March 17, 1931. I. HARTER 1,796,945

HEAT EXCHANGER

Original Filed Oct. 30, 1928

Fig. 1

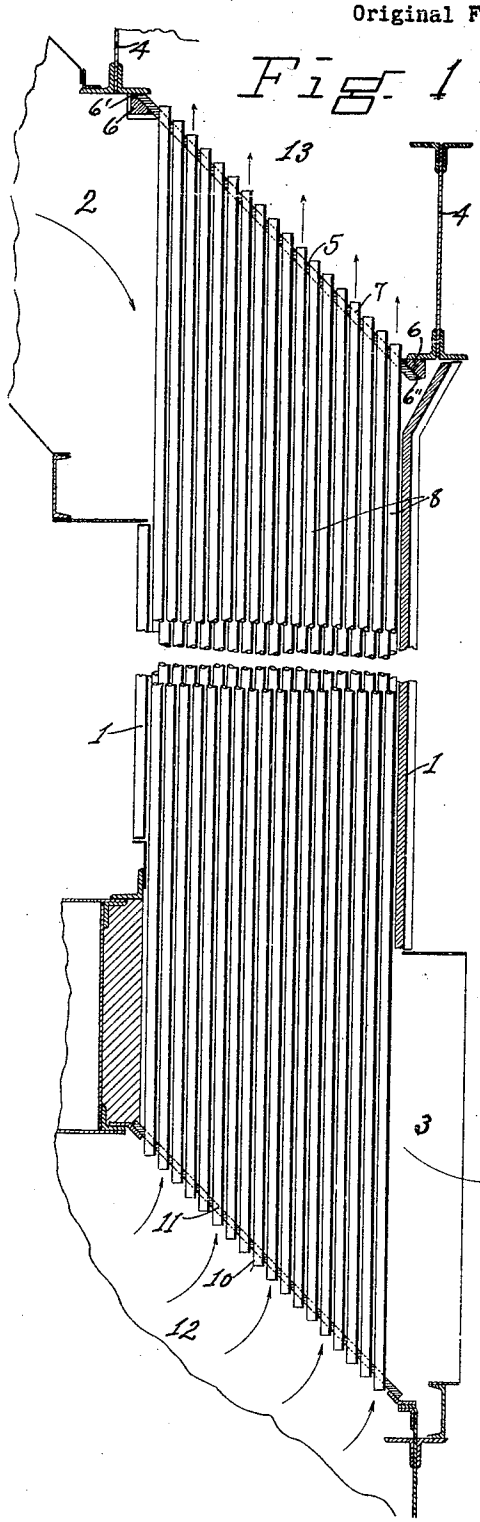


Fig. 2

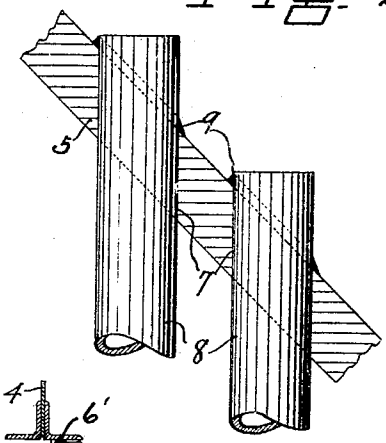


Fig. 3

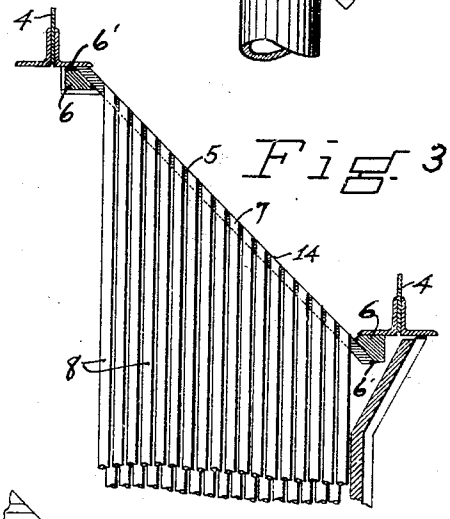
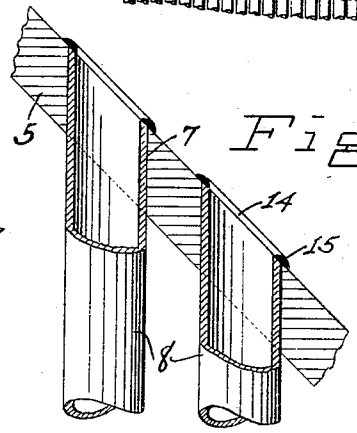


Fig. 4



INVENTOR
Isaac Harter
BY
Gifford & Seul
ATTORNEYS

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UNITED STATES PATENT OFFICE

ISAAC HARTER, OF NEW YORK, N. Y., ASSIGNOR TO THE BABCOCK & WILCOX COMPANY, OF BAYONNE, NEW JERSEY, A CORPORATION OF NEW JERSEY

HEAT EXCHANGER

Application filed October 30, 1928, Serial No. 315,937. Renewed March 5, 1930.

