

Nov. 29, 1938.

J. McELGIN

2,138,187

RADIATOR

Filed June 16, 1937

2 Sheets-Sheet 1

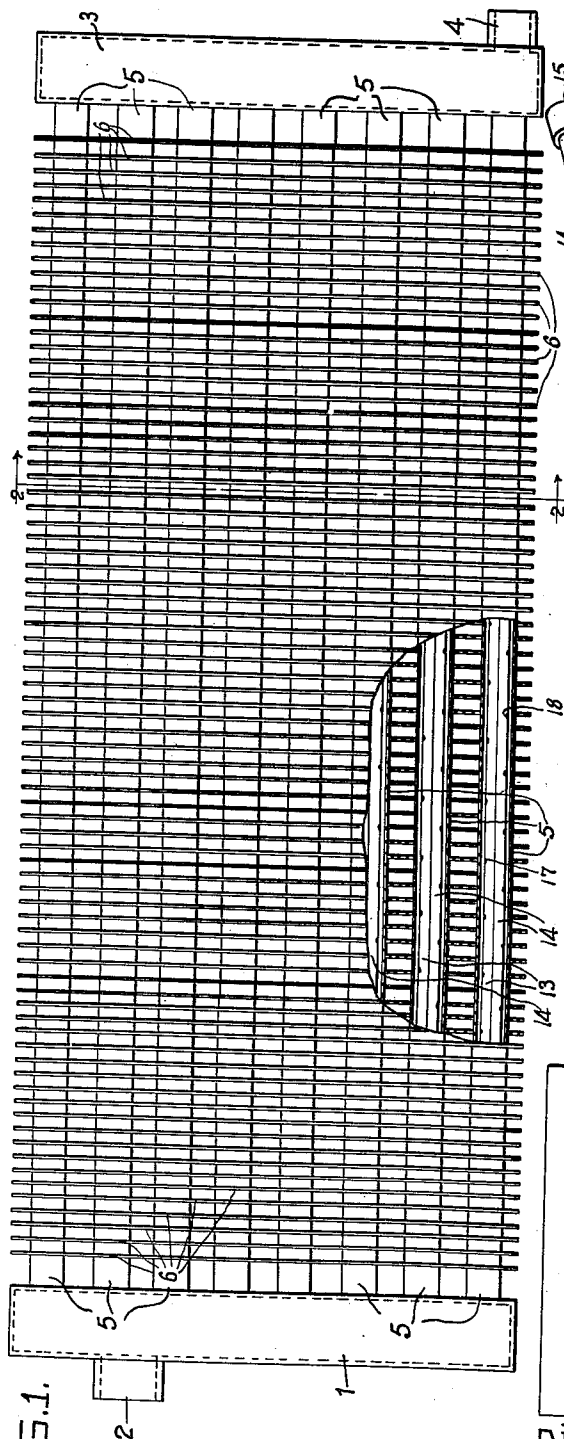


FIG. 1.

FIG. 3.

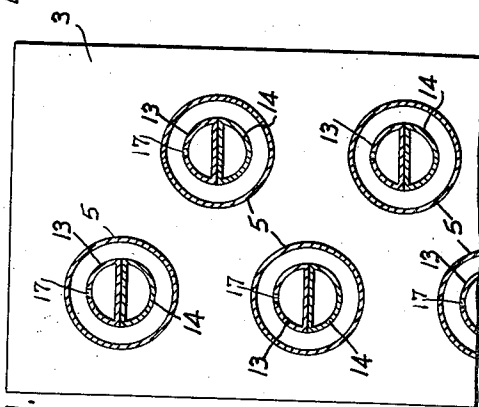
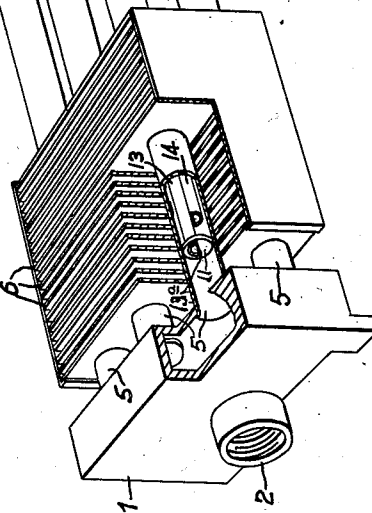


FIG. 2.



