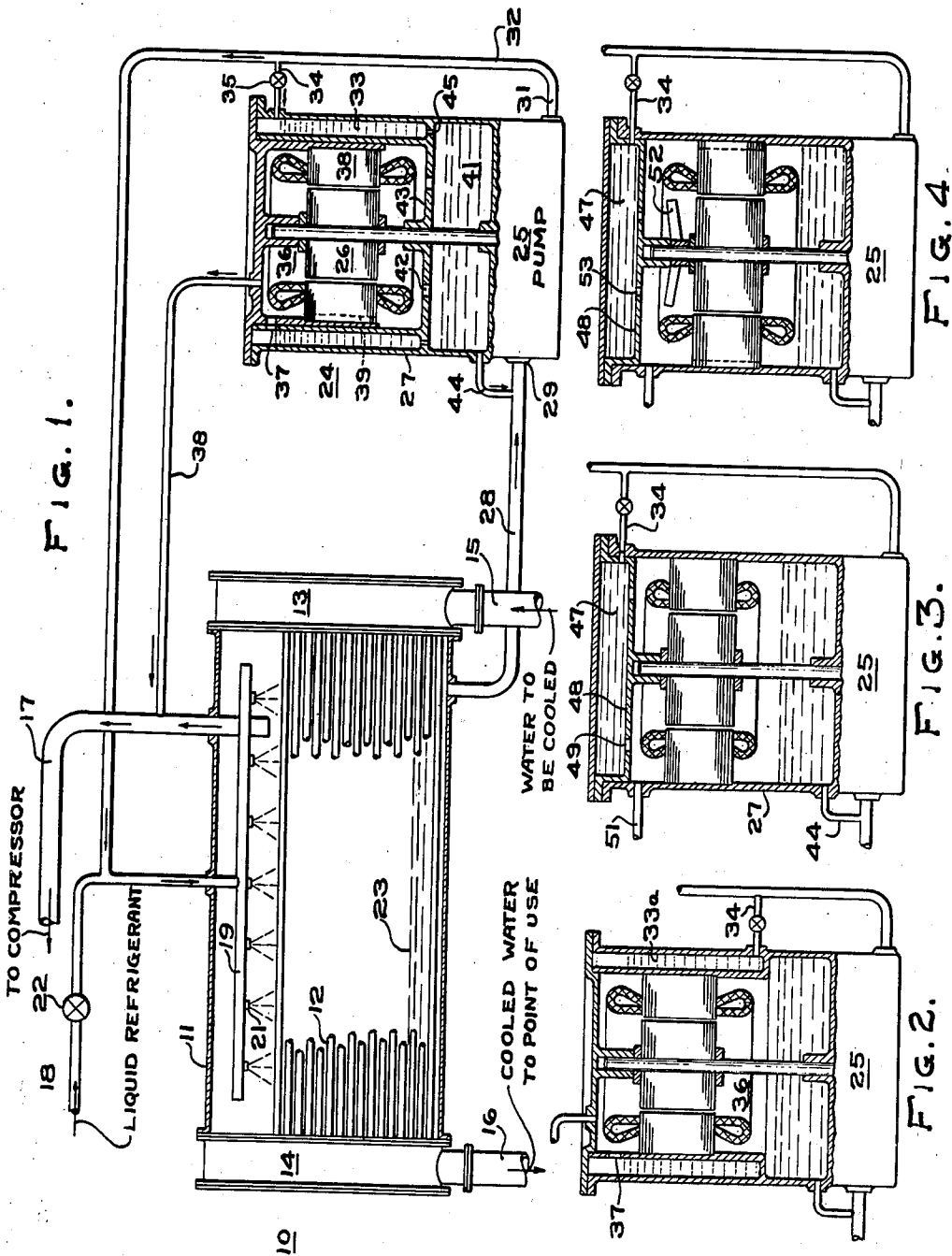


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E. P. CODLING
REFRIGERATING APPARATUS

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WITNESSES:

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REFRIGERATING APPARATUS

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My invention relates to refrigerating apparatus, more particularly to an enclosed motor driven pump unit for circulating liquid refrigerant through the evaporator, and it has for an object to provide improved apparatus of the character set forth.

