Dec. 15, 1936. J. ASKIN 2,064,141

METHOD OF MAKING REFRIGERATING APPARATUS

Filed March 16, 1934

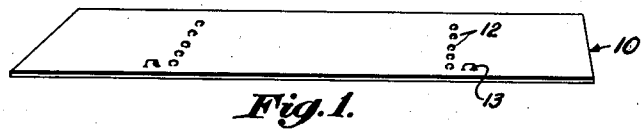


Fig. 1.

Fig. 2.

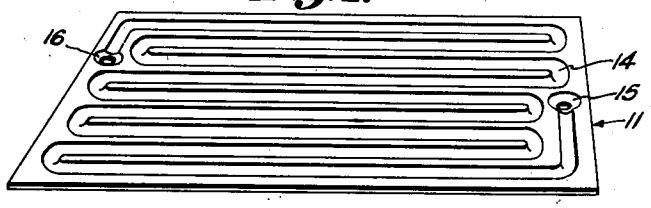


Fig. 3.

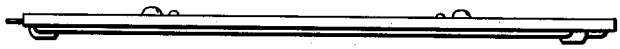


Fig. 4.

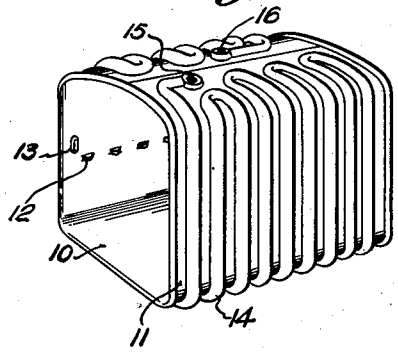


Fig. 5.

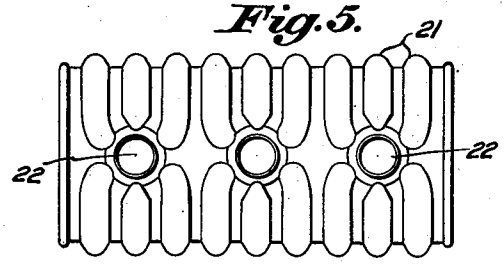


Fig. 6.

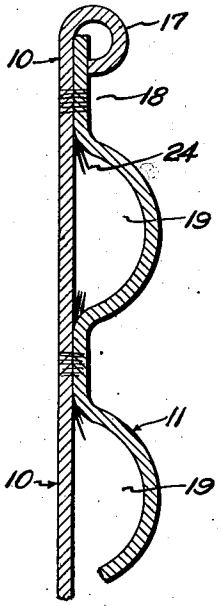
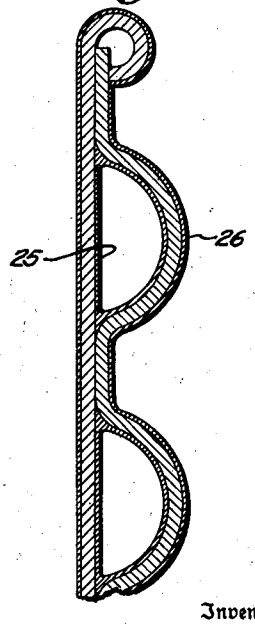


Fig. 7.



Inventor
Joseph Askin

By
Albert R Henry
Attorney

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2,064,141

METHOD OF MAKING REFRIGERATING APPARATUS

Joseph Askin, Buffalo, N. Y., assignor to Fedders Manufacturing Company, Inc., Buffalo, N. Y.

Application March 16, 1934, Serial No. 715,933

2 Claims. (Cl. 113—118)

This invention relates to a refrigeration evaporator and a method of making the same, and it has particular reference to a refrigeration coil in which the refrigerant flows through a continuous tube of metal disposed within a pair of plates which are integrated between the tube portions, and to a method of making such evaporator which provides for the formation of the refrigerant channel between the plates under conditions safeguarding the refrigerant passage from deleterious foreign bodies such as metal slivers or flashings.

A liquid conduit may be made by deforming one or both of a pair of metal plates to provide for spaced and contacting portions when the plates are brought together, and such conduit may be made fluid-tight by welding the plates at their contacting portions. If the welding is conducted under ordinary conditions, as, for example, in the presence of air, the high temperatures attained at the weld cause the metal to disintegrate with the formation of deleterious bodies. In the case of steel sheets, for example, there may be formed an oxide of iron, while in the case of copper or a copper alloy, such as is preferable for many refrigeration devices, there is invariably formed a large number of metallic slivers or needles, which project into the spaced portions defining the liquid conduit.

