

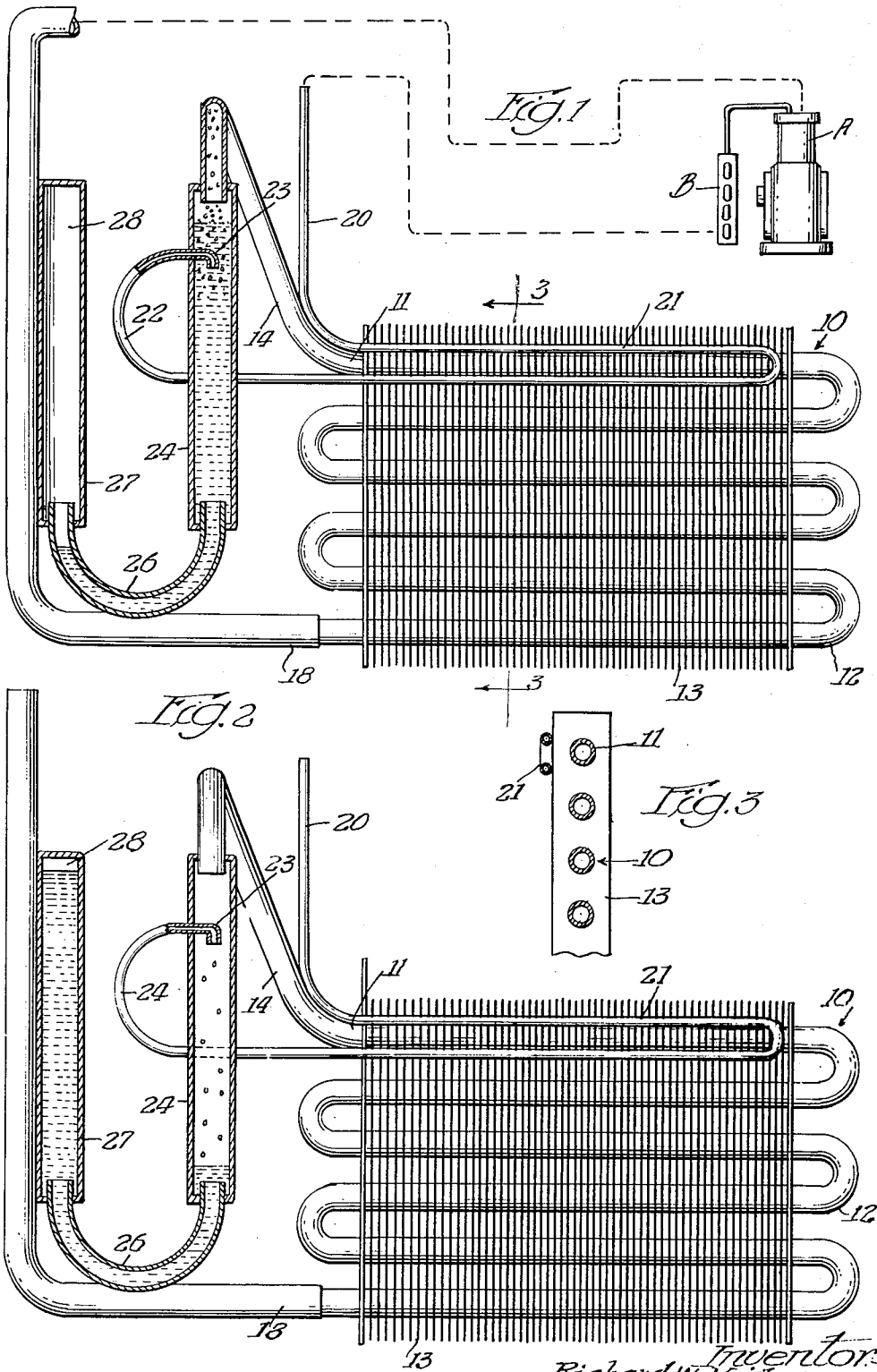
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FEED CONTROL MEANS FOR REFRIGERATING APPARATUS

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FEED CONTROL MEANS FOR REFRIGERATING APPARATUS

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The invention relates to apparatus of the capillary-tube type for feeding condensed refrigerant from refrigerating apparatus to an evaporator or cooling unit.

One object of the invention is to provide capillary-tube type of refrigerant feed means which is controlled by the temperature of the refrigerant of which has passed through the evaporator or cooling unit and which varies responsively to variations in the evaporation of the condensed refrigerant in the evaporator or cooling unit.

Another object of the invention is to provide simple and efficient means of the capillary-tube type for feeding refrigerant to the cooling unit.

Another object of the invention is to provide improved means of the capillary type for feeding refrigerant to an evaporator or cooling unit.

