Sept. 26, 1933. A. MEYER 1,928,386

REFRIGERATING APPARATUS

Filed Nov. 22, 1932 2 Sheets-Sheet 1

Fig. 1.

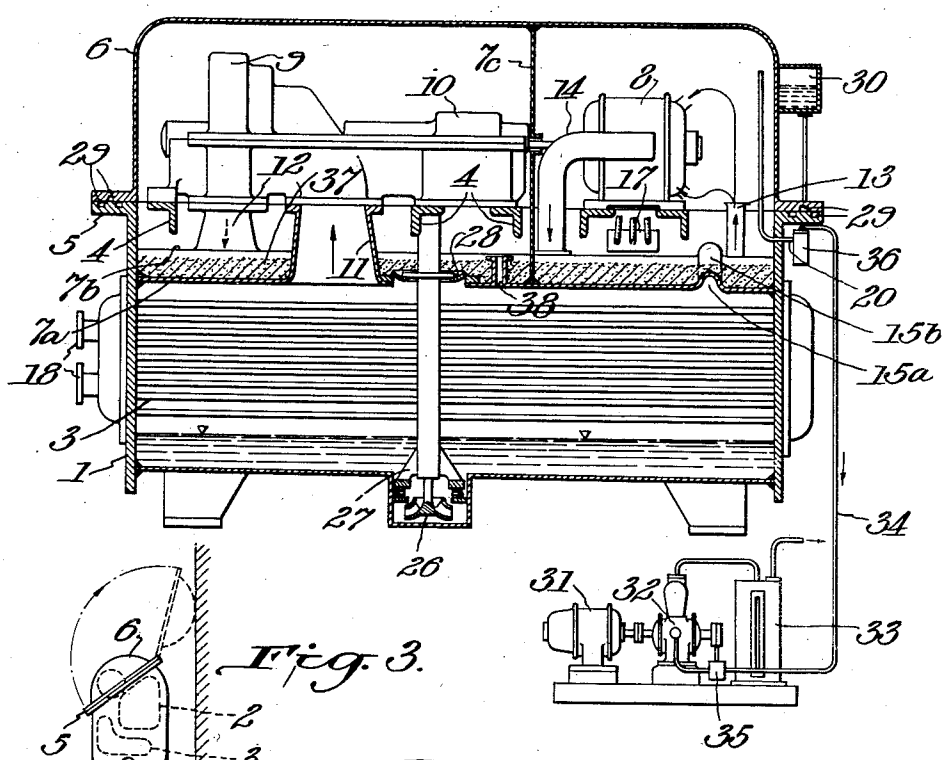
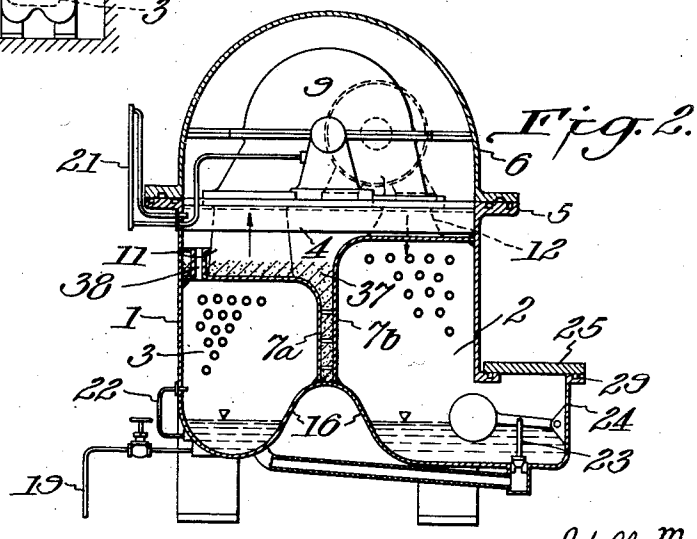


Fig. 3.

