Sept. 13, 1927. 1,641,999

H. WEBSTER

HEAT TRANSFER DEVICE

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Fig. 1

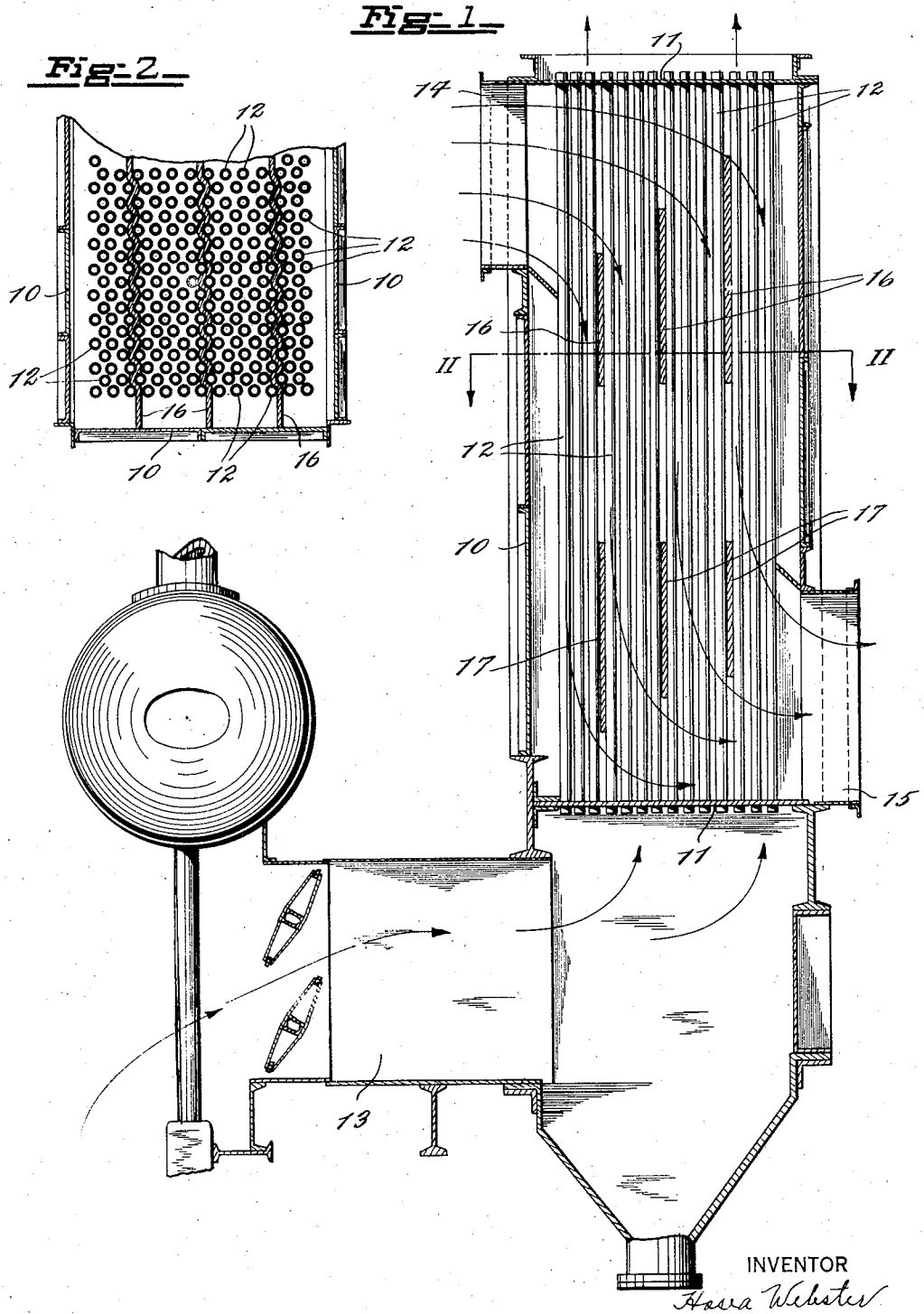



Fig. 2



