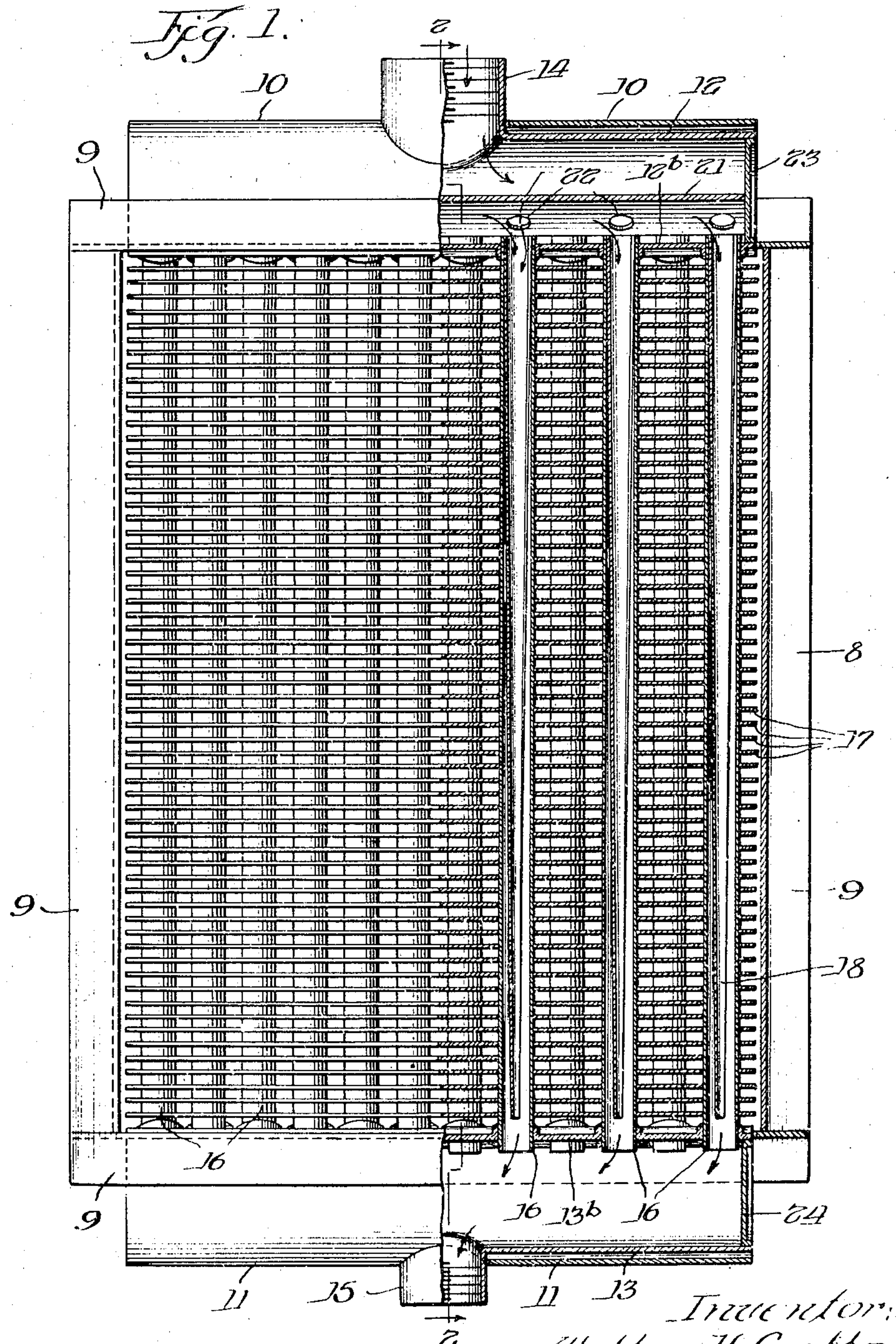
Nov. 22, 1949 W. H. GOELTZ 2,488,623

HEAT EXCHANGER

Filed July 31, 1944 3 Sheets-Sheet 1

Fig. 1.