Other objects will appear from the detail description.

The invention consists in the several novel features hereinafter set forth and more particularly defined at the conclusion hereof.

In the drawings:

Fig. 1 is an elevation of feed-means for the refrigerant embodying the invention, being shown in normal operation with a full load on the evaporator, the compressor and condenser being diagrammatically shown on a smaller scale.

Fig. 2 is a similar view showing the feed-means for the refrigerant, operating to cut-off the feed to the evaporator, when the refrigerant is not being evaporated in the evaporator.

Fig. 3 is a section taken on line 3—3 of Fig. 1.

The invention is exemplified in apparatus or means for feeding condensed refrigerant from a refrigerating apparatus which comprises a motor-driven compressor A for the refrigerant, a condenser B for the refrigerant, and an evaporator or cooling unit in which the refrigerant absorbs heat and is evaporated before it is passed into the suction line to the compressor. The compressor and condenser may be of any suitable construction and operate as well understood in the art.

The invention is exemplified with an evaporator or cooling unit, generally designated 10, which includes a series of parallel tube-sections, serially connected by loops to form a coil 12. A series of fins 13 are provided on the coil for heat radiation.

An inlet 14 for the refrigerant is communicatively connected to tube-section 11 at the inlet end of the coil 12. The outlet end of coil 12 is communicatively connected by a line 18 to the suction side of the compressor.

A capillary tube generally designated 20 is communicatively connected with the condenser B for feeding, at a limited rate, refrigerant from the condenser, into a columnar receptacle 24 from which the refrigerant passes through the inlet tube 14, into the first section of the coil 12 for evaporation, by the absorption of heat. The capillary tube 20 includes a loop 21 which is mounted in contact or heat exchange relation with the fins 13, and extends along the inlet tube-section 11 of the coil 12, for rendering the loop 21 thermally responsive to the tem-

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perature changes in said section of the coil 12. The loop 22 of tube 20 is connected by a bend 22 to a downwardly directed discharge terminal 23 for feeding refrigerant into receptacle 24. These temperature changes result from variations in the evaporation of the refrigerant in the inlet coil 11 of evaporator 12 which vary the density of the refrigerant in loop 21. When liquid refrigerant flowing through loop 11 of the evaporator has not been changed to gas, the loop 21 of the capillary tube is cooled by its contact with the fins 13 and liquid refrigerant will flow through loop 21, bend 22 and terminal 23 into the receptacle 24. When gas is flowing through loop 11 of the evaporator, it will heat capillary loop 21 and reduce the flow of usable refrigerant liquid through loop 21. In this manner, the liquid refrigerant in receptacle 24 will be increased or decreased responsive to the temperature of the refrigerant in loop 11 of the evaporator.

The lower end of receptacle 24 is communicatively connected by a U-tube 26 to the lower end of a columnar receptacle 27 which functions as an expansion-chamber 28. Receptacle 27 is mounted in heat exchange relation with the suction-line 18 for expanding and contracting the gas in chamber 28 responsively to the temperature of the refrigerant flowing through line 18 to the compressor. The receptacles 24 and 27 contain a volume of liquid refrigerant which is retained in receptacle 24 during the normal rate of feed of refrigerant through capillary tube 20, and while the hot gas passing through suction line 18 expands the gas in receptacle 27, as shown in Fig. 1. When there is substantially no evaporation in the coil 12, and the cold refrigerant passes through suction line 18 to the compressor, the gas in chamber 28 in receptacle 27 will be condensed for the transfer of liquid refrigerant from receptacle 24 to receptacle 27, as shown in Fig. 2. While the refrigerant is being evaporated in coil 12, there will be a pressure drop in the inlet section of coil 12 which will lower the temperature of the loop 21 of the capillary tube so that it will remain cool for the normal flow of refrigerant to the receptacle 24 as shown in Fig. 1. While the refrigerant in the suction line 18 cools the gas in the chamber 28, which occurs when there is not enough heat load to evaporate the refrigerant in the coil 12, the condensed gas in chamber 28 will retain the liquid refrigerant in receptacle 27 and out of receptacle 24 as shown in Fig. 2. There will be no pressure drop in the inlet section of loop 11 of coil 12 and an increase of the temperature of the loop 21 of capillary tube 20, which is in heat-exchange relation with the coil 12. The increase in the temperature of the loop 21 will reduce the flow of usable refrigerant to the receptacle 24.

