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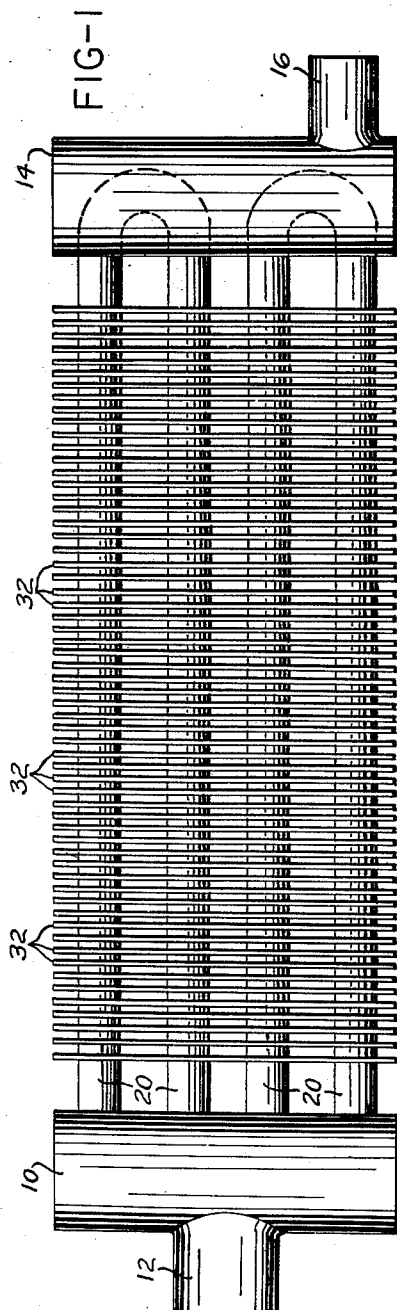
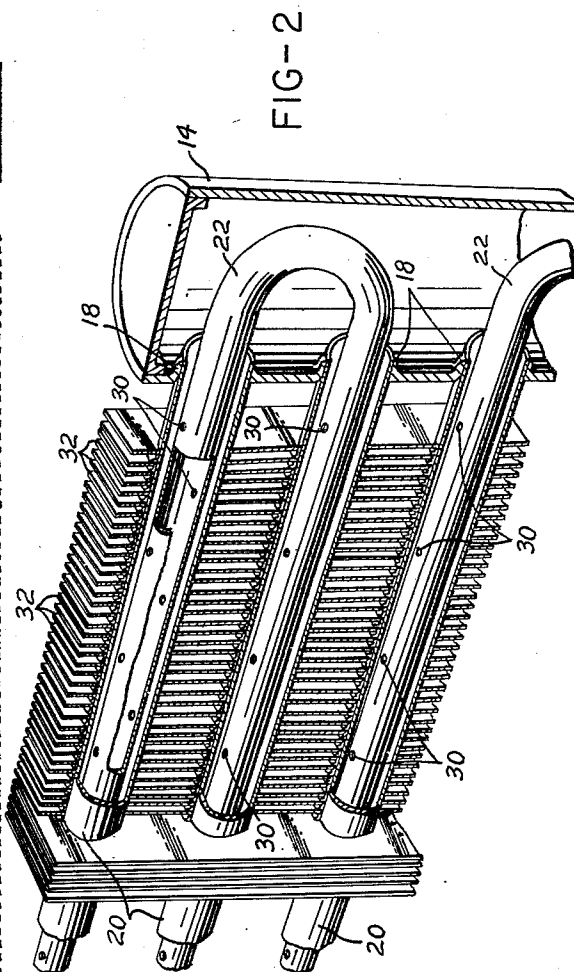
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2,816,738

