Jan. 7, 1941. D. E. DASHER 2,227,537

REFRIGERATING APPARATUS

Filed Aug. 19, 1938 2 Sheets-Sheet 1

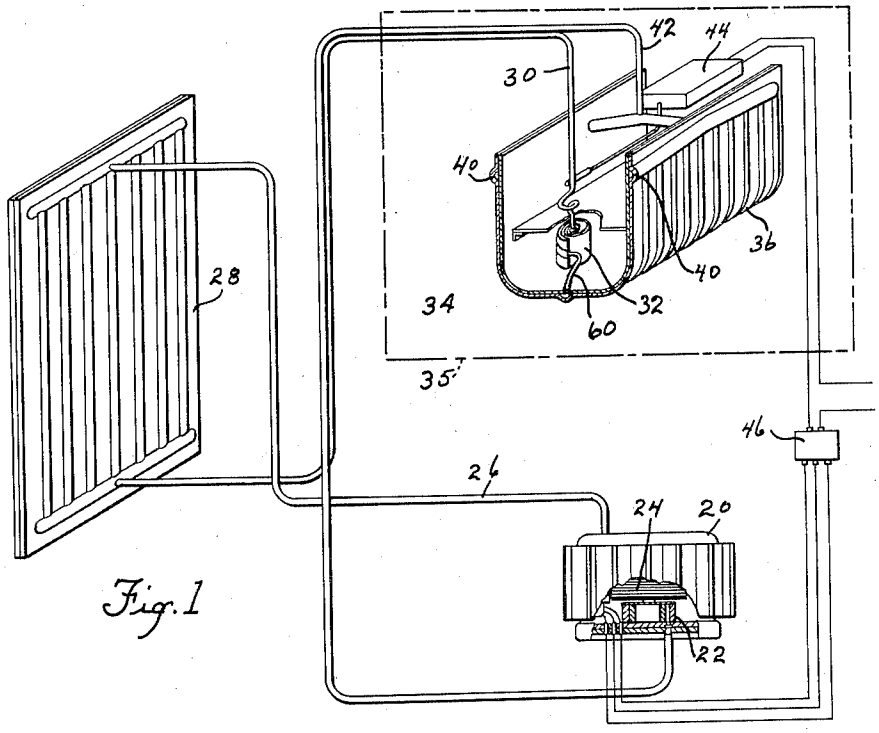


Fig. 1

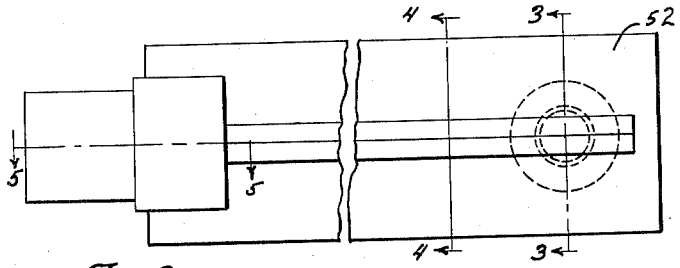


Fig. 2

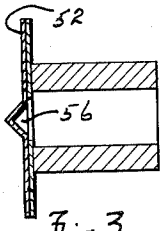


Fig. 3

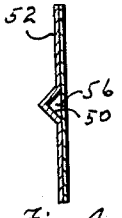


Fig. 4

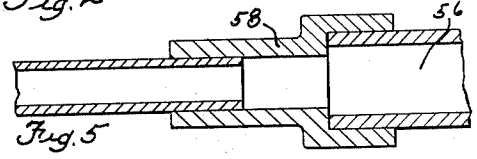


Fig. 5

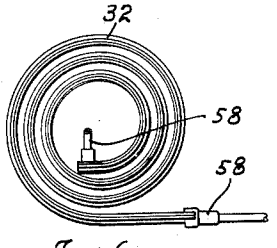


Fig. 6

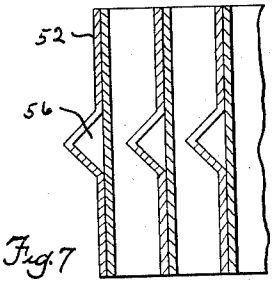


Fig. 7

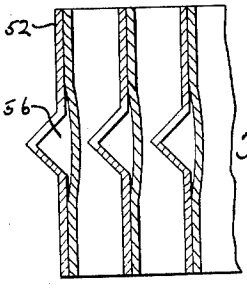


Fig 8

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REFRIGERATING APPARATUS

