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[54] METALLIC FLUE RECUPERATORS 6 Claims, 5 Drawing Figs.

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ABSTRACT: An interchangeable top and bottom support tube type recuperator is provided having a bottom manifold with a plurality of vertical tubes fixed thereto in communication therewith, a top manifold having a plurality of openings slidably receiving the tubes, a retainer ring fixed to a plurality of said tubes within the top manifold and a flexible expansion compensator sheet sealingly engaging the top ends of the tubes and the manifold within the manifold.

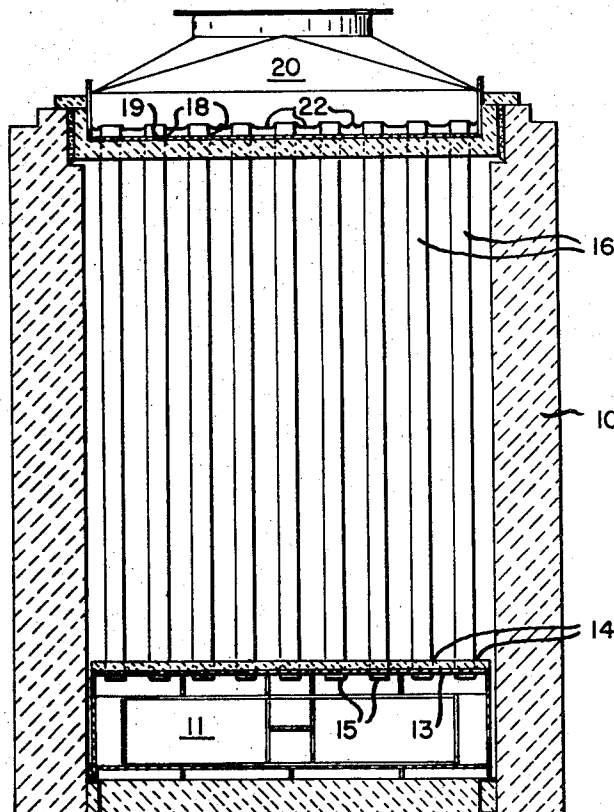


Fig. 2.

