

Oct. 19, 1943.

G. D. MANTLE

2,332,450

HEAT EXCHANGER

Original Filed June 6, 1940

3 Sheets-Sheet 1

Fig. 1.

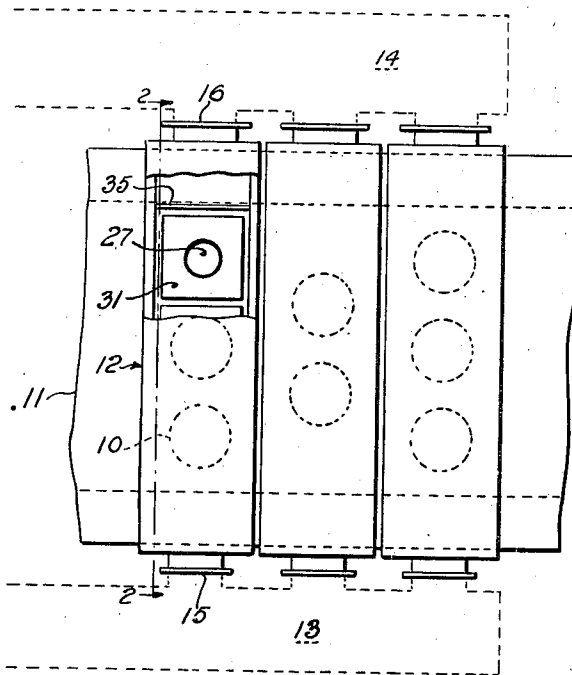
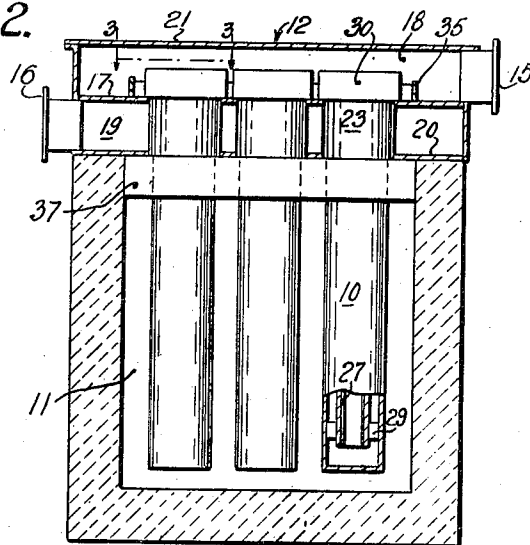


Fig. 2.



Inventor
G. D. Mantle

By
Charles A. Lind
Attorney

Oct. 19, 1943.

