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C. D. WARE ET AL

3,067,818

HEAT DISTRIBUTOR

Filed July 27, 1959

2 Sheets-Sheet 1

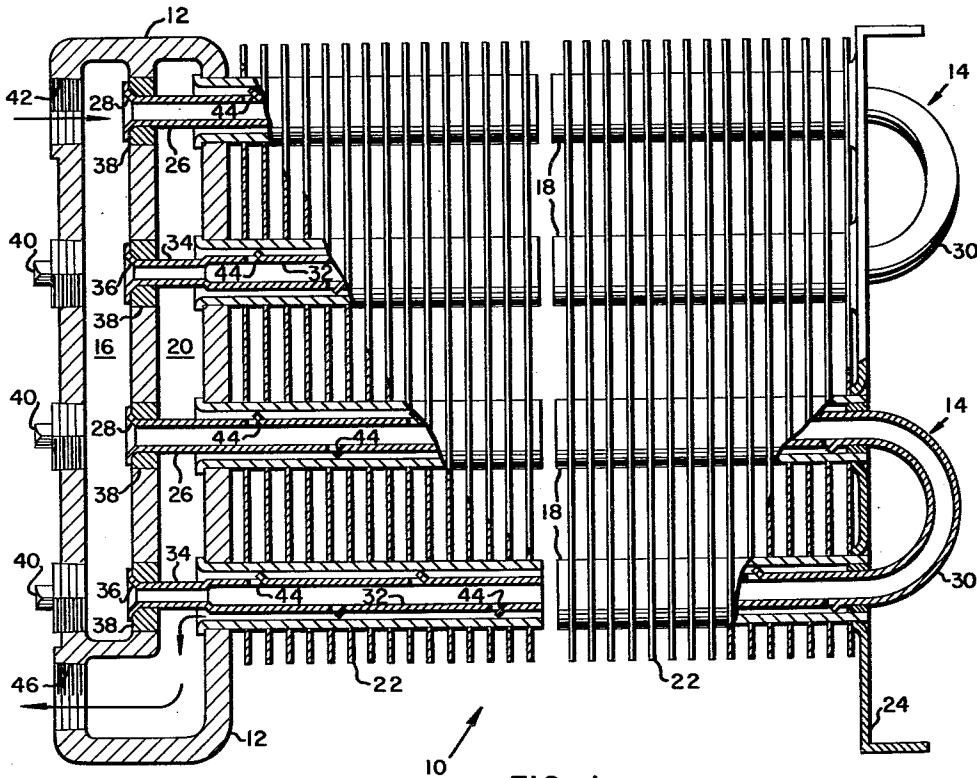


FIG. 1

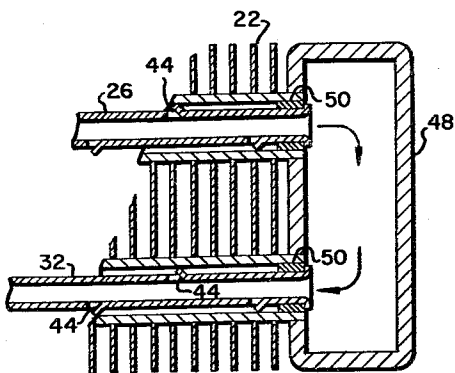


FIG. 2

INVENTORS
CHESTER D. WARE
MARVIN L. VAN DER PLOEG

BY *Holmes & Andersen*
ATTORNEYS

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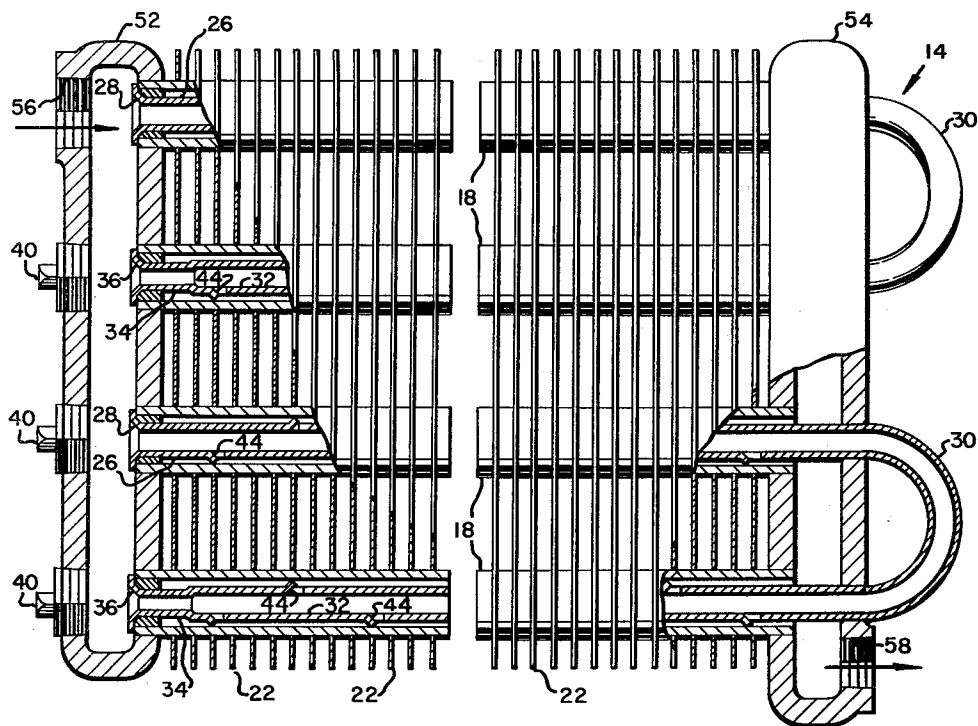


FIG. 3

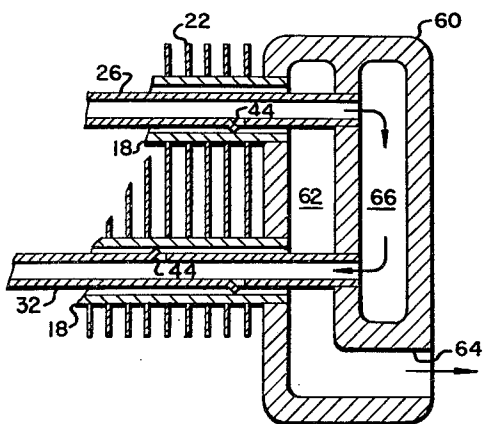


FIG. 4

INVENTORS
CHESTER D. WARE
MARVIN L. VAN DER PLOEG
BY *Holmes & Andersen*
ATTORNEYS

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Chester D. Ware and Marvin L. Van Der Ploeg, La Crosse, Wis., assignors to The Trane Company, La Crosse, Wis., a corporation of Wisconsin
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3 Claims. (Cl. 257-36)

This invention relates generally to heating distributing heat exchangers and more particularly to heat exchangers which employ steam as the heating medium.

In the conventional type of heat exchanger which employs steam as a heating medium, the steam is distributed in the heat exchanger by the use of a single steam distributor in each condensing tube in the manner shown in patents to McElgin, 2,816,738. Each of these conventional distributor tubes have one end connected to the steam supply header while the terminus end is either open or closed but is not open to the supply header. In these conventional types of steam distributing heat exchangers, the resistance to steam flow along the inside of the distributor tube causes the steam pressure to drop which results in an uneven distribution of steam from the distributor tube openings. This pressure drop and unequal distribution of steam is most serious in the longer lengths of U-shaped distributor tubes show in the above mentioned McElgin patent causing serious loss of capacity at full load conditions.

It is an object of the invention to provide a heat exchanger which has even steam distribution and effects efficient and even heating of the air passing over the heat exchanger at all load conditions.