A particular object is to provide improved means for cooling the motor of such an enclosed motor driven pump unit.

The above recited and other objects are effected by my invention as will be apparent from the following description and claims taken in accordance with the accompanying drawing, forming a part of this application, in which:

Fig. 1 is a diagrammatic view of the apparatus in accordance with my invention; and

Figs. 2, 3 and 4 are vertical sectional views showing modified arrangements for cooling the enclosed motor which drives the pump.

Referring to the drawing in detail, I show an evaporator 10, which is in the form of a shell and tube heat exchanger and which is used for cooling water. The evaporator comprises a shell 11, a group of tubes 12 disposed therein, and inlet and outlet chambers 13 and 14 communicating with the opposite ends of the tubes. The water to be cooled is conveyed through a conduit 15 to the inlet chamber 13, then flows through the tubes 12 to the outlet chamber 14, and then to a conduit 16 through which it is conveyed to the point of use. The flow of the water may be effected in any suitable manner, as by means of a pump (not shown).

Cooling of the water flowing through the tubes is effected by spraying liquid refrigerant onto the outer surfaces of the tubes and by maintaining a reduced pressure within the shell 11, so that heat is extracted from the water by vaporization of liquid refrigerant on said outer surfaces. The vaporized refrigerant is removed from shell 11 at a low pressure through a suction conduit 17. It is conveyed to the compressor of any suitable type of condensing unit, in which it is compressed, condensed and then returned to the evaporator 10 through a liquid supply conduit 18. The liquid refrigerant is admitted to the shell 11 in any suitable manner, as through one or more manifolds 19 having nozzles 21 for directing sprays of refrigerant onto the outer surfaces of the tubes. The flow of liquid refrigerant through the conduit 18 is controlled by a valve 22, which is actuated in any suitable and desirable manner known in the art; for example, it may be actuated to maintain a constant level

of liquid refrigerant within the shell 11 as indicated at 23.

Inasmuch as a copious supply of liquid refrigerant is sprayed onto the outer surfaces of the tubes 12, in order to completely wet said surfaces, the major portion of said liquid refrigerant remains unevaporated and collects in the bottom of the shell 11. A motor driven pump unit 24, including a pump 25, is provided for recirculating the unevaporated liquid refrigerant by returning the same to the spray nozzles 21. Liquid refrigerant flows by gravity from the bottom of the shell 11 through a conduit 28 to the inlet 29 of the pump 25. It is discharged from the pump outlet 31 and conveyed to the spray nozzles 21 in the evaporator in any suitable manner; for example, it may be, as shown, conveyed through a conduit 32 to the conduit 18 at a point preferably beyond the valve 22. It mixes with the liquid refrigerant flowing from the condensing unit through the conduit 18 and flows through the manifolds 19 to the spray nozzles 21, from which it is again sprayed onto the outer surfaces of the tubes 12.

The pump 25, so far as the present invention is concerned, may be of any suitable type desired. The motor driven pump unit 24 includes, in addition to the pump 25, a motor 26 direct connected to the pump for driving the same. It further includes a casing 27 for enclosing both the pump and the motor, the purpose of providing a common casing being to eliminate the necessity of a shaft seal where the shaft extends through the casing of the pump. When the motor is enclosed, as in the structure shown on the drawing, there is presented the problem of adequately cooling the motor and the present invention relates to this problem. In accordance with the present invention, I use a portion of the liquid refrigerant circulated by the pump 25 for cooling the motor. The casing 27 is formed with a jacket 33 encompassing the motor 26. Liquid refrigerant discharged from the pump 25 is admitted to the jacket 33 through the conduit 32 and a connecting conduit 34, the latter preferably having a valve 35 by means of which the admission of liquid refrigerant to the chamber 33 may be adjusted. The top of the jacket 33 communicates with the chamber 36, in which the motor is disposed, by means of openings 37. The chamber 36 is in communication with the suction conduit 17, which communication may be provided by a conduit 38 as shown. Cooling of the motor is effected, therefore, by vaporization of liquid, refrigerant in the jacket 33, the refrigerant vapor

flowing through the openings 37, the chamber 36 and the conduit 38 to the suction conduit 17. Preferably, the valve 35 is opened to a sufficient extent to cause liquid refrigerant to overflow through the openings 37 onto the windings and the laminations of the stator 38, so that the stator is also cooled by direct contact with the liquid refrigerant. Slots or recesses 39 are preferably formed in the stator so that surplus liquid refrigerant may flow therethrough to the bottom of the chamber 36.