HEAT EXCHANGER

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2 Sheets-Sheet 1



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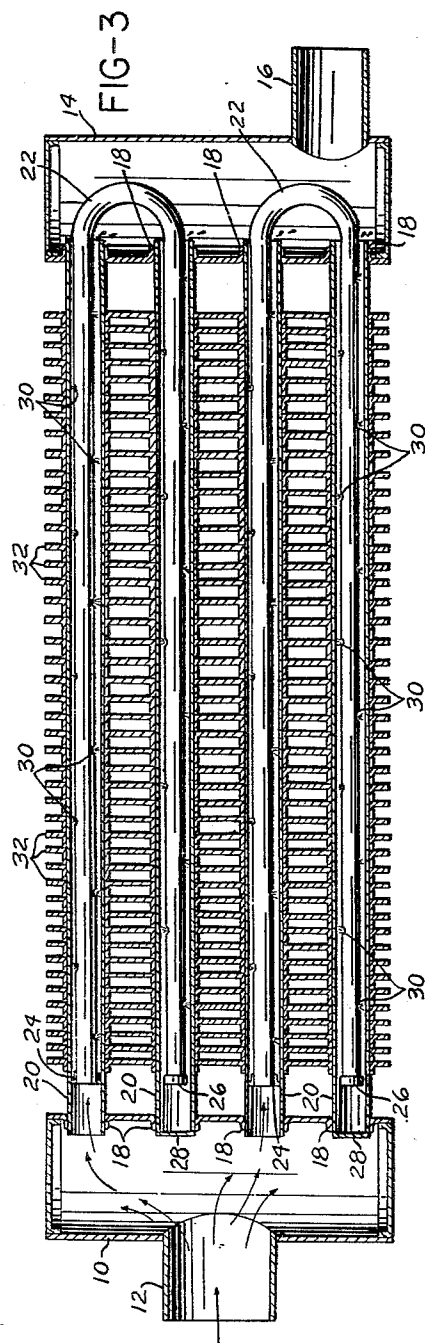
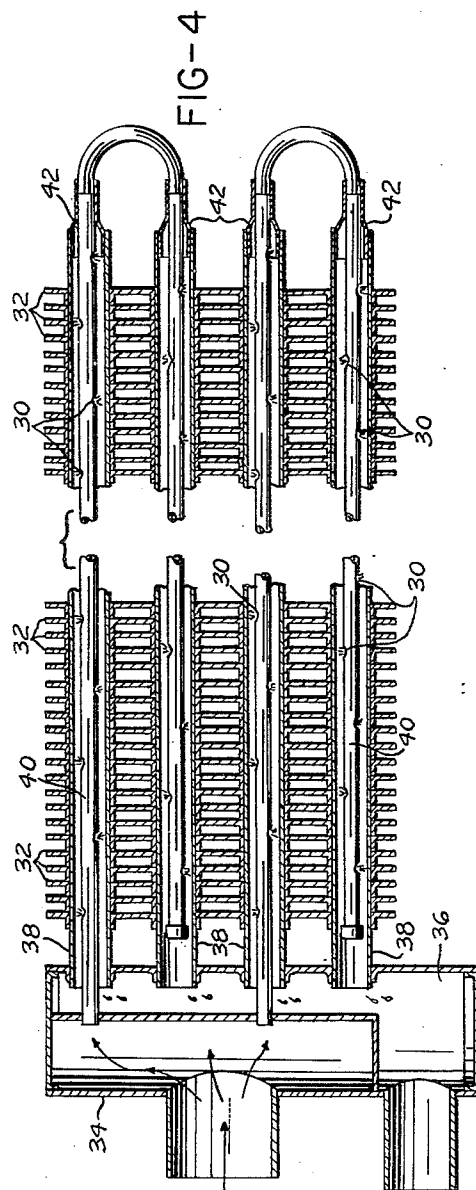
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2 Sheets-Sheet 2



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HEAT EXCHANGER

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7 Claims. (Cl. 257—36)

This invention relates to a heating surface and in particular to finned type radiators which receive heat from a supply of steam.

In the conventional type of radiator or heating surface of the nature which this invention is concerned, each tube thereof is connected with a header from which it receives steam and the condensate from the tube is withdrawn through another header. With this arrangement there is a relatively poor distribution of the steam in the condensing tubes, particularly when the heating surface is operating under a light load.

The uniform distribution of the steam in an arrangement of this nature has long been troublesome and one attempt to refine and improve the operation of a heating surface of this nature is illustrated in my Patent No. 2,138,187. In the patent referred to each condensing tube contains a distributing tube through which the steam is supplied whereby the steam is substantially uniformly distributed throughout the length of the condensing tube, and this, of course, makes for more efficient operation and makes for a more uniform distribution of heat over the entire heating surface.

However, the arrangements referred to above still have an individual distribution tube for each individual condensing tube and this requires as many outlets from the supply headers as there are condensing tubes. This arrangement is, therefore, also at fault, particularly at light loads, in effective uniform distribution of steam throughout the entire body of the heating surface.

Having the foregoing in mind, it is a primary object of the present invention to provide an arrangement whereby the supply of heating medium, such as steam, to a heating surface is made uniform under all conditions, and especially under light loads on the unit when it is usually difficult to effect such distribution.

Another object of the present invention is the provision of an arrangement which permits installation of the heating surface in substantially any position.

A still further object of the present invention is the provision of an arrangement in which the heating surface has a uniform supply of heat thereto with regard to the length and heating surface even under extremely light load conditions.

