

March 25, 1930.

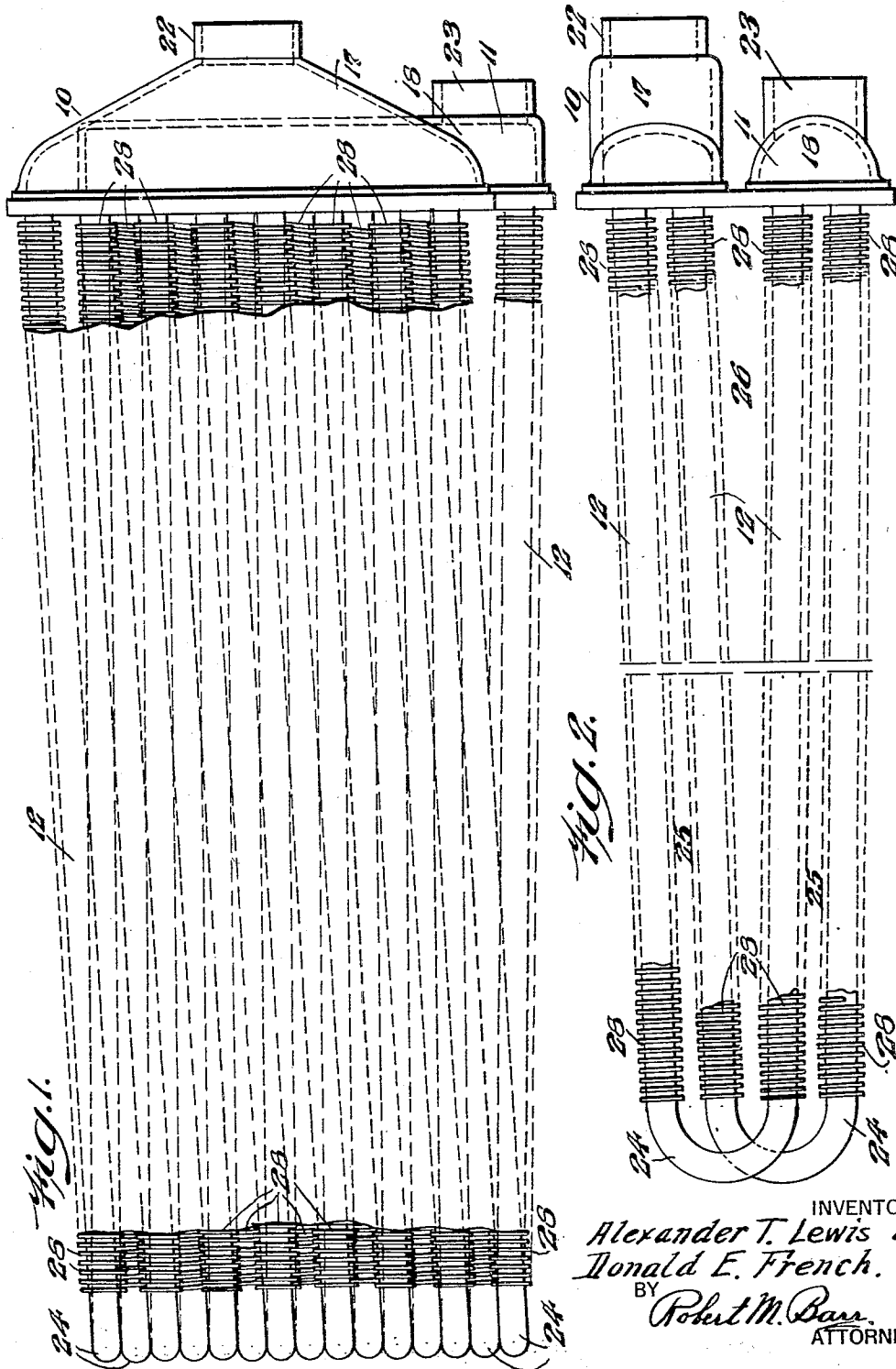
A. T. LEWIS ET AL

1,751,865

METHOD OF BRAZING HEATING COILS

Filed March 9, 1928

2 Sheets-Sheet 1



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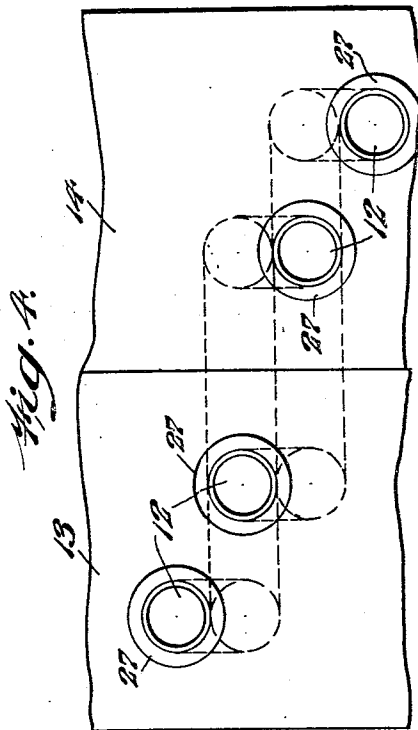
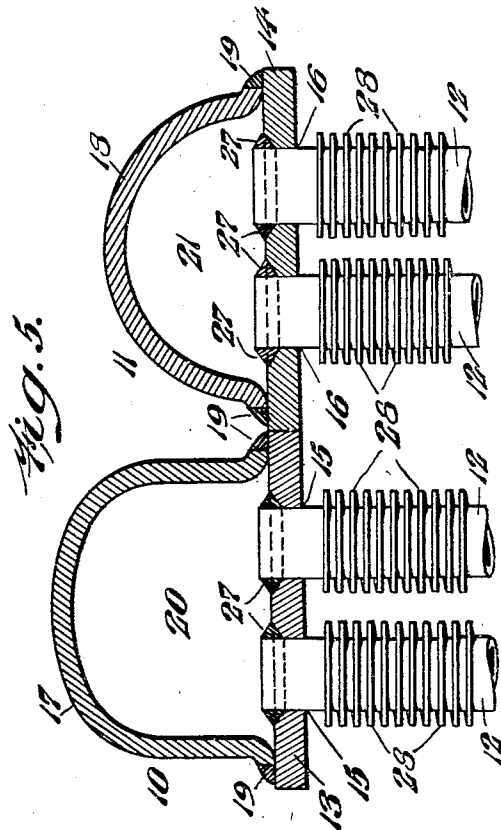
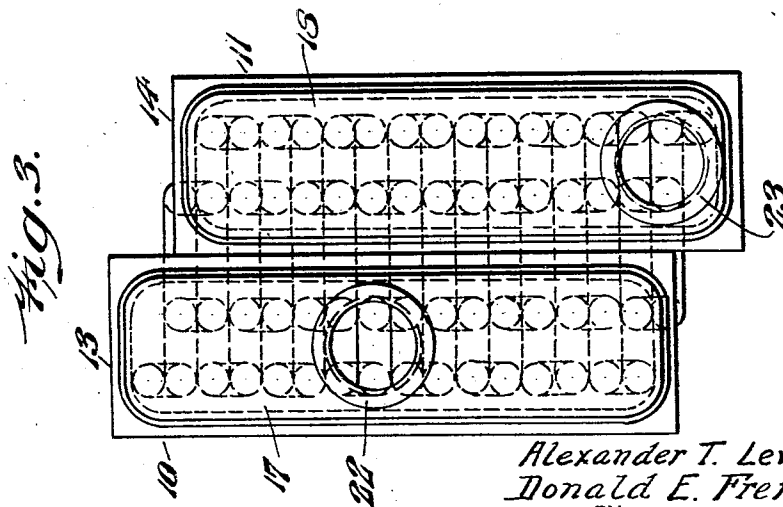
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METHOD OF BRAZING HEATING COILS

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2 Sheets-Sheet 2



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METHOD OF BRAZING HEATING COILS

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The present invention relates to heating apparatus and more particularly to a heating coil of unitary construction and the method of making the same.

5 Some of the objects of the present invention are to provide an improved heating coil; to provide a heating coil consisting of tubes and headers having the ends of the tubes integrally united thereto; to provide a pipe
10 coil heating unit so arranged and constructed that the stress and strains caused by expansion and contraction are automatically absorbed and have no effect upon the joint between the pipes or tubes and the headers; to
15 provide a method of successfully jointing at high temperature the ends of tubes to a header; to provide a method of jointing finned tubes and headers at a temperature higher than the annealing point of the tube
20 or fin and higher than the fusing point of any material used for bonding the fins to the tubes; to provide a method of successfully uniting copper tubes or tubes of metal other than iron or steel to steel or iron headers at a
25 temperature approximating the fusing point of copper or metal other than steel or iron; to provide a finned tube construction wherein a tube or tubes can be integrally attached to a steel header without the use of solder or tin-
30 ning; to provide a coil structure for indirect heating units wherein a maximum heating surface and a maximum passage for air are obtained; and to provide other improvements as will hereinafter appear.

35 In the accompanying drawings, Fig. 1 represents a plan of a heating coil embodying one form of the present invention; Fig. 2 represents a side elevation of the same; Fig. 3 represents an end elevation of Fig. 1; Fig.
40 4 represents an enlarged detail showing the tube pitch of the unit when placed in a vertical position; and Fig. 5 represents a sectional detail of the tube construction after the uniting operation.

