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REFRIGERATED HERMETICALLY SEALED MOTORS

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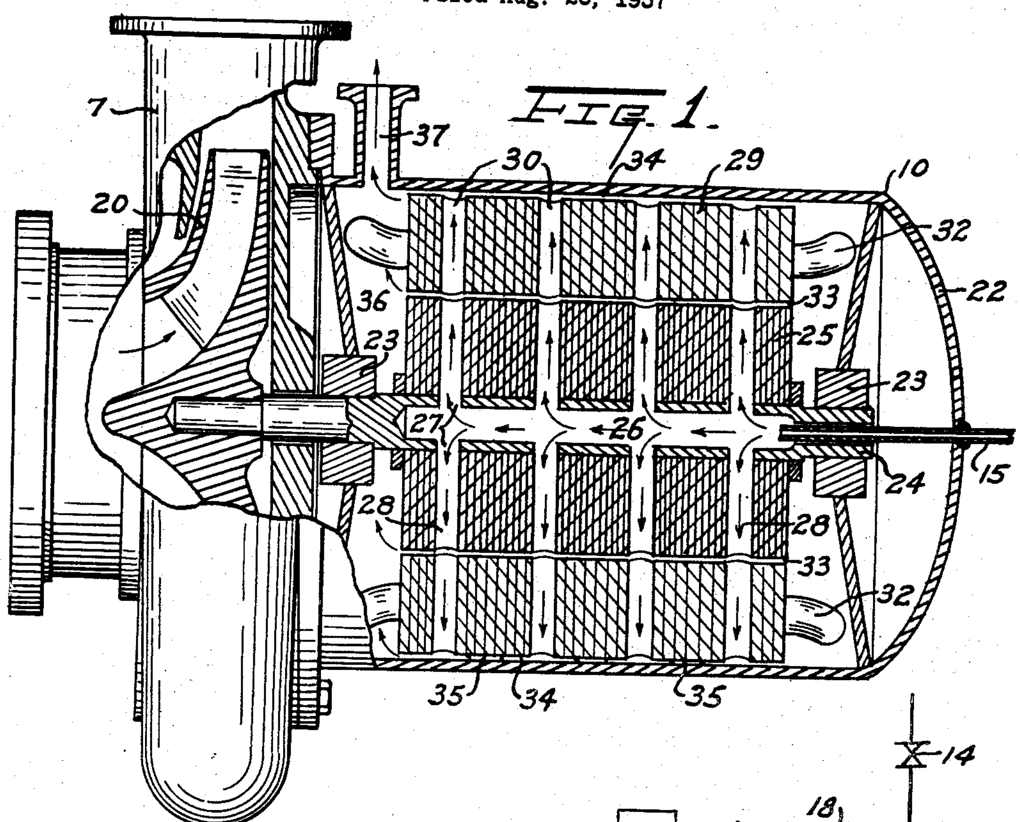
FIG. 1.



