Oct. 3, 1933. J. E. TRAINER ET AL 1,929,376

REHEATER

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Fig. 1

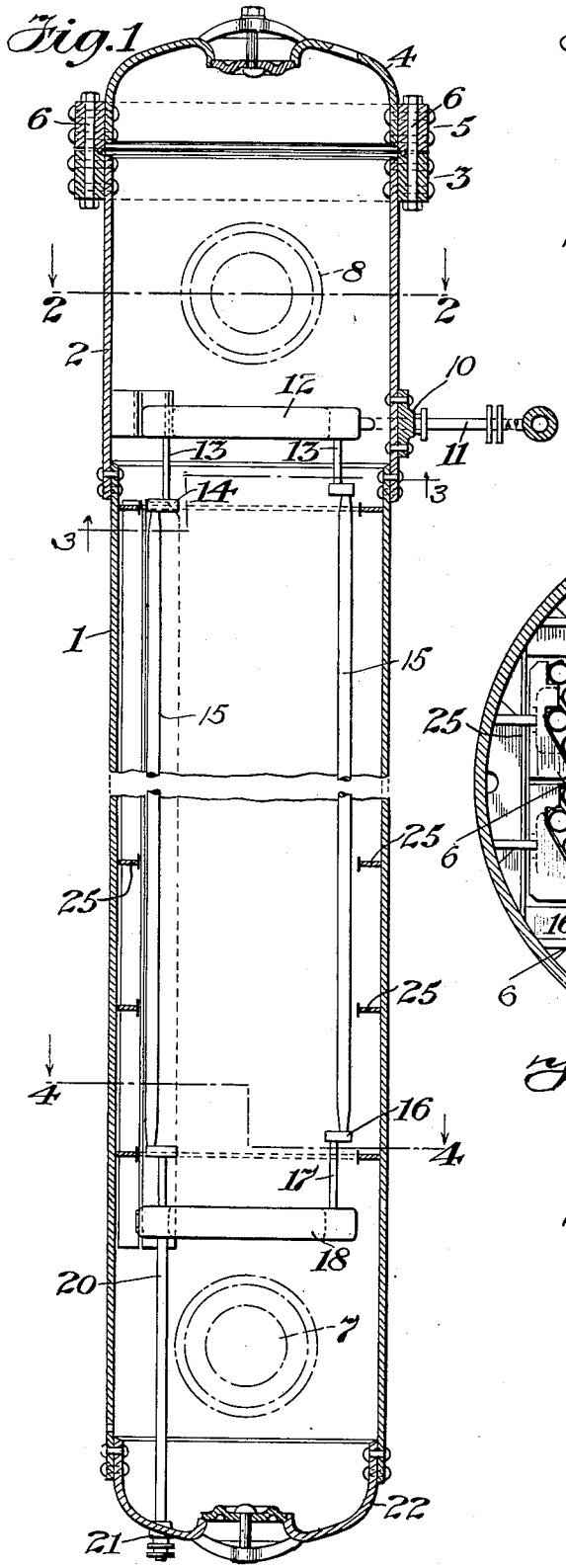


Fig. 2

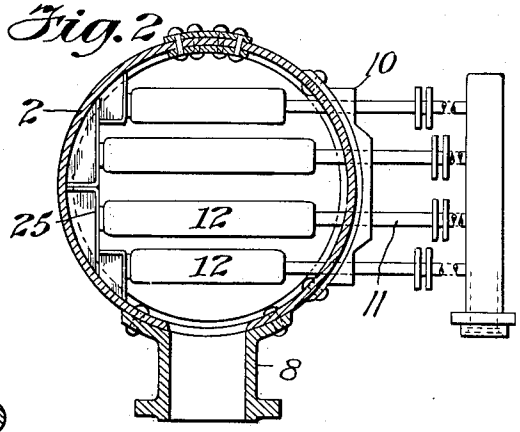


Fig. 4

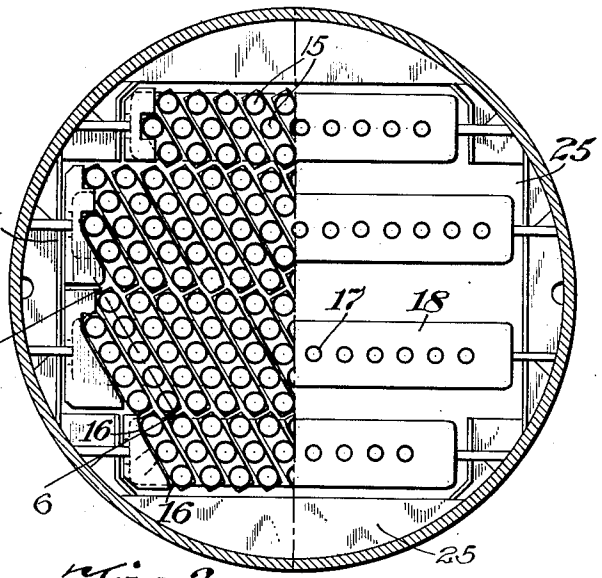


Fig. 3.