The operation is as follows:

Assuming the compressor is operating with a full load on the evaporator, the liquid refrigerant will be disposed in receptacle 24 substantially as illustrated in Fig. 1. Refrigerant will be drawn from receptacle 24 through pipe 14 into the coil 12 of the evaporator. Heat is absorbed by the refrigerant in its passage through the coil 12, and the refrigerant will be evaporated before it reaches the suction-line 18. The evaporation will reduce the pressure in the coil 12, and will start in the inlet section of coil 12 and progressively increase until the hot gas is produced before it reaches the suction line 18. This evaporation in the section of the coil 12 adjacent the loop 21 of the capillary tube will cool and prevent said loop 21 from being heated sufficiently to restrict the normal flow of refrigerant through loop 21 to the coil 12. The hot gas from the evaporator passing through suction line 18 to the compressor will expand the gas in the chamber 28 in the receptacle 27 and hold the liquid refrigerant outside of receptacle 27 and in the receptacle 24. The terminal 23 of the capillary feed-tube will be submerged, and the

suction in the coil 12 will feed the refrigerant from the upper end of receptacle 24 through inlet pipe 14 into the coil 12 of the evaporator. This condition will continue so long as evaporation occurs in the inlet section of the coil 12. The capillary tube will feed refrigerant in proper quantity for cooling the evaporator when it is operating with a full load until the load is reduced or there is an overfeed of refrigerant.

When the load on the evaporator decreases, or an excess of refrigerant is fed to the evaporator, the lack of vaporization in the evaporator will cause cool refrigerant to flow into the suction line 18. The cool refrigerant in the suction line will reduce the temperature in the expansion chamber 28 and condense the gas above the liquid in receptacle 27. This will draw the liquid from receptacle 24 into receptacle 27 as shown in Fig. 2. The terminal 23 of tube 20 will be above the liquid level in receptacle 24, and the inlet pipe 14 will be cut off from the liquid in receptacle 24. The refrigerant from terminal 23 will drop to the bottom of the receptacle 24. There being substantially no flow of refrigerant or vaporization in the inlet section of the coil 12, its temperature will increase and raise the temperature of the loop 21 of the capillary tube 20. This increase in temperature will cause the loop 21 to restrict the flow of the refrigerant to the receptacle 24.

When the liquid refrigerant has been exhausted by the compressor, from the suction line, the temperature of the gas in chamber 28 will increase and it will expand and force the liquid from receptacle 27 into the receptacle 24. The liquid column in receptacle 24 will be raised above the terminal 23 of the capillary tube 20, so that the refrigerant can be fed from receptacle 24 into the coil 12. When the liquid refrigerant has been drawn from the suction line by the compressor, vaporization will occur in the inlet section of the coil 12 and the temperature of the loop 21 of the capillary tube 20 will drop so it will feed the refrigerant to receptacle 24 at the normal rate of flow.

In this manner, the feed of the refrigerant to the evaporator is controlled and varied responsively to variations of temperature of the refrigerant in the suction line, and the feed of the refrigerant will be reduced when unevaporated refrigerant leaves the evaporator or reaches the suction-line. When the refrigerant is evaporated in the evaporator, there will be the normal rate of feed of the refrigerant to the evaporator for a full load.

The invention exemplifies a device of the capillary-tube type for feeding refrigerant to an evaporator or cooling unit, which is responsive to thermal variations of the refrigerant in the suction line, for variably controlling the delivery of the refrigerant to the evaporator or cooling unit, and for reducing the refrigerant when there is an over-feed or a reduction of the load on the evaporator. The device for this purpose is simple in construction and efficient in operation.

Having thus described the invention what I claim as new and desire to secure by Letters Patent is:

1. In a refrigerating system which includes a compressor and a condenser for the refrigerant and an evaporator including tubing and a suction line between the evaporator and the compressor; apparatus for feeding refrigerant to the evaporator, comprising a capillary tube having a portion thereof in heat exchange relation with the exterior of the inlet portion of the evaporator for varying the flow of refrigerant therethrough responsively to temperature changes in said portion of the evaporator, a columnar receptacle into which the capillary tube discharges the refrigerant as varied by said temperature changes in the evaporator, a conduit for refrigerant from the upper portion of the receptacle to the inlet of the evaporator, and means controlled by variations of temperature of the refrigerant from the evaporator for controlling the rate of flow of refrigerant from the receptacle to the evaporator.

2. In a mechanical refrigeration system which includes, a compressor and a condenser for the refrigerant and an evaporator or cooling unit connected to return refrigerant to the compressor; apparatus for feeding refrigerant to the evaporator, comprising: a capillary tube connected to receive refrigerant from the condenser, a receptacle into which the refrigerant is delivered from the capillary tube, and which is connected for feeding the refrigerant into the evaporator, and means controlled by the temperature of the refrigerant from the outlet of evaporator, for controlling the feed of the refrigerant from the receptacle to the evaporator, said capillary tube being in heat transfer relation with the inlet portion of the evaporator, for restricting the flow to the receptacle when the refrigerant is not evaporating in the evaporator.