A second object of the invention is to provide a heat exchanger which employs a U-type steam distributor with the terminal ends open to the steam header and provides even and efficient heat transfer.

Another object of the invention is to provide a heat exchanger with the steam header and the condensate header at the same end of the heat exchanger with a U-shaped steam distributor tube connected at both ends to the steam header.

A still further object of the invention is to provide a heat exchanger with a steam header at one end and a condensate header at the other end and with a U-shaped steam distributor connected at both ends to the steam header.

A fifth object of the invention is to provide a heat exchanger which effects even and efficient heat transfer and which is easily produced and inexpensive in cost.

A still further object of the invention is to provide a steam distributing type heat exchanger with a U-shaped steam distributor connected at both ends to the steam header with one of said ends reduced in diameter to provide the proper pressure drop in the steam distributing tube.

Other objects and advantages of the invention will become apparent as the specification proceeds to describe the invention with reference to the drawings in which:

FIG. 1 is an elevation view partly in section of a same end connection heat exchanger incorporating the new steam distributor design;

FIG. 2 is a partial section view of a modification of the U-bend connection of the steam distribution tube shown in FIG. 1;

FIG. 3 is a view similar to FIG. 1 except the steam header and the condensate header are on opposite ends of the heat exchanger; and

FIG. 4 is a partial section view of a modification of the condensate end of the heat exchanger shown in FIG. 3.

Looking now to FIG. 1, heat exchanger 10 is shown

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with a same end connection header 12 with U-shaped steam distributor tubes 14 communicating with steam chamber 16 and condensing tubes 18 communicating with condensate chamber 20. Heat exchange fins 22 are provided to enhance the transfer of heat from the tubes 18 to the air passing over the tubes. Channel member 24 is provided to support the end of the heat exchanger 10 opposite header 12.

Steam distributor tubes 14 consist of an upper reach 26, bell mouthed at 28 to secure the lowest practical operating pressure drop, U-bend connection 30, and lower reach 32. It should be noted that both the upper reach 26 and lower reach 32 communicate with steam chamber 16. Lower reach 32 is necked down at 34 to form an opening of smaller diameter than the steam inlet to the upper reach 26. The diameter of the necked down portion is so sized that the pressure drop in one-half of the lower reach of steam distributor tube 14 is equal to the pressure drop in the rest of the steam distributor. It has been found that the diameter of the necked down end of the lower reach 26 is not less than fifty percent of the steam distributor tube diameter. Lower reach 32 is also bell mouthed at 36 in order to obtain the lowest practical operating pressure drop. Bushings 38 are provided to seal and maintain the steam distributor tubes 14 in position. Screw plugs 40 are provided to give access to steam distributor tube 14, condensing tubes 18, and bushings 38 for purposes of installation, cleaning, or repair.

Steam enters inlet 42, passes through steam chamber 16 into upper and lower reaches 26 and 32 of steam distributor 14. Steam then leaves steam distributor tube through orifices 44 and condenses in tubes 18 and is discharged into condensate chamber 20. Condensate then passes out condensate outlet 46. Due to the sizing of the inlets to the upper and lower reaches, the steam introduced into the upper reach feeds out of the orifices throughout the upper reach and approximately one-half the lower reach nearest the U-bend 30. The steam introduced through bell mouth 36 and opening 34 normally is dissipated halfway through the lower reach 32.

The modification shown in FIG. 2 substitutes a box-type header 48 for the U-bend 30 to connect the upper reach or reaches 26 to lower reach or reaches 32. Bushings 50 are provided to secure the upper and lower reaches in position.

