

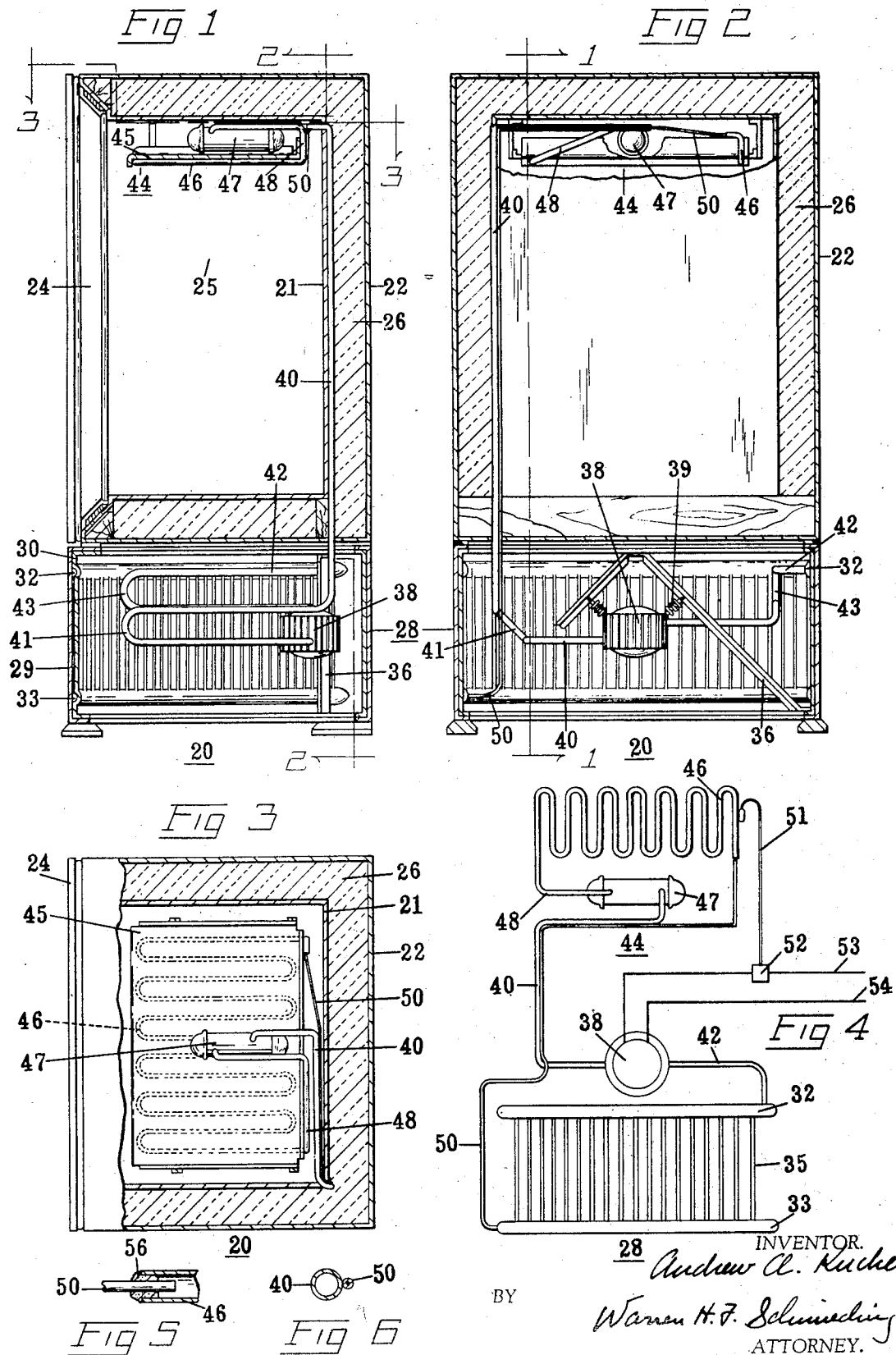
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REFRIGERATING APPARATUS

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REFRIGERATING APPARATUS

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2 Claims. (Cl. 62-116)

The present invention relates to refrigerating apparatus and particularly to the compressor-condenser-expander type system in which a small diameter conduit is utilized as the sole means for causing the necessary reduction of pressure of refrigerant between the condenser and the evaporator.

I am aware that a system has been devised in which a small diameter conduit was used as the pressure reducing means or restrictor between the condenser and evaporator. Such system, to be successful, required the use of a conduit in the form of a helix which helix in itself was a precision instrument and therefore costly to manufacture.

