July 18, 1961 H. F. SIMMONDS, JR 2,992,546

INLET STRUCTURE FOR REFRIGERANT EVAPORATOR

Filed Nov. 14, 1955 2 Sheets-Sheet 1

FIG. 1.

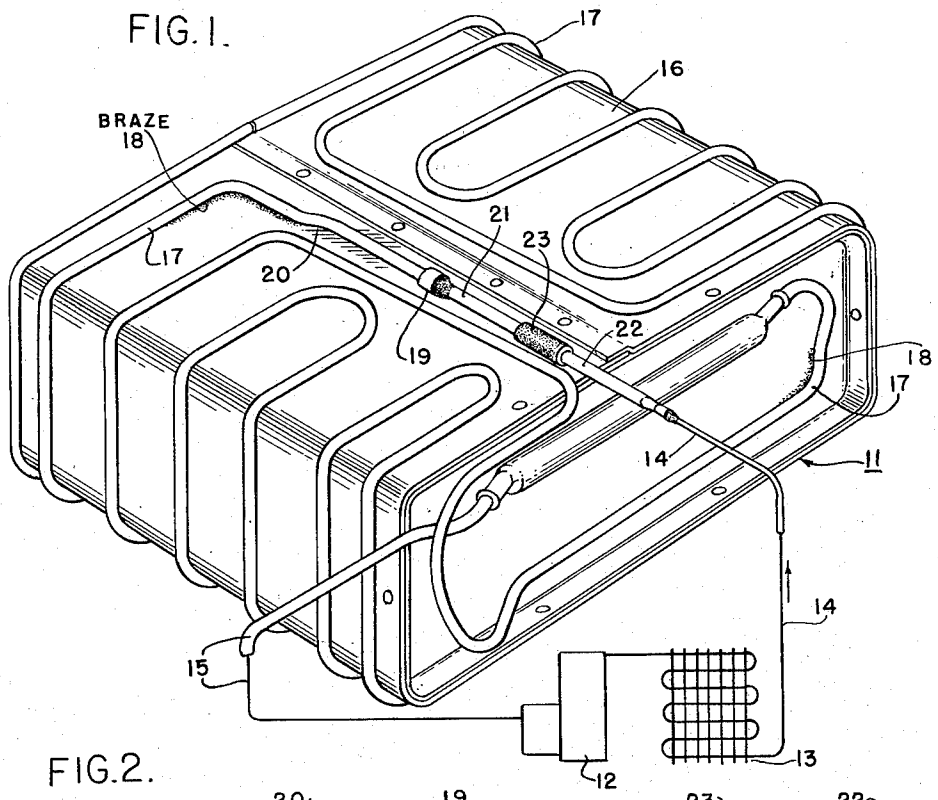
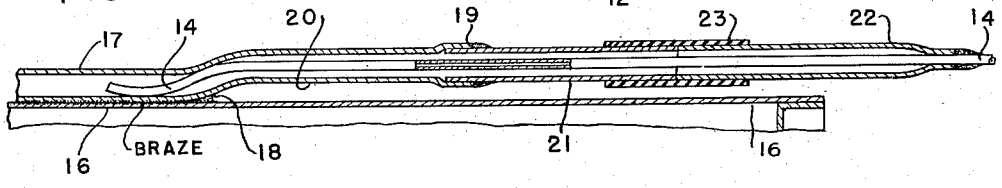



FIG. 2.



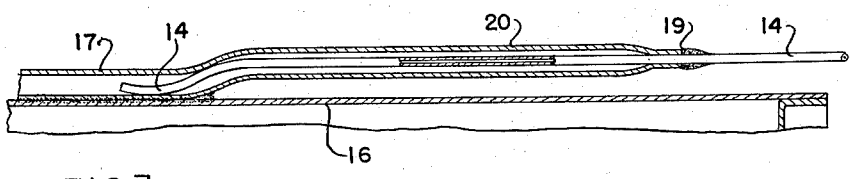




FIG. 3.

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July 18, 1961 H. F. SIMMONDS, JR 2,992,546

INLET STRUCTURE FOR REFRIGERANT EVAPORATOR

Filed Nov. 14, 1955 2 Sheets-Sheet 2

FIG.4.

