June 21, 1949. J. A. BALMER 2,473,561

HEAT EXCHANGER

Filed July 16, 1945

2 Sheets-Sheet 1

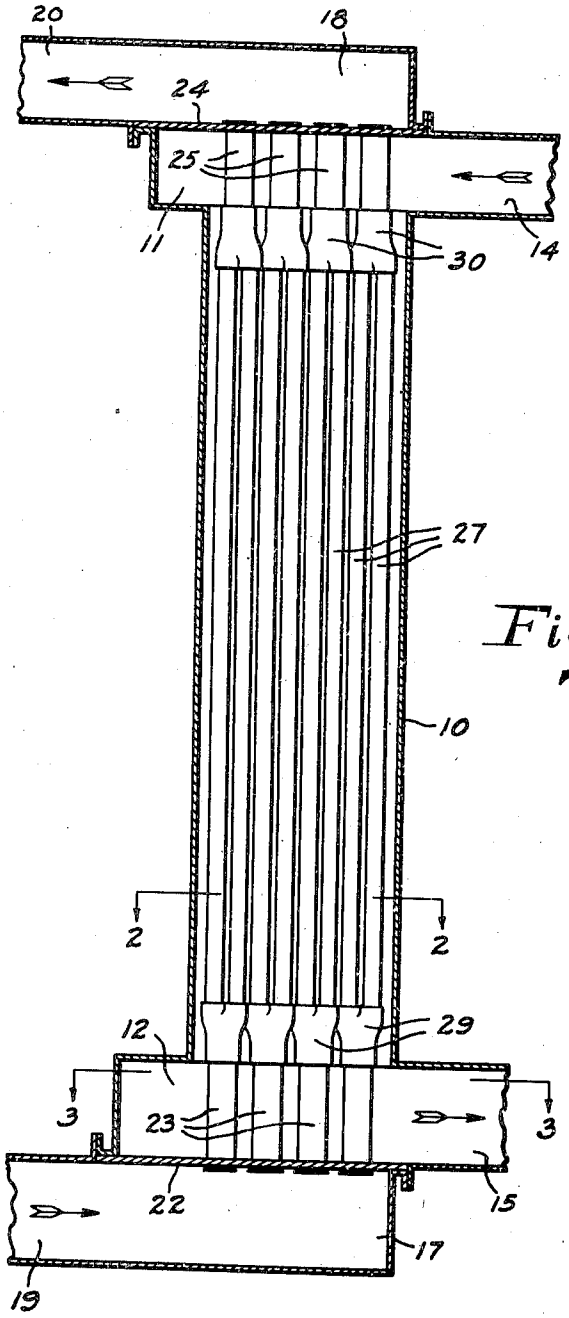


Fig. 1

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2 Sheets-Sheet 2

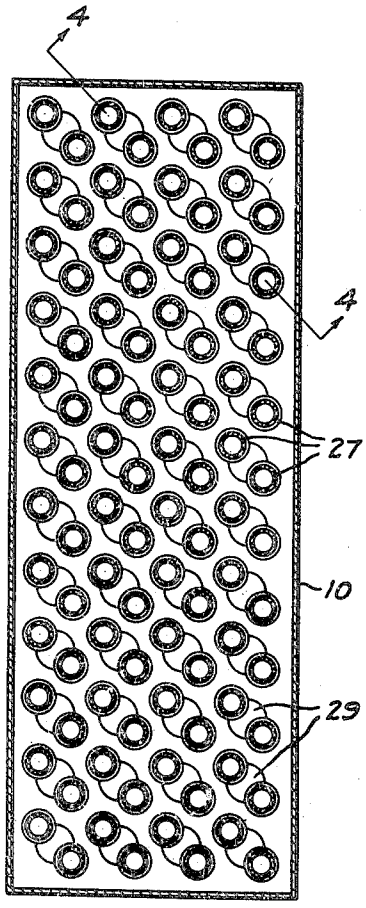


Fig. 2

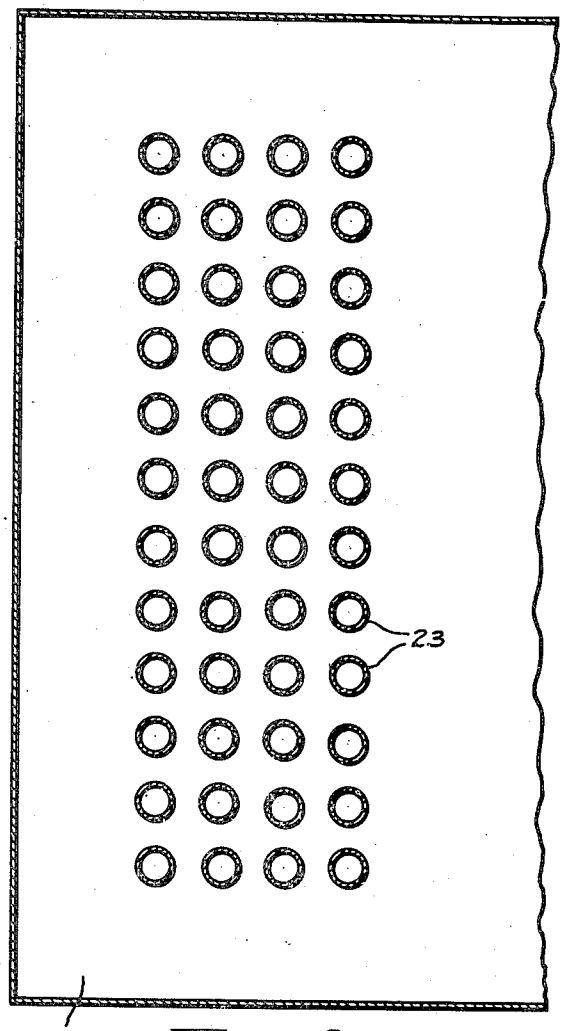


Fig. 3

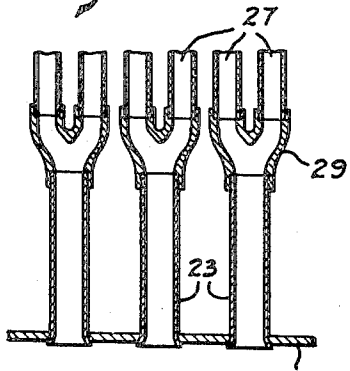


Fig. 4

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Patented June 21, 1949 2,473,561

UNITED STATES PATENT OFFICE

2,473,561

HEAT EXCHANGER

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Application July 16, 1945, Serial No. 605,304

2 Claims. (Cl. 257—224)

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This invention relates to heat exchangers, and more particularly to apparatus of the type having a group of spaced parallel tubes through which a fluid flows in heat exchange relation with a second fluid outside the tubes.

A more rapid and efficient exchange of heat will take place in such an apparatus if the tubes are made of small diameter and closely spaced, but such a construction renders it difficult to distribute fluid uniformly throughout the narrow intertube spaces. Consequently it has been found necessary to use larger and more widely spaced tubes than would otherwise be considered desirable, and the overall dimensions of the entire apparatus have been increased accordingly.

It is one object of the invention to provide a heat exchanger having a group of tubes of comparatively small diameter and closely spaced, the construction being such as to facilitate a substantially uniform distribution of fluid throughout the spaces between the tubes.

It is a further object of the invention to provide a highly efficient tubular heat exchanger having a large heat transfer capacity in proportion to the space occupied.

With these and other objects in view, as will be apparent to those skilled in the art, the invention resides in the combination of parts set forth in the specification and covered by the claims appended hereto.

Referring to the drawing illustrating one embodiment of the invention, and in which like reference numerals indicate like parts,

Fig. 1 is a vertical sectional view through a heat exchanger;

Fig. 2 is an enlarged section taken on the line 2—2 of Fig. 1;

Fig. 3 is an enlarged section taken on the line 3—3 of Fig. 1; and

Fig. 4 is a fragmentary section taken on the line 4—4 of Fig. 2.