3. In a mechanical refrigeration system which includes, a compressor and a condenser for the refrigerant, and an evaporator or cooling unit connected by a suction-line to return refrigerant to the compressor; apparatus for feeding refrigerant to the evaporator, comprising a capillary tube connected to receive refrigerant from the condenser and in heat transfer relation with the inlet portion of the evaporator for varying the flow responsive to variations in evaporation in the evaporator, a connection for feeding refrigerant from the capillary tube to the evaporator, and a receptacle provided with an expansion chamber, and in heat transfer relation with the suction line, for actuating a column of refrigerant to cut off the flow of refrigerant to said connection responsive to the decrease of the temperature in the suction line, and for actuating the column of liquid for the flow of refrigerant to the evaporator when the temperature in the suction line is increased.

4. In a mechanical refrigeration system which includes, a compressor and a condenser for a refrigerant, and an evaporator or cooling unit connected by a suction line to return refrigerant to the compressor; apparatus for feeding refrigerant into the evaporator, comprising: a capillary tube connected to receive refrigerant from the condenser, a columnar receptacle into which the capillary tube discharges the refrigerant, a connection for feeding refrigerant from the top of the receptacle into the evaporator, the capillary tube being in heat transfer relation with the inlet portion of the evaporator for varying the flow of refrigerant to the receptacle responsive to variations in the temperature in the inlet portion of the evaporator and means for raising and lowering a column of refrigerant in the receptacle, responsive to variations in the temperature of the refrigerant in the suction line for controlling the feed of the refrigerant into the evaporator.

5. In a mechanical refrigeration system which includes, a compressor and a condenser for a refrigerant, and an evaporator or cooling unit connected by a suction line to return refrigerant to the compressor; apparatus for feeding refrigerant into the evaporator, comprising: a capillary tube connected to receive refrigerant from the condenser, a columnar receptacle into which the capillary tube discharges the refrigerant, a connection for feeding refrigerant from the top of receptacle into the evaporator, and means for raising and lowering a column of refrigerant in the receptacle, responsive to variations in the temperature of the refrigerant in the suction line, for controlling the feed of the refrigerant into the evaporator, the capillary tube being in heat exchange relation with the evaporator for restricting the flow to the receptacle when the feed to the evaporator is cut off.

6. In a mechanical refrigeration system which includes, a compressor and a condenser for the refrigerant, and an evaporator or cooling unit connected to return refrigerant to a suction line for the compressor; apparatus for feeding refrigerant to the evaporator, comprising: a capillary tube connected to receive refrigerant from the condenser, a receptacle provided with a feed-chamber into which the refrigerant is delivered by the capillary tube and connected for the flow of refrigerant into the evap-

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orator, and a second receptacle provided with an expansion chamber communicatively connected to the feed-chamber, and in heat transfer relation with the suction line, for controlling the flow between said chambers and the feed of the refrigerant to the evaporator the capillary tube being in heat transfer relation with the evaporator for varying the flow of refrigerant into the feed chamber responsive to the temperature of the refrigerant in the inlet portion of the evaporator.

7. In a mechanical refrigeration system which includes, a compressor and a condenser for the refrigerant, and an evaporator or cooling unit connected to return refrigerant to a suction line for the compressor; apparatus for feeding refrigerant to the evaporator, comprising: a capillary tube connected to receive refrigerant from the condenser, a columnar receptacle provided with a feed-chamber into which the refrigerant is delivered by the capillary tube and connected for the flow of refrigerant into the evaporator, and a second columnar receptacle provided with an expansion chamber communicatively connected to the feed-chamber, and in heat transfer relation with the suction line, for controlling the flow between said chambers and the feed of the refrigerant to the evaporator the capillary tube being in heat transfer relation with the evaporator for varying the flow of refrigerant into the feed chamber responsive to the tem-

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perature of the refrigerant in the inlet portion of the evaporator.

8. In a mechanical refrigeration system which includes a compressor and a condenser for the refrigerant, and an evaporator or cooling unit connected to return refrigerant to a suction line for the compressor; apparatus for feeding refrigerant to the evaporator, comprising: a capillary tube connected to receive refrigerant from the condenser and including a section in heat transfer relation with the inlet portion of the evaporator, a receptacle provided with a feed-chamber into which the refrigerant is delivered by the capillary tube and connected for the flow of refrigerant into the evaporator, a second receptacle provided with an expansion chamber communicatively connected to the feed-chamber, and in heat transfer relation with the suction line, for controlling the flow between said chambers and the feed of the refrigerant to the evaporator.

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