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REFRIGERATING APPARATUS

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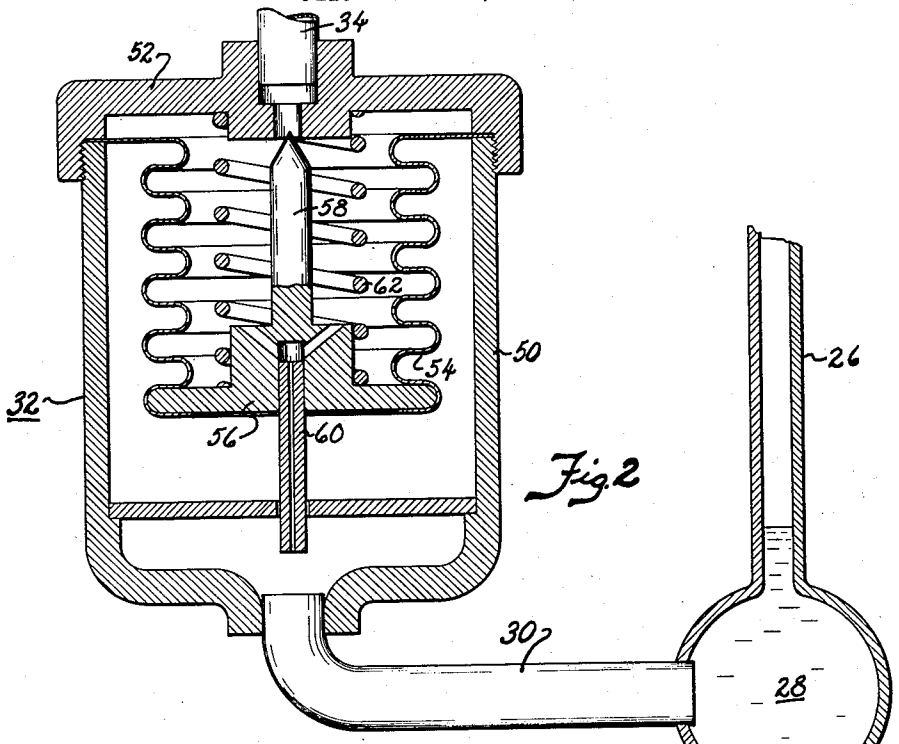

Fig. 2

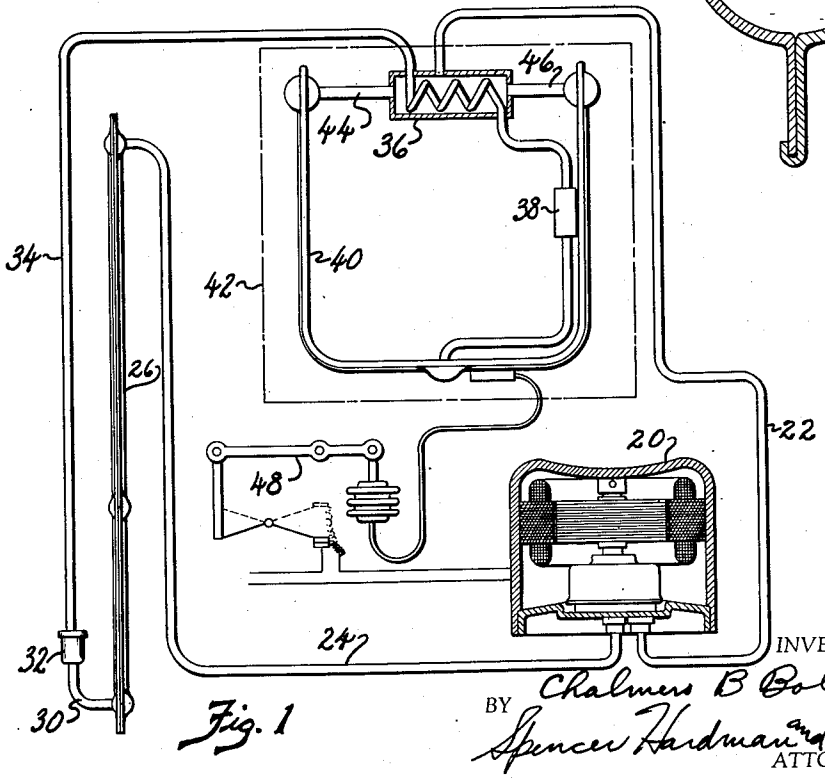

Fig. 1

INVENTOR.
Chalmers B Boles
BY
Spencer Hardman and Fehr
ATTORNEYS

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REFRIGERATING APPARATUS

Chalmers B. Boles, Dayton, Ohio, assignor to General Motors Corporation, Dayton, Ohio, a corporation of Delaware

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6 Claims. (Cl. 62—3)

This invention relates to refrigerating apparatus and more particularly to means for controlling the flow of refrigerant from the liquefying means to the evaporating means.

