

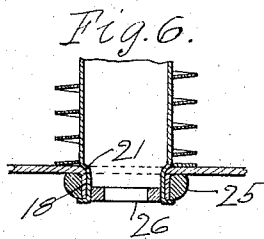
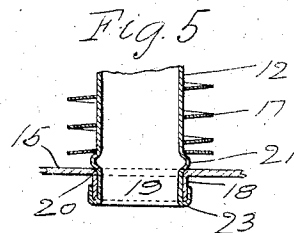
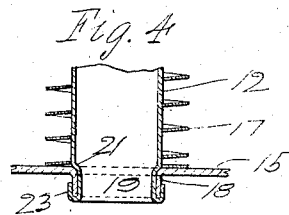
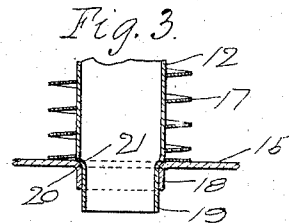
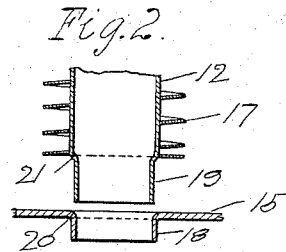
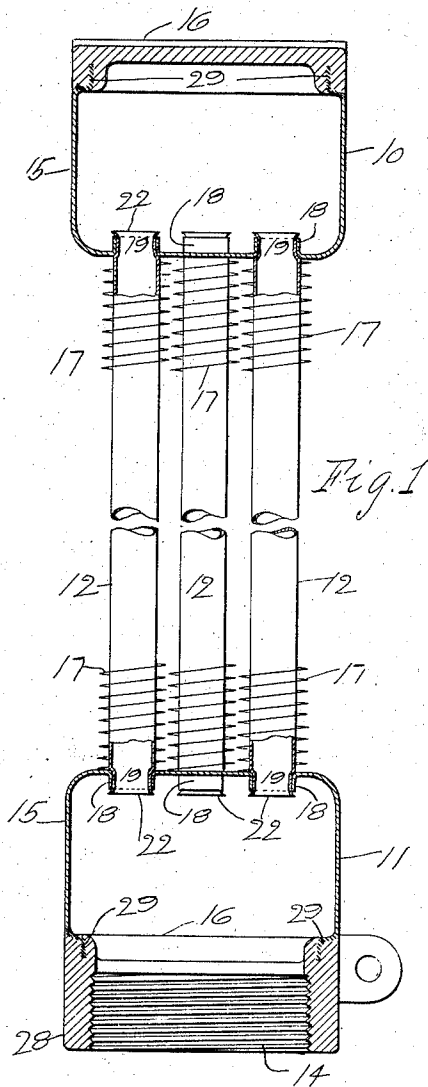
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HEAT EXCHANGE DEVICE

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HEAT-EXCHANGE DEVICE

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This invention relates to tubular radiators or heaters of that kind which have spaced radiating tubes connected to a header or headers and adapted for the flow of steam or other medium through the tubes, and which are used to effect an interchange of heat between the medium flowing through the tubes and the air or medium circulating between the tubes, as for example, for heating the air or external medium, or for cooling the medium circulating through the tubes. More particularly, the invention relates to improvements in radiators or heaters in which the radiating tubes and the tube plates or parts of the header or headers to which the tubes are connected are made relatively thin and flexible, and of brass or other metal of high conductivity so as to produce a radiator of light weight having the maximum conductivity and radiation, and in which the thin tube plates or parts of the headers to which the radiating tubes are joined are adapted to readily flex or give with the changes in length of the radiating tubes, due to the alternate expansion and contraction thereof so as to prevent distortion of the tubes or other parts of the radiator and avoid the opening or weakening of the joints between the parts of the radiator.

Radiators or heaters of the character mentioned are employed extensively in automatically controlled heating and ventilating installations in which steam at relatively high pressures is used in the radiator for heating the air that serves to heat or ventilate the building, and in which the steam is turned on and off, or its supply to the radiator regulated for varying or controlling, as required, the temperature of the air in the system, and owing to the great radiation and rapid conductivity of the metal forming the tubes and connected tube plate or header, these parts are subject to relatively sudden and extreme changes of size or form due to the sudden changes in temperature thereof.