Fig. 2.



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2 Sheets-Sheet 2

Fig. 4.

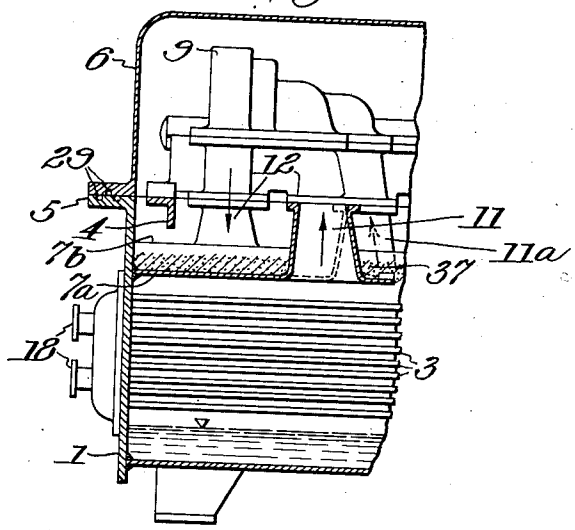
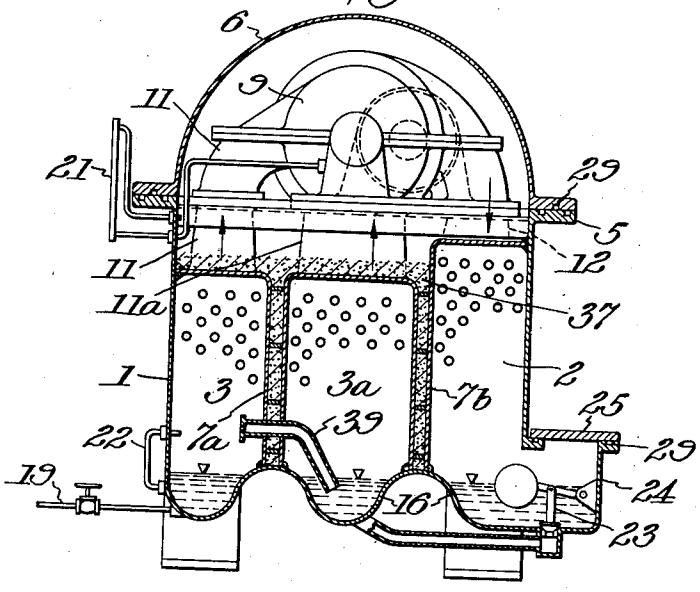


Fig. 5.



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UNITED STATES PATENT OFFICE

1,928,386

REFRIGERATING APPARATUS

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15 Claims. (Cl. 62—115)

This invention relates to refrigerating apparatus, and particularly to refrigerating apparatus of large capacity for industrial use.

A principal object of the invention is to provide a fully enclosed refrigerating apparatus for industrial application.

A further object is to provide a compact refrigerating apparatus of large capacity in which excessive heat loss is avoided and troubles arising from unequal thermal expansion of the structural elements are eliminated.

It is known to build on a block and completely enclose small refrigerating machines such as, for example, household machines, including the motor. Larger machines have also been built on a block, but in this case the enclosing of the motor compressor unit has been avoided.

Because of the crowded nature of the assembly, and the previously practiced arrangement of the individual parts, certain difficulties arise with respect to heat transfer and the varying expansion of the structural elements at very different temperatures, which difficulties readily give rise to disturbances in the operation of the machines.

Briefly stated, the invention comprises a refrigerating apparatus, including a case containing the evaporator, and the condenser, which also serves as a base for the refrigerating machine. The case is reinforced with a number of cross members in order to form a firm foundation for the placing of the motor-compressor unit above the evaporator condenser assembly, and is provided at its upper edge with a flange to which is attached a housing or dome covering the motor-compressor unit. The space enclosed by the case and the dome is subdivided by partitions welded to the case in such a way that evaporator, condenser, motor and compressor with the gears, are disposed separately, each in a chamber.

