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E. H. WALLACE

2,365,670

METHOD OF MAKING HEAT EXCHANGE TUBES

Filed Sept. 12, 1942

FIG. 1

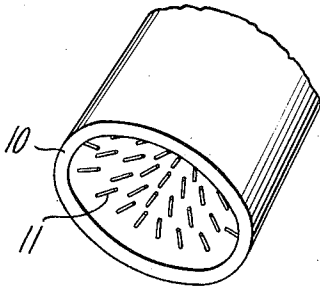


FIG. 2

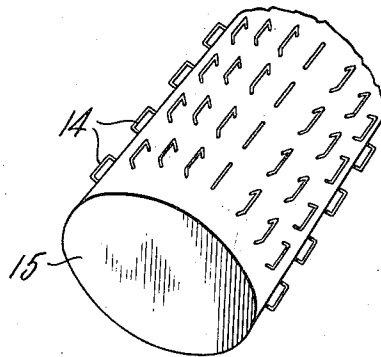


FIG. 3

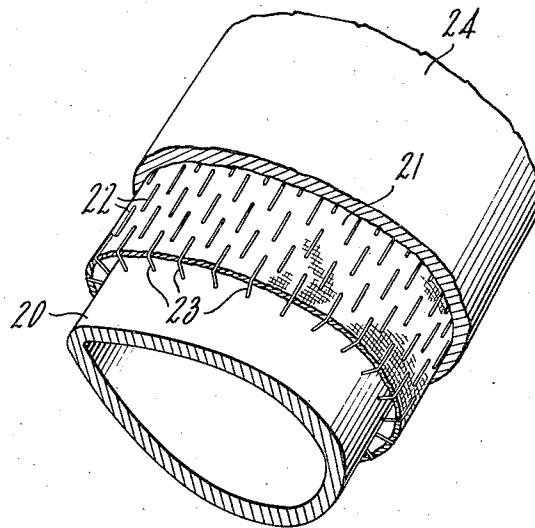
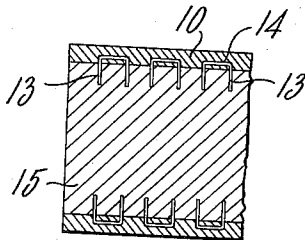
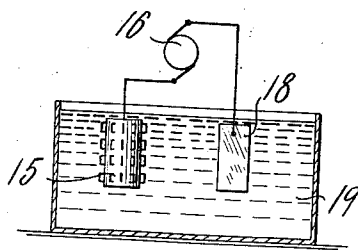


FIG. 4

FIG. 5



INVENTOR.
EDWARD H. WALLACE
BY *Lucas J. Bradley*
ATTORNEY

UNITED STATES PATENT OFFICE

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METHOD OF MAKING HEAT EXCHANGE TUBES

Edward H. Wallace, Detroit, Mich., assignor to
United States Rubber Company, New York,
N. Y., a corporation of New Jersey

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1 Claim. (Cl. 204—9)

This invention relates to methods of making heat exchange tubes or conduits which have heat exchange projections on the inside of the tube. Tubes of this character are difficult to produce in commercial quantities and as far as I am aware tubes having irregular shapes and inside projections or heat exchange elements have not been made.

The primary object of the present invention is to provide an improved and economical method of making heat exchange conduits or tubes having numerous projections inside the tube which greatly increases the interior surface area so as to cause a high thermal transfer coefficient to exist between the projections and their tubular container. Another object is to provide a method whereby a heat exchange tube having the above mentioned internal projections can be readily formed of irregular contour.

Other objects and advantages of the present invention will be apparent from the following description and the accompanying drawing, in which:

Fig. 1 is a perspective view of a heat exchange tube embodying the invention,

Fig. 2 is a perspective view of a core in an intermediate stage of the manufacture of the tube shown in Fig. 1, according to one method embodying the invention,

Fig. 3 is a longitudinal section of the core shown in Fig. 2 with a completed heat exchange tube formed on it,

Fig. 4 is a perspective view, partly broken away, showing a tube and core made by another method embodying the invention, and

Fig. 5 is a diagrammatic illustration of an electrolytic bath for forming the tube.

Referring to the drawing, one form of complete heat exchange tube consists of a metal tube 10, of any suitable shape in cross-section, having on its inside surface a number of metal heat exchange projections, which may be of any desired form, herein illustrated as small pins or filaments 11. The projections are integral with the tube and hence in intimate contact with the wall of the tube, providing a heat transfer contact of high effectiveness. The wires are preferably embedded in the wall of the tube, providing joints of great mechanical strength.

The invention includes methods of conveniently and economically making such a tube. One such method is shown in Figs. 1 and 3. A large number of staples, each including a pair of pins or filaments 13 connected by a connecting end and portion 14, are driven into a suitable core 15,

which may be made of wax, metal which melts at a relatively low temperature such as lead, or any other suitable substance which can readily be removed from the completed tube. Preferably the U-ends 14 project slightly from the core. The core, if made of an electrical non-conductor, is then coated with a conducting layer, for example graphite, which electrically connects all the pins. If the core is of metal the core connects the pins and such coating is not necessary. The core is then connected with a source of electric current 16 and immersed in an electrolytic bath 19, and which contains a suitable anode 18 and is plated with the desired metal to form the tube 10 of the desired thickness. This may be for example, copper or iron. The electrolytically deposited metal forms an intimate contact with the connecting ends of the pins and adheres firmly to them. If the connecting ends of the pins are not in too close contact with the core, the electrolytically deposited metal forms about them so that in the completed heat exchange tube the pins are embedded in the wall of the tube and integral with the metal of the wall. This forms a good thermal and mechanical connection. The filaments themselves, being embedded in the core receive no deposit of metal, and thus do not build up or increase in thickness. After the tube has been formed as described the core is removed. In the case of metal or wax cores, this is done simply by melting out the core.

Fig. 4 illustrates a tube made by another method involving the invention. Card cloth is first formed about any suitable core such as a paper tube 20 of streamlined cross-section. Card cloth is a commercially available article consisting of a fabric backing or support 21 through which are driven a large number of small staples 22 which provide a large number of closely spaced pins 23 projecting from one face of the fabric. The back of the fabric is then coated with graphite and immersed in the electrolyte so that the tube 24 is electrolytically deposited on the fabric and staples. If necessary the projecting pins are coated with any suitable stop-varnish to prevent their receiving a deposit of metal. It is important that the conducting support for the staples be immersed in the electrolyte, as opposed to merely dipping the ends of the staples into the electrolyte, in order that the electrolytically deposited tube may be built up on the conducting support and on the staples at the same time. This produces an intimate thermal and mechanical

bond, and a tube which is strong mechanically and capable of withstanding high pressure.

After the tube 24 has been deposited to the desired thickness, the form 20 and backing 21 are removed by any suitable method, such as by burning or dissolving out, leaving the tube with the pins embedded in its wall and projecting from its interior surface.

Having thus described my invention, what I claim and desire to protect by Letters Patent is: 10
The method of making a heat exchange tube

which consists in providing a core of a predetermined shape, placing around the core in enclosing relation therewith a flexible sheet having numerous metal projections extending therethrough into contacting relation with said core, electrically connecting said projections at the outer surface of said sheet, electrolytically depositing a tube about said sheet to form a heat exchange tube integral with said projections, and removing the core and sheet from the interior of said tube.

EDWARD H. WALLACE.