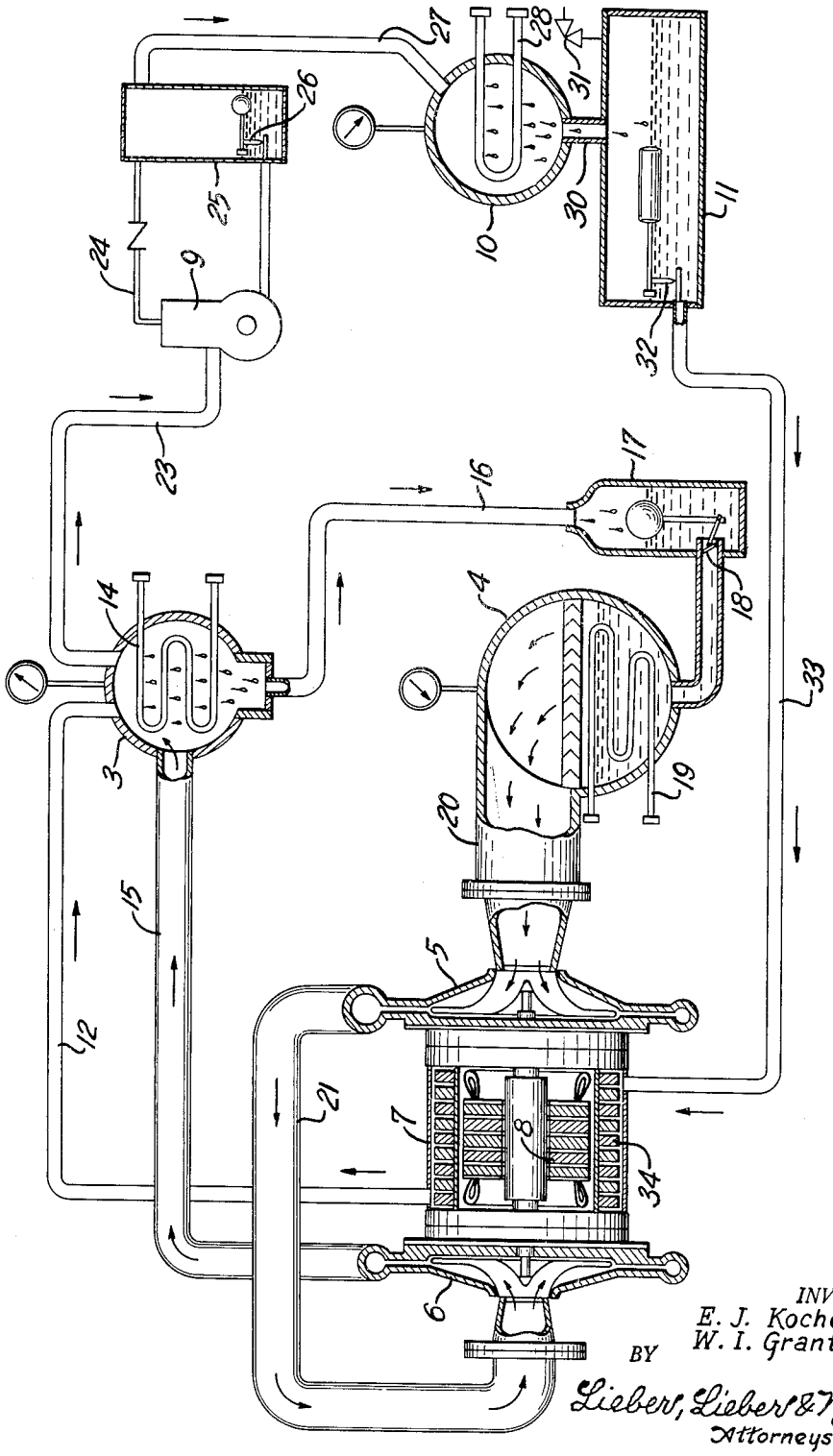
June 6, 1961 E. J. KOCHER ET AL 2,986,905