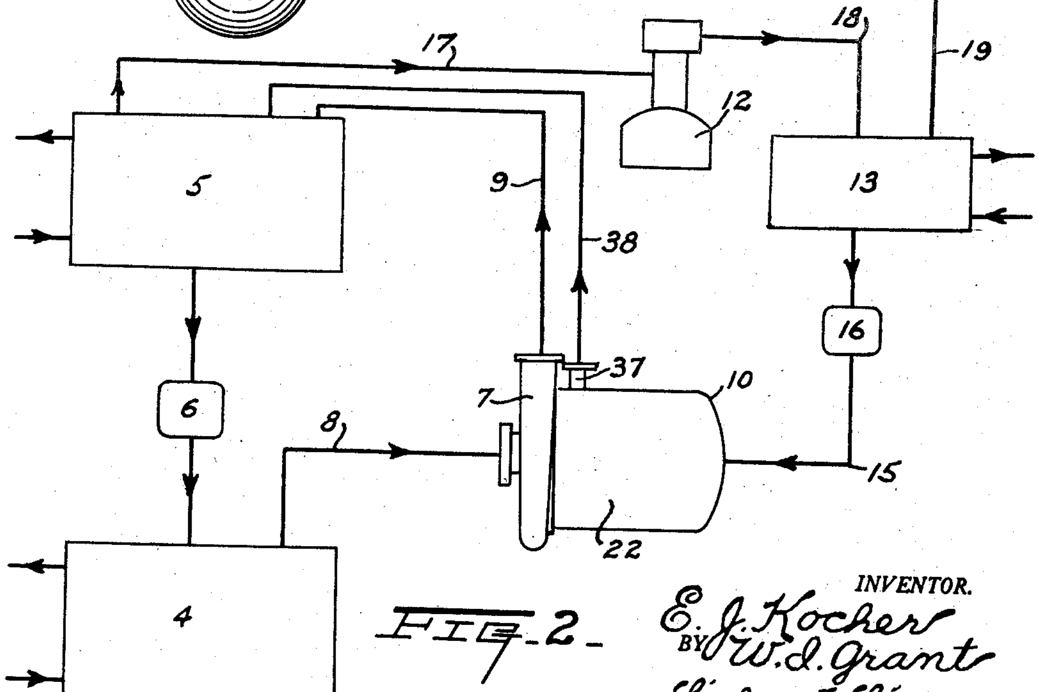




FIG. 2.

INVENTOR.

E. J. Kocher

BY W. I. Grant

Lieber & Lieber

ATTORNEYS.

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# REFRIGERATED HERMETICALLY SEALED MOTORS

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

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7 Claims. (Cl. 62—475)

The present invention relates in general to improvements in the art of refrigeration, and it relates more specifically to improvements in low pressure refrigerating systems employing refrigerant circulating pumps driven by hermetically sealed propelling motors and which utilize some of the refrigerant to cool these motors.

The primary object of this invention is to provide an improved refrigeration system which is simple in structure and efficient in operation.

Refrigerating systems which utilize low pressure refrigerants such as Freon 113, operate at pressures below atmospheric, so that there is always danger of having air enter the circulating system. If permitted to accumulate, this air ultimately increases the pressure in the condenser, and thus results in increased power consumption and decreased capacity, but such objectionable air accumulation can be obviated without wasting refrigerant by providing a so-called purging unit for automatically extracting and delivering the seepage air to the ambient atmosphere.

When employing an electric motor to drive the refrigerant circulating pump of a refrigerating system, it is also very desirable to prevent overheating of the motor and to effect cooling by utilizing some of the refrigerant being circulated through the system, since cooling of the motor by refrigeration eliminates the formation of scale and rust such as are deposited with water cooling. While it has heretofore been proposed to so utilize refrigerant confined within the circulating system by providing a hermetically sealed enclosure for the motor rotor and stator having therein a heat exchanger and a power consuming fan for circulating refrigerant gas from the motor through the heat exchanger and back to the motor, such a system is not only very complicated due to the enclosure of the heat exchanger and fan within the sealed casing, but also because it is impossible to prevent seepage of air into the system when operating with low pressure refrigerant such as Freon 113.

It is therefore an important and more specific object of the present invention to provide an improved refrigerating system operating with confined refrigerant below atmospheric pressure, and wherein an hermetically sealed electric motor is utilized to drive the refrigerant circulating pump and is most effectively cooled to prevent overheating.

Another important object of this invention is to provide an improved assemblage for constantly cooling a sealed motor used to propel a centrifugal circulating pump in a refrigerating system utilizing low pressure refrigerant, with the aid of air free refrigerant confined within the system.

A further important object of the invention is to provide an improved hermetically sealed electric motor structure for driving the circulating pump of a refrigeration system, and which is automatically cooled by utilizing some refrigerant from within the system without providing special heat exchange and refrigerant circulating fans or other complicated accessories within the motor enclosure, and with minimum power consumption.



Still another important object of our invention is to provide an improved cooling system in which low pressure refrigerant such as Freon 113 is confined and circulated through the circulating pump propelling motor, and which is constantly effectively purged for the removal of air which might leak into the sub-atmospheric system.

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

A clear conception of the features constituting the present improvement, and of the assemblage 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 like reference characters designate the same or similar parts in the several views.