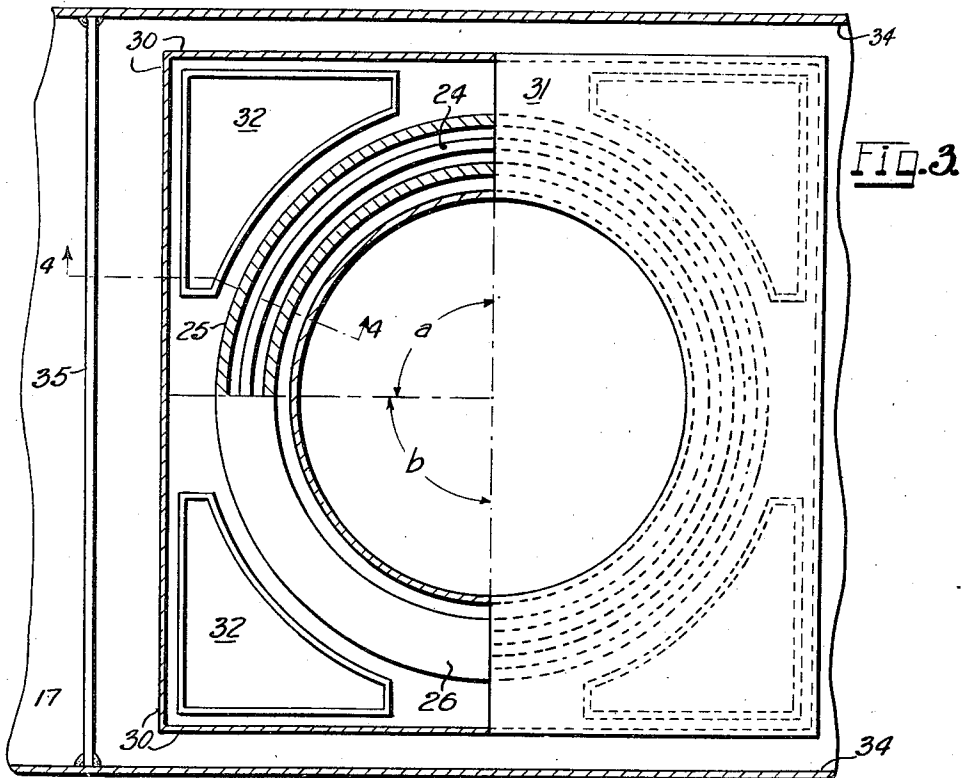
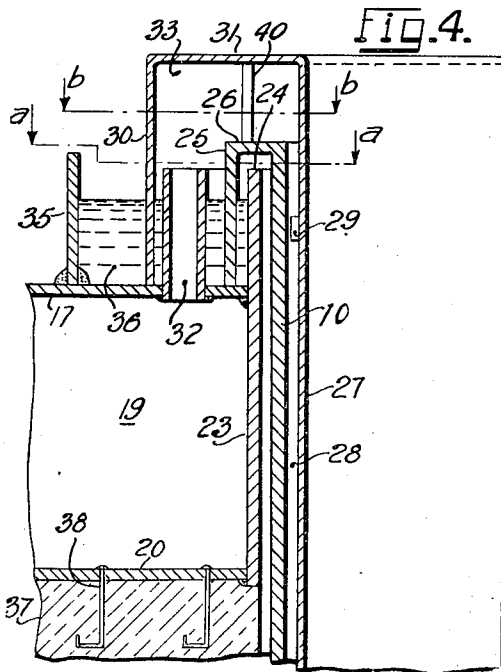
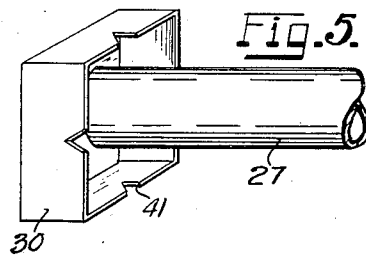
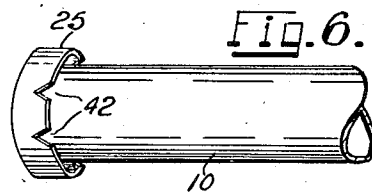
G. D. MANTLE

2,332,450

HEAT EXCHANGER

Original Filed June 6, 1940

3 Sheets-Sheet 2



Inventor

G. D. Mantle

Charles A. Lind

Attorney

Oct. 19, 1943.