One of the objects of the present invention is to provide a refrigerating system in which the restrictor is formed of a substantially non-tortuous tube.

Another object of the present invention is to provide a refrigerating system in which substantially the entire high pressure conduit, between the condenser and evaporator, in itself, functions as the restrictor between these elements.

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

In the drawing:

Fig. 1 is a side view of my improved refrigerating apparatus showing the cabinet in cross section, the section being taken on substantially line 1-1 of Fig. 2, and showing the evaporator and compressor in side elevation;

Fig. 2 is a sectional view taken substantially on line 2-2 of Fig. 1;

Fig. 3 is a view partly in section, the section being taken on substantially line 3-3 of Fig. 1;

Fig. 4 is a diagrammatic view of the refrigerating system;

Fig. 5 is a view partly in section showing the joint between the restrictor and the tube of the evaporator; and

Fig. 6 is a sectional view of the low pressure tube and the restrictor shown in intimate heat exchange relation with one another.

Referring to the drawing, there is shown a refrigerator cabinet 20, the upper part of which has an open front inner lining 21 and an open front outer cover 22. The open fronts are closed by a door 24. The lining 21 forms a refrigerator compartment 25 insulated by the insulated door 24 and the insulation 26 disposed between the lining 21 and cover 22.

The lower part of the cabinet 20 is in the form of a machine compartment 28. The back of this compartment is open while the front and opposite sides are formed of two sheets of metal 29 and 30. In addition to forming the machine compartment these sheets of metal 29 and 30 also form the condenser for the refrigerating apparatus and a base for supporting the upper part of the cabinet. The inner sheet of metal 30 is bulged outwardly at the top and the two sides and front thereof as at 32 and a like bulge is provided in the bottom of this sheet as shown at 33 to thus form headers. The material between the bulges 32 and 33 of sheet 30 are in the form of corrugations in which the runs of the corrugations extend vertically and interconnect the upper header 32 with the lower header 33. The sheets of metal 29 and 30 are hermetically secured with one another around the peripheries and between the corrugations 35. This construction is more clearly shown in my copending application Serial No. 110,494 filed November 12, 1936.

Two angle iron braces 36 extend from adjacent the rear corners of the machine compartment to adjacent the center rear of the cabinet, as clearly shown in Fig. 2 and a compressor 38 is resiliently supported within the machine compartment, to these braces 36 by springs 39. Gaseous refrigerant is conducted to the compressor 38 by a tube 40 having a hairpin type loop 41 within the machine compartment. Compressed refrigerant is conducted by the pipe 42 from the compressor 38 to the header 32 of the condenser. This pipe 42 is also provided with a hairpin type loop within the machine compartment and the purpose of loops 41 and 43 is to permit relative movement between the compressor and the fixed portions of the pipes.

An evaporator 44 is disposed within the upper part of the refrigerator compartment 25 and includes a flat plate 45 for supporting ice trays or the like and the underside thereof is in intimate heat exchange relation with a serpentine shaped evaporator pipe 46. The outlet of the evaporator is connected to a surge tank 47 by a pipe 48 and gaseous refrigerant is withdrawn from the surge tank 47 by the tube 40. The purpose of the surge tank is to provide a large chamber wherein vaporization will take place in the event that liquid refrigerant should flow from the evaporator and the tank therefore prevents liquid refrigerant from entering the compressor. This construction is more clearly shown and described in my copending application executed on even date herewith Serial No. 159,157.

The liquid refrigerant which is condensed in the condenser is conducted from the lower header 33 by a tube 50 to the inlet of the evaporator 46. The refrigerator system herein shown is preferably of the cyclically operating type in which the motor, contained within the compressor casing is started and stopped in response to a predetermined high and a predetermined low temperature. For this purpose I have shown an expansible fluid type thermostat 51 connected with a switch 52 which opens and closes the electrical circuit indicated at 53 and 54.

I have discovered that a non-tortuous tube can be used as the sole restrictor between the condenser and the evaporator for the necessary reduction of pressure between these elements. This is accomplished by providing a relatively small diameter tube 50 arranged in intimate heat exchange relation with the low pressure conduit or tube 40. It will be seen from Fig. 2 that the tube 50 is immediately adjacent the tube 40 substantially from the point that it starts at the condenser to where it stops at the evaporator. Also these tubes are insulated from the environment room temperature at the upper parts thereof by insulation 26. Thus the hot refrigerant flowing from the condenser to the evaporator is cooled by the cold gas flowing from the evaporator to the compressor.