Inventor:
Walter H. Goeltz

By: Hill & Hill Attys.

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Filed July 31, 1944 3 Sheets-Sheet 2

Fig. 2.

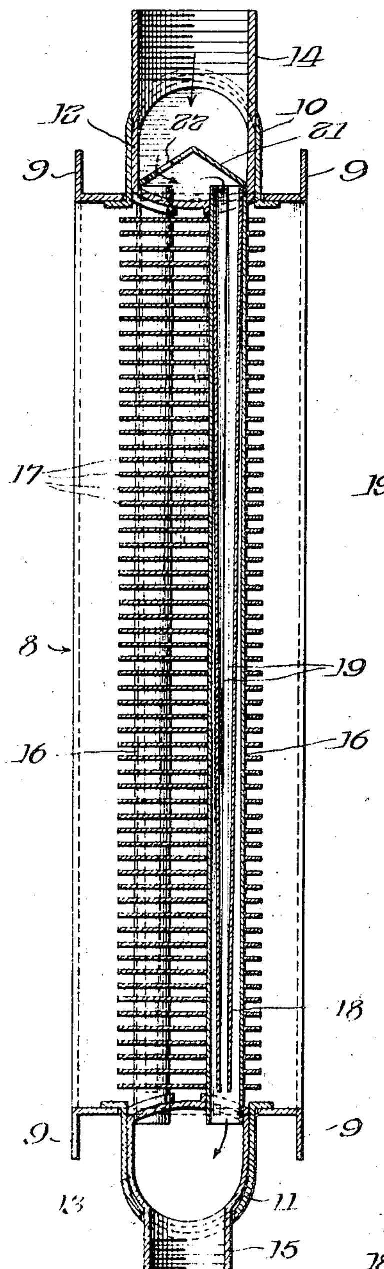


Fig. 3.

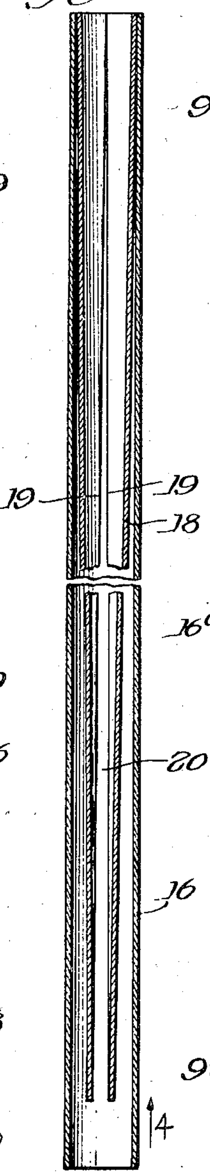
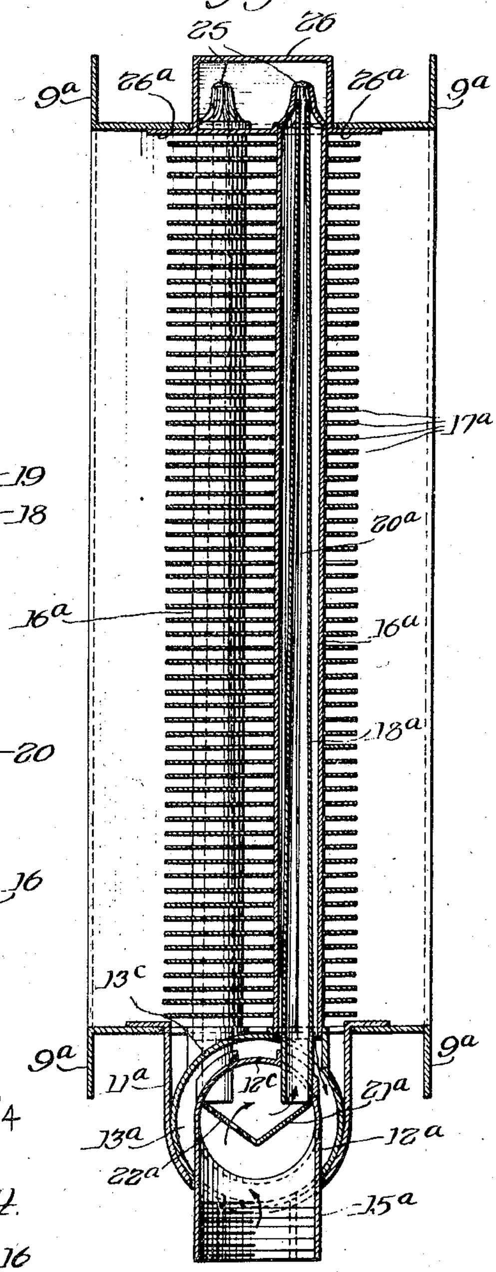