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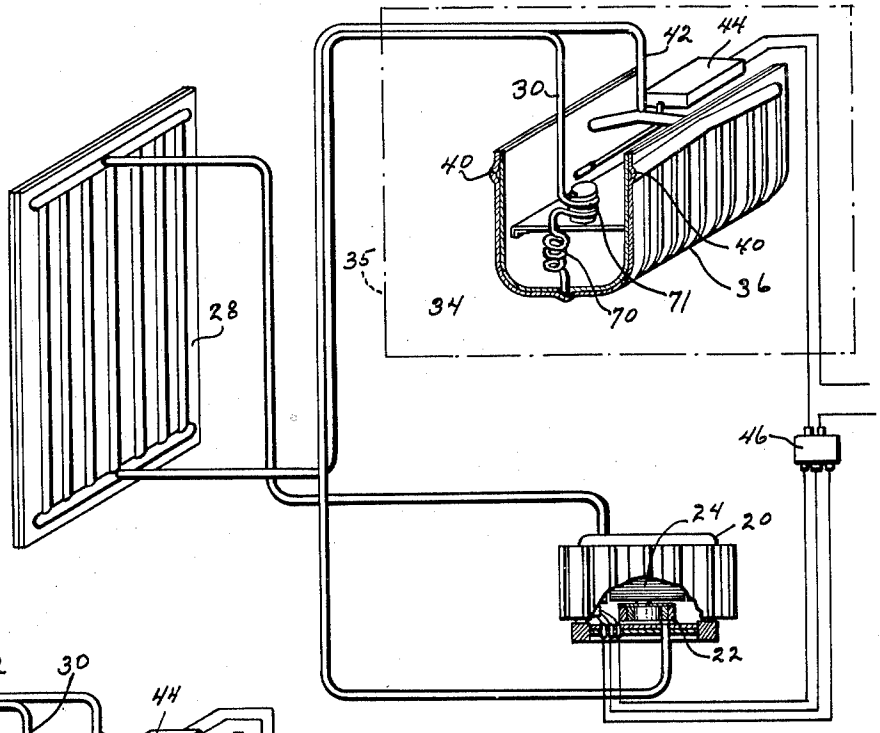


Fig. 9

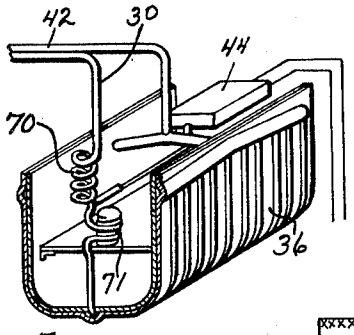


Fig. 10

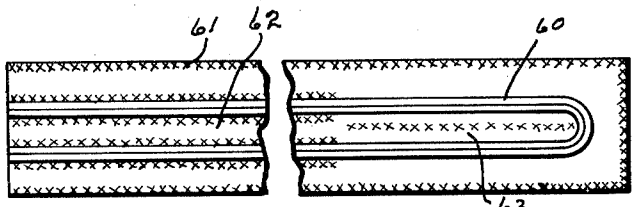


Fig. 11

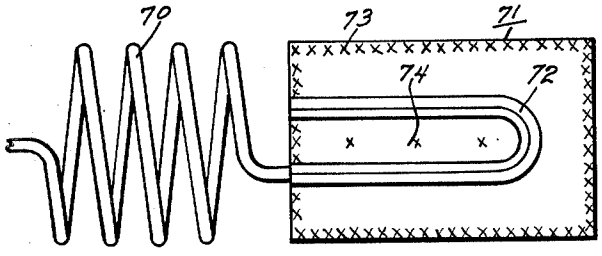


Fig. 12

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Patented Jan. 7, 1941 2,227,537

UNITED STATES PATENT OFFICE

2,227,537

REFRIGERATING APPARATUS

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Application August 19, 1938, Serial No. 225,763

10 Claims. (Cl. 138—46)

This invention relates to refrigerating apparatus and more particularly to control means therefor.