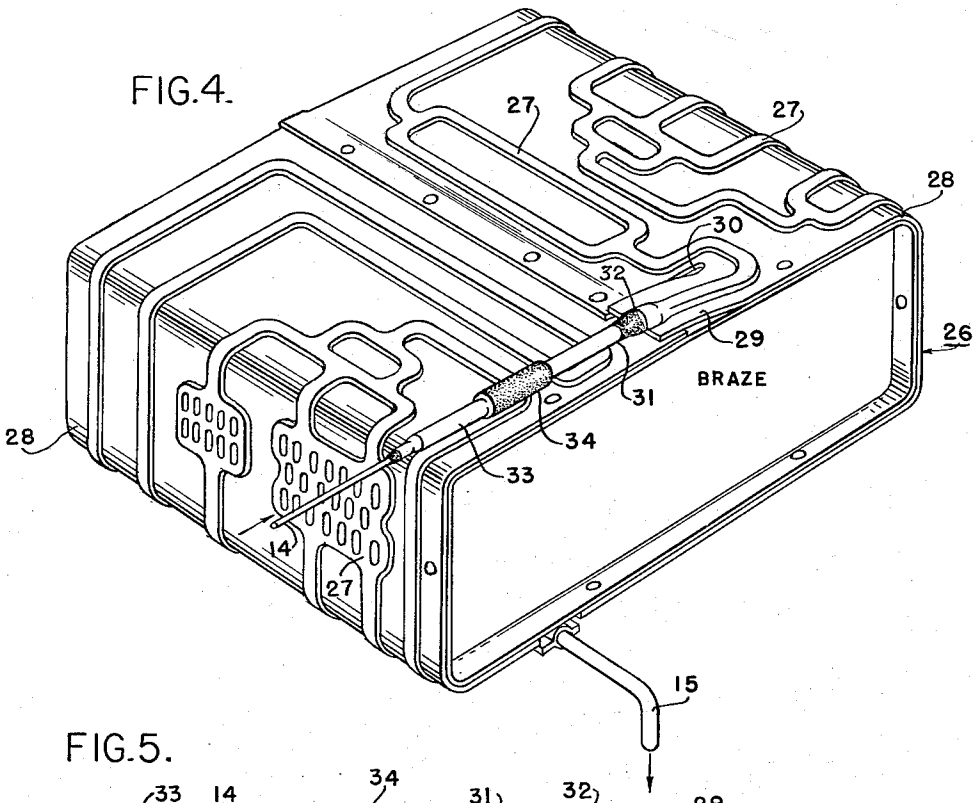
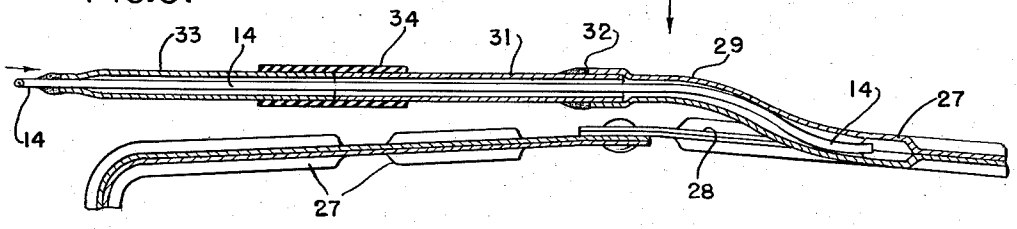



FIG.5.



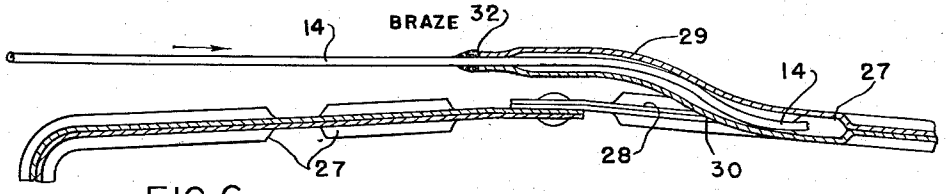




FIG.6.

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# INLET STRUCTURE FOR REFRIGERANT EVAPORATOR

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3 Claims. (Cl. 62—523)

This invention relates to refrigeration apparatus and more particularly to a novel inlet structure for refrigerant evaporators.