Fig. 1 is a somewhat diagrammatic part sectional side elevation of a rotary compressor driven by a hermetically sealed refrigerant cooled electric motor to circulate refrigerant through the improved system, the section having been taken longitudinally and centrally through the compressor and motor; and

Fig. 2 is a simple diagram of an improved refrigeration system, purger unit and motor driven compressor, embodying the invention.

While the improvements have been shown and described herein as having been embodied in a simple refrigeration system comprising more or less standard condensers, valves and an evaporator, these elements may be varied to suit different conditions of operation without departing from the invention; and it is also contemplated that specific descriptive terms employed herein be given the broadest possible interpretation consistent with the disclosure.

Referring to Fig. 2 of the drawing, the refrigeration system shown diagrammatically therein, comprises in general, a refrigerant evaporator **4**; a main refrigerant condenser **5** for liquifying and delivering low pressure liquid refrigerant to the evaporator **4**, past a float controlled valve **6**; an electric motor driven rotary compressor **7** having a suction line **8** communicating with the evaporator **4** and a refrigerant delivery line **9** connected to the condenser **5**; and a purging assemblage or unit interposed between the main condenser **5** and the driving motor **10** of the compressor **7** for constantly removing leakage air from the entire system.

The purging unit for effecting automatic removal of air from the low pressure refrigerant confined in the system, consists primarily of a small capacity compressor **12**; an auxiliary condenser **13**; an air relief valve **14** associated with the condenser **13**; and a liquid refrigerant discharge line **15** leading from the condenser **13** to the motor **10** and having a float controlled valve **16** therein. The small compressor **12** may be of any suitable type adapted to draw mixed refrigerant gas and air from within the top of the main condenser **5** through a conduit **17** and to deliver the mixture under pressure above atmospheric through a conduit **18** to the condenser **13** wherein the air is automatically released from the liquid refrigerant. The relief valve **14** is connected to the condenser **13** by a conduit **19** and is adapted to be set so as to open whenever a predetermined pressure above atmospheric has been reached in the condenser **13**, and to thereby deliver the accumulated free air into the ambient atmosphere, while the condenser **13** is adapted to deliver liquid refrigerant through the discharge line **15** and past the float controlled valve **16** into the hermetically sealed main propelling motor **10** which drives the compressor impeller **20**.

The electric motor **10** has a hermetically sealed casing **22** secured to the compressor housing and which is provided with internal spaced bearings **23** in which the pump impeller driving shaft **24** is journalled, and the motor rotor **25** is secured to this shaft **24** between these bearings **23**, see Fig. 1. The shaft **24** has an internal central passage **26** in open communication with the liquid refrigerant line **15** beyond the float controlled valve **16**, and which is provided with local outlet openings **27** communicating with outwardly directed passages or radial conduits **28** formed in the rotor **25**, and this rotor is embraced by the annular motor stator **29** which also has outwardly directed passages or radial conduits **30** formed therein and which are alineable with the rotor conduits **28** when the motor is operating.

The motor stator **29** is also provided with the usual energizing windings **32** and is separated from the motor rotor **25** by a slight annular space **33** and from the annular outer wall of the casing **22** by a similar space **34** which is interrupted only by local peripheral supporting pads **35** for the stator **29** coacting with the outer casing wall. These annular spaces **33**, **34** communicate with the conduits **28**, **30** and with a sealed end chamber **36** confined within the casing **22**, and this chamber has an outlet **37** for vaporized refrigerant connected by a discharge line **38** with the condensing chamber of the main condenser **5**.

The evaporator **4**, condensers **5**, **13**, compressor **12**, float controlled valves **6**, **16**, and adjustable air relief valve **14** are all of well known construction, and the evaporator **4** and the condensers **5**, **13** have the usual heat transfer connections communicating therewith as depicted in the diagram of Fig. 2.

When the various parts of the improved refrigerating system have been properly constructed and assembled as illustrated, and the system has been supplied with low pressure refrigerant such as Freon 113, its normal operation is as follows. The motor **10** is rotating to drive the main compressor impeller **20** thereby causing this impeller to withdraw gaseous refrigerant by suction from the evaporator **4** through the inlet line **8** and to deliver this refrigerant gas through the main compressor discharge line **9** into the main condenser **5**. In the condenser **5** the major portion of this refrigerant is promptly liquified or condensed and the liquid refrigerant is returned as required to the evaporator **4** past the float controlled valve **6**.