45 Referring to the drawings, one form of the present invention comprises a heating coil consisting generally of an inlet header 10, an outlet header 11, and interconnecting heater tubes 12 through which the heating medium
50 is circulated. In the present instance, the

headers 10 and 11 are steel, while the tubes 12 are of copper, though it will be understood the invention is not specifically limited to these two metals but might be applied or embodied in other heating units having headers and tubes. It should also be noted that Fig. 3 illustrates the heating unit of the present invention in its vertical position, in which case one header is staggered horizontally with respect to the other so that there is a free gravity flow of any liquid in the tubes 12 for return purposes, though such staggered relation of the headers is unnecessary where the unit is mounted in a horizontal position because the natural pitch of the tubes allows for the desired return.

The headers 10 and 11, respectively, consist of header plates 13 and 14 provided with through holes 15 and 16 (here shown as of the same size because the tubes are preferably of the same diameter) for the reception of the respective tubes 12, and casings 17 and 18 of tubular form which are respectively attached to the header plates 13 and 14 in a leak proof manner, such as by welding thereto, as shown at 19. The size of the casing 17 is such as to provide a chamber 20 which communicates with all of the inlet ends of the tubes 12, while the casing 18 is of such a size as to provide a chamber 21 communicating with all of the outlet ends of the tubes 12. At a convenient point, the casing 17 is provided with an inlet nipple 22, and similarly the casing 18 is provided with an outlet nipple 23, these two nipples 22 and 23 establishing circulating connections for the heating medium. By reference to Fig. 2, it will be seen that each tube 12 leaves a common inlet header 10, extends outwardly therefrom, with a slight downward pitch for a predetermined distance, then makes a reverse bend or loop 24 and returns with substantially the same downward pitch to the outlet header 11. For maximum tube area with maximum air circulating space, one row of the tube inlets 15 is staggered with respect to the other row of inlets 15, and one row of tube outlets 16 is staggered with respect to the other row of tube outlets, and in this instance the staggered distance in each case is substantially 100

equal to the outside diameter of a tube. As a result, all of the tube returns or loops 24 at both ends are substantially in contact with each other at opposite sides while the body lengths of the tubes are separated by spaces 25 which communicate with a space 26 formed between the inlet and outlet lengths of the coils. This space 26 is variable with the arc of the loops 24, while the spaces 25 are variable in accordance with the distances between the holes in the header, but whatever the variation in dimensions there is always an unrestricted tortuous path between the pipe coils for the passage of air in contact with the fins 28 which are mounted upon the length of each tube between the loop ends. While this construction provides an effective heat absorbing path for the air, it also furnishes an effective means for automatically compensating for expansion and contraction of the tubing due to changes of temperature. Thus because the two headers are located substantially adjacent one another and are interconnected by substantially U-shaped tubes, the joints between the tubes and headers are not subjected to expansion strains and stresses because the body of each of the tubes is free to move and automatically adjust itself to a change in temperature.

In order to form a leak proof joint between the tube ends and the headers and to provide a joint which unites the parts with an integral construction, each tube 12 has its ends inserted in the respective holes 15 and 16 of the header plates 13 and 14 with a clearance fit, while the annular marginal edges of the respective tubes preferably project slightly beyond the plane of the outer face of the header plates. Also it should be noted that the holes 13 and 14 are counter-bored on the outer face of each header to form annular grooves 29 for the reception of the bonding material. When the tubes have been assembled in the header plates 13 and 14 with their ends protruding through the counter-bore grooves 29, each is successively subjected to the action of a welding torch simultaneously with the application of a bonding material to the joint between the tubes and plates. This bonding material is preferably an alloy, such as bronze, though it may be any other suitable bonding material which has a fusing point approximating the fusing point of copper or other material of which the tube is made. The uniting action, therefore, takes place at a temperature substantially that of the fusing point of copper, and as a result each tube is joined to its plate by an annular ring 27 formed as an integral part of the plate by the simultaneous fusing of the bonding material and the material of the plate.