Recently, in order to control the flow of liquid refrigerant from the high pressure portion of the refrigerating system to the low pressure portion, it has become common practice to employ an elongated passage. Such passages have been made in several different ways, one form being simply a long tube of very small diameter, others employ interfitting cylinders provided with helical grooves, while others employ porous plates. It has been found, however, that such passages if designed for high room temperatures allow too great an amount of liquid refrigerant to flow from the high side to the low side under cold room temperatures and if designed for cold room temperatures, provide too great a restriction and insufficient flow at high room temperature.

It is an object of my invention to provide an elongated passage which can automatically change its resistance in response to pressure and/or temperature variations.

It is a further object of my invention to provide a simple, inexpensive form of elongated passage which is capable of automatically changing its restriction to flow according to the refrigerant pressure within the system and thus responsive to environment temperatures since the refrigerant pressures within the system, particularly in the high pressure portion of the refrigerating system, are in general responsive to the room or environment temperatures.

It is still a further object of my invention to provide an elongated passage for a refrigerating system between sheet metal walls of a curled assembly of two sheet metal portions which is capable of varying the amount of restriction of the passage by the amount of curvature of the curled assembly.

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

In the drawings:

Fig. 1 is a representation of a refrigerating system, partially diagrammatic, embodying my invention;

Fig. 2 is an elevational view of an elongated passage member shown in Fig. 1;

Fig. 3 is a cross sectional view taken on line 3—3 of Fig. 2;

Fig. 4 is a cross sectional view taken on line 4—4 of Fig. 2;

Fig. 5 is a cross sectional view taken on line 5—5 of Fig. 2;

Fig. 6 is an elevational view of the passage member shown in Fig. 1 after being wound into a spiral form;

Fig. 7 is an enlarged view of Fig. 4;

Fig. 8 is an enlarged view of Fig. 4 taken to represent the expansion of a passage under high pressure conditions;

Fig. 9 is a representation of a refrigerating system, partially diagrammatic, embodying a modified arrangement of my invention;

Fig. 10 is a view similar to Fig. 9, omitting the refrigerant liquefying unit, showing a modified positioning of the passage of my invention;

Fig. 11 is an elevational view of a modified form of the elongated passage member; and

Fig. 12 is an enlarged elevational view of the passage member as shown in Figs. 9 and 10.

Briefly, I have disclosed a refrigerating system for a domestic electric refrigerator having a sealed motor-compressor unit, a flat plate type condenser, an elongated passage member and a sheet metal household type of evaporating means connected in closed refrigerant circuit by metal tubing. The passage which controls the flow of liquid refrigerant from the plate type condenser to the evaporating means is formed of a long strip of thin metal which is provided with a groove. This strip of metal may then be folded upon itself or a second sheet of metal placed thereon, sealed at the edges, and rolled into a spiral. One end of the groove is connected to the plate condenser and the other end is connected to the evaporating means. The operation of the motor-compressor unit is controlled by a thermostatic switch according to the temperature of the evaporating unit.

Referring now more particularly to the drawings, there is shown in Fig. 1 a sealed unit 20, containing a rotary compressor 22 directly connected to the rotor 24 of a split phase induction type electric motor provided within the upper portion of the sealed unit. The sealed motor-compressor unit discharges compressed refrigerant through a supply conduit 26 to the top of a vertically fluted plate type condenser 28, ordinarily positioned upon the rear wall of a domestic electric refrigerator. The compressed refrigerant is cooled and liquefied within the plate condenser 28 and is collected in a header at the bottom thereof which header serves as a receiver.

