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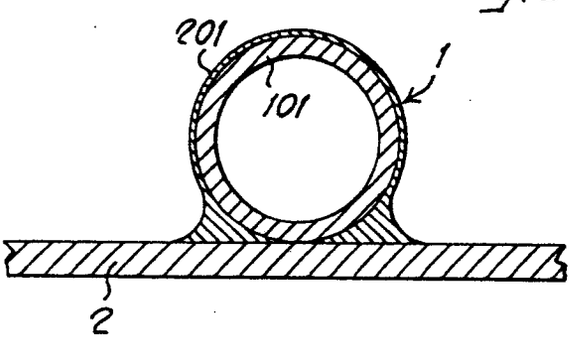
(54) **Heat exchanger, particularly evaporator, and method of manufacturing same.**

(57) The object of the invention is a heat exchanger and particularly an evaporator for refrigerating circuits, which consists of an aluminum or aluminized-steel plate (2) on which one or more aluminized-steel pipes (1) are fixed by brazing or welding.

Moreover, according to the invention, to make the said heat exchanger or evaporator, the pipe or pipes (1) are pressed against the plate into direct contact therewith if welding, or with the interposition of any suitable brazing material (3), particularly an Al Si Mg alloy, if brazing, and the assembly is heated while keeping the said pressure thereon, in a controlled atmosphere furnace or in a vacuum furnace.

Fig. 2



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"Heat exchanger, particularly evaporator, and method of manufacturing same"

The invention refers to heat exchangers, particularly to the evaporators used in refrigerating circuits, which consist of a plate on which one or more pipes, particularly at least one winding pipe, or the like, are fixed.

In the known evaporators of this type, pipes made only of aluminum or only of steel are used, and are connected to the plate by means of an adhesive tape of plastics, a tape of adhesive aluminum, a heat conductive paste or glue, or, when the plate is of steel, by means of welded brackets.

All these known constructions have the drawback of an unstable adhesion, and then of a respective relatively low coefficient of heat transmission between the plate and the pipe or pipes through which the fluid flows.

Moreover, the adhesion andthen the heat exchange between the pipes and the plate vary along the length of said pipes. These conditions cannot be sensibly improved even by increasing the contact surface between the pipe and the plate, for example, by using pipes having a profile with one plane surface, particularly a semicircular profile, instead of pipes having a circular profile.

The invention aims to eliminate the above stated drawbacks and its object is to realize a heat exchanger, particularly an evaporator, of the type as described in the preamble, having a coefficient of heat transmission between the pipe or pipes and the plate which is considerably higher than the coefficient being obtainable with the known constructions, and which at the same time is also substantially constant along the said pipe or pipes.

This problem is solved by the invention in that in a heat exchanger, particularly in an evaporator, of the type as described in the preamble, the pipe or pipes consist of aluminum-steel pipes which are brazed or welded to an aluminum or aluminized-steel plate.

The invention is based on the recognition that thanks to its steel inner part, an aluminized-steel pipe withstands without being deformed, both the melting temperature of its aluminum covering that brings about the welding or brazing thereof to the aluminum or aluminized-steel plate, and the pressures that must be applied on the pipe for keeping it adhering to the plate during the welding or brazing operation, while the said plate can bear both the said temperature and the said pressures without any particular difficulty or deformation problem, since it can be suitably supported, so that it may consist either of aluminized steel, or only of aluminum. The welding or brazing according to the invention between the pipe and the plate, produces a heat conductive intimate continuous connection between the pipe and the plate, and so a respective heat transmission coefficient that is considerably higher than the coefficient which was up to now obtainable in the known heat exchangers and particularly evaporators of the type as described in the preamble. At the same time, in combination with the resulting high capacity of heat exchange, the brazed heat exchanger or evaporator according to the invention, presents a substantial stability both of the heat transmission coefficient and the internal volume along the pipe or pipes, together with a good corrosion strength in a wet atmosphere, a good economy and an easthetic appearance.