A chamber 41 is preferably provided between the pump and motor containing portions of the casing, and openings 42 are provided in the wall 43 between the chambers 36 and 41 through which the surplus liquid refrigerant may drain into the chamber 41. From the chamber 41, the liquid refrigerant flows by gravity through a connecting conduit 44 to the conduit 27 and thence to the pump inlet 25.

If desired, orifices 45 may be formed, as shown, to provide a restricted flow of liquid refrigerant from the jacket 33 to the chamber 41 in order to remove any oil which may accumulate in the jacket 33 due to the vaporization of the liquid refrigerant.

The heat generated in the rotor of the motor 26 is removed in part by the refrigerant vapor within the chamber 36, in part by conduction to the outside of the casing and then by radiation and convection to the atmosphere and also in part by conduction through the stator 38, from which the heat is removed as described above.

In the arrangement shown in Fig. 2, the conduit 34 is connected to the bottom of the jacket 33a. In this case, the orifices 45 of Fig. 1 are not required, as all portions of the liquid in the jacket gradually flow upwardly and outwardly through the openings 37, thereby avoiding any accumulation of oil within the jacket. The bottom wall 43 of Fig. 1 is also omitted, the chamber 36 extending downwardly sufficiently to drain liquid from the parts of the motor to avoid flooding the same.

In the embodiment shown in Fig. 3, the jacket 33, of Fig. 1 is omitted, the motor being cooled by spraying liquid refrigerant directly onto the stator. The cover 46 for the casing 27a is provided with a chamber or jacket 47 to which the conduit 34 is connected. The bottom wall 48 of the chamber 47 is formed with openings 49 disposed to direct sprays or jets of liquid refrigerant against the windings of the stator. In this case, the stator is cooled by direct contact with the liquid refrigerant, the vaporized refrigerant being withdrawn through the conduit 51 and the unvaporized liquid refrigerant being drained through the conduit 44 as in the first embodiment.

In the embodiment shown in Fig. 4, the cover is again provided with a chamber or jacket 47 connected to the conduit 34. An impeller or thrower 52 is mounted on the rotor shaft. The wall 48 is formed with openings 53 disposed so as to direct liquid refrigerant onto the thrower 52. The latter, rotating at high speed with the rotor shaft, throws the liquid refrigerant onto the stator windings by centrifugal force. In other respects, the embodiments shown in Figs. 3 and 4 may be similar to the embodiment shown in Fig. 1 or that shown in Fig. 2.

From the above description, it will be seen that I have provided means for effectively cooling the enclosed motor of a pump for circulating liquid refrigerant through an evaporator. While it utilizes a portion of the refrigerating capacity

of the system, such portion is small and is offset by the simplified arrangement and the effectiveness of the cooling.

While I have shown my invention in several forms, it will be obvious to those skilled in the art that it is not so limited but is susceptible of various other changes and modifications without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What I claim is:

1. In refrigerating apparatus, the combination of an evaporator, means including a pump for circulating liquid refrigerant through the evaporator, a motor for driving the pump, a casing enclosing the pump and the motor, means for supplying liquid refrigerant to the motor containing portion of the casing, means for removing vaporized refrigerant therefrom, and means for draining liquid refrigerant therefrom to the inlet of the pump.

2. In refrigerating apparatus, the combination of an evaporator, means including a pump for circulating liquid refrigerant through the evaporator, a motor for driving the pump, a casing enclosing the pump and the motor, means for conveying liquid refrigerant in heat transfer relation to said motor for cooling the same, means for removing the vaporized refrigerant from said last-mentioned means and for draining unevaporated liquid refrigerant therefrom to the inlet of the pump.

3. In a refrigerating system having a low pressure side including a suction line, the combination of an evaporator, a pump for circulating liquid refrigerant therethrough, a motor for the pump, a casing enclosing the pump and the motor, means for admitting liquid refrigerant from the low pressure side of the system to the motor containing portion of said casing, and means for connecting said motor containing portion with said suction line.