REFRIGERATING SYSTEM

Filed April 15, 1960



INVENTORS.
E. J. Kocher
W. I. Grant
BY
Lieber, Lieber & Nilles
Attorneys

United States Patent Office 2,986,905
Patented June 6, 1961

2,986,905

REFRIGERATING SYSTEM

Erich J. Kocher, Milwaukee, and Whitney I. Grant, Muskego, Wis., assignors to The Vilter Manufacturing Co., Milwaukee, Wis., a corporation of Wisconsin

Filed Apr. 15, 1960, Ser. No. 22,583
4 Claims. (Cl. 62—475)

This invention relates generally to improvements in the art of refrigeration, and it relates more specifically to improvements in the construction and operation of refrigerating systems embodying purging devices cooperating with refrigerant cooled compressor propelling electric motors.

The principal object of the present invention is to provide an improved refrigerating system embodying an electric motor propelled main compressor, in which the driving motor is effectively cooled by purged liquid refrigerant derived from the system and which is evaporated within the motor.

While a number of refrigeration systems embodying motor propelled compressors and wherein it is contemplated to cool the motor by means of refrigerant derived from the system, have heretofore been proposed, they have not proven entirely satisfactory. Although these prior motor cooling systems may have been operable to partially perform their intended function, they were all relatively inefficient due to certain deficiencies. None of these previously proposed systems obtained maximum heat transfer efficiency for cooling by utilizing purged liquid refrigerant and by evaporating the latter within the motor housing, whereby less cooling surface area is required, and greater temperature differential can be maintained. Then, too, the prior systems did not utilize a purging unit controllable independently of the main refrigeration system for supplying air free liquid refrigerant to the motor for cooling purposes while also purging the entire refrigeration system. In addition to these differences, the previous systems did not relieve the main compressor from loss in capacity by returning purged gaseous refrigerant directly from the cooled compressor propelling motor to the main condenser, so that the prior proposed motor cooling systems were relatively ineffective for these and still other reasons.

It is therefore a more specific but important object of the present invention to provide a compressor propelling motor cooling system which obviates all of the above-mentioned objectionable features of the prior proposals, and which not only cools the motor with maximum efficiency but also maintains the main refrigeration system in most effective operating condition.

Another important specific object of this invention is to provide an improved composite refrigerating system embodying a refrigerant cooled electric motor for driving the main refrigerant compressor, and wherein an independently controllable refrigerant conditioning purger is utilized to maintain maximum efficiency of the entire system.

These and other more specific objects and advantages of the invention will be apparent from the following description.

A clear conception of the features constituting the present improvement, and of the construction and functioning of a typical refrigeration system embodying the invention, may be had by referring to the drawing accompanying and forming a part of this specification wherein the various parts are designated by suitable reference characters.

The single figure of the drawing is a diagram of a composite refrigeration system embodying a main electric motor driven compressor cooperating with a main condenser and evaporator, and an auxiliary refrigerant purging and motor cooling assemblage coacting with the main system, most of the more important elements being shown in section.

While the invention has been shown and described herein as having been embodied in a refrigerating system provided with a two-stage rotary main compressor, with a single main evaporator, and with a purger having an oil separator associated therewith, it is not intended to restrict the use of the improved features to such a system; and it is also contemplated that specific descriptive terms employed herein be given the broadest possible interpretation consistent with the disclosure.

Referring to the diagram, the composite refrigeration and motor cooling system shown therein, comprises in general, a main condenser **3**, a main evaporator **4** for receiving volatile liquid refrigerant from the condenser **3** and for converting the same into gas; a rotary two-stage main compressor having a low pressure stage **5** cooperating with a high pressure stage **6** to circulate refrigerant from the evaporator **4** through the condenser **3**; an electric motor having a hermetically sealed casing **7** and a confined rotor **8** drivingly connected to the compressor stages **5**, **6**; an auxiliary compressor **9** for withdrawing gaseous refrigerant from the main condenser **3** and for delivering the same to an auxiliary condenser **10**; a refrigerant purger **11** interposed between the condenser **9** and the motor casing **7** for delivering air-free liquid refrigerant to the motor for evaporation therein; and a conduit **12** connecting the motor casing **7** with the main condenser **3** to deliver evaporated refrigerant directly from the motor to this condenser.