Since one of the main features of the present invention is the formation of a joint at a relatively high temperature, say for example

a temperature not less than 1400° F., it is evident that the desired uniting of the tube and header cannot ordinarily take place without damage either to the tube, or in case of finned tubes to the fins, and to the joint between the fins and the tubes. To the end, therefore, that this uniting operation can be successfully carried out without damage to the tubes, the fins or the bonding material between the tubes and fins, the present invention embodies as a new step in joint construction the use of a bonding material which has a fusing point as near as possible to the fusing point of the material of the tubes. This fusing point of this bonding material should not only be well above the annealing point of the tube material but also well above the annealing point of the material of the fins of a tube in case a finned type of tube is to be united to a header. In addition, the fusing point of the joint bonding material should be well above the melting point of any material ordinarily used to unite fins to tubes. As a component part of the present method, a step has been devised whereby the high fusing bonding material can be successfully brought to its fusing point while maintaining adjacent parts at a relatively low temperature during the fusing operation. This step consists broadly of the application of a cooling medium to parts adjacent the joint being formed and in the preferred form this cooling medium is a bath of water maintained at a low temperature and so arranged that any tube or tubes to be connected to a header plate is or are immersed in the bath to a point in close proximity to the face of the plate in which the joint is to be formed. When so positioned, the fusing operation can be carried out without damage to the tubes, or tube-fin bonding, while allowing free flow and fusing of material at the joint and bringing about a complete integral uniting of the ends of the tubes with the header plate.

In the foregoing, more or less specific reference has been made to the jointing of copper tubes to steel headers, but broadly considered the invention is not limited to any particular metal or metals, and the tubes and headers may be of the same metal instead of different metals without departing from the invention. In other words, the present invention contemplates the successful formation of a high temperature joint, that is one capable of standing up and resisting temperatures of at least as high as 700° F., without breakdown. In the present instance, the high temperature joint completes a unitary heating coil formed of finned tubes by an integral joining of the tubes and headers so that the entire structure is capable not only of resisting all of the strains to which connected tubes and headers are subjected but also temperatures up to approximately 700° F. In the ordinary jointed construction of

tubes and headers, the expansion and contraction causes the joints to open and makes necessary constant repairs in the form of re-expanding, resoldering, and rejoining, while
 5 all such troubles, repairs, and delays are eliminated by the present high temperature uniting method. Also the present construction reduces to a minimum the strains and stresses transmitted to the joints because ex-
 10 pansion and contraction are absorbed by the freely suspended looped form of the tubes. The foregoing structure has been made possible by a new and novel method which consists in locating the end of a tube in a pre-
 15 pared hole in a header plate, subjecting the body of the tube to the action of a cooling medium, applying a bonding material having a fusing point as near as possible to the fusing point of the metal of the tube and
 20 higher than the annealing point of the tube or any fins carried thereby and well above the melting point of any material used to unite the fins to the tube or tubes; and subjecting the bonding material, the end of the
 25 tube, and the plate to heat having a temperature higher than the melting point of the bonding material which unites the fins to the tubes.

Having thus described our invention, we
 30 claim:

1. The method of securing a tube to a header plate where one article is copper and the other is steel, which consists in locating the tube in a hole in the header, subjecting the
 35 copper article to a cooling medium to maintain it at a temperature lower than the fusing point of copper, flowing a bonding material having a fusing point substantially that of copper about the joint between said tube and
 40 plate while simultaneously subjecting the two adjacent portions of the two articles to a temperature closely approximating the fusing point of copper.

2. The method of uniting copper tubes to
 45 a steel header plate which consists in locating the ends of the tubes respectively in prepared counter-bored holes in a header plate, subjecting the tubes to a cooling medium to maintain the tubes at a temperature lower
 50 than the fusing point of copper, flowing a bonding material having a fusing point near the fusing point of copper about the joints of said tubes and plates, while simultaneously subjecting the bonding material and the parts
 55 to be united to a temperature closely approximating the fusing point of copper.

3. The method of forming a joint between a plate and a tube having fins bonded there-
 60 to which consists in supporting the tube with its end in a prepared hole in the plate, subjecting the portion of the tube projecting from said plate to a cooling medium to maintain the tube portion at a temperature below the annealing point of the metal of said tube,
 65 subjecting the tube end and plate surround-

ing portion to a temperature higher than the annealing point of the cooled article and simultaneously applying a bonding material having a fusing point approximately that of the metal of the tube and higher than the
 70 melting point of the bonding material between the fins and tube.

4. The method of forming a joint between a plate and the end of a finned tube capable of
 75 withstanding temperatures at least as high as 700° F., which consists in locating the end of a finned tube in a prepared hole in a plate, maintaining the finned portion of said tube at a temperature below the annealing point of the tube and below the melting point of
 80 any material used to bond the fins to the tube, subjecting the interfitted parts of the tube and plate to a temperature higher than the annealing point of the metal of the tube and plate, and simultaneously applying to the
 85 heated parts a bonding material having a fusing point substantially the same as the fusing point of the tube metal, but higher than the melting point of the fin bonding material.

Signed at Philadelphia, county of Philadelphia, State of Pennsylvania, this 7th day
 90 of March, 1928.

ALEXANDER THORNTON LEWIS.
 DONALD E. FRENCH.

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