The welding or brazing of the aluminized-steel pipe or pipes to the aluminum or aluminized-steel plate may be effected with any suitable method and device fit for the purpose, according to the type of material used for the pipe or pipes and for the plate, and according to the heat exchanger or evaporator to be obtained. Generally, according to the invention, the pipe or pipes are pressed against the plate into direct contact therewith if welding, or with the interposition of any suitable brazing material if brazing, and the assembly is heated while keeping the said pressure thereon, up to a temperature being apt for producing at least a partial melting of the aluminum covering of the pipe and of an aluminum surface layer of the plate, and/or the melting of the interposed brazing material.

In brazing or welding aluminum, the oxidation of aluminum must be avoided.

To this end, according to the invention, the brazing or welding of the aluminized-steel pipe or pipes to the aluminum or aluminized-steel plate is preferably effected with the use of a deoxidizer flux in a controlled atmosphere furnace, or without the use of a deoxidizer flux in a vacuum furnace.

If brazing, particularly good results can be attained both with regard to the quality of the connection between the pipe or pipes and the plate, and to the elimination of the risk of aluminum becoming oxidized, by using, according to the invention, a brazing alloy containing not only a metal, preferably aluminum, but also at least one deoxidizer component and at least one component with a flux action. Preferably, a brazing Al Si Mg alloy, or the like, is used.

These and other features of the invention, and the advantages arising therefrom, will also appear in the following specification of some embodiments of a heat exchanger or evaporator according to the invention, and of some methods of making same, which are shown in a not-limiting way in the annexed drawings, in which:

Figures 1 and 2 are cross-sectional views in an enlarged scale, showing a pipe in a first embodiment of the heat exchanger or evaporator according to the invention, before and after its brazing to the plate.

Figures 3 and 4 are like cross-sectional views in an enlarged scale, showing a pipe in a first embodiment of the b heat exchanger according to the invention, before and after its brazing to the plate.

Figures 5 and 6 are a sectional view and a top plan view showing a clamping device for pressing the pipe against the plate during the brazing operation.

In the drawings, numeral 1 denotes the winding pipe of an evaporator for a refrigerator, while numeral 2 denotes the plate on which the said pipe 1 is to be fixed.

The refrigerating fluid flows through the pipe 1, while the plate 2 acts as surface for a heat exchange with the space or room to be cooled. Therefore, between the pipe 1 and the plate 2 a connection must be obtained that will guarantee the utmost possible coefficient of heat transmission.

To this end, according to the invention, the pipe 1 consists of an aluminized-steel pipe, that is to say, a pipe with a steel inner part 101 and an aluminum outer covering 201, and this pipe 1 is brazed onto the plate 2, which in the embodiment according to Figures 1 and 2, consists only of aluminum. Any suitable alloy, such as, for example, an Al Si Mg alloy, may be used as brazing material.

The brazing operation is, for example, carried out in the following manner: the winding pipe 1 is laid on plate 2 with the interposition of a strip of brazing alloy 3, which preferably is an Al Si Mg alloy, or the like, as shown in Figure 1.

The pipe 1 and the plate 2 are then pressed against each other in a clamping device, as shown in Figures 5 and 6. This device consists of a lower part 4, and the plate 2 is caused to rest on the upper, preferably continuous surface thereof. The pipe 1 is pressed against the plate 2 with the interposition of the strip 3 of brazing alloy by the upper part 5 of the clamping device, which, as shown, may be continuous, or may have slots between the separate lengths of said winding pipe 1. The two parts 4 and 5 of the clamping device are mutually tightened by means of screws 6 which are pivotally connected, for example, to the lower part 4, and are inserted into peripheral notches 105 in the upper part 5, while the nut screws 7 screwed down on the said screws 6, overlap the upper part 5 of the clamping device, as it appears particularly in Figure 5.