Fig. 4.

Fig. 6.



Inventor:
Walter H. Goeltz

By Shee + Shee Attys

Fig. 5

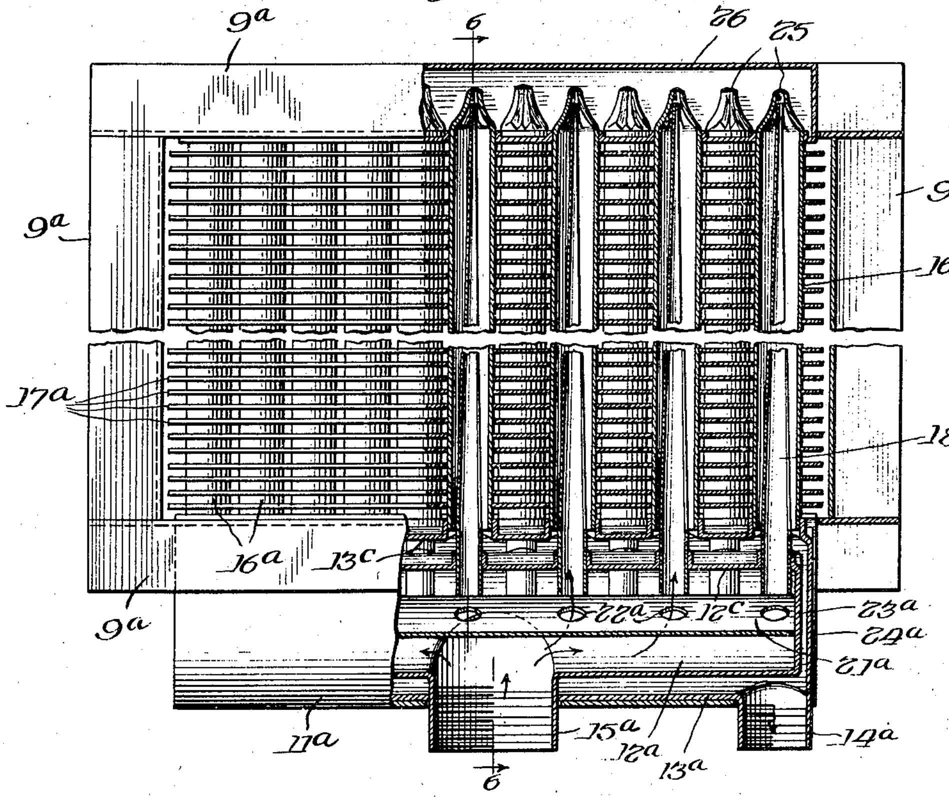
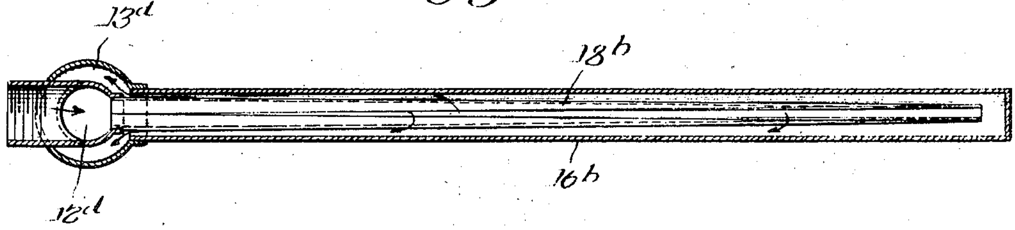