In this arrangement the evaporator and the condenser form the base for the whole assembly. The other parts, compressor, motor and drive, are fixed thereto independently. Connecting ports for maintaining the refrigerant circuit from one chamber to another are provided in the separating partitions which are also provided with resilient or elastic inserts in order to insure free expansion.

The invention will be more fully described with reference to the accompanying drawings.

Fig. 1 shows a longitudinal view, in partial section, of a completely enclosed refrigerating machine assembled upon a single block in accordance with the invention.

Fig. 2 is a transverse view in partial section of the refrigerating machine of Fig. 1.

Fig. 3 is a diagrammatic illustration of a modification of the invention.

Figs. 4 and 5 are a fragmentary longitudinal section and a transverse section of a refrigerating machine having a plurality of evaporators.

In the figures, 1 is a case adapted to form a base for the refrigerating machine and containing the evaporator 3 and condenser 2. Above the evaporator and condenser, the case is reinforced by a number of cross beams 4. These cross beams provide a solid foundation for the motor-compressor unit. The case is provided at its upper edge with a flange 5, and a dome 6 surrounding the motor-compressor unit is secured to this flange. The space enclosed by the case and the dome is subdivided by partitions 7*a*, 7*b*, and 7*c*, welded to the box, into chambers in such a way that the evaporator, the condenser, the motor 8, and the compressor 9 with drive 10 are arranged each in a chamber. The evaporator, condenser and motor-compressor units are arranged horizontally, or nearly horizontally, and axially parallel to each other.

11 is a suction pipe leading from the evaporator to the compressor, 12 is the pressure pipe of the compressor leading to the condenser, and 13 is a pipe connecting with the condenser through which, with the help of the ventilating action of the motor, cooled refrigerant vapors are sucked into cool the motor. These vapors are led back again through connection 14 into the condenser. All of these pipes are connected to the partitions 7*a* and 7*b* of the condenser-, evaporator- and motor-compressor chambers.

In order to equalize the expansion caused by different temperatures, the partitions 7*a*, 7*b* are provided at suitable places with expansion members or inserts of resilient or elastic material 15*a* and 15*b*. Moreover, the thickness of the partitions is so chosen that movement perpendicular to the plate is possible so that the expansions of the cold suction pipe 11 and the warm pressure pipe 12 are sufficiently compensated for.

The tube headers of the condenser and the evaporator form the end surfaces of the base casing 1 and are welded gas-tight thereto. The bottom 16 of the box is formed with a longitudinal arch (see Fig. 2) in order to separate the liquid reservoirs of the condenser and evaporator from each other and thereby prevent undesired heat transfer. The vapor chambers themselves are insulated from each other by filling the space be-

tween partitions 7a and 7b with heat insulating material 37.

All of the devices for current lead-in 17, for cold water and refrigerant 18, for filling and emptying 19, for de-aerating 20, the oil gage 21 and the liquid gage 22 of the evaporator and condenser are preferably attached to the case so that loosening or removal of these devices is unnecessary when the dome must be taken off for any reason.

The liquid regulating valve 23 provided between the condenser and evaporator is shown as a float valve. The outer housing 24 is welded to the side of the base casing and is provided with a removable cover 25. In this way the valve is made accessible for control without the necessity of taking off the dome.

The rotary pump 26 for the circulation of liquid in the evaporator is set into from above through partition 7a. It is supported in the evaporator by spider 27 in such a way that the resilient ring 28 seals the evaporator chamber from the compressor chamber at the point where the sleeve of the pump shaft passes through partition 7a. The impeller of the pump is arranged in a sump in the bottom of the evaporator whereby a greater influx height is provided for the refrigerant. The pump is driven through a horizontal drive shaft. The whole arrangement of the vertical pump is such that it may be simply suspended from above and by its own weight compresses the resilient packing rings so as to effect the proper positioning of the pump as well as the effective closure of the opening in the partition.

