Jan. 30, 1940. L. A. PHILIPP 2,188,893

REFRIGERATING APPARATUS

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Fig. 2

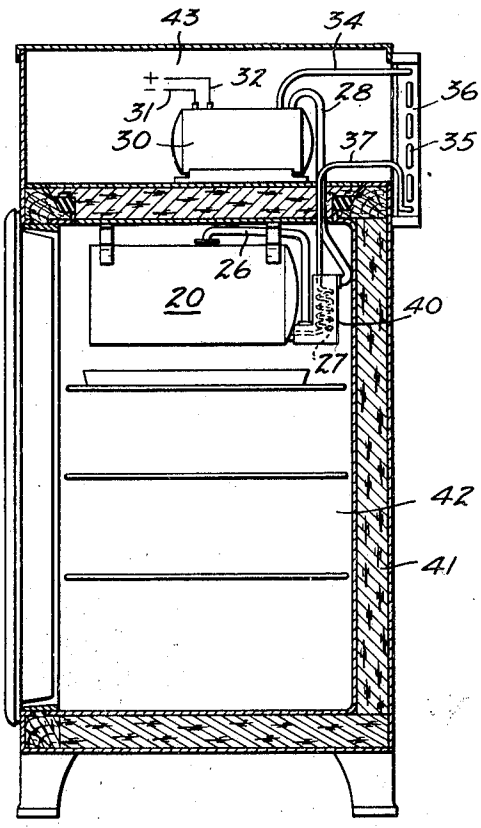
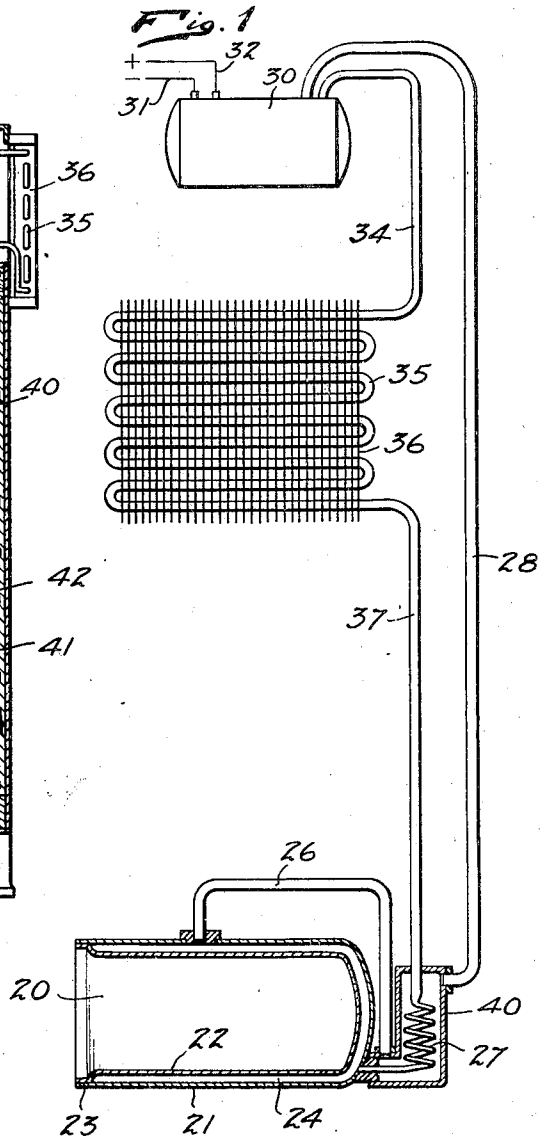