This liquid refrigerant is conducted by a conduit 30 to an elongated passage 32 located within the food compartment 34 of a domestic electric

refrigerator 35 which is illustrated diagrammatically. The elongated passage 32 controls the flow of refrigerant to the plate type evaporating means 36 which is provided with an entrance for liquid refrigerant at the bottom in the form of a header which distributes the liquid refrigerant to refrigerant passages extending up the side walls which terminate in headers 40. The refrigerant in the walls of the evaporating means evaporates under reduced pressure and is returned to the compressor through the return conduit 42.

The operation of the sealed motor compressor unit is controlled by a thermostatic switch means 44 which energizes the compressor-motor whenever the temperature of the evaporating means reaches a predetermined high limit and deenergizes the compressor-motor whenever the evaporating means reaches a predetermined low temperature limit. The motor-compressor unit is also provided with a starting relay 46 for energizing and deenergizing the split phase starting winding at the beginning and the end of each starting period.

The elongated passage 32 is formed by providing a groove 50 in one end of a long strip of thin resilient sheet metal 52. This groove 50 may be of any suitable shape, but as shown, is V-shaped and extends over slightly less than one-half the length of the strip. This strip may then be folded upon itself so that the flat sheet portion closes the V-shaped groove 50 and makes a triangular-shaped passage 56 as best shown in Figs. 3 and 4. The passage 56 may also be formed by an alternate method of placing a flat sheet of metal upon the sheet in which the groove is formed in order to close the V-shaped groove 50 thereby providing a V-shaped passage. A triangular-shaped passage is preferred since it is found that such a passage is less susceptible to the clogging or the collection of foreign matter therein. This folded sheet metal structure, or the structure consisting of two metal sheets, is then sealed along its edges by soldering or preferably by roll welding.

The elongated passage may also take the form as disclosed in Fig. 11. In this form the passage is formed by providing a hairpin-shaped groove 60 in one end of a long strip of thin resilient metal. The metal strip may be folded upon itself to close the open side of the groove 60, or a separate metal sheet may be used, thereby providing an elongated passage between the metal sheets. This sheet metal structure is preferably roll welded along its edges, as indicated at 61, thereby sealing the same. That portion of the metal sheets between the hair pin loops forming the passage are also sealed together, as indicated at 62, by roll welding or other suitable means. This central portion, however, is not sealed together throughout its entire length, but a portion 63 is left partially unsealed which will permit a variation in restriction or a by-passing of liquid through this section 63 when the pressure of the high side of the refrigeration system increases.

The sheet metal structure forming the elongated passage is then curled or rolled into a spiral form as shown in Fig. 6 with the sheet, in which the groove is formed, on the outside. The two open ends of the passage 56 are each provided with connectors 58, one of which connects the entrance of the passage to the tube 30 extending from the plate type condenser, while the exit of the passage connects to the tube 60 which extends to the evaporating means.

In the forms shown in Figs. 9, 10 and 12 a slightly modified arrangement of the elongated passage is shown. In this form the elongated passage consists of a tubular member 70 having a small internal bore. A second portion of the passage consists of a sheet metal structure 71 which is constructed in a manner similar to that previously described in regard to the passage element 32. In this instance, however, the elongated groove 72 formed in one of the thin sheet metal strips is in the form of a hairpin loop. The open side of the V-shaped groove 72 may be closed in a manner as heretofore described in regard to the elongated passage 32. In this instance the passage structure 71 is sealed around the edges by soldering the same, or preferably by roll welding as indicated at 73. The central portion 74 between the parallel legs of the hair pin loop is not sealed so tightly as to prevent expansion of the hairpin loop, for the reason that it is desirable that this portion be permitted to vary in cross sectional area.

In Fig. 9 is shown an arrangement of a capillary tube type restrictor 70 and the sheet metal passage structure 71 wherein the high pressure liquid refrigerant line 30 enters one side of the hairpin loop 72 in the passage structure 71. The exit from the passage structure 71 connects to the inlet side of the capillary tube type passage 70. The exit from the capillary tube type passage connects with the inlet of the evaporating means. In Fig. 10, there is shown an arrangement whereby the high pressure refrigerant line 30 first connects with the capillary tube type passage 70, the sheet metal passage structure 71 being on the end of the capillary tube 70 between the tube and the inlet of the refrigerating means.