JOHN McELGIN,
Toulmin & Toulmin
Attorneys

Nov. 29, 1938.

J. McELGIN

2,138,187

RADIATOR

Filed June 16, 1937

2 Sheets-Sheet 2

FIG. 4.

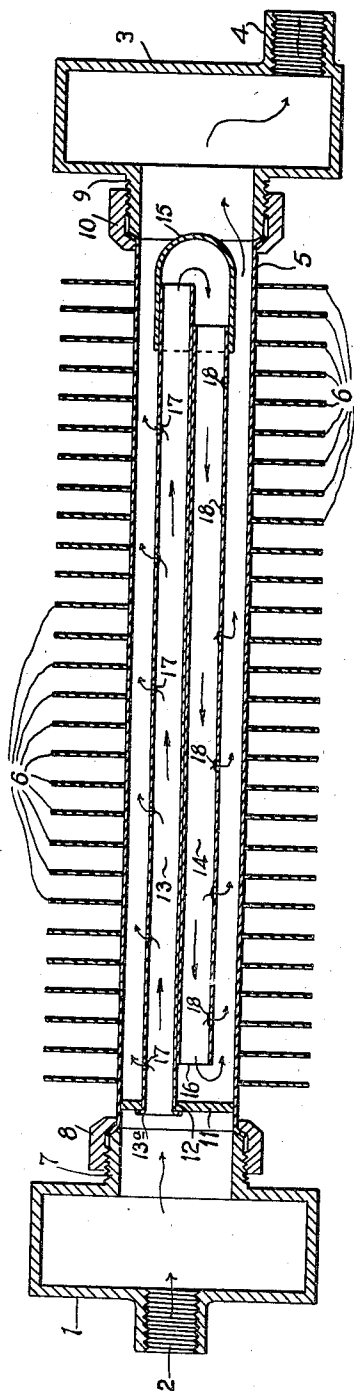
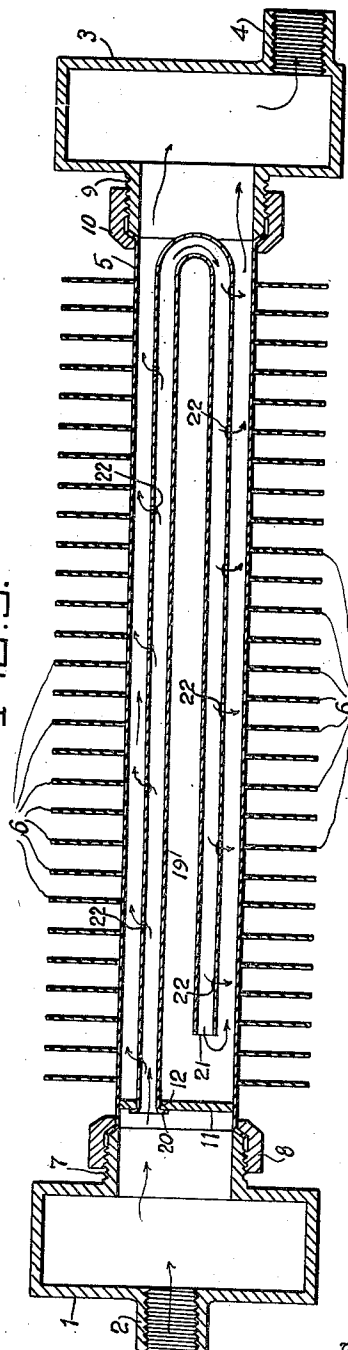


FIG. 5.



BY *John McELGIN,*
Toulmin & Toulmin
Attorneys

UNITED STATES PATENT OFFICE

2,138,187

RADIATOR

John McElgin, Philadelphia, Pa., assignor to
John J. Nesbitt, Inc., Holmesburg, Philadel-
phia, Pa., a corporation of Pennsylvania

Application June 16, 1937, Serial No. 148,533

8 Claims. (Cl. 257—159)

This invention relates to radiators and to an improved method of steam distribution in extended surface heating elements thereof.