Fig. 1



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Fig. 4

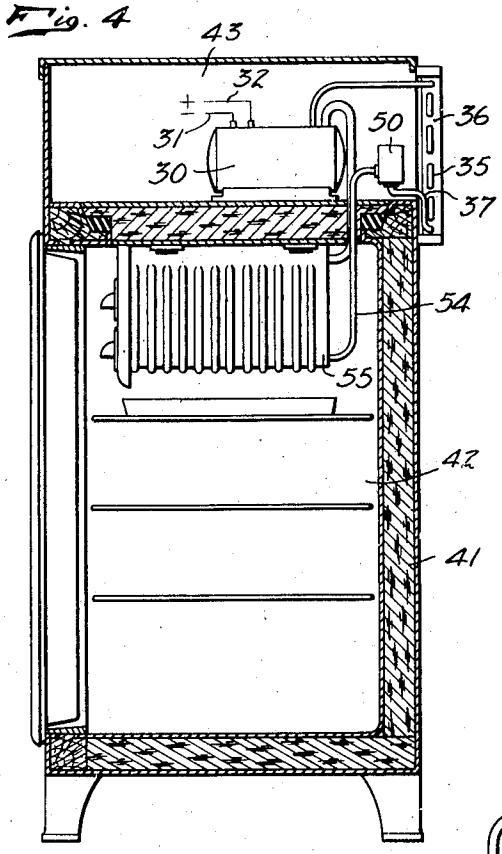
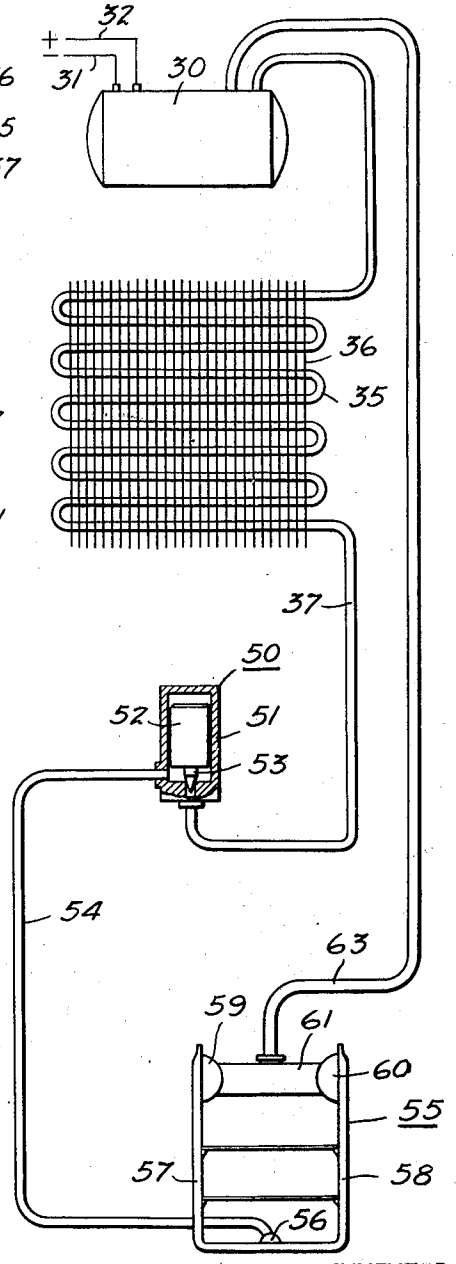


Fig. 3



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Patented Jan. 30, 1940 2,188,893

UNITED STATES PATENT OFFICE

2,188,893

REFRIGERATING APPARATUS

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Application June 4, 1934, Serial No. 728,941

1 Claim. (Cl. 62—115)

The present invention relates to refrigerating system and particularly to refrigerating system of the compressor-condenser-expander type.

One of the objects of the present invention is to provide an improved method of and apparatus for increasing and decreasing the refrigerating effect of a refrigerating system in accordance with increasing and decreasing demands, respectively, for refrigeration on the evaporator of the system.

In carrying out the above object, it is another object of the present invention to increase and decrease the contact surface between the liquid refrigerant and the interior walls of the evaporator in accordance with respective demands for refrigeration on the evaporator.

It is another object of my invention to provide a mechanical refrigerating system of the type wherein the condenser is exposed to environment air where its condensing function is influenced by changes in environment temperature, with conduit means including an elongated orifice interconnecting the evaporator and condenser in such a manner that liquid refrigerant is stored in part of the condenser and to arrange for the interchange of heat between the liquid refrigerant passing through said elongated orifice and the refrigerant leaving the evaporator to aid in passing liquid refrigerant only to the evaporator.

A further object of the present invention is to substantially proportionately vary the liquid refrigerant contents of the high side and low side of a refrigerating system in accordance with variations in demands for refrigeration, for example, to increase the contact area of liquid refrigerant in the evaporator and decrease the contact area of liquid refrigerant in the condenser upon an increase in room temperature and, vice versa, decrease the contact area of liquid refrigerant in the evaporator and increase the contact area of liquid refrigerant in the condenser upon a decreasing demand for refrigeration on the evaporator.

Further objects and advantages will be apparent from the following disclosure, reference being had to the accompanying drawings wherein preferred forms of embodiments of the present invention are clearly shown:

Fig. 1 is a diagrammatic view of my improved refrigerating system;

Fig. 2 is a longitudinally sectional view of a refrigerator cabinet showing the improved refrigerating system therein;

Fig. 3 is a diagrammatic view of a refrigerating system showing a modified form thereof; and

Fig. 4 is a view similar to Fig. 2 but showing the system of Fig. 3 therein.