Fig. 7



Inventor:
Walter H. Goeltz

By: [signature] Attys.

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UNITED STATES PATENT OFFICE

2,488,623

HEAT EXCHANGER

Walter H. Goeltz, Kenosha, Wis., assignor to Modine Manufacturing Company, Racine, Wis., a corporation of Wisconsin

Application July 31, 1944, Serial No. 547,424

6 Claims. (Cl. 138—38)

1

This invention relates to heat exchangers and more particularly it relates to that type of heat exchangers which employ a group of finned tubes forming parallel paths for the flow of the heat transfer fluid between supply and return headers.

When steam heated heat exchangers of this type are employed for heating air, the temperature of the heated air at any point along the core of the heat exchanger is dependent on the presence of the steam at that point and is directly proportional to the steam temperature. Usually the temperature of the steam is controlled by a modulating valve which throttles the steam pressure in accordance with the demands of a thermostat set in the heated air stream. Conditions can easily arise such that the final air temperatures are gained by very low, sub-atmospheric steam pressure. Under these conditions the steam condenses in short sections of the tubes at the supply end of the core, leaving the remaining lengths of the tubes relatively cold, and thus only a portion of the air passing through the core will be heated.

Present day practice to combat the above conditions consists in installing, within the main tubes of the core, smaller tubes with perforations along their lengths to meter out the steam into the spaces between the inner and outer tubes. This practice while greatly improving the performance of the cores, results in a series of hot spots where the inner tubes are perforated.

One of the objects of this invention is to increase the efficiency of heat exchangers of the type under consideration.

Another object is the provision of means to meter the steam in a uniform, constant manner throughout the entire length of the core, whereby the latter is uniformly heated throughout its extent.

Another object is the provision of means to offer less resistance to the steam as it loses its pressure due to friction.

Another object is the provision of means to maintain a substantially constant steam velocity throughout the length of the core.

Another object is the provision of a tapered distributing trough within the main tube whereby to accommodate the increasing volume of condensate along the tube.

Another object is the provision of a tapered distributing trough having a full sized diameter at the steam inlet, thereby avoiding any throttling of the steam at the inlet.

With these and other objects and advantages in view, this invention consists in the several

2

novel features hereinafter fully set forth and claimed.

The invention is clearly illustrated in the drawings accompanying this specification in which:

Fig. 1 is a front elevation, partly broken out, illustrating a heat exchanger embodying one form of the present invention;

Fig. 2 is a vertical cross section taken substantially along the line 2—2 of Fig. 1;

Fig. 3 is an enlarged central longitudinal section, partly broken away and taken through one of the tubes and its distributing trough;

Fig. 4 is an end elevation of the parts seen in Fig. 3 looking in the direction of the arrow 4;

Fig. 5 is a side elevation, partly broken away and partly broken out of a heat exchanger embodying a slightly different form of the invention;

Fig. 6 is a vertical cross section taken on the line 6—6 of Fig. 5; and

Fig. 7 is a longitudinal section taken through a tube, its distributing trough and supply and return headers.

Referring to said drawings, and first to Figs. 1 to 4 inclusive, the reference character 8 designates the main frame of the heat exchanger, desirably composed of sheet metal channel members 9 suitably secured together and providing a rectangular frame-like member. Secured to the upper and lower channel members 9 are casings 10, 11, in one of which is contained a supply header 12 and in the other of which is contained a return header 13, provided respectively with inlet and outlet connections 14, 15. The ends of the supply header and return header are closed by heads 23, 24.