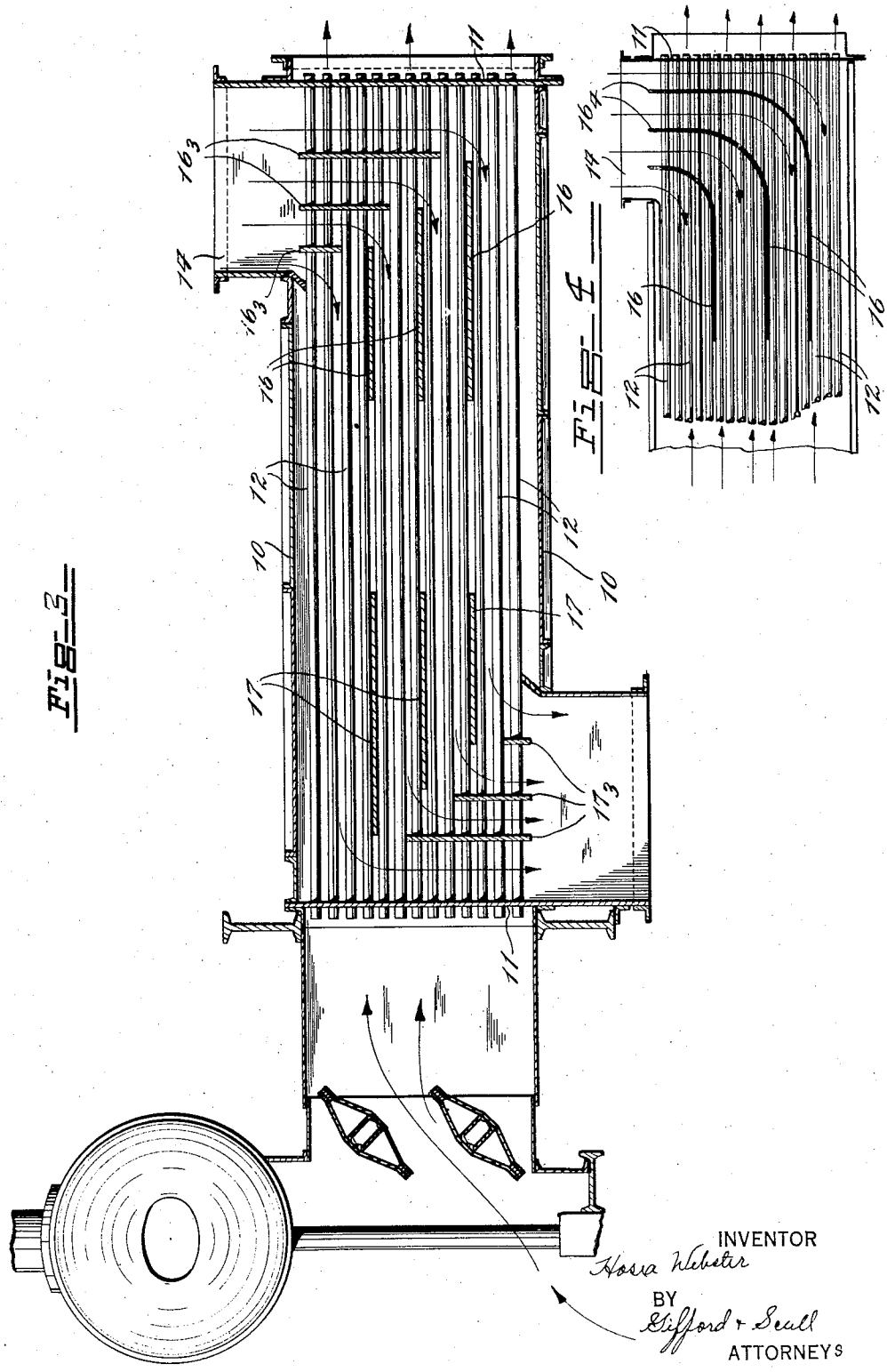

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Fig. 6.

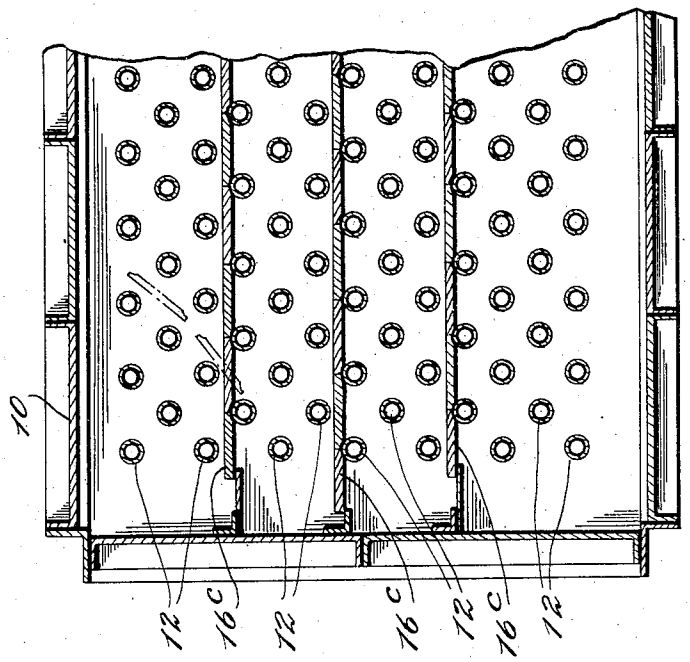
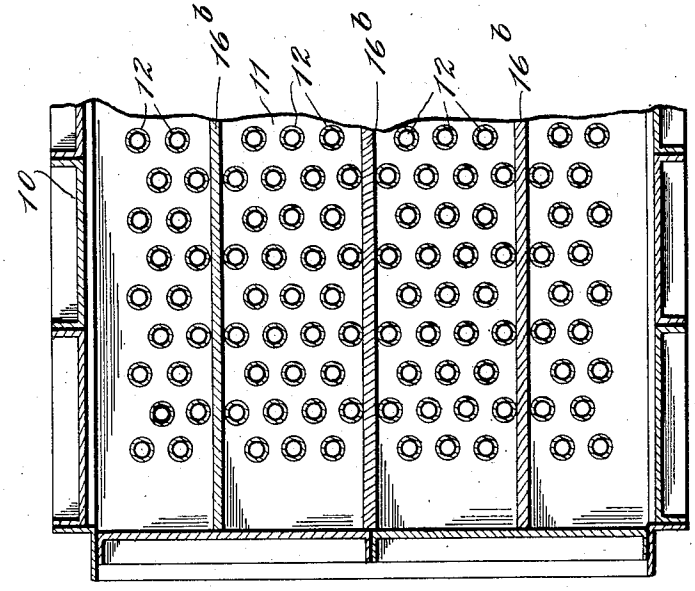