The present invention contemplates broadly, a refrigerating system in which the effective refrigerating capacity of the evaporator is increased and decreased automatically, through inherent characteristics of the system, in accordance with increasing and decreasing demands, respectively, for refrigeration on the evaporator. If the environment of the refrigerator cabinet is relatively warm, the refrigeration effect of the evaporator is increased in order to maintain the interior of the evaporator at a substantially constant temperature at all times. This is accomplished by increasing the cooling surface between the liquid refrigerant and the interior walls of the evaporator so that a larger portion of the evaporator is in contact with the liquid refrigerant upon increasing demand for refrigeration on the evaporator. This refrigerating system contains a fixed quantity of refrigerant. Part of this refrigerant is in the liquid state and the remaining part thereof is in a gaseous state. In accordance with the present invention, the volume of liquid refrigerant is varied in the evaporator and in the condenser in accordance with changes in demands for refrigeration. I have discovered, that by providing a fixed or substantially fixed restriction between the condenser and the evaporator, that a quantity of liquid refrigerant can be shifted from the condenser to the evaporator upon an increasing demand for refrigeration on the evaporator. In this manner more surface of the evaporator is in contact with liquid refrigerant and, vice versa, a quantity of liquid refrigerant is automatically shifted from the evaporator to the condenser upon a decreasing demand for refrigeration on the evaporator whereby, under the latter condition, the condensing surface of the evaporator containing gaseous refrigerant is decreased.

Referring to the drawings particularly to Fig. 1, wherein there is shown an evaporator 20 of the sheet metal type employing two concentric sleeves 21 and 22 spaced from one another throughout a large portion thereof and which are joined together at the edges as at 23. The space 24 between the sleeves 21 and 22 forms a chamber for liquid refrigerant and a gas space at the top. Gaseous refrigerant is withdrawn from the evaporator 20 by a pipe 26 which leads into a chamber 40 and is conducted therefrom by pipe 28 to a motor driven compressor unit

30. Electric current is supplied to this unit 30 by wires 31 and 32. The refrigerant which is compressed by unit 30 is conducted by pipe 34 to a condenser 35 having fins 36 thereon for increasing the heat dissipating surface thereof. The compressed gaseous refrigerant is condensed and liquefied within the condenser 35 and is conducted therefrom by pipe 37. This pipe 37 leads into a chamber 40 and is there joined with a capillary tube 27. It will be appreciated by those skilled in the art, that the capillary tube must be of such length and internal diameter to restrict the flow of liquid refrigerant therethrough to such an extent so as to maintain an appreciable pressure differential on the opposite ends thereof. The outlet of the capillary tube forms the inlet to the evaporator 20.

Fig. 2 shows the application of this system to a refrigerator box in which the numeral 41 indicates the cabinet having a food storage compartment 42 and a machine compartment 43. The evaporator 20 is disposed within the food compartment and the motor compressor unit 30 is disposed within the machine compartment 43. The condenser 35 may be cooled in any suitable manner as for example by forcing air thereover by some mechanical means but for the purpose of illustrating the invention the condenser is disposed outside the machine compartment 43 and due to the heat generated therein causes a natural circulation of air thereover.

I have discovered that with this type of system, the effective refrigerating capacity of the evaporator is increased when the room temperature increases resulting in an increased refrigeration demand. When the room temperature decreases, the refrigeration demand decreases. Therefore by properly designing the size of the evaporator, compressor, condenser and the capillary tube, desired temperatures can be maintained in the food compartment 42 at all times. When there is an excessive demand for refrigeration as for example when there is a relatively large heat leakage through the cabinet due to a warm air environment outside temperature, liquid refrigerant is maintained throughout substantially the entire evaporator so that the major portion of the evaporator is in contact with the cooled liquid refrigerant. Since the refrigerating system contains a fixed quantity of refrigerant, less liquid refrigerant will be contained at this time within the condenser 35. On the other hand, if the heat leakage through the walls of the refrigerator cabinet is low, a smaller volume of liquid refrigerant is contained within the evaporator 20 and therefore the surface contact between the liquid refrigerant and the evaporator is less and in that event a larger quantity of liquid refrigerant is contained within the condenser 35. The reason for the variation in the quantities of liquid refrigerant in the evaporator and in the condenser is that when there is a heavy demand for refrigeration, the condensing pressure increases and therefore the condenser requires a large heat dissipating surface. For example if the environment air flowing over the condenser 35 is relatively warm, its heat dissipating surface in contact with the compressed gaseous refrigerant must be larger in order to remove sufficient heat from the gaseous refrigerant to condense the same. Under this condition a major portion of the condenser 35 is utilized for extracting heat from the gaseous compressed refrigerant, and therefore only a small quantity of liquid refrigerant will be contained in the lower part of the condenser. Since the quantity of liquid within the system is constant and only a small quantity of liquid refrigerant is contained within the condenser 35 a relatively large quantity is contained within the evaporator 20. Thus it is apparent that when the demand for refrigeration on the evaporator is heavy as for example when there is a relatively large heat leakage through the cabinet walls, a greater portion of the evaporator is in contact with liquid refrigerant and thus the heat absorbing area of the evaporator is increased.