A still further object of the present invention is the provision of a heating surface of the nature referred to in which an efficient relationship can be maintained between the condensing tube and a steam distributing tube mounted therein.

It is still a further object of this invention to provide a method of operating a radiator or heating surface in a manner to provide for improved operating results.

These and other objects and advantages of this invention will become more apparent upon reference to the following specification taken in connection with the accompanying drawings, in which:

Figure 1 is a side elevational view of a heating surface according to the present invention;

Figure 2 is a perspective view of the unit of Figure 1

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partially broken away to show the internal construction thereof;

Figure 3 is a vertical transverse section taken through the heating surface of Figure 1; and

Figure 4 is a view similar to Figure 3 but showing a somewhat modified constructional arrangement.

Referring to the drawings somewhat more in detail, in Figure 1 there is shown a heating surface which comprises a supply or inlet header 10 having inlet connection 12 through which steam is supplied. The arrangement comprises a condensate, discharge, or outlet header 14 at the opposite end having a discharge connection 16.

As will be seen in Figures 2 and 3, each of the headers 10 and 14 are provided with inwardly extruded tube collars 18 into which the opposite ends of the condensing tubes 20 extend and to which the said tubes are sealed as, for example, by silver brazing. This arrangement provides for an extremely strong connection which is easily made fluid tight.

According to the present invention each adjacent pair of condensing tubes are provided with a single distribution tube 22. In Figures 2 and 3, for example, the uppermost of the distributing tubes 22 has its upper reach sealed within the pertaining condensing tube 20 as by the collar means 24 so as to receive steam directly from supply header 10.

The lower reach of the distributing tube, on the other hand, is closed adjacent the left end of the pertaining condensing tube by cap 26 and the corresponding end of the condensing tube in which the lower reach of the distributing tube lies is likewise closed by a cap 28. The distributing tube is provided along both legs thereof with apertures 30 through which the steam supplied thereto from header 10 emanates for an exchange of heat with the condensing tube walls.

It will be noted that the apertures in the upper reach of each distributing tube 20 are distributed therealong on opposite sides of the distributing tube, and those in the lower reach of the tube are similarly distributed therealong but are staggered relative to those in the upper reach of the distributing tube.

It will be apparent that there could be as many or as few pairs of condensing tubes as desired, with each pair being provided with a U-shaped or trombone distributing tube as illustrated.

It will further be apparent that, whereas the distributing tubes could advantageously be arranged to fit into adjacent pairs of condensing tubes, they could also be so constructed as to fit into any selected pair of condensing tubes whether adjacent or not.

One of the most important features of the present invention is the uniformity of distribution of steam throughout the heating surface. The construction of the present invention provides for only one-half the number of steam connections to the supply header and thus the quantity of steam supplied to the first leg of each distributing tube is double what it would be in a conventional design. This high steam rate per distributing tube is particularly important when a small quantity of steam is being supplied since this same steam quantity will travel twice as far along the surface length of the heating surface and be effective over twice the surface area.

The arrangement, according to the present invention, thus provides for a more uniform temperature distribution, particularly of partial capacity, and greater protection against the hazard of the heating surface freezing.

Under extremely light loads, of course, the steam supply is only sufficient to make the first leg of each distributing tube active. However, since there are only one-half the number of connections to the steam header as in the conventional design, there is still a more complete and uniform distribution of heat over the area of

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the heating surface than heretofore. This is, of course, important for efficient heating of air passing through the heating surface.

A still further feature of the present invention resides in the staggering of the apertures in the two adjacent legs of the distributing tube which brings about still further distribution of the steam supply along the lengths of the condensing tubes whereby all of the plurality of fins 32 mounted on the condensing tubes are heated to substantially a uniform temperature.

The arrangement seen in Figure 4 is similar to that of Figure 3 except that the steam supply header 34 and the condensating headers 36 are integrally formed and are both located at one end of the heating surface which, as before, comprises condensing tubes 38 and distributing tubes 40 which are U-shaped in arrangement and have the two legs located in different ones of the condensing tubes 38.

In the Figure 4 arrangement the ends of the condensing tubes 38, opposite their connection with the header arrangement, are provided with swaged or necked down sealing connector elements 42 which have their one ends sealingly mounted in the ends of tubes 38 and their other ends sealingly engaging the adjacent portions of the distributing tubes 40. The Figure 4 construction is otherwise identical with the Figure 3 construction. Since the condensate header and the steam supply header are combined, this arrangement is even less likely to freeze than the arrangement of Figure 3 and, likewise, can be located in places where access can be had to only one end of the heating surface.