It has been found, as a result of continuous test and experience, that these slivers or "flashings" cannot be adequately removed by mechanical methods, such as shaking, or blowing with a jet of air. Some of the particles remain, only to be dislodged during subsequent use of the apparatus, and these released slivers find their way back to the refrigerant compressor, where they mix with the lubricant, enter the bearings, creep between the piston and cylinder wall, and thus cause considerable damage to the equipment.

It has been proposed to confine the flashings to the refrigerator or evaporator circuit, by interposing filters in the liquid path, but it has been found that this expedient is not adequate, as the fine particles either pass through the openings in the screens, or else cut their way through, thus destroying the filter.

Notwithstanding this practical obstacle to the manufacture of a satisfactory evaporator, it is recognized that apparatus of this type possesses a number of advantages making it highly desirable for such applications as household refrigerators. Accordingly, the present invention contemplates an evaporator which may be made by welding together with ordinary equipment a pair of deformed metallic plates, but which differs from the ordinary evaporator in that the refrigerant duct or channel is composed of a pipe or tube which is integrated with the plates, and which may be made by a new method, also forming the subject matter of this invention, which method precludes the injection of residual slivers in the refrigerant circuit.

Certain phases of the invention are illustrated in the accompanying drawing, wherein:

Fig. 1 is a perspective view of one plate of an evaporator;

Fig. 2 is a perspective view of the other plate of the evaporator;

Fig. 3 is a longitudinal view of the two plates joined together;

Fig. 4 is a perspective view of the plates shown in Fig. 3, as they appear when bent to form a tray-enclosing evaporator;

Fig. 5 is a top plan view of an evaporator having a somewhat different arrangement of refrigerant passages;

Fig. 6 is a section through a portion of the plates shown in the preceding views, illustrating the points of weld, the spaced portions, and the flashings projecting thereinto; and,

Fig. 7 is a view similar to Fig. 6, showing the interior construction as developed by the present invention.

The evaporator shown in Figs. 1, 2 and 3 is composed of a pair of sheet metal plates 10 and 11, the sheet 10 being plane except for rows of aligned bumps 12 and 13, which may be used as tray slides, and the sheet 11 being formed with a serpentine channel 14 within the confines of the plate, terminating in inlet and outlet openings 15 and 16. These plates may be deformed by ordinary press equipment, and, when placed one on top of the other, form the article shown in Fig. 3, the section of which may be regarded as illustrated in Fig. 6.

Referring to this figure, it will be noted that the edges of the plate 10 are bent or rolled around the edges of the plate 11, as indicated by the numeral 17, and the contacting portions 18 of the sheets, are welded together by an ordinary spot or stitch-welding method, thereby holding the plates firmly together and defining between them a liquid conduit 19.

The structure shown in Fig. 3 may further be bent into the shape shown in Fig. 4, to form a partially closed chamber in which may be placed trays contaning water to be frozen.

Another form of evaporator made from pressed sheets is shown in Fig. 5, in which, as it will be noted, the formed liquid channels 21 are grouped in units of three each, disposed in parallel relation, and terminating in large apertures 22 through which refrigerant may enter and leave the cooling channels 21. Those skilled in the art will recognize the device of Fig. 3 as a flat evaporator, while that of Fig. 4 is a shelf evaporator intended to operate on the "dry" principle or sys-

tem, while the unit shown in Fig. 5 is adapted for use on "flooded" systems.

Irrespective of the system of refrigeration employed, however, or the specific structure of the evaporator, of which only a few possible types are illustrated, the inherent defect of all of them, which renders them commercially impractical, is the presence of the metallic slivers or foreign bodies which are formed by the welding operation, and which, as shown by the numeral 24, extend from the weld points into the liquid channels. It has been found that these flashings cannot be entirely dislodged by shaking the welded unit, or by blowing through it with an air hose, or washing, as these methods do not remove the particles which cling tenaciously between the plates 10 and 11 at the weld points. During use, these remaining particles free themselves, enter the refrigerant circuit, and so are carried back to the compressor.

In order to render the above described type of unit a commercially practical device, the present invention provides for the treatment of the welded unit with agents serving to fix the flashings, and to line the channels 19 with a medium which is inert to the refrigerant, and is impenetrable by the flashings, thereby, in effect, removing the flash from the refrigerant conduit. In the preferred form of this method, recourse is had to the following steps.