The modification of FIG. 3 embodies the basic principles of the invention shown in FIG. 1. Like elements will be denoted by the same reference number. The modification of FIG. 3 differs from FIG. 1 basically in the header arrangement. FIG. 3 shows an opposite end connection with the inlet or steam header 52 at one end of the heat exchanger and the condensate return header 54 at the other end. The steam, in this form of the invention is introduced into steam header 52 through steam inlet 56 and is fed into upper and lower reaches 26 and 32 of the steam distributor tube 14. The steam leaves the steam distributor 14 through openings 44 and is condensed in tubes 18. The condensate, in this form of the invention is collected in condensate header 54 and discharged through condensate outlet 58. The only difference in operation of this heat exchanger from that of FIG. 1 is that the condensate is collected at the end of the heat exchanger opposite the steam header.

FIG. 4 is a modification of FIG. 3. In FIG. 4, the U-bend connection 30 has been eliminated and a combination box type header 60 is used to pass the steam from the upper reach 26 to the lower reach 32 and also to collect the condensate from the condensing tubes 18. Looking at FIG. 4, the combination header consists of a condensate chamber 62, a condensate outlet 64, and a steam chamber 66. Obviously, steam from upper reach 26 will pass into steam chamber 66 and pass into lower

reach 32 and the condensate from condensing tubes 18 will drain into condensate chamber 62 and discharge out the condensate outlet 64.

Our new and improved steam distributing heat exchanger overcomes the disadvantages of conventional types of heat exchangers discussed and is economical to manufacture. Our new and improved heat exchanger operates with a lower pressure drop through the heat exchanger and has increased capacity at full load conditions due to positive displacement of the condensate from the condensing tubes and the above mentioned lower pressure drop.

Although we have described in detail the preferred embodiments of our invention, we contemplate that many changes may be made without departing from the scope or spirit of our invention, and we desire to be limited only by the claims.

We claim:

1. In a heat exchanger; inlet and outlet headers, a plurality of condensing tubes each with one end connected to said outlet header and the other end closed, U-shaped distributor tube means having a first reach and a second reach, said first reach lying in one of said condensing tubes and being connected to said inlet header, said second reach lying in another of said condensing tubes and being connected to said inlet header, said inlet end of said first reach being smaller in diameter than the inlet end of said second reach and greater than one-half the diameter of the distributor tube means, and apertures in said first reach and said second reach whereby steam introduced into said inlet header will pass into said U-shaped distributor means, be condensed in said first reach and said second reach, and flow into said outlet header.

2. In a heat exchanger; spaced inlet and outlet headers, a plurality of condensing tubes each with one end connected to said outlet header and the other end closed, U-shaped distributor tube means having a first reach and

a second reach, said first reach lying in one of said condensing tubes and being connected to said inlet header, said second reach lying in another of said condensing tubes and being connected to said inlet header, said inlet end of said first reach being smaller in diameter than the inlet of said second reach and greater than one-half the diameter of the distributor tube means, and apertures in said first reach and said second reach whereby steam introduced into said inlet header will pass into said U-shaped distributor means, be condensed in said first reach and said second reach, and flow into said outlet header.

3. In a heat exchanger, a header, partition means in said header separating said header into an inlet chamber and an outlet chamber, a plurality of condensing tubes each with one end connected to said outlet chamber and the other end closed, U-shaped distributor tube means having a first reach and a second reach, said first reach lying in one of said condensing tubes and being connected to said inlet chamber, said second reach lying in another condensing tube and being connected to said inlet chamber, said inlet end of said first reach being smaller in diameter than the inlet end of said second reach and greater than one-half the diameter of the distributor tube means, and ports distributed along the two reaches of each distributing tube means so that a supply of steam to said inlet chamber will be distributed by said U-shaped distributor tube means to said condensing tubes and the condensate therefrom will discharge from said condensing tubes to said outlet chamber.

References Cited in the file of this patent

UNITED STATES PATENTS

1,948,355	Merad	Feb. 20, 1934
2,650,799	Fritzberg	Sept. 1, 1953
2,707,868	Goodman	May 10, 1955
2,816,738	McElgin	Dec. 17, 1957