The interior heat losses of such an enclosed refrigerating machine can be diminished by arranging the individual elements in such a way that there are no large temperature differences between them. For instance, in the case of a multi-stage evaporation and condensation, the individual parts of the apparatus are adjacent each other, according to increasing or decreasing temperature, so that the temperature difference between the neighboring parts is therefore a minimum.

The flange connection between case 1 and dome 6, as well as all of the connections, are advantageously provided with a liquid closure against air entrance and exit. For this purpose, channels 29 are provided which are automatically filled from a reservoir 30 containing refrigerant.

The de-aeration of the assembly is effected by means of an auxiliary unit placed near the main assembly. This auxiliary unit consists of motor 31, compressor 32 and auxiliary condenser 33. The de-aeration pipe 34 is provided with an automatic valve 35 which is automatically cut off from connection with the main apparatus after de-aeration. In this way, passage of air from the de-aeration pipe back to the main assembly is prevented. It is advantageous to build the pump as a high vacuum pump so that it can be used likewise for production of a vacuum. It can also be used for filling the apparatus in that the apparatus when pumped free of air will automatically suck up liquid through pipe 19 from a container placed at a lower level. On the de-aerating pipe there is provided an air gage 36 which indicates the amount of air present at any time.

As indicated diagrammatically in Fig. 3, condenser 2 and evaporator 3 may be arranged in a different manner from that shown in Figs. 1 and 2. The separating flange and the dome are shown in an inclined position. The dome 6 may be constructed in the form of a lid.

In the machine shown in Figs. 4 and 5 there are two evaporators 3 and 3a connected for flow of liquid refrigerant from 3a to 3 or in the order of decreasing temperatures by conduit 39. The evaporators 3 and 3a are connected to compressor 9 by conduits 11 and 11a, respectively.

In the previously known machines of this type, great care must be taken to provide for heat insulation of the different partitions, especially because the whole housing is filled with vaporized refrigerant, and insulation by means of air layers is impossible. Every machine part and every wall in the interior of the machine which is at a temperature below the saturation point of the surrounding vapor becomes a condensation surface. Since the heat conductivity of the condensing vapor is high, this may lead to very great heat losses. It is impossible to protect such condensing surfaces against heat transfer by means of the usual insulation, since the usual heat insulating materials which are valuable in ordinary uses are practically useless in the machine in most cases. This is because such materials are almost always porous and effect very good insulation by reason of the fact that they contain very fine air spaces. In a vapor atmosphere such as obtains in machines of the present type, these pores do not serve any useful purpose, since they become filled with vapor which condenses at low temperatures. The insulation then becomes completely saturated with refrigerant liquid and the insulating effect is considerably diminished. This behavior of the insulating materials cannot be prevented by impregnation, since nearly all materials used for this purpose are soluble in refrigerating agents, so that they are washed out of the insulating material.

These disadvantages are overcome in the present invention by maintaining the spaces in which the heat insulating material is placed at the lowest pressure obtaining in the machine; that is, at the evaporator pressure. The gas pressure in the pores of the insulating material is the saturation pressure which corresponds to the lowest temperature in the machine, but since the insulating material, because of its position between cold and warm spaces, is at a higher temperature than that, no condensation can take place. The pores are therefore filled with superheated vapor, the insulating effect of which is very good, as is well known.

In the present construction this effect can be best obtained by placing the space containing compressor 9 and drive 10 under the evaporator pressure with the aid of opening 38 in partition 7a. The insulating layers 37 which are all in this space will not now become wet, as explained above, and will have a permanent insulating action. The motor remains under the condenser pressure, since it is advantageous to connect the ventilation circuit of the motor to the condenser so that the windings are cooled with the refrigerant at condenser pressure and the motor heat losses are directly removed by the cooling water in the condenser.