The principal object of this invention is the reduction of noise produced by the rush of refrigerant entering an evaporator from a capillary tube expansion device.

Another object of this invention is the provision of an improved inlet structure for refrigerant evaporators.

A further object of this invention is the provision of an improved inlet structure for joining the capillary expansion tube to an evaporator constructed of metal which is electromotively dissimilar to the metal from which the capillary tube is constructed.

This invention is particularly applicable to sheet metal evaporator structures of the type employed in domestic refrigerators. In this type of evaporator the refrigerant inlet structure preferably includes a tubular extension bent away from the main body of the evaporator to facilitate the welding or brazing of the capillary tube to the evaporator. In the past it has been the practice to join the end of the capillary tube to the end of the inlet tube with the capillary extending into the inlet tube but a short distance. I have discovered that this structure produces noise when the refrigerating system is in operation; this noise probably being the result of vibrations set up in the unsupported inlet tube by the pulsating jet of refrigerant liquid and gas issuing from the end of the capillary tube.

This invention contemplates the elimination of this inlet tube vibration noise by extending a continuous portion of the capillary tube entirely through the inlet tube and into a refrigerant passage in the main evaporator structure. The added mass of the sheet metal portions of the evaporator damps vibrations in the refrigerant passages of the evaporator structure, and refrigerant issuing from the end of the capillary in this region produces little noise.

Other objects and advantages of this invention will be apparent from the following detailed description of the invention taken in connection with the accompanying drawings, forming a part hereof, in which:

FIG. 1 is a diagrammatic view of a refrigerating system embodying this invention and showing a tube-on-sheet evaporator structure in perspective;

FIG. 2 is an enlarged sectional view through the inlet passage portion of the evaporator shown in FIG. 1;

FIG. 3 is a view similar to FIG. 2, but showing a modified inlet structure;

FIG. 4 is a perspective view of a different type of evaporator structure embodying this invention;

FIG. 5 is an enlarged sectional view through the inlet passage portion of the evaporator shown in FIG. 4; and

FIG. 6 is a view similar to FIG. 5 but showing a modified inlet structure.

Referring to FIG. 1 of the drawings, the numeral 11 indicates generally a tube-on-sheet refrigerant evaporator structure of the type frequently employed in domestic refrigerators. This evaporator structure 11 forms a part of a compression refrigeration system which comprises a motor-compressor unit 12, a condenser 13 for liquefying the hot gas compressed by said motor compressor 12, a capillary expansion device 14 for conducting refrigerant liquid to the evaporator structure 11 on the low pressure side of the system, and a suction conduit 15 for returning gaseous refrigerant to the motor compressor 12.



The evaporator structure 11 is of box-like configuration and constructed of metal sheet 16 which is preferably aluminum or other good heat conducting material. To the sheet 16 is bonded a tubular conduit 17 arranged in serpentine fashion to define a plurality of refrigerant flow passages surrounding the evaporator structure. The conduit 17 is preferably also made of aluminum and is bonded to the sheet 16 throughout substantially its entire length by brazing, as indicated at 18, or other suitable means. A short section of the conduit 17 adjacent the inlet end 19 of the conduit is left unattached to sheet 16 to permit this section, identified by numeral 20, to be bent away from the main body of the evaporator structure 11 to facilitate connection of a refrigerant supply tube thereto. In most instances, this connection is made by hand brazing or welding, and for the workman to have access to the connection it must be clear of the main body of the evaporator structure.

It can readily be seen that the evaporator structure 11 of FIG. 1 presents a rigid structure in which all refrigerant passages defined by conduit 17, with the exception of the inlet portion 20, are interconnected by the metal sheet 16. It can also be appreciated that the mass of the bonded portions of conduit 17 and the sheet 16 secured thereto will tend to damp any vibrations occurring in any given portion of the refrigerant passage defined by the bonded portion of conduit 17. Vibrations occurring in the free or unbonded conduit inlet portion 20 would not, however, be damped because of the comparatively low mass of this portion of the conduit. Thus, the prior art practice of joining the end of the capillary tube 14 to the conduit inlet 19 produced a noise-emanating structure which was excited by the pulsating jet of liquid refrigerant issuing from the end of the capillary tube 14 and impinging against the inner wall of the conduit inlet portion 20.