Refrigerating systems in which a restrictor is provided for controlling the flow of refrigerant from the liquefying means to the evaporating means have become very popular in recent years. Such systems are ordinarily designed in order to provide the maximum refrigerating output during high load conditions when it is most necessary to provide adquate refrigeration. I find, however, when a system is so designed, that the system becomes inefficient at low refrigerating loads. This is usually because there is not enough restriction to the flow of refrigerant from the liquefying means to the evaporating means, and because of this, some uncondensed gas passes from the liquefying means through the flow control means to the evaporating means, or where an interchanger is provided to the interchanger where the uncondensed gas is condensed by the cold evaporated gas from the evaporating means.

Operation under such conditions is rather inefficient and it is therefore an object of my invention to provide a pressure-operated flow control means which will prevent any substantial amounts of uncondensed gas flowing from the liquefying means to the interchanger or to the evaporating means.

It is another object of my invention to provide a pressure-operated valve means which will shut off the flow of refrigerant when uncondensed gas begins to flow from the liquefying means to the evaporating means.

It is still another object of my invention to provide a control system having a restricted passage sufficiently large to pass adequate amounts of liquid refrigerant under all conditions which will offer a greater resistance to the passage of an equal mass of gas and to employ the pressure differential created by the passage of gas through the restricted passage for closing a valve means.

It is still another object of my invention to provide a valve means located in series with a restricted passage which is opened and closed according to the pressure differential which exists on opposite ends of the passage.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing, wherein a preferred form of the present invention is clearly shown.

In the drawing:

Fig. 1 is a view partly diagrammatic showing a refrigerating system embodying my invention; and

Fig. 2 is an enlarged sectional view of the valve means and restricted passage shown in Fig. 1.

Briefly, I have shown a refrigerating system of the household type having an interchanger and a capillary tube and restrictor for controlling the flow of refrigerant from the condenser to the evaporating means. Between the condenser and the capillary tube I provide a valve means operatively connected to a bellows which is pierced by a restricted passage in series with the valve means. The restricted passage will permit adequate flow of liquid refrigerant through the valve means to take care of any refrigerating requirements which the system is expected to accommodate.

However, when the condenser is emptied of liquid refrigerant and the gas begins to flow through the restricted passage, the condenser pressure will rise because the restricted passage cannot accommodate as great a weight of gas as it can of liquid refrigerant. The gas will then travel through the restricted passage more rapidly causing a greater pressure drop through the restricted passage and thus increasing the pressure differential on opposite sides of the bellows and the ends of the restricted passage, which pressure differential will cause the valve to close. As long as gas continues to flow through the restricted passage the valve will be kept nearly closed permitting a volume of gas to pass through which is substantially equal to the volume of liquid which is passed through under similar condenser and evaporator pressures under ordinary conditions. This will enable liquid to be condensed in the condenser and thereby will prevent the continued flow of large amounts of condenser gas to the interchanger and evaporating means.

Referring now to the drawing and more particularly to Fig. 1, there is shown a sealed unit 20 containing a rotary compressor driven by an electric motor for drawing evaporated refrigerant through the suction conduit 22, compressing the gas and forwarding the compressed gas through the conduit 24, to a flat plate type condenser 26 where the compressed refrigerant is cooled and liquefied under ordinary conditions. The bottom of the condenser 26 is provided with a cylindrical chamber 28 for receiving the condensed refrigerant. The condensed refrigerant in the chamber 28 is conducted through a conduit 30 to a valve means 32 which is normally open. From

the normally open valve means 32 the liquid flows through a capillary tube 34 to an interchanger 36 where the liquid is cooled and thence conducted to a restrictor 38 which controls the flow of the liquid into the evaporating means 40.

The evaporating means 40 is located within the food compartment 42 of a household refrigerator and absorbs heat from the air in the food compartment as well as from water in ice trays which are normally provided in the evaporating means. This absorption of heat causes the liquid refrigerant to evaporate under reduced pressure and this evaporated refrigerant flows out of the evaporating means through the dual conduits 44 and 46 which connect to the interchanger at 36 from which the suction conduit 22 conducts the gas to the compressor 20. The operation of the motor-compressor unit is controlled by a snap acting switch means 48 controlled by a thermostat bulb fastened to the evaporator 40.

Under medium and heavy loads liquid refrigerant is always present in the lower portion of the condenser as shown in Fig. 2, and fills the conduit 30 as well as the valve means 32 and the capillary tube 34. Under such operation the valve means 32 always remains in an open position. However, under light loads less compressed refrigerant is pumped to the condenser and a lower pressure is maintained within the evaporating means so that less refrigerant is liquefied in the condenser. Under such conditions the capacity for liquid flow in the capillary tube 34 and the restrictor 38 is greater than the amount of liquid to be drawn from the condenser so that the condenser is drained of liquid refrigerant and gas begins to flow from the condenser through the capillary tube 34 to the heat interchanger 36 and condenses in the interchanger 36 rather than in the condenser. This results in a marked decrease in the efficiency of the system because the system is designed to remove heat from the food compartment and to dissipate this heat in the condenser. If the heat is dissipated in the interchanger which is located in the food compartment the whole purpose of the system is defeated.