4. In refrigerating apparatus, the combination of a pump unit comprising a pump, a motor for driving the pump, and a casing enclosing the pump and the motor, the motor containing portion of said casing having an inlet for liquid refrigerant and an outlet for vaporized refrigerant, and means for draining unevaporated liquid refrigerant to the inlet of said pump.

5. In a refrigerating system, the combination of an evaporator, means for removing vaporized refrigerant from the evaporator, means including a pump for delivering liquid refrigerant to the evaporator, a motor for driving the pump, a casing enclosing the motor, means for supplying liquid refrigerant from the outlet of the pump to the casing to cool the motor, and means connecting the casing with said vapor removal means to effect cooling of the motor by vaporization of liquid refrigerant.

6. In a refrigerating system, the combination of an evaporator, means for removing vaporized refrigerant from the evaporator, means including a pump for delivering liquid refrigerant to the evaporator, a motor for driving the pump, a casing enclosing the motor, means for supplying liquid refrigerant from the outlet of the pump to the casing to cool the motor, means connecting the casing with the vapor removal means to effect cooling of the motor by vaporization of liquid refrigerant, and means for drain-

ing unevaporated liquid refrigerant from the casing to the inlet of the pump.

7. In refrigerating apparatus, the combination of a pump unit for liquid refrigerant comprising a pump, a motor for driving the pump, and a casing enclosing the pump and the motor, means for directing liquid refrigerant onto the windings of the motor, means for removing vaporized refrigerant from the casing, and means for draining unevaporated liquid refrigerant from the motor winding to avoid flooding thereof.

8. In refrigerating apparatus, the combination of an evaporator, means including a pump for circulating liquid refrigerant through the evaporator, a motor for driving the pump, a casing enclosing the pump and the motor, means for directing a stream of liquid refrigerant onto the windings of the motor, means for removing vaporized refrigerant from the motor containing portion of the casing, and means for draining liquid refrigerant from said motor containing portion to the inlet of the pump.

9. In a refrigerating system, the combination of an evaporator, a pump for circulating liquid refrigerant through the evaporator, a motor for driving the pump, a cooling fluid jacket for the motor, means for admitting liquid refrigerant from the outlet of the pump to the jacket, and means for subjecting the interior of the jacket to the reduced pressure in the evaporator and for removing vaporized refrigerant therefrom.

10. In refrigerating apparatus, the combination of a pump unit for liquid refrigerant comprising a pump, a motor for driving the pump, and a casing enclosing the pump and the motor, said casing having a motor-containing chamber and a cooling jacket encompassing the chamber, means for delivering liquid refrigerant from the outlet of the pump to the jacket and to the motor windings, means for removing vaporized refrigerant

from the chamber and from the upper portion of the jacket, and means for draining unevaporated liquid from the motor windings to the inlet of the pump.

11. In refrigerating apparatus, the combination of an evaporator, a liquid line for supplying liquid refrigerant to said evaporator, a suction line for removing vaporized refrigerant from said evaporator, means receiving unevaporated liquid refrigerant from the bottom of said evaporator and circulating the same through said evaporator, said means including a liquid pump, a motor driving said pump, and a casing enclosing said pump and said motor, means for directing liquid refrigerant from the bottom of said evaporator into contact with said motor, and means for conveying vaporized refrigerant from the motor-containing portion of said casing to said suction line to effect cooling of the motor by vaporization of liquid refrigerant.

12. In refrigerating apparatus, the combination of an evaporator, a liquid line for supplying liquid refrigerant to said evaporator, a suction line for removing vaporized refrigerant from said evaporator, means receiving unevaporated liquid refrigerant from the bottom of said evaporator and circulating the same through said evaporator, said means including a liquid pump, a motor driving said pump, and a casing enclosing said pump and said motor, said casing having a chamber in which said motor is disposed, means for directing liquid refrigerant from the bottom of said evaporator into contact with said motor, means for conveying vaporized refrigerant from said chamber to said suction line to effect cooling of the motor by vaporization of liquid refrigerant, and means for draining unevaporated liquid refrigerant from said chamber.

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