This noise problem is heightened when the use of dissimilar metals for the evaporator structure 11 and the capillary tube 14 requires the addition of a water-proofed junction between the two metals in the inlet tube area to prevent electrolytic action, which structure adds an unsupported length of noise emanating tubing. FIGS. 1 and 2 illustrate the type of inlet construction required when the evaporator structure 11 is made of aluminum and the capillary tube 14 is made of an electromotively dissimilar metal such as copper. Because of the presence of moisture on and around the evaporator structure, the junction between such dissimilar metal parts must be covered or coated with a waterproof material to prevent the junction from deteriorating through electrolytic action. A junction of this type is most conveniently and economically made at a location other than where the capillary tube is joined to the evaporator structure. In other words, this junction is preferably made up separately by joining two short sections of tubing 21 and 22 and applying a waterproof covering 23 of plastic, rubber, or the like, over the junction. The tube 21 is aluminum, or other metal electromotively similar to aluminum, and is joined, as by welding, to the evaporator conduit inlet 19. The other tube 22 is copper, or a similar metal, and is joined, as by brazing or soldering, to the capillary tube 14.

In accordance with this invention, and as is best shown in FIG. 2, the capillary tube 14 is not terminated in the low mass conduit and tube portions 20, 21 or 22, but extends continuously through these members into a region of the evaporator conduit 17 which is bonded to the sheet 16. Thus, the discharge end of the capillary 14 is in a region of the evaporator refrigerant passage where vibrations of the conduit 17 are damped, by the

mass of sheet 16 and adjoining passage portions, to the extent that little or no noise is produced.

FIG. 3 shows an inlet structure for the evaporator structure of FIG. 1 such as can be employed when the evaporator structure 11 and capillary tube 14 are made of similar metals. With this arrangement no waterproofed junction is required. In accordance with this invention the capillary tube 14 has a continuous extension thereof passing through the interior of conduit inlet portion 20 and terminates in a region of conduit 17 which is securely bonded to the evaporator sheet 16. The capillary tube 14 and conduit portion 20 are joined at the conduit inlet 19 where the connection may be easily made by soldering or brazing. As in the structure of FIG. 2, the jet of refrigerant from the outlet of the capillary tube 14 impinges, not on the wall of the low mass conduit portion 20, but on the wall of a portion of conduit 17 which is bonded to the relatively rigid evaporator structure 11.

FIGS. 4, 5 and 6 on sheet 2 of the drawings illustrate the application of this invention to a sheet metal evaporator structure 26 in which the conduits or refrigerant passages 27 are formed by and between the sheets 28 which form the evaporator. This type of evaporator may be made in a number of ways but the illustration is of a so-called "roll bonded" sheet structure in which two sheets are bonded together by hot rolling with a pattern of stop-weld material therebetween. The pattern corresponds to the refrigerant passage circuit desired in the finished sheet and, following rolling, fluid pressure is applied between the sheets to cause the sheets to separate where the stop-weld material is present.

To facilitate attaching refrigerant inlet tubes to the refrigerant passage 27, the inlet portion 29 of the passage is separated along its edges from the remainder of the evaporator structure 26 by slitting the sheets 28, as shown at 30. This permits the inlet portion 29 to be bent up out of the plane of the sheets 28 to permit an inlet tube 31 to be welded, or otherwise joined, to the inlet edge 32 of passage portion 29. As in the case of tube-on-sheet evaporators previously described, the evaporator structure 26 may be made of metal which is dissimilar to the capillary tube 14. In this event, a waterproofed connection is required which is made by means of two short tubes, one tube 31 of metal similar to the aluminum evaporator structure 26 being joined to a second tube 33 made of metal similar to copper capillary tube 14, with a waterproofed covering 34 over their junction. This structure is shown in FIG. 5. In accordance with this invention, the capillary tube is joined to the free end of tube 33 but extends through this tube and also passes through tube 31 and through the inlet portion 29 of the refrigerant passage and terminates in a region of the passage 27 which is beyond the slit 30 and securely bonded or attached to the remainder of the sheets 28. This insures that refrigerant issuing from the end of capillary tube 14 impinges on a passage wall portion which is damped by the mass of the surrounding portions of sheets 16 and the remainder of the evaporator structure 26.