The assembly consisting of the winding pipe 1 and the plate 2, which in the clamping device 4, 5 are pressed against each other with the interposition of the strip 3 of brazing alloy, is heated in a controlled atmosphere furnace with the use of a deoxidizer flux, up to such a temperature, for example ranging between 250 and 620°C, as to cause the melting of the brazing alloy 3, and possibly also at least a part-melting of the contiguous zones of the aluminum covering 201 of pipe 1, and of a surface layer of the aluminum plate 2, whereby the brazing between the pipe 1 and the plate 2 is brought about, as shown in Figure 2.

The higher temperatures within the said range of 250-620°C will lead to a better result of the brazing operation, since they cause the melting of thicker layers, which are thus involved in the brazing, both of the aluminum covering 201 of pipe 1 and of the surface of the aluminum plate 2, thus increasing also the area affected by the brazing, and then furhter improving the coefficient of heat transmission between the pipe 1 and the plate 2, which is already very good owing to said brazing.

While it is possible to use any suitable alloy for the brazing operation, the preferred brazing alloy is the Al Si Mg alloy, since the magnesium contained therein acts as deoxidizer, that is to say, it prevents the oxidation of aluminum, while silicon has a flux action, which reduces the melting point of aluminum and its surface tension. The brazing filler material mainly consists of aluminum, and therefore it is like the material of the two surfaces to be brazed.

The embodiment according to Figures 3 and 4 differs from the above disclosed embodiment only in that in place of an aluminum plate 2, it is used an aluminized-steel plate 2, that is to say, a plate 2 having a steel core 102 provided with an aluminum covering 202 preferably on both of its faces, or at least on its face turned toward the winding pipe 1. Also in this case, the aluminized-steel pipe 1 is connected by brazing to the aluminized-steel plate 2 by means of a strip 3 of brazing alloy, preferably consisting of an Al Si Mg alloy, in the manner as described by referring to Figures 1, 2 and 5, 6.

In both of the above instances, instead of effecting the brazing in a controlled atmosphere furnace with the use of a deoxidizer flux, it is possible to proceed in the same manner as above disclosed, with the brazing being however effected in a vacuum furnace, without the use of a deoxidizer flux.

Differently from the illustrated embodiments, the winding pipe 1 made from aluminized steel, may be connected by welding, i.e., without any filler material, to the plate 2 also made particularly from aluminized steel. In this case, the procedure is substantially the same as disclosed above, however without a strip 3 of brazing material being

interposed between the pipe 1 and the plate 2, the pipe 1 /plate 2 assembly compressed within the clamping device 4, 5, being heated in a controlled atmosphere furnace with the use of flux, up to a temperature close to the melting of aluminum, i.e., of about 650°C.

The practical realization of an evaporator according to the invention for a refrigerating circuit, may have, merely by way of a non-limiting example, the following values: The aluminized-steel pipe 1 may have one of the most common diameters ranging between 4 and 10 mm, while the thickness of the wall of its steel inner part 101 may be in the order of 0.6 -0.8 mm, with an aluminum covering 201 of a thickness between 20 and 200 micron. The plate 2 may be of any suitable shape and size, but practically it seldom exceeds a maximum size of 1200 x 600 mm. In the instance of an aluminized-steel plate 2, the thickness of the steel core 102 of the plate may be in the order of 0.3 - 1.5 mm, with an aluminum covering 202 having a thickness between 10 and 80 micron. Also a plate 2 made only from aluminum, may have a thickness between 0.3 and 1.5 mm.

It is however understood that the evaporators made according to the invention, may have any suitable configuration and size, and may be used in any type of refrigerators and freezers. More particularly, the aluminum or aluminized-steel plate may be curved or bent in any desired manner, for example, it may be U-bent, after the aluminized-steel pipe having been welded or brazed thereto.

From the foregoing it is evident that the invention is not limited to the just described and shown embodiments, so that the same may be widely changed and modified, the more so within the limits of the equivalents, without departing from the leading principle as set forth above, and as claimed hereinafter.