This invention relates to a device for transmitting heat from one fluid to another without causing the fluids to contact with each other or become mixed. The invention is especially suitable for heating air by means of hot gases but is not restricted to this particular use.

The invention will be understood from the description in connection with the accompanying drawings in which Fig. 1 is a vertical section through an illustrative embodiment of the invention partly broken away; Fig. 2 is a section on an enlarged scale showing some of the details; Fig. 3 is a section similar to Fig. 1 partly broken away showing a modification; and Fig. 4 is a view similar to Fig. 2 on an enlarged scale showing some of the details of Fig. 3.

In the drawings reference character 1 indicates the casing of a heat exchanger or air heater that is vertically disposed. An air inlet 2 is provided on one side at the upper end and an air outlet 3 on the other side at the lower end so that the air or other fluid to be heated passes in a general direction longitudinally along the outside of the tubes from the inlet to the outlet.

The heat exchanger is supported from above by means of I-beams 4. The upper tube plate 5 is attached along its edges to the supports 4 by means of cross bars 6 that are welded or otherwise attached to the plate 5 and the supports 4, the welding being indicated at 6'.

The plate 5 is of appreciable thickness and is provided with rows of holes 7 parallel to each other at an angle of about 45° to the surfaces of the plate 5. Rows of tubes 8 extend through the holes 7 in the plate 5 and are welded to the plate as indicated at 9 (Fig. 2). The tubes 8 are straight and fit the holes 7 tightly or are expanded into the holes which form tube seats therefor. The connection of the tubes 8 to the plate 5 in this manner aids in stiffening the plate 5 so that the tendency for the same to bow or sag down because of the tubes will be decreased or entirely overcome. The welding of the tubes to the plate results in appreciably stiffening and strengthening the tube plate. The lower ends of the tubes 8 pass loosely through the lower tube plate 10 that is inclined and provided with holes simliar to the plate 5. The holes 11 in tube plate 10 are to be sufficiently large to permit the tubes 8 to slide therethrough due to expansion and contraction.

An inlet for hot gases which pass through the tubes is indicated at 12 at the lower end of the device and an outlet 13 for the cooled gases is provided at the top.

In the modification shown in Fig. 3 the ends of the tubes 8 that pass through the holes 7 in the plate 5 are beveled as shown at 14 so that they are flush with the upper surface of the tube plate instead of projecting above the same as indicated in Fig. 1. The upper ends of the tubes are welded to the tube plate as shown at 15.

By this invention the tubes 8 are made straight so that the inside thereof can be readily cleaned by passing a tube cleaner therethrough. They are installed parallel to each other and are supported from above and permitted to move freely through the lower tube plate to provide for expansion and contraction. The tube plates are inclined so that the gas or air to be heated can enter and leave the device in such a manner that pockets or dead spaces are not left. The fluid to be heated may pass along the outside of the tubes and the heating fluid through the tubes or vice versa.

I claim:

1. In a heat exchanger, tube plates at opposite ends thereof at an angle of about 45° to the central axis of said exchanger and straight tubes extending through both of said plates and attached to the upper one.

2. In a heat exchanger, tube plates at opposite ends thereof at an angle of about 45° to the central axis of said exchanger and straight tubes extending through both of said plates and welded in holes in the upper one.

3. In a heat exchanger, tube plates at opposite ends thereof at an angle of about 45° to the central axis of said exchanger and straight parallel vertically disposed tubes

extending through both of said plates and attached to the upper one.

4. In a heat exchanger, tube plates at opposite ends thereof at an angle of about 45° to the central axis of said exchanger and straight tubes extending through both of said plates and attached to the upper one, the upper ends of said tubes being beveled to be flush with the surface of its tube sheet.

5. In a heat exchanger, tube plates at opposite ends thereof at an angle of about 45° to the central axis of said exchanger and straight tubes extending through both of said plates and attached to the upper one and passing loosely through the other one.

6. In a heat exchanger, tube plates at opposite ends thereof at an angle of about 45° to the central axis of said exchanger, straight tubes extending through both of said plates and attached to the upper one, an inlet for fluid on one side at one end of said exchanger and an outlet in the other side at the other end.

7. In a heat exchanger, tube plates at opposite ends thereof at an angle of about 45° to the central axis of said exchanger, straight tubes extending through both of said plates and attached to the upper one, an inlet under the upper edge of one plate and an outlet above the lower edge of the other one.

8. In a heat exchanger, tube plates at opposite ends thereof at an angle of about 45° to the central axis of said exchanger and straight tubes extending through both of said plates and attached to one only of them.

ISAAC HARTER.