I claim:

1. A completely enclosed refrigerating apparatus including a motor-compressor assembly, a condenser and an evaporator, a casing providing a container for said evaporator and condenser, a plurality of transverse stiffening members positioned in the upper portion of said casing and

cooperating therewith to provide a rigid base for said motor-compressor assembly, a dome adapted to be fastened to the top of said casing and to enclose said motor-compressor assembly, and partitions dividing the space enclosed within said casing and dome into chambers separately enclosing the evaporator, the condenser, the compressor and the motor.

2. A completely enclosed refrigerating apparatus including a motor-compressor assembly, a condenser and an evaporator, a casing providing a container for said evaporator and condenser, a plurality of transverse stiffening members positioned in the upper portion of said casing and cooperating therewith to provide a rigid base for said motor-compressor assembly, a dome adapted to be fastened to the top of said casing and to enclose said motor-compressor assembly, partitions dividing the space enclosed within said casing and dome into chambers separately enclosing the evaporator, the condenser, the compressor and the motor, said partitions being provided with openings adapted for the conduction of vapor from the evaporator to the compressor, from the compressor to the condenser, and from the condenser to the motor.

3. A completely enclosed refrigerating apparatus including a motor-compressor assembly, a condenser and an evaporator, a casing providing a container for said evaporator and condenser, a plurality of transverse stiffening members positioned in the upper portion or said casing and cooperating therewith to provide a rigid base for said motor-compressor assembly, a dome adapted to be fastened to the top of said casing and to enclose said motor-compressor assembly, partitions dividing the space enclosed within said casing and dome into chambers separately enclosing the evaporator, the condenser, the compressor and the motor, said partitions being provided with expansion members adapted to permit thermal expansion of the structural units of the assembly.

4. A completely enclosed refrigerating apparatus including a motor-compressor assembly, a condenser and an evaporator, a casing providing a container for said evaporator and condenser, a plurality of transverse stiffening members positioned in the upper portion of said casing and cooperating therewith to provide a rigid base for said motor-compressor assembly, a dome adapted to be fastened to the top of said casing and to enclose said motor-compressor assembly, partitions dividing the space enclosed within said casing and dome into chambers separately enclosing the evaporator, the condenser, the compressor and the motor, the headers of the tube sheaves of the condenser and evaporator being welded to said casing to form a portion of the surface thereof.

5. A completely enclosed refrigerating apparatus including a motor-compressor assembly, a condenser and an evaporator, a casing providing a container for said evaporator and condenser, a plurality of transverse stiffening members positioned in the upper portion of said casing and cooperating therewith to provide a rigid base for said motor-compressor assembly, a dome adapted to be fastened to the top of said casing and to enclose said motor-compressor assembly, partitions dividing the space enclosed within said casing and dome into chambers separately enclosing the evaporator, the condenser, the compressor and the motor, the external auxiliary devices of said apparatus being positioned on said casing.

6. A completely enclosed refrigerating apparatus including a motor-compressor assembly, a condenser and an evaporator, a casing providing a container for said evaporator and condenser, a plurality of transverse stiffening members positioned in the upper portion of said casing and cooperating therewith to provide a rigid base for said motor-compressor assembly, a dome adapted to be fastened to the top of said casing and to enclose said motor-compressor assembly, partitions dividing the space enclosed within said casing and dome into chambers separately enclosing the evaporator, the condenser, the compressor and the motor, and a valve adapted to control the flow of liquid from said compressor to said evaporator, the housing of said valve being integral with said casing and having a removable cover external to said casing.