While the main evaporator **4**, compressor **7**, condenser **5**, and float valve **6** are thus functioning, some free air is bound to leak or seep into the low pressure refrigerant circulating system, and this entering air rises to the top of the main condenser **5**. The auxiliary compressor **12** will them function to constantly withdraw the seepage air mixed with gasified refrigerant from within the condenser **5** through the conduit **17**, and to compress the mixture to a pressure above atmospheric and will deliver the compressed mixture through the conduit **18** into the auxiliary condenser **13**. The air thus admitted to the condenser **13** is released while the refrigerant is being liquified or condensed, and the free air is withdrawn and escapes through the duct **19** and relief valve **14** to the surrounding atmosphere, while the condensed liquid refrigerant flows through the discharge line **15** as required past the float controlled valve **16** and line **15** and is delivered into the motor **10**.

As this liquid refrigerant flows from the conducting line **15** into the hermetically sealed motor casing **22** and through the central shaft passage **26**, the centrifugal force generated by the rapidly revolving rotor **25**, withdraws refrigerant through the shaft openings **27** and radial conduits **28** and delivers this refrigerant through the stator conduits **30** and through the annular spaces **33**, **34** into the chamber **36**. The heat generated by the revolving rotor **25** and its shaft **24** rapidly vaporizes the refrigerant flowing through the conduits **28**, **30** and through the annular spaces **33**, **34** and thereby effectively cools the motor **10**, and the gasified refrigerant entering the sealed chamber **36** escapes through the outlet **37** and is delivered into the main condenser **5** through the discharge line **38** to mingle with the refrigerant being circulated through this condenser **5** by the main compressor impeller **20**.



After initial proper installation and adjustment the entire system functions automatically to purge the refrigerant and to supply the evaporator **4** and the motor **10** with abundant supplies of air free liquid refrigerant. The hermetically sealed motor **10** which drives the main refrigerant circulating compressor **7** is most effectively cooled with minimum power consumption and without the aid of special power consuming fans and complicated heat exchangers confined within its casing **22**, and no special seals are required between the motor **10** and the compressor impeller **20** since any refrigerant which may escape from the motor casing **22** into this compressor **7** will be delivered into the main condenser **5**. The improved hermetically sealed motor **10** is obviously simple, compact and durable in construction, and the refrigerant supply line **15** may be welded to the end head of the casing **22** as in Fig. 1 in order to eliminate possible air ingress at this point.

It should be understood that it is not desired to limit this invention to the exact details of construction and operation of the system and parts herein specifically shown and described, for various modifications within the scope of the appended claims may occur to persons skilled in the art.

We claim:

1. In a refrigerating system operating with confined refrigerant below atmospheric pressure, an evaporator for the refrigerant, a refrigerant condenser cooperable with said evaporator, a compressor having an impeller for withdrawing refrigerant from said evaporator and for delivering the same into said condenser, an electric motor having a rotor drivingly connected to said compressor impeller and a stator embracing its rotor and being provided with a hermetically sealed casing enclosing said rotor and stator, said motor rotor being provided with a central refrigerant inlet passage and both said rotor and stator having therein alineable conduits extending outwardly from said central rotor inlet passage and said casing having a refrigerant outlet communicating with said condenser, a purging unit for removing air from the confined refrigerant being circulated through said condenser and evaporator by said compressor, and means for conducting purged refrigerant from said unit into said central rotor passage.

2. In a refrigerating system operating with confined refrigerant below atmospheric pressure, an evaporator for the refrigerant, a refrigerant condenser cooperable with said evaporator, a compressor having an impeller for withdrawing refrigerant from said evaporator and for delivering the same into said condenser, an electric motor having a rotor drivingly connected to said compressor impeller and a stator embracing but spaced from its rotor and being provided with a hermetically sealed casing enclosing said rotor and stator, said motor rotor being provided with a central refrigerant inlet passage and both said rotor and stator having therein alineable radial conduits extending outwardly from said central rotor inlet passage and said casing having a refrigerant outlet communicating with said condenser, a purging unit communicating with said condenser and being operable to remove air from the confined refrigerant being circulated through said condenser and evaporator by said compressor, and conduit means for conducting air free refrigerant from said unit into said central rotor passage.