It is an object of this invention to provide a method and apparatus for obtaining uniform distribution of steam in blast heating radiators or the like such as are employed in unit ventilators, unit heaters, central fan heating and air conditioning systems.

It is a further object of this invention to provide, in radiator means, return flow steam distributing tubes for use in condensing tubes of heating elements having extended surfaces.

It is a further object of this invention to provide, in a method of steam distribution, for directing through a closed channel excess steam from the return end of such a condensing tube to the steam end thereof.

It is a further object of this invention to provide a return flow steam distributing tube structure particularly adapted to provide uniformity of steam distribution to a radiator condensing tube irrespective of the capacity or supply of heating steam thereto.

It is a further object of this invention to provide such structure wherein the condensing capacity of the tube is substantially increased by the use of the return flow steam distributing tube therein.

It is a further object of this invention to provide such a return flow steam distributing tube structure, by means of which, uniformity of steam distribution throughout the length of an equipped condensing tube may be achieved irrespective of the pressure and/or velocity of steam supplied through the distribution tube.

These and other objects and advantages will appear from the following description taken in connection with the drawings.

In the drawings:

Figure 1 is an elevational view, partly in section, of a radiator having the condensing tubes thereof equipped with return flow steam distributing tubes constructed according to the principles of this invention;

Figure 2 is a fragmentary section taken on the line 2—2 of Figure 1;

Figure 3 is a view, in perspective, partly broken away, of a radiator structure equipped according to the principles of this invention;

Figure 4 is a diagrammatic view, in section, showing a condensing tube of a radiator equipped with one form of return flow steam distributing tube constructed according to the principles of this invention; and

Figure 5 is a view similar to Figure 4, but showing a modified form of return flow steam distributing tube.

Referring to the drawings in detail, the radiator illustrated in Figures 1 to 5 inclusive comprises a steam header designated 1 provided with a steam inlet 2, a return header 3 provided with a steam outlet 4 and condensing tubes 5 disposed therebetween, each connected at one end to the steam header 1 and at the other end to the return header 3. Common fins 6 are rigidly secured in any suitable manner, in spaced relation, to the condensing tubes 5 of the radiator.

In the construction shown in Figures 1 and 3, the condensing tubes have their ends secured to the respective headers by beading over; while, as an alternative construction as shown in Figures 4 and 5, the steam or inlet header 1 is provided with suitably located integral nipples 7, each having associated therewith a threaded flange nut 8, by means of which one flanged end of a tube 5 is secured to a nipple 7. Similar nipples 9 are formed integrally with the return header 3 and are each provided with a screw-threaded flange nut 10 similar to the flange nut 8, by means of which the opposite flanged end of the tube 5 is secured to the return header 3.

Secured in the condenser tube 5, adjacent the inlet header, is a distributing tube support plate 11 provided with a suitable aperture 12, by means of which the steam distributing tube is rigidly secured in supported relation to the support plate 11 in such manner as to be disposed centrally of the tube 5 and in spaced relation to the inner wall thereof. As shown in Figs. 1, 2, 3 and 4, the distributing tubes are each formed of a main tube member 13 of semi-circular or half round section having one end beaded or upset at 13a to rigidly secure the tube member 13 to the support plate 11. Disposed adjacent the main tube member 13 is a second tube member 14 of similar section, which tube members together form a double conduit of circular or round exterior section. The ends of the tube members 13 and 14 are closed by the cap or cap member 15 which is rigidly secured to the end portions of the tube members 13 and 14 in any suitable manner. The tube members 13 and 14 are thus secured to form, with the cap or cap member 15, a U-shaped return flow conduit for steam entering from the inlet end of the tube member 13 and flowing from the outlet end 16 of the tube member 14.

The tube member 13 is provided, along its length, with a plurality of apertures 17, through which steam flowing through the tube member 55

13 may escape to the space between the exterior of the distributing tube and the interior of the condensing tube 5. Similar apertures 18 are provided along the length of the tube member 14.