One of the objects of the invention is to join the radiating tubes to the flexible tube plates or parts of the headers in a novel manner, such that notwithstanding the thinness of the walls of the tubes and the tube plates,

nevertheless very strong and reliable unions are effected between the parts, which insure perfect steam-tight joints which are prevented from becoming loosened or being injured by the extreme and rapid changes of size or form of the parts; also to construct the joints so that notwithstanding the comparative thinness of the walls of the tubes and the connected tube plates, relatively large bearing areas are provided between the tubes and tube plates which insure a strong, rigid connection, and the tubes and tube plates are provided with integral, interengaging shoulders or parts which positively secure the tubes against both inward and outward movement relatively to the tube plate; and also to improve the construction of tubular radiators or heaters in the other respects hereinafter described and set forth in the claims.

In the accompanying drawings:

Fig. 1 is a transverse sectional elevation of a radiator or heater embodying my invention.

Figs. 2, 3 and 4 are sections showing one construction of the joint between one of the radiating tubes and the tube plate, these figures showing respectively the parts before connection, the tube seated in the flanged hole of the tube plate, and the completed joint.

Figs. 5 and 6 are sections showing two slightly modified forms of joint between the radiating tube and the tube plate or flexible wall of the header.

The radiator illustrated in the drawings comprises upper and lower headers 10 and 11 connected by parallel, spaced radiating tubes 12 so that a fluid medium supplied to one of the headers, for example, as by a pipe connected to the upper header, can pass through the several radiating tubes to the other header and discharge through a discharge pipe 14 connected with the latter. Each header, as shown, comprises a flexible or relatively thin sheet metal plate, wall or part 15 and a strong, rigid or cast plate or part 16, connected to the flexible part by a fused or other suitable form of hermetic joint, and the radiating tubes, which have relatively thin walls, are secured at their ends to the flexible plate or shell of the header, the tubes

being preferably provided with the usual projecting radiating fins 17 formed by a thin metal ribbon wound helically around and soldered or otherwise suitably secured to each tube. In so far as this invention is concerned, however, except for the construction of the joints between the radiating tubes and the flexible tube plate or wall of the header, the radiator may be of any suitable form and construction.

The construction of the joints connecting the radiating tubes to the flexible tube plate or part of the header can be modified more or less, as shown in the several figures of the drawings. The flexible tube plate or header part 15 is formed as by stamping or drawing in suitable dies to provide therein holes surrounded by integral, inwardly projecting lips or flanges 18 to receive the ends of the radiating tubes. The internal diameter of each of these flanges 18 is preferably slightly smaller than the external diameter of that portion 19 of the tube which is to fit in the flange, said portion 19 being preferably made cylindrical and of an external diameter adapting it to enter the rounded or bevelled edge 20 at the outer end of the flange 18 so that by driving or pressing the tube into the flanged hole of the tube plate, the part 19 of the tube is slightly compressed or the flange 18 slightly expanded, or both, and a very tight driven fit of the tube in the flanged hole results. The tube is also provided with an external, circumferential shoulder 21 which is adapted to engage or bear against the rounded, outer end 20 of the flanged hole when the portion 19 of the tube has been fully pressed into place in the flanged hole, thereby limiting the inward movement of the tube into the hole and preventing inward movement of the tube in the tube plate in the completed joint. This external shoulder 21 on the tube can be made by forming an outwardly projecting, circumferential bead or corrugation in the wall of the tube, as shown in Fig. 5, or the shoulder can be formed by contracting or compressing the tube at its end portion so as to make the portion 19 of the tube of less diameter than the remainder of the tube, as clearly shown in Figs. 2-4 of the drawings. By thus compressing the end portion of the tube to make it of less than its original diameter, the metal in the reduced portion 19 is made denser or thicker, thereby strengthening it. Another beneficial effect of thus compressing or contracting the end portions of the tubes to a smaller diameter is that while the tubes as produced commercially may vary somewhat in diameters, the end portions 19 of all of the tubes can be readily reduced to the same diameter by means of dies or other suitable mechanism, so that the portions 19 of all of the tubes will accurately fit in the flanged holes of the tube plate and insure uniformly perfect joints between the

tubes and the tube plate. Also the tubes can be reduced at their ends in this way at less expense and with less danger of loss by rupturing or weakening the tubes than if the shoulders 21 are formed by expanding the walls of the tubes. After the end of the tube has been pressed or driven into the flanged hole of the tube plate with the shoulder 21 of the tube against the outer edge 20 of the hole, the extremity of the tube is flanged outwardly or shaped by suitable means to provide an external shoulder or enlargement on the end of the tube which engages the inner end of the flange 18 of the tube plate so as to rigidly and permanently retain the tube in the flanged hole of the tube plate and prevent relative outward movement of the tube in the hole. The end of the tube can be simply expanded or flared outwardly to form a shoulder 22 engaging the inner end of the tube plate flange 18, as shown in Fig. 1, but preferably the end of the tube is bent or rolled back over the end of the flange 18 so as to tightly embrace the latter, as shown at 23, Figs. 4 and 5. By the described construction, even though the tube plate is relatively thin, each tube has a driven fit and a relatively long bearing in the tube plate and, in addition, is secured against endwise movement in both directions by integral shoulders on the tube engaging the opposite ends of its bearing, that is the flange 18 of the tube plate. In pressing the tubes into the holes in the tube plate, the rounded, outer edges 20 of the flanged holes, which are quite rigid, act in the nature of dies on the shoulders 21 of the tubes and press the shoulders to the shape of the edges 20, thereby ensuring very close contact and fit of the shoulders against the edges 20.

