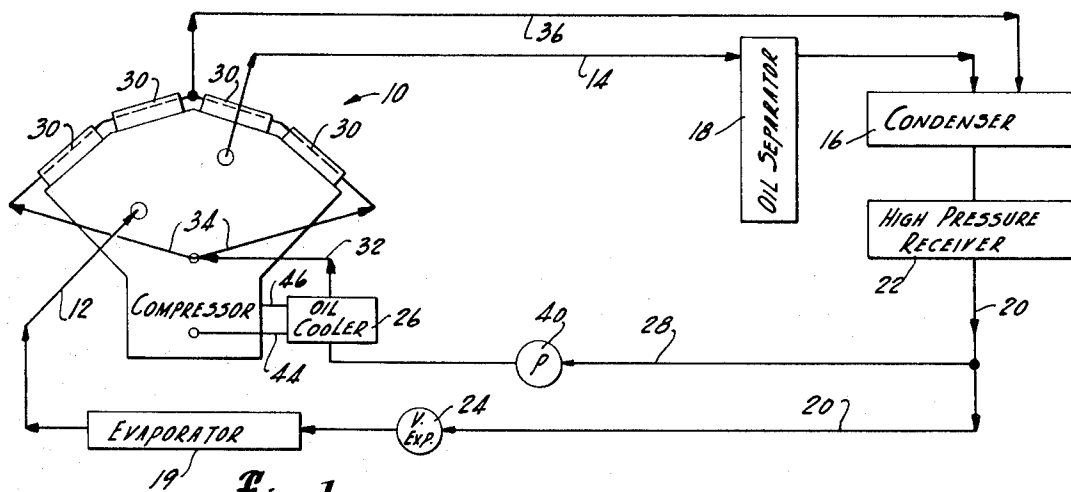
Primary Examiner—Meyer Perlin
Attorney—James E. Nilles

[57] **ABSTRACT**

In a refrigerating system including a compressor, condenser, evaporator, and an oil cooler, a refrigerant cooling system for the compressor including a bypass line connected between the condenser and evaporator, and including a pump for providing high pressure liquid to the oil cooler and to the heads of the compressors, and a return conduit connecting the discharge refrigerant from the compressor cooling system through a desuperheater in the compressor discharge line to the condenser.

5 Claims, 3 Drawing Figures





INVENTOR:
ERICH J. KOCHER
BY: *James E. Nilles*
ATTORNEY

REFRIGERANT COOLED COMPRESSOR

BACKGROUND OF THE INVENTION

It has been the practice for many years to cool ammonia and R-22 refrigerant compressors with water by circulating the water around the compressor heads. The water would initially pass through the oil cooler and then through the compressor jackets and be discharged to an open drain. As the cost of water increased, it became necessary to use the liquid refrigerant as a cooler as shown in Grant Pat. No. 3,379,033. In this type of a system, the oil cooler and the jackets are supplied with refrigerant through a thermostatic expansion valve. The evaporating temperature is controlled by a backpressure regulator which holds the evaporating temperature at a preset fixed level. The evaporated refrigerant is then fed back into the compression suction line. A liquid line solenoid valve is installed ahead of the expansion valve to prevent feeding refrigerant into the compressor when the compressor does not operate. The principal drawback to this type of a system is the reduction in the useful capacity of the compressor as a result of the reduction of the coolant refrigerant temperature in passing through the oil cooler and compressor jacket. As a result, the compressor must be down-rated in capacity. Also, in this type of a system three automatic valves are used in order to make the system operate.

SUMMARY OF THE INVENTION

The refrigeration system of the present invention generally includes a compressor, condenser, high pressure receiver, and an evaporator. An oil separator is provided in the discharge conduit from the compressor to the condenser. Liquid refrigerant from the condenser is bypassed by a pump to the oil cooler, then to the compressor jackets, and back to the condenser. The liquid refrigerant is evaporated as it passes through the oil cooler and compressor jackets, with evaporation taking place at the condensing temperature. It should be apparent that this system does not affect compressor capacity since the refrigerant which is used to cool the compressors is returned to the condenser. Increased load, if any, is present in the condenser, rather than the compressor. It also should be apparent that the system eliminates the use of water. The only additional mechanical device required to operate this system is a small pump provided in the bypass line. Self-regulation is also provided by this system since evaporation takes place at the condensing temperature and therefore cannot overcool the oil cooler or compressor jackets.

The effectiveness of the oil separator can also be increased by the present system by incorporating a de-superheater in the compressor discharge line and in the refrigerant discharge line. Since evaporation of the liquid refrigerant in the compressor cooling jackets is achieved at condensing temperature, overcooling of the discharge gas from the compressor is prevented. The compressor discharge gas will therefore never be reduced below condensing temperature and will always be a gas as it passes through the oil separator. It is generally well known that an oil separator operates better at lower temperatures in separating oil from high pressure gas such as the refrigerant in the discharge conduit from the compressor.

Other objects and advantages of this invention will become apparent from the following description when read in connection with the accompanying drawings.

THE DRAWINGS

FIG. 1 is a diagrammatic view of a refrigeration cycle incorporating the present invention;

FIG. 2 is a diagrammatic view of an alternate refrigeration cycle incorporating the present invention;

FIG. 3 is a perspective view of a compressor incorporating the concept of the present invention.

DESCRIPTION OF THE INVENTION

A refrigeration system of the type contemplated herein generally includes a compressor 10 having a low pressure suction conduit 12 and a high pressure discharge line or conduit 14. The high pressure discharge conduit 14 is connected to a condenser 16 through an oil separator 18. The condenser 16 is connected to an evaporator 19 by a high pressure liquid refrigerant conduit 20. A high pressure receiver 22 and an expansion valve 24 can be provided in the conduit 20. The evaporator 19 is connected to the compressor 10 by the low pressure suction conduit 12. An oil cooler 26 is connected to the crankcase of the compressor 10.