G. D. MANTLE

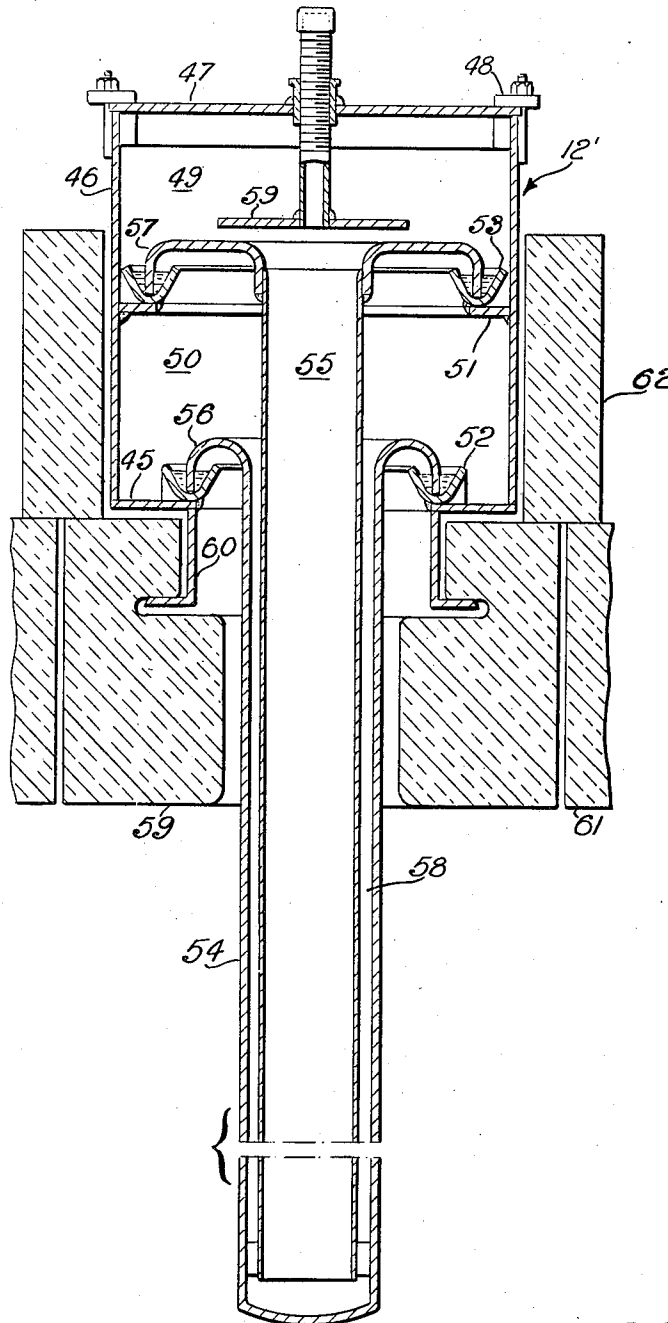
2,332,450

HEAT EXCHANGER

Original Filed June 6, 1940

3 Sheets-Sheet 3

Fig. 7.



23g

Inventor
G. D. Mantle

Charles A. Lind
Attorney

UNITED STATES PATENT OFFICE

2,332,450

HEAT EXCHANGER

Gregory D. Mantle, Coral Gables, Fla., assignor,
by mesne assignments, to General Properties
Company, Inc., a corporation of Delaware

Substituted for abandoned application Serial No.
339,129, June 6, 1940. This application April
19, 1941, Serial No. 389,421. In Great Britain
November 29, 1940

5 Claims. (Cl. 257—231)

This application is a substitute for my application filed June 6, 1940, Serial No. 339,129.

The present invention relates to a heat exchanger and more particularly to a recuperator comprising tubes which depend from an overhead support adapted to serve as a closure for the top side of a heated chamber or flue and the object of the invention is to provide improvements in means for supporting the tubes in a manner to permit them to be readily disconnected from the overhead support for inspection and repairs.

In the drawings—

Fig. 1 is a plan view showing how a number of the improved recuperator units may be disposed side by side in spaced relation above a conduit for hot flue gases, one of the units having a portion of its top wall broken away to expose a constructional feature;

Fig. 2 is a vertical section on line 2—2 of Fig. 1;

Fig. 3 is a greatly enlarged detail plan view on line 3—3 of Fig. 2 with parts in section, the sections of quadrants *a* and *b* being taken on lines *a—a* and *b—b*, respectively, of Fig. 4;

Fig. 4 is a vertical section on line 4—4 of Fig. 3;

Figs. 5 and 6 are fragmentary perspective views of the inner and outer tubes respectively shown in the preceding views, and

Fig. 7 is a vertical cross section of a modified form of the invention, the view being crosswise of the air distributing box.

The improved recuperator comprises an air box 12 adapted to serve as a closure for the top of a hot flue gas conduit 11. As shown in Fig. 1, a number of these boxes may be arranged side by side and be connected to common air headers 13 and 14, each box having its own air inlet and outlet 15 and 16, respectively.

Positioned in the conduit 11 to absorb heat from the hot gases flowing therethrough are tubes 10 which depend from the air box 12, the lower end of each tube being closed. When a plurality of boxes are arranged side by side as shown in Fig. 1, the tubes of one box will preferably be staggered with respect to the tubes of the next adjacent box for better heating as will be readily understood. The number of tubes 10 associated with each box will depend on the size of the tubes and on the size of the gas conduit 11 as will be readily appreciated.

