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Swaney, Jr.

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[54] **TREATMENT OF METAL ARTICLES**

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Related U.S. Application Data

[62] Division of Ser. No. 124,747, March 16, 1971, abandoned.

[52] **U.S. Cl.** ..... **29/527.2,** 72/47, 72/700, 148/11.5 R, 148/31.5

[51] **Int. Cl.** **B23p 17/00**

[58] **Field of Search** ..... 148/11.5 R, 31.5; 29/527.2; 72/46, 47, 700

[56] **References Cited**

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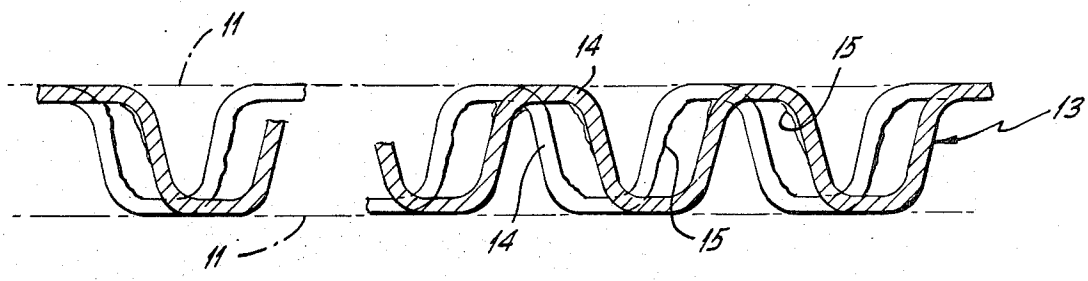
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[57] **ABSTRACT**

A fin and plate type heat exchanger made by a vacuum brazing process comprises dish-shaped plates positioned in confronting relation to form refrigerant passages therebetween, and in back-to-back relation to form air passages therethrough. Heat exchange fins are disposed in the air passages and extend between the backs of adjacent plates. Spacer fins are disposed in the refrigerant passages between the plates to serve as structural reinforcing members and to afford turbulent flow of the refrigerant to enhance heat exchange. Prior to assembly and brazing, the spacer fins are formed by lancing and convoluting a thin blank, such as aluminum plate, from which burrs must be removed. The blank is coated with a clad, such as an alloy of aluminum, magnesium and silicon, prior to lancing and convoluting, so that, in the brazing operation, the clad alloy forms a low melting temperature eutectic alloy with the material of the burrs effectively dissolving them, and leaving a smooth surface upon solidification.

6 Claims, 5 Drawing Figures



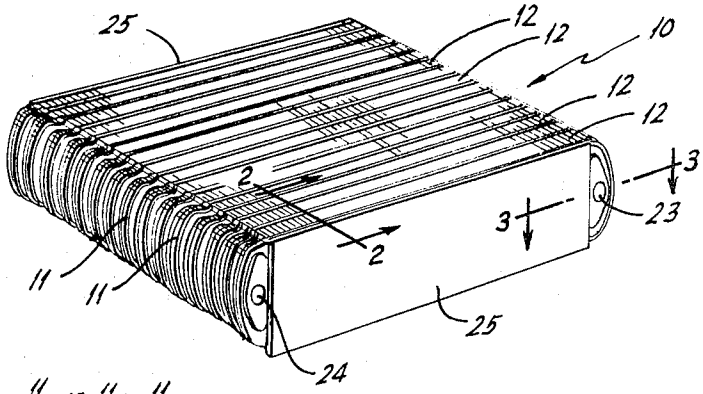


FIG. 1.