In accordance with the invention, means are provided for bypassing liquid refrigerant from conduit 20 to cool the compressor cylinder heads or jackets 30. Such means is in the form of a bypass conduit 28 connected between the high pressure liquid refrigerant conduit 20 and the oil cooler 26. Any liquid refrigerant which passes through the oil cooler 26 is directed to the compressor heads 30 of the compressor 10, by means of a conduit 32 connected to a pair of inlet conduits 34 connected to the cylinder heads 30 for the compressors. The gaseous discharge from the cylinder heads 30 is returned to the condenser 16 through a refrigerant discharge conduit 36.

As seen in FIG. 1, the high pressure liquid refrigerant bypassed from the conduit 20 by the bypass conduit 28 is pumped by means of a pump 40 through the oil cooler 26 into the jackets 30 of the compressor 10. Some of the liquid refrigerant is evaporated in the oil cooler 26 and the compressor jackets or heads 30. Evaporation of the liquid refrigerant which does occur in passing through the oil cooler and compressor jackets is normally achieved at condenser temperature. This is due to the absence of complete evaporation by the flow of the liquid refrigerant through the oil cooler and the compressor. The vaporized refrigerant which is evaporated in passing through the oil cooler and compressor jackets is recondensed when it returns to the cylinder.

More particularly, and referring to FIG. 3, a compressor 10 of the type contemplated herein generally includes a number of compressor cylinder heads 30. The heads 30 are connected in series by the conduits 34 which pass through the heads on each side of the compressor and are connected to the common discharge conduit 36. The oil cooler 26 is connected to the crankcase by oil lines 44 and 46. The rate of flow of liquid refrigerant through the compressor jackets or heads 30 normally required to achieve sufficient cooling can be predetermined from the rated capacity of

the compressor. This effect is achieved without reducing the the compressor capacity since the entire flow of liquid refrigerant for cooling is independent of the flow of refrigerant through the compressor 10. The pump 40 can be selected initially on the basis of the rate of capacity of the compressor to provide sufficient liquid refrigerant flow to achieve the desired result.

Referring to FIG. 2 of the drawing, a modified system is shown which includes a compressor 10 having inlet and discharge passages 12 and 14, a condenser 16 and an oil separator 18. The condenser is connected to the evaporator 19 through a high pressure receiver 22 by a liquid refrigerant conduit 20. An expansion valve 24 is provided in the conduit 20, as is generally understood in the art. Liquid refrigerant is bypassed by means of the bypass conduit 28 and the pump 40 through the oil cooler 26 into the compressor heads 30 through conduits 32 and 34.

In this system, the discharge conduit 36 is connected through a de-superheater 48 to the condenser 16 by discharge conduit 36. The high pressure discharge line 14 of the compressor is connected in heat exchange relationship with liquid refrigerant from the cooling system through the de-superheater 48 to the condenser 16. This system provides an increase in the effectiveness or efficiency of the oil separator 18 by reducing the temperature of the discharge gas from the compressor in conduit 14. It is generally well known that an oil separator 18 works better at low superheated vapor than with the higher superheated vapors. Since evaporation of the liquid refrigerant from the cooling system in the de-superheater is always at condenser temperature, as described above, overcooling of the discharge gas from the compressor 10 is prevented thereby reducing the discharge gas temperature without allowing liquid refrigerant to enter the oil separator 18.

I claim:

1. In a refrigerating system including a compressor having at least one compression cylinder, a condenser, a first high pressure discharge conduit connecting said compressor to said condenser, an oil separator connected to said discharge conduit between said compressor and said condenser, an evaporator, a second high pressure liquid refrigerant conduit connecting said condenser to said evaporator, an expansion valve in said second conduit, a third low pressure liquid refrigerant conduit connecting said evaporator to said compressor,

an oil cooler connected to said compressor, a cylinder head for said compressor cylinder, a fourth bypass conduit connecting said second liquid refrigerant conduit in heat exchange relation to said oil cooler, a liquid refrigerant pump means in said fourth conduit for pumping liquid refrigerant to said oil cooler, a fifth conduit connecting said oil cooler discharge refrigerant to said cylinder head, and a sixth conduit connecting said cylinder head discharge refrigerant to said condenser.

2. In a refrigerating system according to claim 1 including a plurality of compressor heads, each being connected in series with said fifth conduit.

3. In a refrigerating system according to claim 1 including a de-superheater connected in said first conduit and said sixth conduit to place said high pressure refrigerant from said compressor in heat exchange relation with the compressor head refrigerant discharge gas.

4. A refrigerating system including a compressor having a number of cylinder heads, a condenser and an evaporator, means for connecting the condenser, evaporator and compressor in series, an expansion valve in said connecting means between said condenser and said evaporator, an oil cooler connected to the compressor, means for bypassing high pressure liquid refrigerant in heat exchange relation through said oil cooler to said cylinder heads, said means including a bypass conduit connected to bypass the high pressure liquid refrigerant from said condenser to said cooler, a refrigerant coolant discharge conduit connecting said cylinder heads to said condenser, and a liquid refrigerant pump in said bypass conduit for pumping liquid refrigerant to said oil cooler.

5. The refrigerating system according to claim 4 wherein said connecting means includes a high pressure refrigerant discharge conduit connected between said compressor and said condenser, an oil separator connected in said high pressure refrigerant discharge conduit and a de-superheater connected in said high pressure refrigerant discharge conduit between said compressor and said oil separator, said refrigerant coolant discharge conduit being connected to said oil separator in heat exchange relation with said high pressure refrigerant.

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