The main condenser **3** is provided with an internal coil **14** through which cooling medium may be circulated to condense the compressed refrigerant gas received from the main compressor through the duct **15**, and the condensed refrigerant discharged from the condenser **3** is delivered to the main evaporator **4** through a conduit **16** having therein an accumulator **17** provided with a float valve **18** for controlling the flow of the liquid refrigerant. The main evaporator **4** is also provided with an internal coil **19** through which evaporating medium may be circulated to vaporize the liquid refrigerant admitted to this evaporator, and the refrigerant vapor generated in the main evaporator **4** is delivered through a passage **20** to the low pressure stage **5** and through a duct **21** to the high pressure stage **6** of the compressor, each stage of which is provided with a revolving compression impeller direct connected to the motor rotor **8**.

The various elements of the main refrigeration system described in the preceding paragraph, are old and well known; but the cooperation of the purger **11** with an auxiliary evaporator for effecting cooling of the motor and which maintains the refrigerant within the entire system in most effective condition for most efficient operation constitutes an important feature of the present improvements. The auxiliary compressor **9** may be of any type adapted to further compress regulated quantities of high

pressure gaseous refrigerant withdrawn from the main condenser 3 through a conduit 23, and to deliver the highly compressed refrigerant gas through a valve controlled duct 24 into an oil separator 25 having therein a float actuated valve 26 for periodically discharging accumulated oil into the lubricated bearings of the compressor 9. The oil-free compressed refrigerant escapes from the separator 25 through another conduit 27 into the auxiliary condenser 10 wherein it is converted into liquid by a cooling coil 28.

The high pressure liquified refrigerant from the auxiliary condenser 10 flows through a duct 30 into the purger 11 wherein the air escapes from the compressed refrigerant and is discharged to the ambient atmosphere through a relief valve 31. As the air-free liquid refrigerant accumulates in the separating chamber within the purger 11, it is periodically released by another float controlled valve 32 and delivered still under high pressure through a conduit 33 into the hermetically sealed casing 7 of the main compressor propelling motor. The air-tight casing 7 of this motor besides housing the motor rotor 8 which is drivingly connected to the compressor inpellers, also has an annular energizing stator 34 which surrounds the rotor 8 confined therein, and the motor rotor 8 and stator 34 should be provided with suitable passages through which the refrigerant can flow into intimate contact with the concealed motor parts. While thus passing through the motor casing 7, the liquid air-free refrigerant admitted from the purger 11 through the duct 33 evaporates and effectively cools the motor rotor 8 and stator 34 and the resultant high pressure refrigerant gas flows directly into the main condenser 3 through the conduit 12.

The normal operation of the present improved composite refrigeration and motor cooling system should be apparent from the foregoing detailed description, but attention is especially directed to the following facts and advantages involved. While the use of refrigerant derived from a main refrigerating system to cool the main compressor propelling motor of the system has heretofore been generally proposed, the present improved assemblage effectively removes all non-condensibles such as air from the refrigerant used to cool the motor thereby avoiding accumulation of impurities within the refrigerant distributing passages within the motor. The use of purged liquid refrigerant and the evaporation thereof within the motor for cooling purposes, provides more efficient heat transfer than is possible by utilizing gaseous refrigerant alone for such purpose, consequently, either less cooling surface is required or lower temperature differential need be maintained.

The return of high pressure gaseous refrigerant from the motor to the main condenser does not reduce the main compressor capacity, as would be the case if this gas were returned to the suction line of this compressor. The differential in pressure established between the main refrigeration system and the motor cooling system by the auxiliary compressor 9, permits the motor to be cooled with high pressure liquid refrigerant which when evaporated may still be returned under pressure to the main condenser without the use of a pumping device. And last but not least, the purging device may be operated to vary the amount of refrigerant withdrawn from the main condenser 3, so as to insure most effective removal of non-condensibles from the entire system and to insure most efficient cooling of the motor.