The bottom wall of the air box is indicated at 20, its top wall at 21 and its side walls at 34. The top wall 21 is detachably secured to the side walls

in any preferred way to permit access to be had to the interior of the box for reasons presently appearing. A partition wall 17 divides the box into upper and lower compartments 18 and 19.

Extending through the partition wall 17 and through the bottom of the air box is a series of sleeves 23 through which the tubes 10 extend out of the air box. As best shown in Fig. 4, each of these sleeves extends some distance above the partition wall and is surrounded by a sealing material 36 which can be poured into the upper compartment. Extending across the upper compartment between the air inlet 15 thereto and the next adjacent sleeve 23 is a barrier wall 35 to prevent said sealing material from running out of the upper compartment by way of said air inlet, 15. A similar barrier wall may be provided inwardly of the opposite end of said compartment for the purpose of limiting the surface area covered by said material.

At the upper end of each tube 10 is a circumferential flange 26 and depending from this flange is a collar 25 for dipping into the sealing material 36. The collar may rest on the wall 17 and thus also serve as a support for the tube 10. However, the tube may be otherwise supported. For example, the upper end 24 of the sleeve 23 might just as well engage with the underside of the flange 26 instead of being spaced therefrom as shown.

Extending into the tube 10 is a tube 27, the tubes being in radially spaced relation to form a flow passage 28 between their adjacent walls. Upper and lower spacer lugs 29 may be employed for centering the tubes. At the upper end of the tube 27 is a circumferential flange 31 and depending from this flange is a square collar 30 for dipping into the sealing material 36. The collar may rest on the wall 17 and thus also serve as a support for its tube 27. However, the tube 27 may be otherwise supported. For example, an open work support 40 might well rest on the flange 26 of the tube 10 with its top in engagement with underside of the flange 31 of the tube 27 in which event the collar 30 would not need to rest on the wall 17 as will be readily understood.

It will now be apparent that the upper end of the inner tube 27 is in direct communication with the upper compartment 18 of the air box whereas the upper end of the outer tube 10 is not because of the hood formed by the collar 30 and flange 31 of the inner tube 27. However, the upper end of the outer tube 10 is in communication with the chamber 33 formed by the said hood

and the chamber 33 is in communication with the lower compartment 19 by way of a plurality of upright conduits 32 which extend through the partition wall 17, it being understood that these conduits are surrounded by the sealing material 36. The primary purpose of making the collar 30 of the inner tube 27 square is to permit four large size conduits 32 to be employed, one at each corner of the collar, rather than a greater number of smaller conduits as would necessarily be required if the collar were circular.

It will now be understood that the air to be heated flows into the inner tube 27 from the upper compartment 18; thence upwardly in the space 28 between the two tubes 10 and 27 to the chamber 33, and thence downwardly through the conduits 32 into the lower compartment 19.

To remove the tubes 10 and 27 from the box 12, the top cover 21 of the latter is first removed after which the inner tube 27 is first lifted out and then the tube 10. The simplicity with which the tubes may be removed from the air box is obviously of great practical importance from the standpoint of repairs.

The sealing material 35 is preferably lead which may or may not remain molten. To permit free flow of the lead on being poured to form the seals between the wall 17 and the collars 25 and 30, the collars may be notched as indicated at 41 and 42, respectively.

To protect the bottom wall 20 of the air box against objectionable heating by the hot flue gas, a layer of insulating material may be secured to the underside of the wall in any preferred way as by hanger rods 38.

In the modified form of the invention shown in Fig. 7, 12' indicates an air box which like the air box 12 is adapted to be disposed above a hot gas flue conduit not shown but corresponding to the conduit 11 in Figs. 1 and 2. The bottom wall of the box is indicated at 45, its side walls at 46 and its top wall at 47, the latter being shown as removably secured to the box by clamping means 48. The box is divided into upper and lower compartments 49 and 50 by a common partition wall 51. At one end of the upper compartment is an air inlet not shown but corresponding to the inlet 15 in Fig. 1 and at one end of the lower compartment is an air outlet not shown but corresponding to the air outlet 16 in Fig. 1.