Therefore I have provided a pressure-operated valve which slows down the flow of refrigerant under such conditions to such a rate that refrigerant can collect in the bottom of the condenser as is desired. This valve 32 is placed between the conduit 30 and the capillary tube 34. The valve includes a cup-shaped housing member 50 which is connected to the conduit 30 at its bottom end and is provided with a threaded upper rim which receives the threaded rim of the closing cap 52 which is provided with an aperture connected to the capillary tube 34. Within the cup-shaped member 50 is a bellows 54 having its rim clamped between the upper rim of the cup-shaped member 50 and the shoulder provided on the inside of the cap member 52. Preferably the rim of the bellows is sealed in some suitable manner to the rim of the cup-shaped member 50, for example, by solder or a suitable soft metal gasket.

The end plate of the bellows 54 is formed by a metal member 56 which includes a valve stem 58 adapted to engage a valve seat provided at the mouth of the aperture in the cap member 52 which connects to the capillary tube 34. This metal member 56 also carries a restrictor tube 60 containing a restricted passage which is ample in size to permit an ample flow of liquid refrigerant from the condenser to the evaporating means under all refrigerating conditions for which the system is designed. This restricted passage provides a passage for the refrigerant from the outside of the bellows 54 to the inside. The member 56 is provided with passages which connect with the restricted passage in the tube 60.

A compression type coil spring 62 extends from the cap member 52 to the metal member 56 and is held in position by shoulders provided upon the cap member and the member 56 which are concentric with the valve 58. This coil spring 62 is sufficiently strong to hold the valve 58 in open position during all conditions of liquid flow through the restricted passage in the tube 60. In other words, the pressure differential created between the exterior and the interior of the bellows 54 is less than the force of the coil spring as long as liquid refrigerant flows through the restricted passage in the tube 60. However, under light load conditions when the liquid refrigerant is drawn from the bottom of the condenser at a faster rate than the rate at which it is condensed therein, gas begins to flow through the restricted passage in the tube 60. However, inasmuch as the volume of a pound of gas is enormously greater than a pound of liquid, a considerable lesser weight of gas than liquid can pass through the restricted passage in the tube 60. This causes the pressure differential upon the exterior and interior of the bellows 54 to rise and this pressure differential soon becomes sufficiently great to overcome the force of the coil spring 62 and causes the valve 58 to be moved to closed position.

For a brief time this valve will remain in closed position but since the restricted passage in the tube 60 remains open, the pressure differential upon the bellows 54 will be reduced and the valve 58 will open a slight amount and will permit a restricted flow of refrigerant into the capillary tube 34. This flow is sufficiently restricted so that refrigerant is condensed in the condenser 26 at a greater rate than the liquid is withdrawn so that liquid again begins to flow through the restricted passage 60 into the capillary tube 34. The valve 58, whenever gas flows through the restricted passage, will throttle the flow sufficiently to prevent any appreciable amount of gas to flow into the capillary tube. This will prevent any substantial loss in efficiency under light load conditions.

While the form of embodiment of the invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. Refrigerating apparatus including evaporating means and liquefying means for withdrawing evaporated refrigerant from the evaporating means and for supplying liquid refrigerant to the evaporating means, pressure reducing means for controlling the flow of liquid refrigerant into the evaporating means, pressure-operated means for controlling the flow of refrigerant from the liquefying means to the pressure reducing means; said pressure-operated means including means providing a restricted passage through which the refrigerant flows from the liquefying means to the pressure reducing means, and means operated by the pressure differential of the refrigerant flowing through said passage for shutting off the flow of refrigerant to the pressure reducing means.

2. Refrigerating apparatus including evaporating means and liquefying means for withdrawing evaporated refrigerant from the evaporating means and for supplying liquid refrigerant to the evaporating means, means providing a restricted passage through which the refrigerant flows from the liquefying means to the evaporating means, and means operated by the pressure differential of the refrigerant flowing through said passage for shutting off the flow of the refrigerant to the evaporating means.

3. Refrigerating apparatus including liquefying means and evaporating means, means forming a restricted passage for controlling the flow of refrigerant from the liquefying means to the evaporating means, a valve means located in series with said restricted passage between said passage and the evaporating means, and means responsive to the pressure differential across said restricted passage for operating said valve means.

4. Refrigerating apparatus including liquefying means and evaporating means, means forming a restricted passage for controlling the flow of refrigerant from the liquefying means to the evaporating means, a valve means located in series with said restricted passage between said passage and the evaporating means, and means responsive to an increase in the pressure differential across said restricted passage for closing said valve means.

5. Refrigerating apparatus including liquefying means and evaporating means, means forming a restricted passage for controlling the flow of refrigerant from the liquefying means to the evaporating means, a valve means located in series with said restricted passage between said passage and the evaporating means, and diaphragm means subject on opposite sides to the pressure existing on opposite sides of said restricted passage and operably connected to said valve means.

6. Refrigerating apparatus including liquefying means and evaporating means, a valve means for controlling the flow of refrigerant between said means, diaphragm means in series with said valve means, said diaphragm means having a restricted passage therethrough through which the refrigerant flows to the valve means, said diaphragm means being operatively connected to said valve means.

CHALMERS B. BOLES.