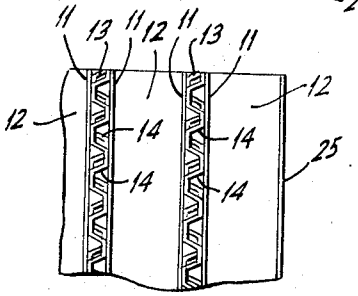
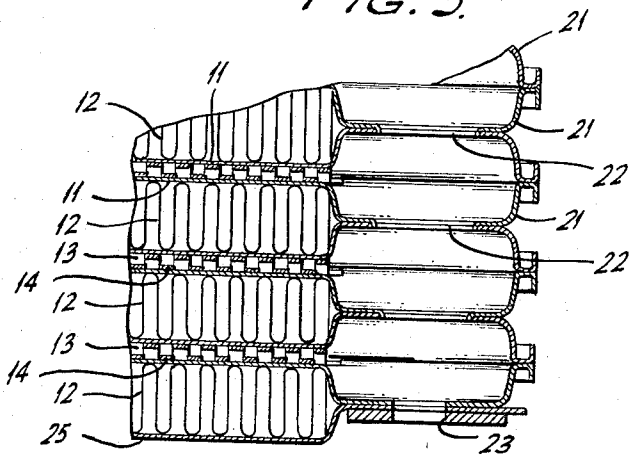


FIG. 2.

FIG. 3.



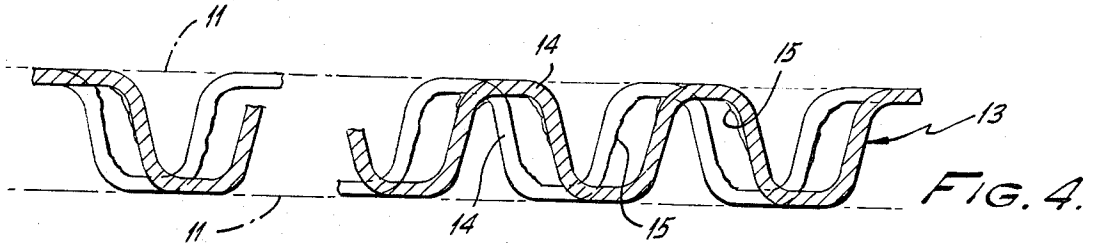


FIG. 4.

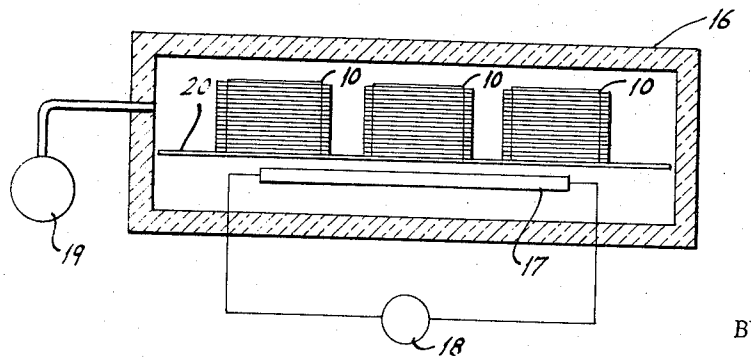


FIG. 5.

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TREATMENT OF METAL ARTICLES

This is a division of application Ser. No. 124,747, filed Mar. 16, 1971 and now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to the treatment of metals, and especially to a novel method for removing burrs from stamped metal articles. While of broader applicability, the method has particular utility in the fabrication of so-called fin and plate type heat exchangers useful in the field of refrigeration.

In refrigeration apparatus, such as automobile air-conditioners, vacuum brazed fin-and-plate heat exchanger assemblies have exhibited a number of advantages, particularly economy of fabrication and efficiency of operation. However heat exchangers of this type have been the source of contaminants arising from dislodgement of burrs and the like primarily from the lanced and convoluted internal spacer plate positioned in the refrigerant passages. For rather obvious reasons such plates have become known as "turbulator" plates.

It has been proposed to overcome these difficulties by resort to special deburring operations. However these are inherently costly and time consuming. I have discovered that the need for such special deburring operations can be eliminated by fabricating the turbulator plates from a suitably clad material, for example making them of sheet aluminum coated or clad with an aluminum-magnesium-silicon alloy. This virtually eliminates problems arising from burr-type contaminants, since during the subsequent vacuum brazing operation, when the heat exchangers are assembled, the alloy coating advantageously melts and forms a eutectic alloy with the aluminum burrs, effectively dissolving them and leaving a smooth surface upon solidification of the alloy coating.

It will therefore be appreciated that the invention has as a general objective the provision of a novel method for removing burrs from metal articles.