Extending between said headers are a plurality of tubes 16 to which are secured fins 17 in the usual manner. Secured within the tubes 16 at their inlet ends are distributing troughs 18, desirably of tapered formation, tapering from the inlet ends of the tubes toward their discharge ends.

The edges 19 of each trough (see Fig. 3) taper toward each other from the smaller end of the trough to its larger end forming a tapered slot or opening 20. The tapered slot or opening 20 provides a steam metering slot through which the steam is metered throughout the length of the trough from the interior thereof to the space between the trough and tube.

With the use of a tapered distributing trough tapering from its inlet end to its outlet end, it maintains a constant steam velocity through its length and forces the steam through the metering slot, and by widening the slot between the edges of the trough, from its inlet end to its outlet end, it offers less resistance to the steam as it loses pressure due to friction. Furthermore, the tapering trough makes the steam space between it and the tube greater towards its outlet end to accommodate the increasing volume of the condensate along the tube. The trough being full size at its greatest diameter and fitting against the internal wall of the tube it does not throttle the steam.

The headers are formed with flanged holes to receive the ends of the tubes, and a baffle 21 is secured in the supply header above the end of the tubes. The walls of the baffle slope downwardly from its medium line to the side walls of the header to provide greater stream inlet area and divide the header into two chambers, one of which may be considered as an inlet chamber. The baffle is provided with holes 22 for the passage of the steam from the inlet chamber of the header to the tubes.

Two rows of tubes are illustrated, those in one row being staggered with respect to those in the other row, and the holes in the baffle are also staggered, and staggered with respect to the tubes. In constructing the heat exchanger brazing or bonding material is applied to the several parts and after assembly the device is placed in a suitable oven and heat is applied thereto, whereby to fuse the bonding material and thereby integrally unite all of the parts of the device.

In operation when steam is admitted to the supply header it flows through the holes 22 in the baffle and into the distributing troughs 18. The steam then flows through the troughs and is metered through the tapered slots thereof into the spaces between the troughs and the tubes in a uniform and constant manner throughout the length of the troughs, thereby heating the entire length of the tubes, from which the heat is radiated by the fins to the air passing through the core. The condensate collects in the return header and discharges through the return pipe. (Not shown.)

While the above description concerns heat exchangers in which the tubes extend vertically, the tubes may lie at any angle which permits the free discharge of condensate.

In the modified form of the invention illustrated in Figs. 5 and 6 the general construction is substantially the same as that shown in Figs. 1 to 4 inclusive, except that the supply header 12*a* and return header 13*a* are disposed at the lower end of the heat exchanger, with the supply header contained within the return header. In this form of the invention the headers are shown as of cylindrical form, although this is not essential to the invention. The ends of the supply header 12*a* and return header 13*a* are closed by heads 23*a*, 24*a*. The supply header has a pipe connection 15*a* extending down through the lower wall of the return header, and the upper wall 12*c* of the header is provided with flanged holes for receiving the lower ends of the tapered distributing troughs 18*a*. The upper wall 13*c* of the return header 13*a* is also formed with flanged holes aligned with the flanged holes in the supply header for receiving the lower ends of the tubes 16*a*. As in the other forms of the invention, the return header is contained within a casing 11*a* having flanges secured to the lower channel member 9*a*.

As in the other form of heat exchanger illustrated, the distributing troughs taper from their inlet ends and are formed with tapering metering slots 20*a* which are widest at the small ends of the troughs. The upper ends of the tubes are closed over the small ends of the troughs, as at 25, and center said ends of the tubes. A cap or other enclosure 26 secured to the upper channel member 9*a*, as by flanges 26*a*, may be used to enclose the upper ends of the tubes.