Various modes of carrying out the invention are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention.

We claim:

1. In a refrigerating system having a main condenser cooperable with a main evaporator, a main compressor interposed between the main evaporator and main condenser and being operable to withdraw gaseous refrigerant from said evaporator and to deliver the same into said condenser, an electric motor having a hermetically sealed casing confining a stator cooperating with a rotor drivingly connected to said main compressor, and a refrigerant purger for the system interposed between said main condenser and said motor and being provided with an auxiliary compressor having an inlet for withdrawing gaseaus refrigerant from the main condenser and with a compressed gaseous refrigerant outlet connected to an auxiliary condenser cooperating with an air separator communicating directly with said motor to deliver air free liquid refrigerant thereto, the liquid refrigerant derived from said purger being evaporable within said motor casing to cool said stator and rotor, and said motor being connected to said main condenser by a conduit through which the resultant gaseous refrigerant is conducted to the main condenser.

2. In a refrigerating system having a main condenser cooperable with a main evaporator, a main compressor interposed between the main evaporator and main condenser and being operable to withdraw gaseous refrigerant from said evaporator and to deliver the same into said condenser, an electric motor having a hermetically sealed casing confining a stator cooperating with a rotor drivingly connected to said main compressor, and a refrigerant purger for the system interposed between said main condenser and said motor and being provided with an auxiliary compressor having an inlet for withdrawing gaseous refrigerant from the main condenser and with a compressed gaseous refrigerant outlet connected to an auxiliary condenser cooperating with an air separator communicating directly with said motor to deliver air free liquid refrigerant thereto, said purger being operable independently of the main condenser and evaporator and the liquid refrigerant derived from the purger being evaporable within said casing to cool said stator and rotor, and said casing being connected directly to said main condenser by a conduit through which the gaseous refrigerant resulting from said evaporation is conducted to the main condenser.

3. In a refrigerating system having a main condenser cooperable with a main evaporator, a main compressor interposed between the main evaporator and main condenser and being operable to withdraw gaseous refrigerant from said evaporator and to deliver the same into said condenser, an electric motor having a hermetically sealed casing confining parts drivingly associated with said main compressor, and a refrigerant purger for the system interposed between said main condenser and said motor and being provided with an auxiliary compressor having an inlet for withdrawing gaseous refrigerant from the main condenser and with a compressed gaseous refrigerant outlet connected to an auxiliary condenser cooperating with an air separator communicating directly with said motor to deliver air free high pressure liquid refrigerant thereto, the high pressure liquid refrigerant derived from said purger being evaporable within said motor casing to cool said confined motor parts, and said motor being connected to said main condenser by a conduit through which the resultant high pressure gaseous refrigerant is conducted to the main condenser.

4. In a refrigerating system having a main condenser cooperable with a main evaporator, a main compressor interposed between the main evaporator and main condenser and being operable to withdraw gaseous refrigerant from said evaporator and to deliver the same into said condenser, an electric motor having a hermetically sealed casing confining motor parts drivingly associated with said main compressor, and a refrigerant purger for the system interposed between said main condenser and said motor and being provided with an auxiliary high pressure compressor having an inlet for withdrawing gaseous refrigerant from the main condenser and also having a

compressed gaseous refrigerant outlet connected to an auxiliary condenser cooperating wtih an air separator communicating directly with said motor to deliver compressed air free liquid refrigerant thereto, said purger being operable independently of the main condenser and evaporator and the high pressure liquid refrigerant derived from the purger being evaporable within said casing to cool said compressed motor parts, and said casing being connected directly to said main condenser by a conduit

through which the gaseous refrigerant resulting from said evaporation is conducted under pressure to the main condenser.

References Cited in the file of this patent

UNITED STATES PATENTS

Re 24,802	Kocher et al.	Mar. 27, 1960
2,746,269	Moody	May 22, 1956
2,776,542	Cooper	Jan. 8, 1957