It is a further, and more specific objective of the invention to provide an improved method for deburring metal articles, which method can be carried to completion utilizing vacuum brazing techniques. Specifically the invention contemplates eliminating burrs formed during the manufacture of evaporator turbulator plates.

SUMMARY OF THE INVENTION

In achievement of the foregoing as well as other general objectives and advantages of the invention, the invention contemplates a method for removing burrs and the like from lanced and convoluted sections formed in a blank sheet of metal, comprising the steps of: coating said blank sheet with an alloy of said metal having a melting temperature below the melting temperature of said metal; forming said lanced and convoluted sections; and elevating the temperature of said coated metal sheet to a value sufficient to melt said coating and effectively to dissolve said burrs by formation of a eutectic alloy of said metal burrs with said coating. Subsequently, said metal sheet is permitted to cool, leaving smooth surfaces on said lanced and convoluted sections.

Such a process offers numerous advantages over heretofore known deburring operations involving use of abrasives, chemicals, heat, and the like. Such prior art operations tend not to be uniformly effective and require an additional, final cleaning step. In contrast, the process contemplated by my invention achieves consistently uniform results, and is inexpensive since it is carried out concurrently with a final vacuum brazing step in assembling a heat exchanger.

The manner in which the objectives and advantages of the invention may best be achieved will be more fully understood from a consideration of the following description, taken in light of the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective showing of elements of a heat exchanger assembled for treatment in accordance with the method contemplated by my invention;

FIG. 2 is a fragmentary sectional view taken generally along the line indicated by arrows 2—2 applied to FIG. 1, and illustrating to particular advantage the lanced and convoluted spacer plate from which burrs are to be removed in accordance with principles of my invention;

FIG. 3 is a fragmentary sectional view taken generally along the line indicated by arrows 3—3 as applied to FIG. 1, and illustrating further structural features of elements of the assembly on which the method is performed;

FIG. 4 is an enlarged showing of a portion of the section illustrated in FIG. 2, and further illustrating the nature and locations of metal burrs to be removed; and

FIG. 5 is an elevational showing, partly in section, of the heat exchangers positioned within a low pressure vacuum furnace operable to braze the heat exchangers, in achievement of teachings of the invention.

DESCRIPTION OF THE PREFERRED PRACTICE OF THE INVENTION

With more detailed reference to FIGS. 1, 2, and 3, a heat exchanger 10, of the fin and plate type, includes a plurality of dish-shaped plates 11 positioned in confronting relation to form refrigerant passages therebetween and in back-to-back relation to form air passages therethrough. Plates 11 include oppositely dished, end portions 21 also confronting one another, provided with apertures 22 and cooperably disposed to form refrigerant flow headers for the aforementioned passages. Inlet and outlet ports 23, 24 are provided in bracket means 25 extending over and affixed to the end-most plates 11. Sinuous heat exchange fins 12 are disposed in the air passages and extend between backs of plates 11, and between end-most plates 11 and bracket means 25. Spacer fin elements 13 are disposed in the refrigerant passages between plates 11, both to serve as structural members and to afford turbulent flow of the refrigerant for improved heat exchange.

Spacer fin elements 13 are fabricated by forming lanced and convoluted sections in somewhat staggered array, as seen at 14 (FIGS. 2, 3 and 4), in a thin blank such as aluminum plate, to form a plurality of tortuous refrigerant flow paths. In operation, convoluted sections 14 enhance turbulent flow of the refrigerant, with consequent improvement in the heat exchange relationship between the refrigerant and plates 11, as air is caused to flow between plates 11, and over fins 12, to give up heat to the refrigerant.

The assembly dealt with thus far, and in the following paragraphs, is described in terms of its orientation of elements for the brazing operation, and no clamping or holding means for these elements, such as a "strong

back," or the like, will be described, since such structures are well known in this art and need not be shown for an understanding of the invention.

In the course of fabrication by lancing and convoluting the blank, numerous burrs **15**, such as are shown in FIG. **4**, are formed on the cut metal and must be removed, since in the course of operation of a heat exchanger of this type it has been found that burrs **15** become dislodged by the flowing refrigerant and are carried through the refrigerant flow circuit as contaminants. It is the removal of these burrs to which the invention is particularly directed.