Claims

1. A heat exchanger, particularly an evaporator for refrigerating circuits, consisting of a plate (2) on which one or more pipes, particularly at least one winding pipe (1), or the like, are fixed, characterized in that the pipe or pipes consist of aluminized-steel pipes (1) which are brazed or welded to an aluminum or aluminized-steel plate (2).

2. A method of making a heat exchanger, particularly an evaporator, according to claim 1, characterized in that the pipe or pipes (1) are pressed against the plate (2) into direct contact therewith if welding, or with the interposition of any suitable brazing material (3) if brazing, and the assembly is heated while keeping the said pressure thereon, up to a temperature which is apt for causing at least a partial melting of the aluminum covering (201) of the pipe or pipes (1) and of an aluminum surface layer (202) of the plate (2), and/or the melting of the interposed brazing material (3).

3. The method according to claim 2, characterized in that the brazing or the welding of the aluminized-steel pipe or pipes (1) to the aluminum or aluminized-steel plate (2) is effected in a controlled atmosphere furnace with the use of a deoxidizer flux, or in a vacuum furnace, preferably without the use of a deoxidizer flux.

4. The method according to any one of claims 2 or 3, characterized in that if brazing, abrazing alloy (3) is used that not only contains a metal, but also at least one deoxidizer component and at least one component having a flux action.