5 In the embodiment illustrated in Figure 5, the steam distributing tube comprises a U-shaped tube member 19 upset or beaded over at one end 20 to rigidly secure the tube member 19 in supported relation to the support plate 11. The opposite or outlet end 21 of the tube member 19 is directed toward the support plate 11 and is disposed adjacent thereto. Throughout its length the tube member 19 is provided with apertures 22 which are unequally spaced in the same manner as are the apertures 17 in tube member 13 and apertures 18 in tube member 14, as shown in Fig. 5, and which apertures are likewise of different areas.

Heretofore, in the construction of blast steam 20 heating surfaces, the primary aim has been the achievement of a high condensing capacity in a compact space. While certain existing fin and tube constructions have successfully met this requirement, scant attention has been paid, however, to the performance (and efficiency) of the surface under less than maximum demand. The efficiency of operation at less than maximum capacity has become an extremely important consideration since the application of automatic control to heating, ventilating and air conditioning systems. It is, therefore, necessary, in the construction of heating surfaces, to consider the flexibility or ability of a surface efficiently to adapt itself to close and continuous control as well as its ability to transfer heat. The use of multiple distribution tubes, in dividing each condensing tube or element into multiple lengths which are separately fed from the main header, has substantially improved this condition. However, even by the use of multiple tubes, either concentrically arranged or otherwise, it is necessary to accept a loss in capacity at the steam end of a condensing tube in order to secure good or satisfactory distribution under modulated control.

45 According to the principles of this invention, wherein I direct, through a closed channel, the excess steam from the return end to the steam end of a condensing tube, the necessity for loss in capacity at the steam end of the tube is obviated. As shown in Figure 4, the tube members 13 and 14 and their connecting cap member 15 form a U-shaped return flow distributing channel, while the apertures 17 and 18, disposed along this channelway, provide for the flow of steam entering the channel into the space between the distributing channelway and the interior of the condensing tube 5. Any excess steam or steam not flowing through apertures 17 and 18 must flow from the outlet end 16 of the channelway, which is adjacent the steam end of the condensing tube 5. The direction of flow of excess steam to the steam end of the condensing tube 5 instead of the return end thereof prevents starving of the steam end of the condensing tube 5, where the steam capacity or velocity of steam flow through the distributing tube is substantial or of such magnitude as hitherto caused the failure of flow through the orifices in straight distributing tube lengths.

70 By the use of the return channelway or U-shaped path provided by the return flow distributing tubes of Figures 4 and 5, all parts of the condensing tubes 5 receive a full quantity of steam when full steam pressure is supplied. A wide control of distribution may be exerted, while

substantially no loss of capacity (as compared with condensing tubes unequipped with distributing tubes) is sustained.

While the use of multiple distribution tubes, either concentrically arranged or otherwise, and provided with orifices predeterminedly spaced along their lengths and having a greater number of orifices or a greater orifice area at the return end of the distributing tube, has been quite satisfactory in operation at reduced steam capacity; when the valve is wide open and the heat element operating at its full capacity, the steam tends to rush through the tube to the return end of the element whereby higher capacity is obtained at the return end than at the steam end of the element and uniformity of distribution is destroyed. This causes a reduction of condensing capacity at the steam end of the element and the respective condensing tubes thereof. The high velocity of steam in the various orifices of these straight or multiple distributing tubes prevents the flow of excess steam from the return end backwardly in the condensing tube to the steam end. The desired distribution is, therefore, obtained at the expense of ultimate capacity due to the fact that the efficiency of the heating element at high capacity is substantially reduced by the use of such tubes, wherein the excess steam is conducted from the steam or inlet header through a straight path and delivered from an outlet situated at the return end of the condensing tube.

By conducting the excess steam through a substantially U-shaped or return path, and delivering it at the inlet or steam end of the condensing tube, I, therefore, totally obviate the loss of efficiency at high capacity and provide structure for and a method of steam distribution, whereby the ultimate heat energy is extracted from the steam which is prevented from passing through the condensing tube of the heating element with such rapidity as to prevent the extraction therefrom of the ultimate degree of heat energy.