Fig. 5.




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# UNITED STATES PATENT OFFICE.

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## HEAT-TRANSFER DEVICE.

Application filed July 9, 1925. Serial No. 42,335.

My invention relates to heat transfer devices and has particular reference to means for insuring that one of the thermally contacting fluids is distributed over the heat transfer surfaces with substantial uniformity. In the case of air heaters for steam boilers where, for example, the air to be heated enters and leaves at right-angles to the heating surface, there is a tendency for the air to take the shortest path through the heater and thus to avoid contact with a considerable part of the heating surface.

My invention will best be understood by reference to the following detailed description and to the annexed drawings of air heaters for steam boilers and the like, which I have chosen as illustrative embodiments of the invention. Fig. 1 of the drawings is a view in vertical section of said embodiment; Fig. 2 is a view of a section taken along line II—II of Fig. 1; Fig. 3 is a view also in vertical section, showing a modification; Fig. 4 is a similar view showing a second modification, partly broken away; Figs. 5 and 6 are views of sections taken similarly to Fig. 2 and show modifications of the arrangement of the tubes and construction of the baffles.

Referring to Fig. 1, 10 denotes the casing of an air heater having headers 11, 11 in which are held conduits or tubes 12. Furnace gases from the boiler pass through the damper-controlled duct 13, and through the tubes or conduits 12 to the stack. The air to be heated enters the heater through inlet openings 14 and leaves by exit opening 15, both said openings being disposed sidewise of casing 10.

For insuring a more uniform distribution of air over the tubes 12, I may provide one or more baffles 16 opposite inlet opening 14. Baffles 16 are spaced across the heater and extend graduated distances into the region opposite the inlet opening; that is, with the baffle furthest from inlet 14 extending furthest across the projection of such opening on the plane thereof and each of the other baffles a successively less distance. This, in effect, produces side openings in a series of parallel ducts extending longitudinally of the tubes. Preferably similar baffles 17 are similarly disposed with reference to exit opening 15.

In the modification shown in Fig. 3, another set of baffles $16_3$ is placed near the mouth of the inlet opening 14 at an angle to the baffles 16 so as to provide a series of ducts leading into proximity with the ducts formed by the baffles 16. These baffles $16_3$ extend across the tubes 12 to different distances as indicated in the drawing so as to minimize the tendency for an excessively large proportion of the air to follow the shortest path and consequently fail to come into effective contact with all of the heat exchanging surfaces of the tubes. A similar set of cross baffles may be installed at the other end of the tubes 12 as shown at $17_3$ in proper relation to the baffles 17, if desired.

In the modification shown in Fig. 4, the transverse baffles $16_4$ are made as prolongations of the baffles 16, which lie along the tubes, being joined thereto along curved lines and extending across the tubes 12 in proximity to the inlet opening 14.

In Figs. 2, 5 and 6, I have shown different methods of disposing the baffles between tubes 12. In Fig. 2, the baffles 16 are given a sinuous or corrugated shape in order to accommodate them to the tube spacing. In this construction, as it is applied to the arrangement shown in Fig. 1, the baffles are preferably inserted while the tubes are being secured in place during the construction of the heater. If it should become necessary to remove the baffles, the tube rows adjacent the baffle to be removed are first cut out whereupon the baffle 16 may be removed sidewise of the heater. While this arrangement is not so convenient for the removal of the baffles, it is advantageous because it permits a close spacing of the tubes in a staggered relation.