It will be understood that the heating surface as disclosed according to the present invention is adapted for operation with floor or thermostatic traps and the like which may be employed to control the discharge of condensate from the condensate header. The units are also adapted for having the heat supply thereto under the control of a steam valve and the arrangement of the present invention is important in a system of this nature since the uniformity of distribution of steam through the heating surface insures that a change in the steam supply to the unit will be accomplished by a corresponding change in the temperature of the air stream in the region where the control thermostat for the unit is located.

It will be understood that this invention is susceptible to modification in order to adapt it to different usages and conditions, and accordingly, it is desired to comprehend such modifications within this invention as may fall within the scope of the appended claims.

I claim:

1. In a heat exchange surface; inlet and outlet headers, a plurality of condensing tubes having their one ends opening into said outlet header and their other ends closed, a plurality of distributing tubes having their one ends opening into said inlet header, each distributing tube having its other end capped and being U-shaped with one reach lying in one condensing tube and the other reach lying in the other condensing tube, apertures distributed along opposite sides of the two reaches of the said distributing tube, and the two reaches of each distributing tube being disposed in adjacent condensing tubes and each adjacent pair of condensing tubes being in communication with a single inlet header.

2. In a heat exchange surface; spaced inlet and outlet headers, a plurality of condensing tubes extending between said headers, U-shaped distributing tubes mounted in said condensing tubes and extending substantially the full length thereof and the loop joining the two reaches of the distributing tube being located in the outlet header, means sealing one end of each distributing tube in the pertaining condensing tube and caps closing the other end of each distributing tube and the adjacent end of the pertaining condensing tube, and ports distributed along the two reaches of each distributing tube so that a supply of steam to said inlet header will be distributed solely via said dis-

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tributing tubes to said condensing tubes and the condensate thereof will discharge from said condensing tubes to said outlet header, and each adjacent pair of condensing tubes being in communication with a single inlet header.

3. In a heat exchange surface; a plurality of condensing tubes, a U-shaped distributing tube for each pair of condensing tubes, each distributing tube having one reach thereof in each of the pertaining pair of condensing tubes, means sealing between said distributing tube and the one ends of the pertaining pair of condensing tubes, inlet header means connected with the end of each distributing tube adjacent the point where it is sealed to a condensing tube and the other end of each distributing tube being capped, and discharge header means connected with one end of each of said condensing tubes, and each adjacent pair of condensing tubes being in communication with a single inlet header, said distributing tubes being apertured along the length of said condensing tubes to discharge steam therealong upon a supply thereof to said inlet header.

4. In a heat exchange surface; a plurality of condensing tubes, a U-shaped distributing tube for each pair of condensing tubes, each distributing tube having one reach thereof in each of the pertaining pair of condensing tubes, means sealing between said distributing tube adjacent one end thereof and the adjacent end of the pertaining condensing tube, inlet header means connected with said one end of each distributing tube and the other end of each distributing tube being capped, said inlet header being in communication with at least two condensing tubes, and discharge header means connected with said condensing tubes, said distributing tubes being apertured along the length of said condensing tubes to discharge steam therealong upon a supply thereof to said inlet header means, said inlet header means being located within said discharge header, both condensing tubes opening into said discharge header and both being closed off from said inlet header means.

5. In a heat exchange surface; inlet and outlet headers, condensing tubes communicating with said discharge header only, distributing tubes communicating with said inlet header only, each distributing tube extending along the axis of one of said condensing tubes from said inlet header and returning along the axis of another of said tubes, the end of each distributing tube opposite the connection thereof with the inlet header being capped, said inlet header being in communication with at least two condensing tubes, port means distributed along both reaches of said distributing tube, and means sealing between the inlet ends of said distributing tubes and said condensing tubes thus preventing a direct supply of heating medium from said inlet header to said condensing tubes.

6. In a heat exchange surface; inlet and outlet headers, condensing tube means adapted for receiving steam from one of the headers and for discharging condensate to the other of said headers, and distributing tube means having one end communicating with said inlet header and the other end capped, said inlet header being in communication with at least two condensing tubes, and each distributing tube means extending through two condensing tube means, each distributing tube means receiving the entire supply of steam from the inlet header for the pertaining condensing tube means, and both of said condensing tube means opening into the discharge header.

7. In a heat exchange surface; inlet and outlet headers, two pairs of condensing tubes having their one ends opening into said outlet header and their other ends closed, a pair of distributing tubes having their open ends opening into a common inlet header, each of said distributing tubes having its other end capped and being U-shaped with one reach lying in one condensing tube and the other reach lying in the other condensing tube, apertures distributed along opposite sides of the two reaches of the said distributing tube, and the apertures in each reach of the

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distributing tube being staggered relative to those in the other reach thereof.

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