FIG. 6 illustrates an aluminum capillary 14 joined directly to an aluminum roll-bonded evaporator structure 26 in accordance with this invention. Here the capillary tube 14 is welded to the evaporator passage inlet 32, but, again, passes through the inlet portion 29 of the refrigerant passage and terminates in a region of passage 27 which is securely bonded to the remainder of the sheets 28.

From the foregoing it will be apparent that this invention provides an improved manner of joining the capillary expansion tube to the evaporator in a refrigeration system to reduce noise produced by the flow of refrigerant fluid through this critical portion of the system. This accomplishes the desired objective by means of structure which is both economically and easily manufactured. The structural arrangements described above do not require any special assembly skills, tools or fixtures beyond those normally required to make the fluid-tight connections in a refrigerating system. In this regard it should be pointed out that this invention does not rely, for effectiveness, on maintaining any spaced or insulated relationship between the capillary tube and the inlet passage portions of the evaporator structure through which the capillary tube extends. As shown in the drawings, the capillary may actually be in contact, at some points, with the passage side wall through which it extends. The inlet passages may, therefore, be bent to any desired shape either before or after the capillary tube is secured thereto.

In the appended claims, the term "bonded" is employed as defining a rigid and secure relationship between the elements, which relationship is produced either by joining separate members or by forming them integrally.

The term "capillary tube" as employed in the foregoing description and in the appended claims refers to the elongated tube of small bore which connects the high pressure side of a refrigerating system to the low pressure side of the system. Though not a true capillary attraction tube, this expansion device is commonly referred to as a "capillary tube" because of its comparatively small bore.

While the invention has been shown in several forms, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various other changes and modifications without departing from the spirit thereof.

What I claim is:

1. In a refrigerating system, a sheet metal evaporator structure, said evaporator structure having means defining refrigerant flow passages in heat exchange relationship with the metal sheet, said sheet being bonded to said passage means substantially throughout the length of said passage means whereby vibrations of said passage means caused by the flow of refrigerant therethrough are damped by the mass of the metal sheet, means defining an inlet passage for said evaporator structure, said inlet means being in open communication with the initial passage means of said evaporator structure but spaced from said sheet substantially throughout its length, whereby said inlet means obtains substantially no damping effect from the sheet, and means for supplying liquid refrigerant to said evaporator structure and comprising a capillary expansion tube joined to the inlet of said inlet means and extending through the passage therein and into said evaporator passage means, said capillary tube terminating in an outlet end in a region of said evaporator passage means which is bonded to said evaporator sheet.

2. In a refrigerating system, a sheet metal evaporator structure having a refrigerant tube bonded to said sheet throughout substantially the length of the refrigerant tube, said refrigerant tube having a portion thereof adjacent the inlet end thereof free of said sheet, and a capillary tube for conveying refrigerant to said evaporator, said capillary tube being joined to the inlet of said refrigerant tube and having a continuous, free portion thereof extending within and through said inlet portion of said refrigerant tube and terminating in a portion of said refrigerant tube which is bonded to said sheet.

3. In a refrigerating system, the combination with a metal evaporator structure comprising passage means having an inlet and an outlet and means structurally interconnecting said passage means whereby vibrations produced in any portion of the passage means by refrigerant flowing therethrough are damped by the mass of the evaporator structure, and a capillary tube for conducting refrigerant to said evaporator structure, said capillary tube being made of a metal which is electromotively dissimilar to the metal of said evaporator structure, of means for connecting said capillary tube to the inlet of

said evaporator structure, said means comprising two tube members which are joined, end to end, one of said tube members being constructed of a metal electromotively similar to said capillary tube and having its free end joined to said capillary tube, the other of said tube members being constructed of a metal electromotively similar to said evaporator structure and having its free end joined to the inlet of said evaporator structure, and a fluid-tight covering for the junction between said tube members, said capillary tube having a continuous extension thereof passing through said tube members and terminating in



the passage means of said evaporator structure, whereby refrigerant issues from said capillary tube in a region of the evaporator passage means which is damped by the mass of the evaporator structure.

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