After the tubes have been firmly secured in the flanged holes in the tube plate, as thus described, the joints between the tubes and the tube plate are welded, soldered or tinned so as to still further increase the strength of the joints and make them perfectly fluid-tight so as to preclude the possibility of leakage through the joints even when high pressure steam is used in the radiator.

The joint shown in Fig. 6 is similar to that shown in Fig. 4, except that a strengthening collar 25 surrounds and tightly fits the hole flange on the tube plate, and the out-turned flange at the end of the tube overhangs this collar as well as the hole flange, thereby securing the collar in place. The collar is of substantial cross section and is therefore strong and rigid and greatly strengthens the hole flange against expansion. In this construction a restriction ring 26 is also shown secured in the end of the tube. The openings of these restriction rings are so proportioned relatively to the fluid supply to the radiator as to prevent the steam or other fluid from flowing through a part only of the tubes.

They, therefore, act to equalize the distribution of the steam or fluid to all of the tubes and prevent dead or inactive tubes in the radiator. As in the other construction, the several parts of the joint are soldered or welded together.

Since manufacturing considerations make it practically essential that ready access be afforded to the ends of the tubes at the inner side of the tube plate or shell in making joints of the character described between the tubes and the tube plate or shell, the tubes are joined to the tube plate or shell before the latter is joined to its complementary part of the header. Then, after attaching the tubes to the tube plate or shell, the latter is secured to the complementary header part by a suitable strong and reliable steam-tight joint between the periphery of the tube plate or shell and the other or cast part of the header. A fused or welded joint 29 between the header parts is shown.

In the header constructed as described, the wall or part constituting the tube plate to which the radiating tubes are joined is flexible and can be formed from a relatively thin plate or sheet of suitable metal having the required flexibility and conductivity, such for instance as sheet brass, so that this plate or wall can readily flex or give with changes in dimensions of the tubes due to variations in their temperature. At the same time, however, the other part 16 of the header which is formed or provided with the screw collar or other part 28 for the attachment of the steam supply or other pipe to the radiator, is sufficiently strong and rigid to withstand strains and shocks incident to the attachment of the pipes to and their disconnection from the radiator, and the expansion and contraction of the pipes.

I claim as my invention:

1. In a heat exchange device, the combination of a header having a thin flexible wall provided with holes surrounded by inwardly projecting flanges formed by integral parts of said wall, and radiating tubes having thin walls of substantially uniform thickness throughout provided with portions having driven fits in said flanged holes and with integral circumferential external shoulders which engage the outer end edges of said holes, the inner ends of said tubes being flanged over the inner ends of the flanges of the flexible wall, whereby said tubes are secured to said wall against inward and outward movement relatively thereto.

2. In a heat exchange device, the combination of a header having a thin flexible wall provided with holes surrounded by integral inwardly projecting flanges on said wall, strengthening collars surrounding said flanges, and radiating tubes having portions fitting tightly in said flanged holes, said tubes being provided with integral circumferential

projections which engage the edges of said holes at the outer side of the tube plate, and said tubes having their inner ends flanged over the inner ends of said flanges of the flexible wall and said strengthening collars.

3. In a heat exchange device, the combination of a header having a thin flexible wall provided with holes surrounded by integral inwardly projecting flanges on said wall, radiating tubes having portions fitting tightly in said flanged holes, said tubes having integral external projections which engage the inner and outer ends of said flanges on said flexible wall whereby said tubes are secured to said wall against inward and outward movement relatively thereto, and rings secured in the end portions of said tubes and having openings of smaller diameter than the internal diameter of the tubes.

4. In a heat exchange device, the combination of a header composed of complementary walls joined together by a fluid tight fused metal joint, radiating tubes having relatively thin walls joined to one of said header walls by fluid tight fused metal joints, and distribution-equalizing rings in the end portions of said tubes and having openings of smaller diameter than the internal diameter of the tubes.

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