As in the other form of the invention, a baffle 21*a* is provided in the supply header and is secured to the walls thereof. In this case the baffle inclines upwardly from its medium line to the side walls of the supply header and is formed with staggered holes 22*a* which are also staggered with respect to the troughs.

In this form of the invention the steam enters the distributing troughs at their lower ends and is metered out through the slots into the spaces between the troughs and tubes. To permit the condensate to escape from the tubes, the latter are made of a slightly greater diameter than the greatest diameter of the troughs, thereby leaving annular discharge openings at the lower ends of the tubes. The condensate discharges from these annular spaces into the return header and is carried away by the return pipe (not shown) which is secured in the outlet connection 14*a*.

While the above description concerns heat exchangers in which the tubes extend vertically, the tubes may lie at any angle which permits the free discharge of condensate, as shown in Fig. 7, where each tube 16*b* surrounds the tapered slotted distributing trough 18*b* substantially in the same manner as is illustrated in Figs. 5 and 6.

In this form of the invention one end of the tube is closed and the steam is metered out from the troughs into the spaces between the troughs and tubes, as in the other forms, and the condensate discharges from the space between the troughs and tubes into the return header. In this form of the invention the tubes are disposed in one row only but double rows of tubes may be used in the same manner as in the other forms above described.

While I have shown and described the distributing troughs as applied to a steam heated heat exchanger, they are adaptable to the distribution of a vaporizing fluid for refrigeration.

Having thus described my invention, it is obvious that various immaterial modifications may be made in the same without departing from the spirit of my invention; hence I do not wish to be understood as limiting myself to the exact form, construction, arrangement and combination of parts herein shown and described, or uses mentioned.

What I claim as new and desire to secure by Letters Patent is:

1. In a heat exchanger, a fluid conducting tube having an inlet end, a tapered slotted distributing trough contained in the tube with its larger end disposed at the inlet end of the tube and the slot increasing in width from the inlet end of the tube to the other end thereof.

2. In a heat exchanger, a fluid conducting tube, a tapered distributing trough supported within the tube with its greatest diameter disposed at the inlet end of the tube, said trough being formed with a lengthwise extending slot in its wall which progressively increases in width from the inlet end of the tube to the other end thereof.

3. In a heat exchanger, a fluid conducting tube having an inlet end, a tapered distributing trough supported within the tube with its greatest diameter disposed at the inlet end of the tube, the

interior of the trough opening to the space between the trough and tube through a tapered slot in the wall of the trough, and said slot tapering toward the inlet end of the tube.

4. In a heat exchanger, a fluid conducting tube having an inlet end, a tapered slotted distributing trough contained in the tube with its larger end disposed at the inlet end of the tube and the slot increasing in width from the inlet end of the tube to the other end thereof, said other end of said tube being closed.

5. In a heat exchanger, a fluid conducting tube, a tapered distributing trough supported within the tube with its greatest diameter disposed at the inlet end of the tube, said trough being formed with a lengthwise extending slot in its wall which progressively increases in width from the inlet end of the tube to the other end thereof, said other end of said tube being closed.

6. In a heat exchanger, a fluid conducting tube having an inlet end and a closed end, a tapered distributing trough supported within the tube with its greatest diameter disposed at the inlet end of the tube and converging towards said closed end, the interior of the trough opening to the space between the trough and tube through a tapered slot in the wall of the trough, and said slot tapering toward the inlet end of the tube.

WALTER H. GOELTZ.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,117,050	Honigmann	Nov. 10, 1914
1,447,688	Reed	Mar. 6, 1923
1,689,927	Newhouse	Oct. 30, 1928
1,802,930	Seelert	Apr. 28, 1931
1,847,608	Harnett	Mar. 1, 1932
2,238,952	Stacey Jr.	Apr. 22, 1941

FOREIGN PATENTS

Number	Country	Date
255,445	Germany	Apr. 2, 1912