7. A completely enclosed refrigerating apparatus including a motor-compressor assembly, a condenser and an evaporator, a casing providing a container for said evaporator and condenser, a plurality of transverse stiffening members positioned in the upper portion of said casing and cooperating therewith to provide a rigid base for said motor-compressor assembly, a dome adapted to be fastened to the top of said casing and to enclose said motor-compressor assembly, partitions dividing the space enclosed within said casing and dome into chambers separately enclosing the evaporator, the condenser, the compressor and the motor, and a pump disposed in said evaporator to circulate the liquid thereof, said pump being driven from the compressor drive shaft and being so positioned in that the opening between the compressor chamber and the evaporator chamber is closed by the weight of the pump resting on a resilient closure member.

8. A refrigerating apparatus as defined in claim 1 comprising a plurality of evaporators arranged in the order of decreasing temperatures.

9. A completely enclosed refrigerating apparatus including a motor-compressor assembly, a condenser and an evaporator, a casing providing a container for said evaporator and condenser, a plurality of transverse stiffening members positioned in the upper portion of said casing and cooperating therewith to provide a rigid base for said motor-compressor assembly, a dome adapted to be fastened to the top of said casing and to enclose said motor-compressor assembly, partitions dividing the space enclosed within said casing and dome into chambers separately enclosing the evaporator, the condenser, the compressor and the motor, the closure between said casing and said dome including a liquid seal containing refrigerant.

10. A completely enclosed refrigerating apparatus including a motor-compressor assembly, a condenser and an evaporator, a casing providing a container for said evaporator and condenser, a plurality of transverse stiffening members positioned in the upper portion of said casing and cooperating therewith to provide a rigid base for said motor-compressor assembly, a dome adapted to be fastened to the top of said casing and to enclose said motor-compressor assembly, partitions dividing the space enclosed within said casing and dome into chambers separately enclosing the evaporator, the condenser, the compressor and the motor, and means external of said casing for indicating the gas and liquid contents of said apparatus.

11. A completely enclosed refrigerating apparatus including a motor-compressor assembly, a condenser and an evaporator, a casing providing a container for said evaporator and condenser, a plurality of transverse stiffening members positioned in the upper portion of said casing and cooperating therewith to provide a rigid base for said motor compressor assembly, a dome adapted to be fastened to the top of said casing and to enclose said motor-compressor assembly, partitions dividing the space enclosed within said casing and dome into chambers separately enclosing the evaporator, the condenser, the compressor and the motor, the motor-compressor assembly, the condenser and the evaporator being arranged with their longitudinal axes parallel.

12. A completely enclosed refrigerating apparatus including a motor-compressor assembly, a condenser and an evaporator, a casing providing a container for said evaporator and condenser, a plurality of transverse stiffening members positioned in the upper portion of said casing and cooperating therewith to provide a rigid base for said motor-compressor assembly, a dome adapted to be fastened to the top of said casing and to enclose said motor-compressor assembly partitions dividing the space enclosed within said casing and dome into chambers separately enclosing the evaporator, the condenser, the compressor and the motor, and heat insulating means between said evaporator and said condenser, maintained under the pressure prevailing in the evaporator.

13. A completely enclosed refrigerating apparatus including a motor-compressor assembly, a condenser and an evaporator, a casing providing a container for said evaporator and condenser, a plurality of transverse stiffening members positioned in the upper portion of said casing and cooperating therewith to provide a rigid base for said motor-compressor assembly, a dome adapted to be fastened to the top of said casing and to enclose said motor-compressor assembly, partitions dividing the space enclosed within said casing and dome into chambers separately enclosing the evaporator, the condenser, the compressor and the motor, the chamber in which the motor is placed being maintained under the pressure prevailing in the condenser.

14. A refrigerating system comprising a completely enclosed refrigerating apparatus as defined in claim 1 and means associated therewith for de-aerating said apparatus including a high vacuum pump.

15. A refrigerating system comprising a completely enclosed refrigerating apparatus as defined in claim 1, means associated therewith for de-aerating said apparatus including a high vacuum pump and an automatic liquid seal between said apparatus and said de-aerating means adapted to prevent the passage of air from said de-aerating means into said apparatus.

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