In Fig. 5 I have shown the use of straight baffles $16^b$, tubes which would normally be positioned in the plane of such baffles being removed. In this construction the baffles $16^b$ are removable without the necessity of cutting out any of the tubes. In Fig. 6 I have shown the baffles as made up in sections $16^c$ of a width equal the distance between adjacent tubes in line with the baffle, each of which sections may be passed through the diagonal lanes between the tubes 12. By means of this construction the tube spacing is not disturbed while the baffles may be removed without necessitating the removal of any of the tubes. If desired, the baffles sections $16^c$ may be made of a width equal to a small multiple of the distance between ad-

jacent tubes in the plane of the baffle, so long as they are capable of being inserted between the diagonal lanes through the tubes.

It will be seen that by reason of this baffle arrangement the air or other fluid contacting with the heat-exchanging surfaces is substantially uniformly distributed over such surfaces by being divided into a plurality of streams which are caused to come into effective heat exchanging relationship with the heat exchanging surfaces as the streams are guided in approximately parallel paths to the tubes or other form of heat-exchanging surface throughout practically their entire lengths. In the preferred embodiment I have shown the baffles 16 parallel to the heat-exchanging surfaces, but it is obvious that the baffles may be inclined toward the entrance or exit openings.

I claim:—

1. In a heat transfer device, a casing, longitudinally extending conduits therein, means for passing a first fluid through said conduits, said casing having longitudinally separated openings in the side thereof for admission and withdrawal, respectively, of a second fluid externally of said conduits, transversely spaced, deflecting baffles extending graduated distances into the region opposite at least one of said openings so as to divide said second fluid into a plurality of streams and guide said streams in approximately parallel paths to the conduits.

2. In a heat transfer device, a casing, longitudinally extending tubes therein, means for passing a first fluid therethrough, said casing having longitudinally separated openings in the side thereof for admission and withdrawal, respectively, of a second fluid externally of said tubes, parallel, transversely spaced baffles, each disposed between adjacent tube rows, said baffles extending graduated distances into the region opposite at least one of said openings so as to divide said second fluid into a plurality of streams and guide said streams in approximately parallel paths to the tubes.

3. In a heat transfer device, a casing, longitudinally extending tubes therein, means for passing a first fluid therethrough, said casing having longitudinally separated openings in the side thereof for admission and withdrawal, respectively, of a second fluid externally of said tubes, parallel transversely spaced baffles, each composed of sections of widths equal at least to the distance between adjacent tubes in the line of the baffle, said baffles extending graduated distances into the region opposite at least one of said openings so as to divide said second fluid into a plurality of streams and guide said streams in approximately parallel paths to the tubes.

4. In a heat transfer device, a casing, longitudinally extending conduits therein, means for passing a first fluid through said conduits, said casing having longitudinally separated openings in the sides thereof for admission and withdrawal, respectively, of a second fluid externally of said conduits, and a baffle extending into the region opposite at least one of said openings so as to divide said second fluid into a plurality of streams and guide said streams in approximately parallel paths to the conduits.

5. In a heat transfer device, a casing, longitudinally extending conduits therein, means for passing a first fluid through said conduits, said casing having longitudinally separated openings in the sides thereof for admission and withdrawal, respectively, of a second fluid externally of said conduits, a baffle extending into the region opposite at least one of said openings so as to divide said second fluid into a plurality of streams and guide said streams in approximately parallel paths to the conduits, and a transverse baffle leading from said opening approximately to said first named baffle.

6. In a heat transfer device, a casing, longitudinally extending conduits therein, means for passing a first fluid through said conduits, said casing having longitudinally separated openings in the sides thereof for admission and withdrawal, respectively, of a second fluid externally of said conduits, and means extending into the region opposite at least one of said openings so as to divide said second fluid into a plurality of streams and guide said streams in paths approximately parallel to the conduits.

7. In a heat transfer device, a casing, longitudinally extending conduits therein, means for passing a first fluid through said conduits, said casing having longitudinally separated openings in the sides thereof for admission and withdrawal, respectively, of a second fluid externally of said conduits, and means extending into the region opposite at least one of said openings so as to divide said second fluid into a plurality of streams and guide said stream in paths approximately parallel to the conduits, said means comprising a plurality of baffles.

HOSEA WEBSTER.

## CERTIFICATE OF CORRECTION.

Patent No. 1,641,999. Granted September 13, 1927, to

HOSEA WEBSTER.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, lines 25, 38, and 52, claims 1, 2, and 3, for the word "side" read "sides"; same page, line 112, claim 7, for "stream" read "streams"; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 11th day of October, A. D. 1927.

Seal.

M. J. Moore,
Acting Commissioner of Patents.