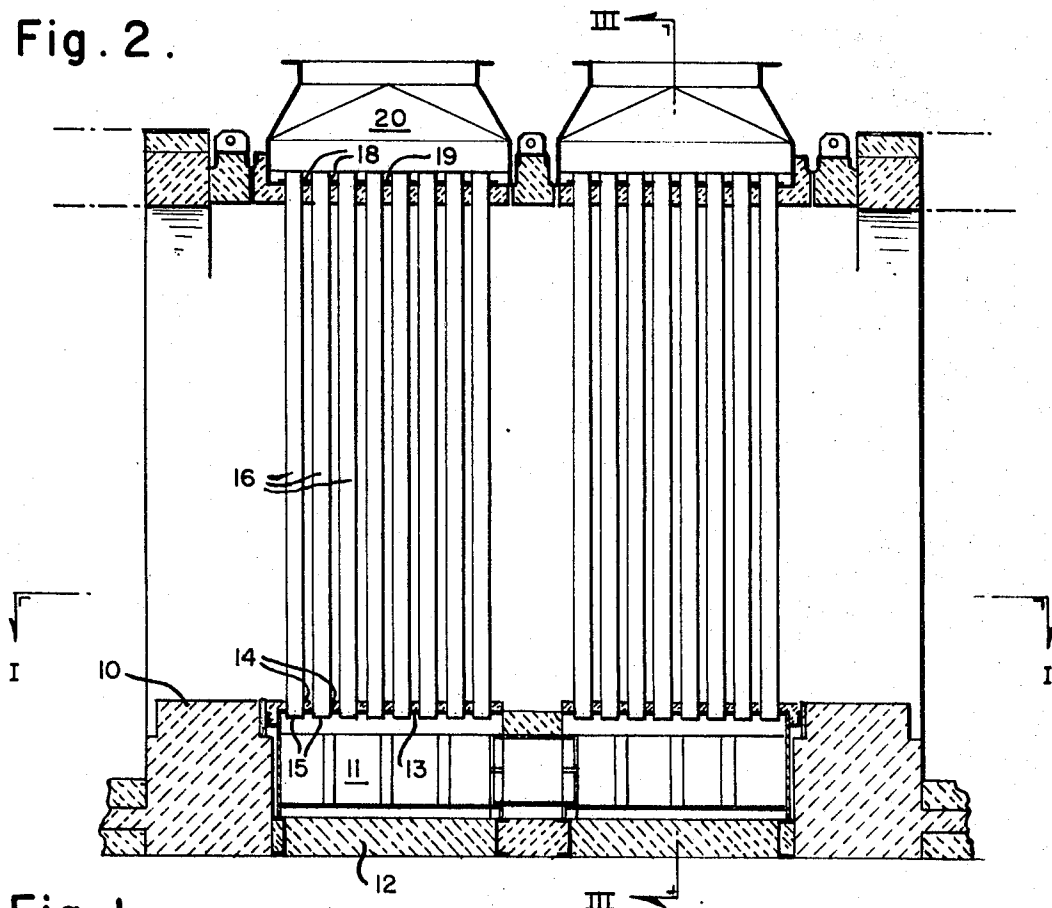
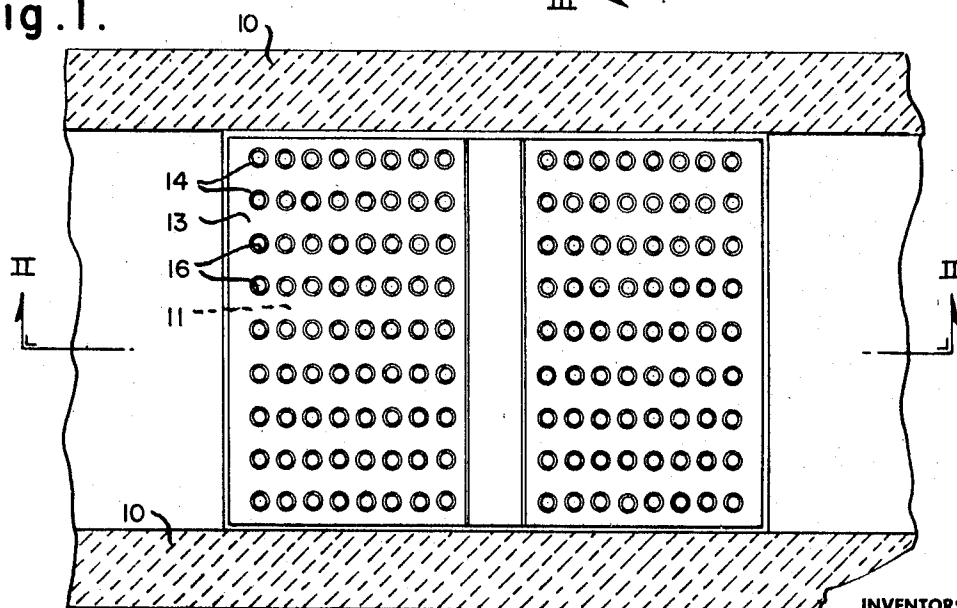


Fig. 1.



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Fig. 5.

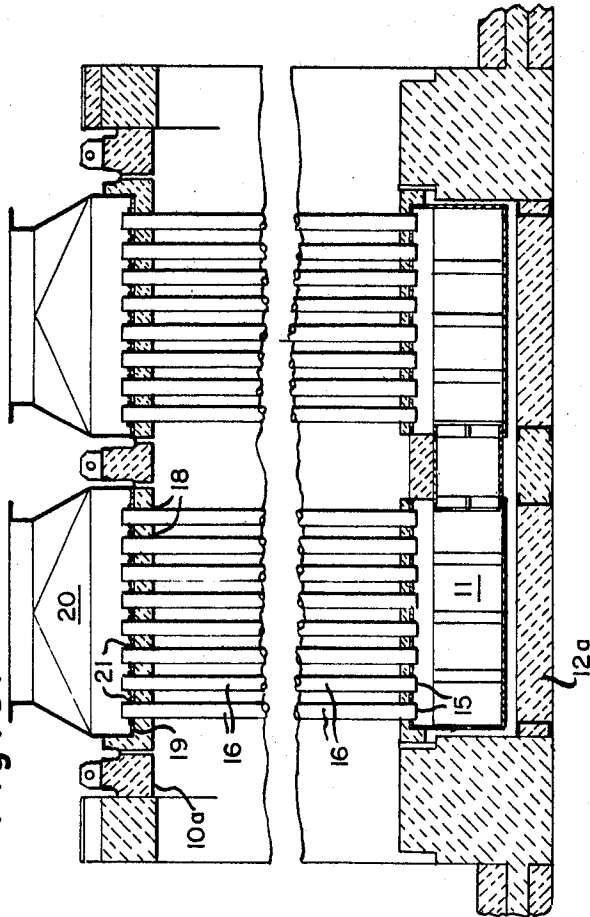


Fig. 4.