I have also discovered that the desirable size of the tube, forming the restrictor, can be calculated thus minimizing experimentation as to the selection of the size tube to be employed for restricting or pressure reducing purpose. I have found that this can be computed through the cubical capacity of the compressor.

In the preferred embodiment, the compressor has a cubical capacity of .437 cubic inch per revolution and rotates at 1750 R. P. M. The cubical capacity of the tube 50 from the condenser to the evaporator should not be more than 20% of the cubical capacity of the compressor per revolution when operating at 1750 R. P. M. In other words the tube 50 should not have a factor of more than .00011 between the volume of the tube and the volumetric displacement per minute of the compressor. In the preferred embodiment, the cubic capacity of the tube 50 is approximately 8% of the cubical capacity of the compressor per revolution or it has a factor of .000045 between the volume of the tube and the volumetric displacement per minute of the compressor when the compressor operates at 1750 R. P. M. The tube 50 is approximately five feet long and has an inside diameter of .027 inch. The refrigerant employed is isobutane (C_4H_{10}) and the compressor is driven by a $\frac{1}{2}$ H. P. motor. The condenser outlet is located adjacent the bottom of the cabinet and the evaporator is located adjacent the top of the refrigerator compartment 25 as shown. Figs. 1, 2 and 3 being approximately 1 to 8 scale. The low pressure tube 40 is also approximately five feet long and is in intimate heat exchange relation substantially throughout its length with tube 50.

In the specific embodiment illustrated the following pressures were observed for different environment room temperatures:

Room	Back pressure absolute	Head pressure absolute
	Pounds	Pounds
70°	11	59
90°	12	74
110°	13	104

Although the head pressure increases materially from a 70° room to a 110° room, on the other hand the back pressure increases only a relatively slight amount. Thus it is apparent that approximately uniform evaporator conditions are maintained throughout widely varying room temperature conditions to which the refrigerator is normally subjected.

Another satisfactory embodiment includes a tube 50 which is sixty eight inches long and has an inside diameter of .032 inch. This longer tube is used with the same size apparatus heretofore described. The volume thereof is 12% of the cubical capacity per revolution of the compressor and therefore has a factor of .000071 between the volume of the tube and the volumetric displacement per minute of the compressor.

I have found that it is impractical to decrease the diameter of the tube to such an extent that its volume is less than 5% of the cubical capacity of the compressor per revolution of the compressor i. e., for practical purposes it should not have a factor of less than .000025 between the volume thereof and the volumetric displacement per minute of the compressor.

It will be understood that the words "non-tortuous" as herein used does not mean that the tube 50 is straight and has no bends. The phrase "non-tortuous tube" is employed to distinguish from the spirals or helix conductor heretofore employed as the restrictor.

From the foregoing it will be seen that I have provided a refrigerating system in which the costs of manufacture can be materially reduced since it is necessary only to employ a substantially non-tortuous tube between the condenser and the evaporator. This tube not only functions as the conductor for the liquid refrigerant but also functions as the sole restrictor between the condenser and evaporator.

In the preferred form of the invention the tube 50 extends a substantial distance into the evaporator tube 46 for the purpose of preventing the solder 56, which unites the tubes 50 and 46, from entering the end of the tube 50.

While the form of embodiment of the present 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.

I claim:

1. A refrigerating system comprising in combination, a household refrigerator cabinet having an evaporator therein; means for withdrawing gaseous refrigerant from the evaporator and for compressing the same; a condenser operably connected with said means for cooling and liquefying the compressed refrigerant, and means for delivering refrigerant from the condenser to the evaporator and forming the sole metering means for controlling the flow of refrigerant from the condenser to the evaporator, said means consisting merely of a substantially non-tortuous capillary tube disposed substantially entirely outside of the evaporator and comprising substantially the entire conduit between the condenser and evaporator, said tube having a factor ratio of less than .00011 with respect to the volumetric displacement per minute of the compressor.

2. A refrigerator comprising in combination, a cabinet having a food storage compartment and a machinery compartment; an evaporator in the food storage compartment; means in the machinery compartment for withdrawing gaseous refrigerant from the evaporator and for compress-

ing the same; a condenser in the machinery compartment, operatively connected with said means, for cooling and liquefying the compressed refrigerant; and means for delivering refrigerant from the condenser to the evaporator and forming the sole metering means for controlling the flow of the refrigerant from the condenser to the evaporator, said means consisting merely of a

5 small diameter, substantially non-tortuous tube disposed substantially entirely outside of the evaporator and out of heat exchange relation therewith, the last mentioned means comprising substantially the entire conduit between the condenser and evaporator.

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