The sheet metal passage assemblies when constructed in accordance with this invention have very definite advantages. In the first place, the initial amount of restriction provided in the elongated passage may be obtained by controlling the size of the passage 56 during manufacture. Also, when the temperature of the environment in which the refrigerating apparatus is placed increases, it is desirable that the passage be able to pass a greater quantity of liquid than when the temperature of the environment is low. This is possible in the structure of this invention because the thin metal sheets from which the passage is constructed are elastic. A pressure increase within the refrigeration system will tend to expand the sheets as shown in Fig. 8, thereby increasing the size of the passage and decreasing its restriction to the flow of refrigerant or other fluid therethrough. In this way, the passage is able to operate in a manner so as to automatically control the rate of flow through the passage in response to pressure variations within the refrigeration system.

When the passage assembly is curled with a small radius of curvature, the initial restriction provided in the passage may be controlled by varying the radius of curvature and the amount of curl of the assembled sheet metal portions. This arrangement provides a highly sensitive way of providing the proper amount of initial restriction through a passage. It is also possible for the curled passage structure to act in a manner which bears a slight resemblance to the action of a Bourdon tube. Thus, when a refrigerant pressure within the system and particularly when the refrigerant pressure within the condenser is high, for example, when the room temperature is high, the sheet metal product will tend to uncurl slightly and to provide a slight

separation of the sheets by the bowing of the inner sheet as shown in Fig. 8. This will also provide a means whereby the cross sectional area of the passage will vary with the pressure in the system in order to provide a variation in the amount of restriction provided by the elongated passage.

The passage member, as disclosed in Fig. 2 and consisting of a single passage extending from one end to the other of the sheet metal structure, may vary throughout its entire length in cross sectional area. The function of the passage is to permit a regulated flow of fluid therethrough according to the initial restriction placed in the passage during manufacture. If the resistance of the passage were fixed to meet the refrigeration requirements of the refrigerator when in a low temperature environment, this same passage would pass too small a quantity of refrigerant when the temperature of the environment of the refrigerator increased. However, the functioning of the passage of my invention will be to permit an increased flow of liquid refrigerant through the passage when the refrigerant pressure on the high side of the refrigeration system increases. The reduced restriction of that portion of the passage which connects with the high pressure refrigerant line will be effective to permit a greater flow of liquid refrigerant therethrough. The length of the passage which will be increased in cross sectional area will be indeterminate and, if necessary, may be throughout the entire length of the passage.

The sheet metal passage structure 71 or 32 can be formed from two sheets of metal each having a different coefficient of expansion, thereby providing an element which will be sensitive to temperature variations like any bimetal element. The metal having the greater coefficient of expansion is placed on the inner side of the spiral sheet metal passage assembly, in which instance as the temperature of the environment in which the passage is placed increases the spiral sheet metal element will reduce the degree of its curvature thereby lessening the degree of restriction offered by the passage. This temperature responsive element may be used in any arrangement in place of the pressure responsive element.

In the arrangement of the passage elements 70 and 71 as shown in Fig. 10 the sheet metal passage is constructed of two sheets of metal having different coefficients of expansion and thus is responsive to the temperature of its environment. In this instance the temperature environment is the temperature of the cooling means. Since the temperature responsive sheet metal passage element is connected between the capillary tube type passage 70 and the inlet of the cooling means, the pressure within the passage structure 71 is substantially that of the evaporating means which is relatively low and substantially constant. This arrangement of the passage elements thus provides a system wherein a portion of the passage is substantially responsive to temperature only.

In the arrangement of the passage elements 70 and 71 as disclosed in Fig. 9 the portion of the passage, capable of having its restriction varied, is responsive to pressure variations of the high pressure side of the refrigeration system since the inlet of the passage is connected directly to the high pressure liquid line 30. The sheet metal passage element may, however, be made responsive to both temperature and pressure if the sheets of metal of the passage structure are such that they have different coefficients of expansion.

This application is a continuation in part of my application for Flow restrictors, Serial No. 61,569, filed January 30, 1936.