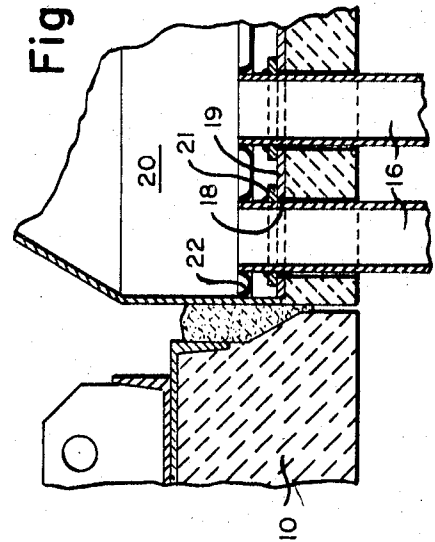
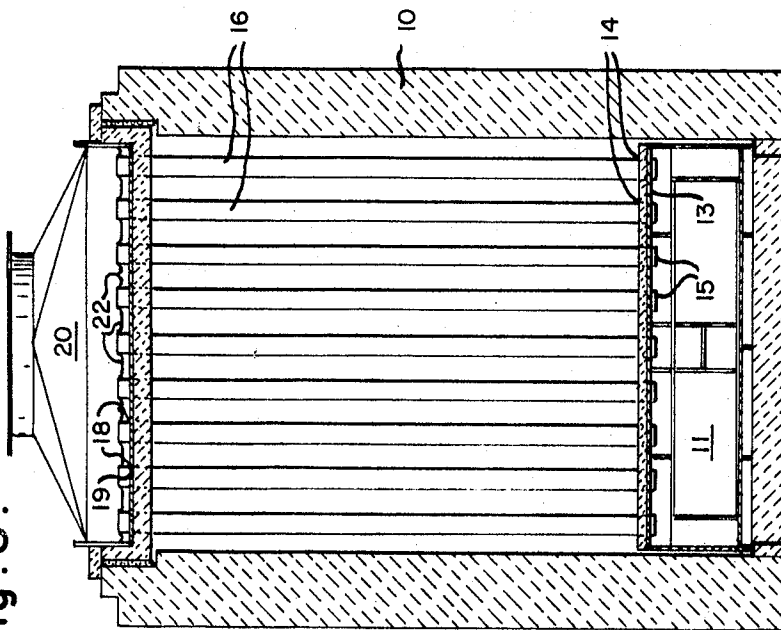


Fig. 3.



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METALLIC FLUE RECUPERATORS

This invention relates to metallic flue recuperators and particularly to tube type recuperators in a combination top and bottom supported configuration.

It is well known that in any round tube flue type recuperator, there exists the problem of thermal expansion of the tubes due to the elevated temperatures at which the recuperators operate.

There are recognized in the prior art two basic ways to support the round tube flue type recuperator. One is the bottom support type in which the tube is fixed to and supported by a bottom tube support sheet of the bottom manifold which supports all tubes in the assembly. An enlarged tube hole in the upper tube sheet of the top manifold allows the tube to elongate into the upper manifold. The other is the top support type in which the entire recuperator including the bottom manifold is supported from the upper tube support sheet of the top manifold. In this form the tubes may freely elongate in the downward direction carrying the bottom manifold.

It is obvious that these two forms can be used only in the way they are originally designed to be used and are not interchangeable. This is, of course, quite restrictive in the manner in which such units can be used.

We have invented a novel recuperative structure which combines the attributes of both bottom and top supported tube type recuperators and may be used in place of either.

Preferably we provide a tube type recuperator comprising a bottom manifold having a bottom support sheet forming a part thereof, a plurality of vertical tubes fixed at their bottom to the bottom support sheet and communicating therethrough to the bottom manifold, a top manifold having a top support sheet having openings slidably receiving the said plurality of vertical tubes, a tube retainer ring fixed adjacent the top end of each said vertical tubes within the top manifold and a flexible tube expansion compensator sealingly fixed around the top ends of the vertical tubes and to the top manifold providing communication from the tubes to the top manifold while sealing the manifold against loss through the holes in the top support sheet. Preferably horizontally extending support lugs are provided on each side of the top manifold whereby the assembly may be top supported where desired.