The unit, in the form shown in either Figs. 3, 4, or 5, or other suitable form, is shaken or tapped with a mallet, to loosen as many as possible of the slivers and remove them through the conduit ends or openings. After the loose dirt is removed, the unit is dipped, for a very short time, in a bath of strong acid, such, for example, as strong nitric acid. As this reagent is very active, and tends to eat the metal, particularly copper or copper alloy, the time of immersion is relatively short, say about ten seconds. The acid dip serves the purpose of etching or cleansing the interior and exterior of the evaporator, and also dissolves a certain amount of very fine flash particles.

Immediately following the acid dip or wash, the unit is flooded with water, to remove the residual acid, and thereby arrest the reaction, and flush out any loose particles. The water is then drained out of the unit, and the evaporator is dipped into a fluxing bath. For use on copper (silicon) manganese alloys, and when using the hereinafter described coating material, it has been found satisfactory to make the flux of the following composition: water, 85%; hydrochloric acid, 3 to 4%; mixture of zinc chloride and ammonium chloride, 11 to 12%.

After the flux is drained from the unit, its entire exposed surface, both interior and exterior, is cleansed and primed for treatment with an adherent coating agent, it being understood, of course, that not all the flash has been removed by the preliminary treatment. The coating agent which is preferred is composed of a bath of molten metal having a relatively low melting point, such, for example, as lead and tin solder, pure tin, a bismuth solder, or other alloy which has a low melting point, is adhesive to the material of which the plates 10 and 11 are formed, is sufficiently ductile to maintain its adherence during conditions of manufacture and use, and which is inert to the refrigerant used.

The lead and tin solders, consisting essentially of equal parts of lead and tin to eighty-five parts lead and fifteen parts tin, and which may be employed in the molten state at temperatures between 750° and 850° F., have been found satisfactory. They are less expensive than pure tin, and are not as likely to crack or deteriorate during use. They are also inert to such refrigerants as methyl chloride and sulphur dioxide, and form adhesive coatings on the evaporator surfaces. When the unit is dipped into a bath of this nature, the molten metal runs through the channel 19, into the interstices between adjacent weld points, and firmly bonds all remaining and mechanically held slivers. The coating also seals any cracks in the plates themselves.

The time of immersion in the bath may be from one quarter to one half minute, which is sufficient to effect the desired coating. The evaporator is then withdrawn to a point above the bath, and allowed to drain, provision being made at this point, of course, to prevent too rapid cooling, which would cause the bath to freeze in the channels.

While the unit is at a relatively high temperature, it may be blown with hot air, to expel a greater amount of solder. The evaporator is then allowed to cool, and, upon cooling, the metal, which is retained as a coating on the inside and outside of the unit, solidifies to form a separate channel 25 on the interior, which enshrouds and permanently holds all flash particles remaining in the unit. The exterior of the unit is also provided with a coating 26, which may either be polished to develop a pleasing surface of high heat transfer value, or may be employed as a base for plating by an electrolytic process.

From the foregoing description, it will be understood that a method is provided to counterbalance the deleterious and unavoidable effects of flashing in the welding of the evaporator plates, and such method also provides for a liquid passage which is permanently sealed to the plates, and also provides a finish for the article. Such advantages more than offset the cost. It will further be understood that the principles of the invention may be otherwise applied than as hereinabove set forth, and it is therefore intended that the invention should be construed as commensurate with the scope of the following claims.

I claim:

1. In the manufacture of refrigerating apparatus which includes the steps of deforming a pair of sheets, superimposing them, and welding them together in the presence of air at contacting points, the method which comprises cleaning the interior of the structure with a corrosive solution, and thereafter coating the interior with molten metal, said metal being adherent to the sheets when cold, whereby flashings entrapped between the sheets are permanently imprisoned.

2. The method of making refrigerating devices which comprises superimposing a pair of plates having a recessed portion between them defining a path for refrigerant, securing the plates together by welding them in the presence of air at their contacting surfaces, bending the plates into a form suitable for use as a refrigeration evaporator, applying flux to all internal and external surfaces of the completed structure, and finally in solder-coating said surfaces by dipping in a solder bath, the solder coating in said recessed portion entrapping all of the flash deposits of the prior welding operation, and said exterior solder coating providing protective and polishable surfaces.

JOSEPH ASKIN.