The importance of the need for removal of the burrs will be more fully appreciated when it is considered that in a typical blank of aluminum about 9¼ in. long × 3½ in. wide and 0.012 in. thick, there are formed about **64** convoluted rows each having about 23 convolutions. These convolutions **14** cooperate to provide an effective spacer thickness of about 0.080 in., and each convolution acts as a potential source of contaminants by virtue of the nature of its formation by lancing.

As will be more fully explained in what follows, this potential problem is readily met by coating a suitable blank comprising a flat aluminum sheet having overall dimensions preferably of the order described, with an alloy of aluminum, magnesium, and silicon prior to the lancing and convoluting operation, so that during the brazing operation to be described in connection with FIG. **5**, the coating will form a low melting temperature eutectic alloy with the material of the burrs **15**, effectively dissolving them and leaving a smooth surface upon solidification.

With reference to FIG. **5**, vacuum brazing is performed in a conventional vacuum furnace **16** provided with a heater element **17** connected to a source of energy **18** capable of affording an internal environmental temperature in the order of 1,100° F. to 1,200° F., and vacuum pumping system **19** capable of producing a vacuum in the range from about 1×10^{-4} torr to about 1×10^{-6} torr.

In carrying out the process, heat exchangers **10**, held in sub-assembled form as illustrated in FIG. **1**, are placed on suitable supporting means, such as shelf or rack **20**, within furnace **16**. Prior to such sub-assembly, each of the elements of the heat exchanger, including the fin spacer element **13**, will have been clad with a fluxless brazing alloy of a preferred composition comprising 7 percent silicon, 2 to 3 percent magnesium, and a balance of aluminum. The brazing alloy has a melting temperature in the range from about 1,070° F. to about 1,130° F. The fin spacer blank comprises a sheet of 3003 aluminum, having a melting temperature in the range from about 1,198° to about 1,205° F, which, of course, is above the melting temperature of the brazing alloy.

The sub-assemblied heat exchangers **10** as described are placed in furnace **16**, and the pressure is reduced to a vacuum preferably of about 1×10^{-6} torr, and the temperature is elevated preferably to about 1,130° F, to melt the brazing alloy. This pressure and temperature environment is held for about three minutes, and in particular accordance with the invention, the alloy on spacer **10** melts and forms a eutectic solution with the burrs of aluminum, effectively dissolving the burrs and leaving a smooth surface. The vacuum is then removed, the oven heater deenergized, and the heat exchanger sub-assemblies **10** permitted to cool in preparation for such further processing as may be necessary.

I claim:

1. A method of manufacturing a metal sheet having lanced and convoluted sections, which sheet is free of burrs and the like, comprising the steps of: providing a blank sheet coated with an alloy of said metal having a melting temperature below the melting temperature of said metal; forming said lanced and convoluted sections; and heating said coated metal sheet after such forming to a temperature sufficient to melt said coating and to effect formation of a eutectic alloy of said metal burrs with said alloy coating, effectively dissolving said burrs and leaving smooth surfaces on said lanced and convoluted sections.

2. The method according to claim **1**, and characterized in that said metal comprises essentially aluminum, and said alloy comprises essentially aluminum and silicon.

3. The method according to claim **1**, and characterized in that said metal comprises an alloy of about 98.8 percent aluminum and 1.2 percent manganese, and said alloy coating comprises about 7 percent silicon, 2 to 3 percent magnesium, and a balance of aluminum.

4. The method according to claim **1**, and characterized further by the inclusion of the step of subjecting said coated metal sheet to a vacuum as it is heated.

5. The method according to claim **4**, and further characterized in that said vacuum is in the order of from about 1×10^{-4} torr to 1×10^{-6} torr.

6. The method according to claim **2**, wherein said alloy has a melting temperature in the range from about 1,070° F to about 1,130° F and heating to melt said coating is carried out at a temperature of about 1,130° F, said method characterized further in that said metal sheet is heated in the presence of a vacuum.

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