Now when the environment temperature is lower, less heat exchange is necessary between the condenser and the gaseous refrigerant therein to condense the same. In that event less condensing surface is necessary and consequently a larger quantity of liquid refrigerant will be contained within the condenser 35 and, since the quantity of liquid refrigerant within the system does not vary, it necessarily follows that less liquid refrigerant is contained within the evaporator 20 and therefore the heat absorbing area of the evaporator in contact with the liquid refrigerant is decreased whereby less heat will be extracted by the evaporator.

I have discovered that by providing a substantially fixed restriction between the outlet of the condenser and the inlet to the evaporator, a substantial pressure differential can be maintained between the condenser and the evaporator. The resistance offered by the capillary tube 27 is computed with respect to the size of the condenser 35, evaporator 20 and the quantity of liquid refrigerant contained within the system so that under high condensing pressures it will so restrict the flow that liquid refrigerant will be present at the entrance to the capillary tube and thus only liquid refrigerant will flow through the capillary tube 27 and under a low condensing pressure condition, it will so restrict the flow of the liquid refrigerant as to cause liquid refrigerant to back up in the condenser whereby to reduce the heat absorbing surface of the condenser in contact with the gaseous refrigerant therein. Thus it is apparent that the capillary tube permits only liquid refrigerant to flow therethrough and is so computed as to cause variations of gas and liquid heat absorbing surface of the condenser.

Under extreme high condensing conditions, it is desirable to insure liquid within the capillary tube 40 and for this purpose I provide for contacting the capillary tube with the gaseous refrigerant flowing from the evaporator 20. To accomplish this I cause the relatively cold gas to pass through the chamber 40 to cool the refrigerant within the capillary tube 27.

The system shown in Figs. 3 and 4 is in all respects like that shown in Figs. 1 and 2 except that in this embodiment of the invention I provide a weighted valve 50. This weighted valve includes a housing 51. A weight 52 is disposed within the housing 51 and carries a valve 53. The valve 53 is lifted from its seat against the weight 52 due to the difference in high pressure within the condenser 35 and the lower pressure in the evaporator 55. The liquid refrigerant is then conducted by a pipe 54 to the evaporator. Like the capillary tube 27, a predetermined pressure differential must be obtained before refrigerant can flow from the condenser 35 into the evaporator therefore the principle of the operation of this embodiment is substantially the same as that disclosed in Figs. 1 and 2. The evaporator 55 shown in Fig. 3 comprises a lower inlet header 56, spreading chamber 57 and 58

connected with the header 56 and upper headers 59 and 60 respectively. These upper headers are connected with one another by pipe 61 and this pipe is connected directly to the motor compressor unit 35 by pipe 63.

From the foregoing it will be seen that I have provided a refrigerating system in which the refrigerating effect of the evaporator is increased and decreased respectively by increasing and decreasing demand for refrigeration. This I accomplish in a facile manner by increasing and decreasing, respectively, the liquid contact surface between the liquid refrigerant and the evaporator. If desirable, efficient operation thereof may be maintained by operating the motor compressor unit constantly because the load on the motor necessarily varies with the demand for refrigeration or if desirable a system may be arranged to operate intermittently in the well known manner in response to changes in temperature of pressure of the evaporator or in response to changes in temperature in the food storage compartment.

While the forms of embodiment of the present invention as herein disclosed constitute preferred forms, it is to be understood that other forms might be adopted, all coming within the scope of the claim which follows.

I claim as my invention:

In a mechanical refrigerating system, the combination of a refrigerant compressor, an evaporator for evaporating liquid refrigerant in said system, a refrigerant condenser exposed to environment air where its condensing function is influenced by changes in environment temperature, conduit means including an elongated orifice interconnecting the evaporator and condenser in such a manner that liquid refrigerant is stored in part of the condenser and means for interchanging heat between the liquid refrigerant passing through said elongated orifice and the refrigerant leaving the evaporator to aid in passing liquid refrigerant only to the evaporator.

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