In the foregoing general description, we have set out certain objects, purposes and advantages of our invention. Other objects, purposes and advantages of our invention will be apparent from a consideration of the following description and the accompanying drawings in which:

FIG. 1 is a top plan view of a bottom supported recuperator assembly according to our invention;

FIG. 2 is a section on the line II—II of FIG. 1;

FIG. 3 is a section on the line III—III of FIG. 2;

FIG. 4 is an enlarged fragmentary section showing the top of the vertical tubes on the top manifold; and

FIG. 5 is a vertical section similar to FIG. 2 of the same recuperator assembly in a top supported configuration.

Referring to the drawings we have illustrated a recuperator assembly within a supporting housing 10. Each recuperator assembly is made up of a bottom manifold 11 resting on the base 12 of the housing and having a bottom support sheet 13 having parallel rows of openings 14 into which the bottom ends 15 of vertical tubes 16 are welded. The top ends 17 of vertical tubes 16 extend through and are slidable in parallel rows of openings 18 in top support sheet 19 forming a part of top manifold 20. A tube retainer ring 21 is welded to at least a part of the individual tubes 16 within the top manifold adjacent the top end of the tube. A flexible tube compensator 22 is fixed to the inner periphery of the manifold and to the top of each tube 16

to provide a seal. The top manifold 20 is supported on some of the tubes, which are welded to the tube sheet 19.

The operation of the structure shown in FIGS. 1-4 is typical of bottom support recuperators. The bottom manifold 11 is supported on the base 12 and the top manifold 20 is supported by some (preferably four) tubes 16 welded into top support sheet 19. When the recuperator is in use the hot gases passing through the unit cause tubes 16 to elongate differently due to different temperatures. This they do in the vertical direction moving through openings 18 in top support plate 19, the flexible sheet tube compensator moving with them. The overall expansion is compensated by expansion joints between the housing and the tube sheets as shown in FIG. 2, for example.

In FIG. 5 we have illustrated the same structure as in FIGS. 1-4 but in a top supported configuration. In this arrangement the bottom manifold 11 does not rest on the housing base 12a but is spaced above it and is supported from top support plate 19 by the rings 21 welded to tubes 16 which bear on plate 19 around holes 18. The top manifold and the suspended tubes 16 and bottom manifold 11 are all supported on housing 10a.

In this configuration the tubes 16 expand downwardly in the vertical direction when heated thus moving bottom manifold 11 downwardly. Thus the same operation is achieved as in a conventional top supported recuperator where the tubes are welded to the top support plate instead of being movable in holes therein.

It will be seen from the foregoing description that the present invention makes it possible with a single interchangeable structure to accomplish what heretofore required two separate and distinct noninterchangeable devices.

While we have illustrated and described certain preferred practices and embodiments of our invention, it will be understood that this invention may be otherwise embodied within the scope of the following claims.

We claim:

1. In a recuperator having a chamber traversed by combustion gases and in which is disposed a plurality of tubes the improvement comprising; a bottom manifold, said tubes fixed at one end to said bottom manifold and communicating therewith, a top manifold having openings slidably receiving the said plurality of vertical tubes, a tube retainer ring fixed adjacent the top end of at least a part of said vertical tubes within the top manifold limiting the movement of the tubes in the openings in the top manifold, and a flexible expansion compensator sheet sealingly fixed around the ends of the vertical tubes within the top manifold sealing the manifold against loss through the holes in the top manifold.

2. A recuperator as claimed in claim 1 wherein a tube retainer ring is welded to each tube adjacent the top end within the top manifold.

3. A recuperator as claimed in claim 1 wherein the top manifold is provided with horizontally extending support lugs.

4. A recuperator as claimed in claim 1 wherein the bottom manifold is provided with a support sheet forming the top surface thereof, said support sheet having a plurality of rows of parallel spaced openings within which the bottom end of the vertical tubes is fixed.

5. A recuperator as claimed in claim 1 wherein the top manifold is provided with a support sheet forming the bottom surface thereof, said support sheet having a plurality of rows of parallel spaced openings within which the top ends of the vertical tubes are freely slidable.

6. A recuperator as claimed in claim 4 wherein the top manifold is provided with a support sheet forming the bottom surface thereof, said support sheet having a plurality of rows of parallel spaced openings within which the top ends of the vertical tubes are freely slidable.