The embodiment illustrated comprises walls forming a vertical passage 10 of rectangular cross section which opens at its upper end into an inlet chamber 11 and at its lower end into an outlet chamber 12. An inlet passage 14 is connected with one side of the chamber 11, and an outlet passage 15 is connected with one side of the chamber 12. Walls are also provided forming an inlet chamber 17 beneath the outlet chamber 12, and an outlet chamber 18 above the inlet chamber 11. An inlet passage 19 is connected with the inlet chamber 17, and an outlet passage 20 is connected with the outlet chamber 18. The inlet chambr 17 is separated from the outlet chamber

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12 by a horizontal plate 22 which is provided with a plurality of rows of holes to receive the lower ends of short vertical tubes 23. The outlet chamber 18 is separated from the inlet chamber 11 by a horizontal plate 24 which is provided with a plurality of rows of holes to receive the upper ends of short vertical tubes 25. The tubes 25 extend downwardly from the tube plate 24 substantially across the inlet chamber 11 to its junction with the passage 10. Similarly, the tubes 23 extend upwardly from the tube plate 22 substantially across the outlet chamber 12 to its junction with the passage 10. As shown in Fig. 3, the tubes 23 in adjacent rows are aligned, and the rows extend parallel with the walls of the passage 10.

Within the vertical passage 10 there are provided a plurality of rows of long vertical tubes 27 with the rows parallel with the passage walls and the tubes in adjacent rows staggered, there being twice as many of the tubes 27 as there are tubes 23 or 25. The tubes 27 are somewhat smaller in diameter than the tubes 23 and 25. Each tube 23 is connected to the lower ends of two of the tubes 27 by means of a bifurcated fitting 29, and each tube 25 is connected to the upper ends of two of the tubes 27 by means of a similar bifurcated fitting 30. As best shown in Fig. 2, these fittings are spaced from one another to provide ample room for the flow of fluid therebetween.

It will now be apparent that the invention may be used for various purposes which require a transfer of heat from one fluid to another. For example, the construction illustrated is particularly adapted for utilizing the flue gases from a steam boiler to preheat the air required for combustion of the fuel. In such use the flue gases will travel through the passage 19 and chamber 17, thence upwardly through the tubes 23, fittings 29, tubes 27, fittings 30, and tubes 25 to the chamber 18 and outlet passage 20. The air will travel through the passage 14 and chamber 11, thence downwardly through the passage 10 in contact with the outer surfaces of the tubes 27, and then through the chamber 12 and outlet passage 15.

In entering the inlet chamber 11 from the passage 14, and in leaving the outlet chamber 12 through the passage 15, the air will flow in directions transverse to the large tubes 25 and 23 respectively. Because of the relatively wide spacing of these tubes 23 and 25, and their arrangement in aligned rows, the air may flow freely among them and it will be distributed very uniformly throughout the passage 10, with negligible loss of draft at the entrance and exit ends of this pas-

sage. Because of the relatively close spacing of the tubes 27, an intimate contact will be obtained between the air and these tubes, the air velocity in the passage will be high, a very efficient transfer of heat will take place, and the space occupied by the apparatus will be considerably reduced.

The tubes 25 at the cold end of the apparatus are more likely than the other tubes to be corroded by reason of moisture condensing from the flue gases. Since these tubes are short as compared with the tubes 27, they can be replaced at small expense when necessary. Furthermore, if desired they can be made of non-corroding metal at slight additional cost.

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

1. A heat exchanger comprising walls forming two chambers connected by a passage, means to supply fluid to one side of one chamber and to withdraw the said fluid from one side of the other chamber, a group of relatively small tubes extending longitudinally within the passage, a group of relatively large tubes located in one of the chambers and extending substantially across the same in the direction of the passage, a plurality of fittings each of which connects one of the large tubes to a plurality of the small tubes, the fittings being spaced from one another to provide ample room for the flow of the said fluid therebetween, and means to supply a second fluid for flow through the two groups of tubes in series to effect a transfer of heat from one fluid to the other.

2. A heat exchanger comprising walls forming

two chambers connected by a passage, means to supply fluid to one side of one chamber and to withdraw the said fluid from one side of the other chamber, a group of relatively small tubes extending longitudinally within the passage, two groups of relatively large tubes located in the respective chambers and extending substantially across the same in the direction of the passage, a plurality of fittings each of which connects one of the large tubes to a plurality of the small tubes, the fittings being spaced from one another to provide ample room for the flow of the said fluid therebetween, and means to supply a second fluid for series flow through one group of large tubes, the group of small tubes, and the other group of large tubes to effect a transfer of heat from one fluid to the other.

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