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. Means forming an elongated passage for controlling the flow of a fluid comprising an elastic metallic structure formed of two superimposed elastic thin metal strip portions, said superimposed strip portions being sealed together at their edge portions but having a broad substantial expanse in the central portion unconnected except at the edge portions as stated, one of said strip portions having its inner face grooved to provide an elongated passage between the sheets, the central portions of said strip portions being movable to permit varying degrees of separation to enlarge the cross-sectional area of portions of the elongated passage.

2. Means forming an elongated passage for controlling the flow of a fluid comprising an elastic metallic structure formed of two superimposed elastic thin metal strip portions, said superimposed strip portions being sealed together at their edge portions but having a broad substantial expanse in the central portion unconnected except at the edge portions as stated, one of said strip portions having its inner face grooved to provide an elongated passage between the sheets, the central portions of said strip portions being movable to permit varying degrees of separation to enlarge the cross-sectional area of portions of the elongated passage, said superimposed strip portions being curled in such a manner as to cause the structure to assume varying degrees of curvature and restriction under varying fluid pressures in said passage.

3. Means forming an elongated passage for controlling the flow of a fluid comprising an elastic metallic structure formed of two superimposed elastic thin metal strip portions, said superimposed strip portions being sealed together at their edge portions but having a broad substantial expanse in the central portion unconnected except at the edge portions as stated, one of said strip portions having its inner face grooved to provide an elongated passage between the sheets, the central portions of said strip portions being movable to permit varying degrees of separation to enlarge the cross-sectional area of portions of the elongated passage, said superimposed strip portions being of different metals having a different rate of thermal expansion, said bimetal strip portions causing said structure to curl in varying degrees according to the temperature of the structure to vary the cross sectional area of portions of the elongated passage.

4. Means forming an elongated passage for controlling a fluid comprising a curled elastic metallic structure, said structure having wall portions provided with means forming therein an elongated passage through which the fluid passes, said structure being curled and uncurled in the manner of a Bourdon tube by pressure variations within the elongated passage to vary the restriction of the passage.

5. Means forming an elongated passage for controlling a fluid comprising a curled elastic metallic structure, said structure having wall portions provided with means forming therein

an elongated passage through which the fluid passes, said structure being curled to a greater or lesser degree in the manner of a Bourdon tube according to pressure variations within the elongated passage, the restriction of said passage being established by the degree of curling of said structure.

6. Means forming an elongated passage comprising a bimetal strip having relatively flat passages formed within the strip, said strip being formed of different metals bonded together, said different metals having different rates of thermal expansion causing the strip to curl and uncurl with changes in temperature, the restriction of said passages being established by the degree of curling of the strip.

7. Means forming an elongated passage comprising a bimetal strip having passages formed within the strip, said strip being formed of different metals bonded together, said strip being also provided with a by-pass for said passages, said by-pass being opened when the strip uncurls and closed when the strip is fully curled, said different metals having different rates of thermal expansion causing the strip to curl and uncurl with changes in temperature.

8. Means forming an elongated passage comprising a strip having passages formed within the strip, said strip being formed of two superimposed metal sheets bonded together, said strip being provided with a by-pass for said passages, said by-pass being opened when the strip uncurls and closed when the strip is fully curled, said strip being constructed and arranged for uncurling when the pressure within the passages is high and for curling when the pressure within the passages is low.

9. A restrictor formed of superposed secured together sheet metal members, a portion of one of said sheet metal members being directed outwardly away from a portion of the other sheet metal member to provide walls of a continuously open passage between the members having a predetermined cross-sectional area, said sheet metal members being so secured together and arranged with respect to one another that said portion of one of said members is movable in response to certain conditions relative to said portion of the other of said members to change the cross-sectional area of the passage.

10. A restrictor comprising a curled elastic structure formed of superposed secured together sheet metal members, a portion of one of said sheet metal members being directed outwardly away from a portion of the other sheet metal member to provide walls of a continuously open passage between the members having a predetermined cross-sectional area, said portion of one of said members being movable relative to said portion of the other of said members for changing the cross-sectional area of the passage, and said structure being curled and uncurled in the manner of a Bourdon tube to cause said relative movement of said portions of said members.

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