Surrounding concentric openings in the walls 45 and 51 are circular troughs 52 and 53, respectively. Extending out of the box 12' are two concentric tubes 54 and 55, the tube 54 being closed at its lower end and it being also understood that the tube 54 is externally heated by the hot flue gases. The upper end of the outer tube 54 has a downturned peripheral flange 56 for seating in the trough 52 and the upper end of the tube 55 has a downturned peripheral flange 57 for seating in the trough 53. Sealing material in the troughs provides a gas tight seal between the flanges and their respective troughs. It is to be understood that the tubes are supported in the position shown by their flanges. The air to be heated flows from the upper compartment 49 downwardly through the tube 55, thence upwardly in the space 58 between the adjacent walls of the tubes and then into the lower compartment 59. If desired an adjustable valve 59 may be provided at the top end of the inner tube to control the air flow.

To remove the tubes from their setting the top wall 47 is removed after which the inner tube 55 is first lifted out and then the outer tube 54,

it being noted that the inner diameter of the annulus forming the upper trough 53 is greater than the external diameter of the flange 56 of the outer tube 54.

59 indicates insulating material for protecting the bottom wall 45 against overheating by the hot flue gas, the material being shown as being on hooks 60 depending from the said wall. 61 indicates the insulating material of next adjacent air boxes and 62 an insulating brick or the like between adjacent boxes.

What I claim is:

1. In apparatus of the class described, the combination of a support having upper and lower compartments separated by a partition wall, a first tube depending from said support, the upper end of the tube being above said wall, a collar secured to and surrounding the upper end of the tube in spaced relation, a second tube depending from said support and projecting downwardly into the first tube in spaced relation to form an air passage between the tubes, the upper end of the inner tube being above the upper end of the outer tube, a collar secured to the upper end of the inner tube and surrounding the collar of the outer tube in spaced relation, and means for establishing a gas connection between the lower compartment and the space encompassed by the collar of the inner tube.

2. In apparatus of the class described, the combination of a pair of upright tubes, one within the other in spaced relation to form an air passage between the tubes, means forming a container for sealing material around but out of contact with the outer tube, a collar secured to and surrounding the outer tube for dipping into said sealing material, a collar secured to and surrounding the inner tube for dipping into said sealing material, the collar of the inner tube being of a size to encompass the collar of the outer tube and having its top above the upper end of the outer tube whereby to form an air chamber above the said sealing material.

3. In apparatus of the class described, the combination of means forming a box having upper and lower compartments, a first tube having one end in the upper compartment and extending downwardly through and beyond the lower compartment for external heating outside of the compartments, a second tube having one end in the upper compartment and extending downwardly into the first tube to form an air passage between the tubes, means within the upper compartment cooperating with the upper end of the inner tube and with the bottom of the upper compartment to seal off the upper end of the outer tube from the upper compartment, and means for establishing a gas connection between the lower compartment and the upper end of the outer tube.

4. In apparatus of the class described, the combination of means forming a box having upper and lower compartments, a sleeve extending from the upper compartment through the lower compartment, a first tube having one end in the upper compartment and extending downwardly through and beyond the lower compartment by way of said sleeve for external heating outside of said compartments, means in the upper compartment forming a container for sealing material around but out of contact with the upper end of said tube, an annular sealing flange carried by the upper end of said tube for dipping into the sealing material in said container, a second tube having one end in the upper compartment and extending downwardly into the first tube to form

an air passage between the tubes, means carried by the upper end of the second tube for sealing off the upper end of the first tube from the upper compartment, and means for establishing a flow connection between the lower compartment and the upper end of said air passage.

5. In apparatus of the class described, the combination which comprises a structure adapted to overlie and bridge a heated space between two upright walls, a first tube supported by said structure and depending therefrom for external heating in said space, a second tube projecting downwardly into the first tube and having at its upper end an outwardly extending peripheral flange by which it is detachably hung on said structure, the lower end of the first tube closed and said

structure comprising walls forming two air chambers of which one is in air connection with the top of the second tube and of which the other one is in air connection with the top of the air passage between the tubes so that air can be conducted from one of said chambers to the other by way of said tubes, said second tube being withdrawable from the first tube by upward displacement, and a trough for sealing material into which the rim of said flange dips, the trough surrounding the second tube in such spaced relation as to permit the first tube to be removed from said structure by upward displacement after the second tube has been removed from said structure.

GREGORY D. MANTLE.