3. In a refrigerating system operating with confined refrigerant below atmospheric pressure, an evaporator for the refrigerant, a refrigerant condenser cooperable with said evaporator, a compressor having an impeller for

withdrawing refrigerant from said evaporator and for delivering the same into said condenser, an electric motor having a rotor drivingly connected to said compressor impeller and an annular stator surrounding but spaced from its rotor and being provided with a hermetically sealed casing enclosing its rotor and stator, said motor rotor being provided with a central refrigerant inlet passage extending approximately throughout the entire length and said rotor and stator having alineable conduits radiating from said passage and said casing having a refrigerant outlet communicating with said condenser, a purging unit for removing air from the confined refrigerant withdrawn from the top of said condenser, and means for conducting refrigerant from said unit into one end of said central rotor passage.

4. In a refrigerating system operating with confined refrigerant below atmospheric pressure, an evaporator for the refrigerant, a main refrigerant condenser cooperable with said evaporator, a main compressor having an impeller for withdrawing refrigerant from said evaporator and for delivering the same into said condenser, an electric motor having a rotor drivingly connected to said compressor impeller and a stator embracing its rotor and being provided with a hermetically sealed casing enclosing said rotor and stator, said motor rotor being provided with a refrigerant inlet passage extending approximately throughout the entire length and said rotor and stator having several sets of alineable conduits radiating outwardly from said passage and said casing having a refrigerant outlet communicating with said passages and said condenser, a purging unit having an auxiliary compressor communicating with said condenser and also having an auxiliary condenser and a relief valve operable to remove air from the confined refrigerant being circulated through said main condenser and evaporator, and conduit means for conducting purged refrigerant from said unit into said central rotor inlet passage.

5. In a refrigerating system operating with confined refrigerant below atmospheric pressure, an evaporator for the refrigerant, a refrigerant condenser cooperable with said evaporator, a compressor having a rotary impeller for withdrawing refrigerant from said evaporator and for delivering the same into said condenser, an electric motor having a rotor drivingly connected to said compressor impeller and an annular stator surrounding said rotor and being provided with a hermetically sealed casing enclosing said rotor and stator, said motor rotor being provided with a single central refrigerant inlet passage and said rotor and stator having several sets of alineable conduits communicating with and radiating from said inlet passage, and said stator being separated from said rotor and casing by annular spaces communicating with said condenser and with said conduits, a purging unit communicating with said condenser and being operable to remove air from the confined refrigerant being circulated through the condenser and evaporator by said compressor, and conduit means for conducting purged refrigerant from said unit into one end of said central rotor passage.



6. In a refrigerating system operating with confined refrigerant below atmospheric pressure, an evaporator for the refrigerant, a refrigerant condenser cooperable with said evaporator, a compressor having an impeller for withdrawing refrigerant from said evaporator and for delivering the same into said condenser, an electric motor having a rotor drivingly connected to said compressor impeller and a stator embracing its rotor and being provided with a hermetically sealed casing enclosing said rotor and stator, said rotor rotor being provided with a central refrigerant inlet passage and said rotor and stator having therein several laterally spaced sets of alineable conduits radiating from said inlet passage, and said stator being separated from said rotor and casing by annular spaces communicating with said conduits and said condenser, and means for conducting motor refrigerant from said condenser into one end of said central rotor passage.

7. In a refrigerating system having an evaporator and a main condenser cooperable therewith and being provided with a purging unit operable to remove air from the refrigerant confined within the system, a compressor having a rotary impeller for withdrawing refrigerant from the condenser and for delivering the same into the evaporator, and an electric motor having a rotor drivingly connected directly to said compressor impeller and a stator surrounding the rotor, said motor rotor and stator being confined in a hermetically sealed casing having a refrigerant inlet connected to the purging unit and an outlet connected to the evaporator and said motor rotor being provided with a coaxial passage communicating with said casing inlet while both said rotor and stator have therein alineable conduits radiating from said passage and connecting the latter with said casing outlet.


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