While the operation of the structure shown in Figures 1 to 4 inclusive has been described, it is, of course, to be understood that the principle of operation of the structure shown in Figure 5 is substantially identical therewith. In the operation of the structure shown in Figure 5, steam from the inlet or steam header 1 passes through the inlet end of the tube member 19 and a portion thereof escapes through the suitably spaced orifices 22, while any steam not escaping there-through, which may be termed "excess steam", is conducted through a return or substantially U-shaped path from the inlet end of the tube 19 to the outlet 21 thereof, which outlet opening is directed toward and disposed adjacent the distributing tube support plate 11, at the steam end of the distributing tube 5.

Where the diameter of the tube 5 is such as to permit the use therein of the construction of the distributing tube illustrated in Figure 5, the use of this tube may, in some cases, be preferable, but where the condensing tube diameter is substantially small and it is necessary to provide a compact return flow distributing tube structure, it is, of course, desirable to utilize the construction shown in Figure 4. The performance and essential features of each construction of tube are substantially the same.

The size, location and/or spacing of the apertures 17, 18 and 22 are preferably (but not necessarily) non-uniform and susceptible of substantial variation in adapting the structure to various ranges and conditions of operation.

It is, of course, to be understood that the above described structure is merely illustrative of the manner in which the principles of my invention may be utilized and that I desire to comprehend within my invention such modifications as come within the scope of the claims and the invention.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent is:

10 1. In a radiator, spaced headers, an interconnecting condensing tube, and a distributing tube on the interior of said condensing tube defining a return path extending from a point adjacent one header through a bend adjacent the other header and thence to a point adjacent said first header.

2. In a radiator, spaced headers, an interconnecting condensing tube, and a distributing tube on the interior of said condensing tube defining a return path extending from a point adjacent one header through a bend adjacent the other header and thence to a point adjacent said first header, said tube having predeterminedly spaced apertures throughout the length thereof.

25 3. In a radiator, spaced inlet and outlet headers, an interconnecting main tube between said headers, and means on the interior of said tube defining a return path having an inlet communicating with the inlet header and an outlet adjacent said inlet header, said path extending from a point adjacent said inlet header to a point adjacent said outlet header and returning to a point adjacent said inlet header.

35 4. In a radiator, spaced headers, an interconnecting main tube, and means on the interior of said tube defining a return path having an inlet communicating with one header and an outlet adjacent said header, said path extending from a point adjacent said header through a bend adjacent said other header and containing predeterminedly spaced outlets throughout the length thereof.

45 5. In a radiator, spaced headers, an interconnecting main tube, and means on the interior of said tube defining a return path having an inlet communicating with one header, an outlet adjacent said header, said path extending from a point adjacent said header through a bend adjacent said other header and containing prede-

terminedly spaced outlets of predetermined size throughout the length thereof.

6. In a heater exchanger, an inlet header, a return header spaced therefrom, a heat exchange tube connected between said inlet header and said return header, an apertured distributing tube support plate in said condensing tube adjacent the inlet header, a fluid distributing tube having one end secured in said aperture and communicating with said inlet header and having an outlet adjacent its other end, said distributing tube having therein a bend adjacent said return header, and its other end adjacent and directed toward said distributing tube support plate, said tube support plate adjacent said aperture having a solid baffle portion which serves to repel and redirect the fluid issuing from said outlet in said other end of said tube.

7. In a heat exchanger, an inlet header, a return header, a heat exchange tube connected therebetween, and steam distributing means in said heat exchange tube comprising a pair of pipes of semi-circular section with flattened side wall portions, a cap connecting adjacent ends of said pipes and supporting said flattened side wall portions substantially in engagement, the opposite end of one pipe having communication with said inlet header, and the opposite end of the other pipe having communication with the interior of said heat exchange tube at the end thereof adjacent said inlet header.

8. In a heat exchanger, an inlet header, a return header, a heat exchange tube connected therebetween, and steam distributing means in said heat exchange tube comprising a pair of pipes of semi-circular section with flattened side wall portions, a cap connecting adjacent ends of said pipes and supporting said flattened side wall portions substantially in engagement, the opposite end of one pipe having communication with said inlet header, and the opposite end of other pipe having communication with the interior of said heat exchange tube at the end thereof adjacent said inlet header, said pipes having predeterminedly spaced apertures therein providing communication between the interior of the path defined by said tubes and the interior of said heat exchange tube.

JOHN McELGIN.