5. The method according to claim 4, characterized in that an Al Si Mg alloy is used as brazing alloy (3).

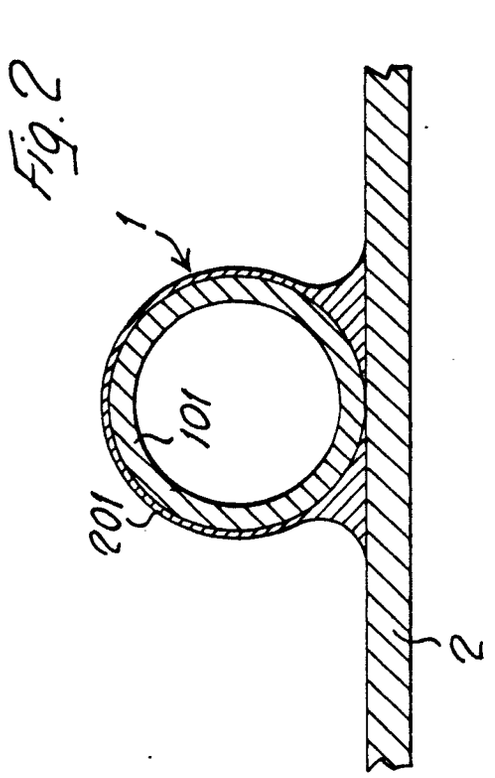

Fig.2

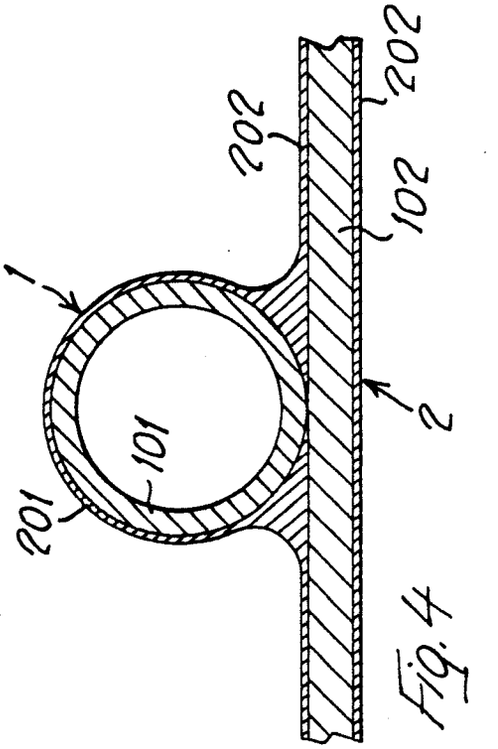

Fig.4

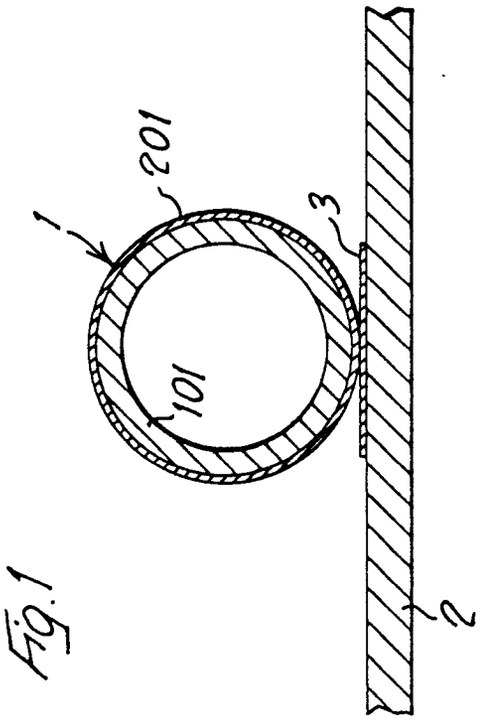

Fig.1

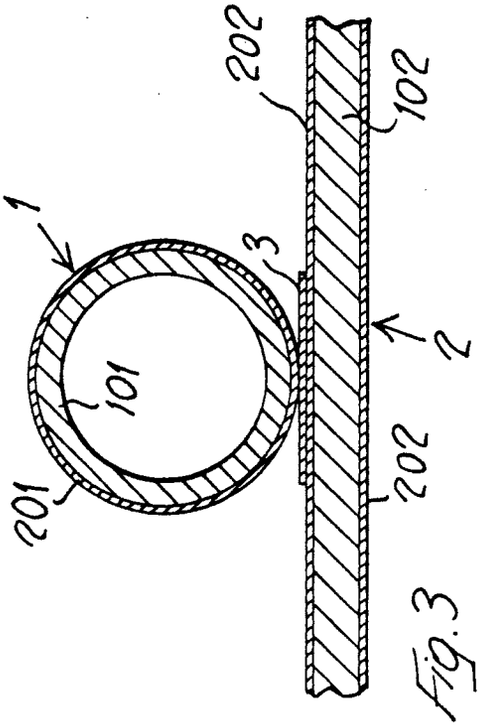

Fig.3

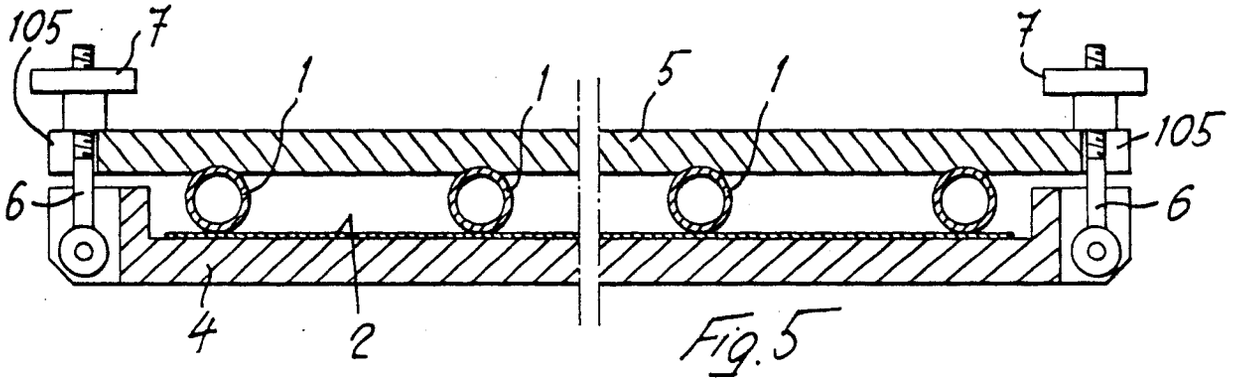

Fig. 5

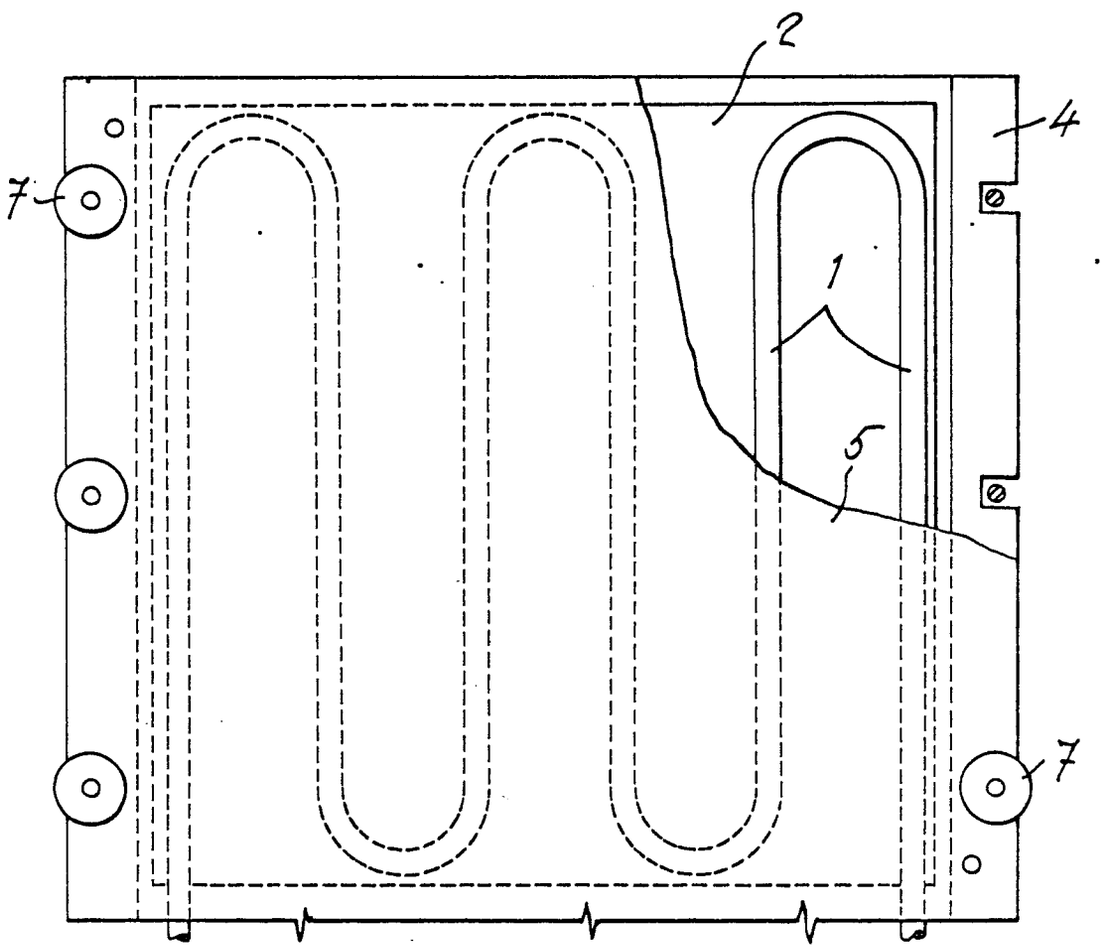

Fig. 6

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EUROPEAN SEARCH REPORT

Application number

EP 86 11 4077

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	US-A-2 386 889 (FURRY) * Whole document *	1,2	F 25 B 39/02
Y		3,4,5	
Y	US-A-4 146 164 (ANDERSON et al.) * Whole document *	3,4,5	
X	US-A-2 306 772 (BENSON) * Whole document *	1	
A	US-A-4 146 163 (ANDERSON et al.)		

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

F 25 B
B 23 K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	23-02-1987	SILVIS H.

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