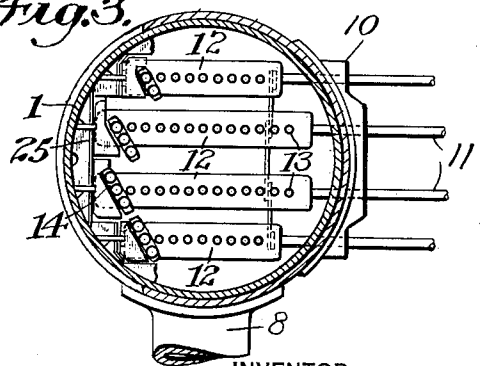


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Fig. 6

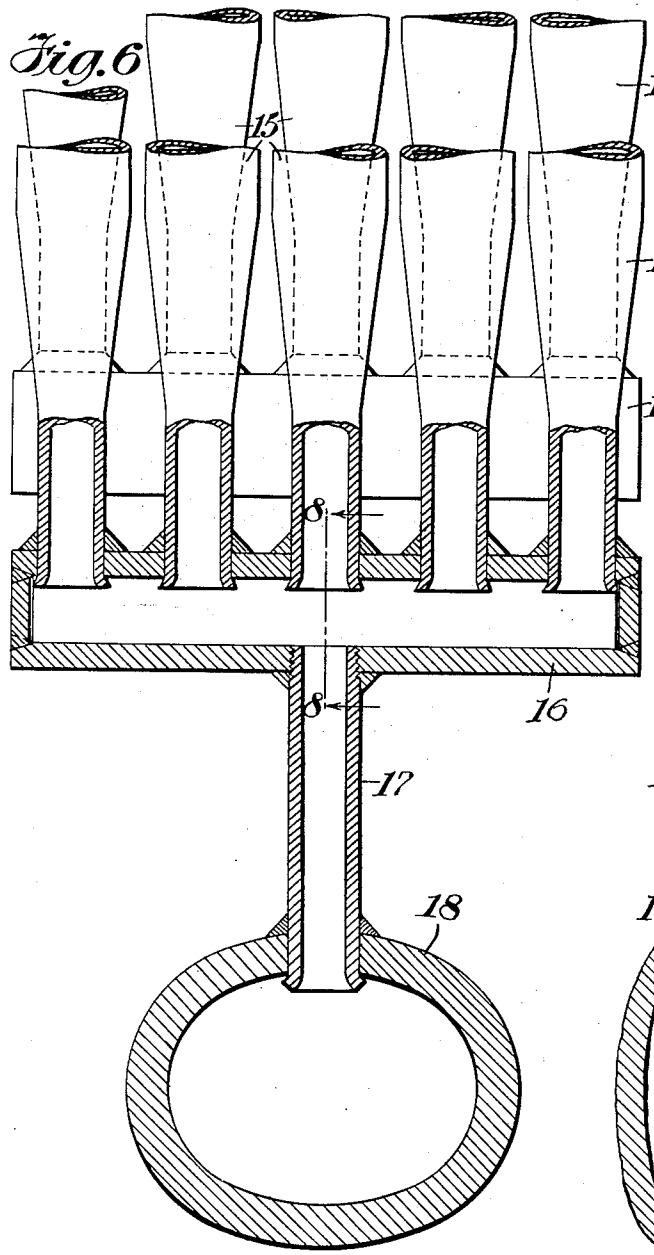



Fig. 5

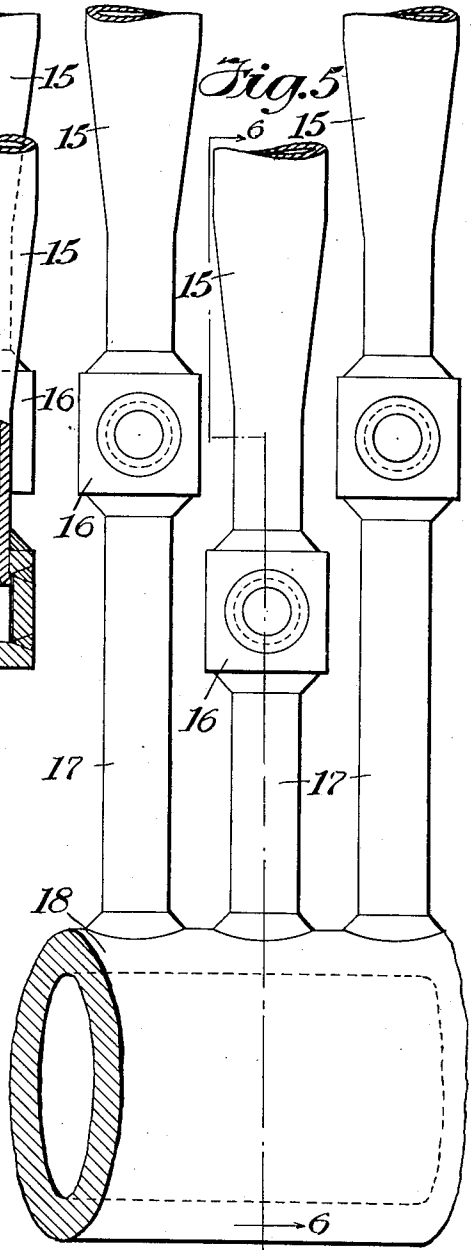



Fig. 7

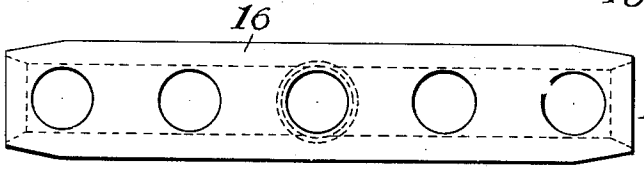
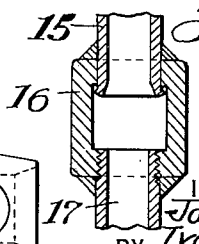



Fig. 8

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# UNITED STATES PATENT OFFICE

1,929,376

## REHEATER

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Application September 6, 1930. Serial No. 480,148

11 Claims. (Cl. 257—227)

This invention relates to reheaters and more particularly to a reheater for steam in which the heating medium is steam at a high temperature.

An object of the invention is to provide a heater in which steam at a relatively low pressure is heated by steam at a higher pressure.

Other objects of the invention will be apparent to those skilled in this particular art from the description in the specification in connection with the drawings, in which—

Fig. 1 is a side view partly in section of an embodiment of the invention;

Fig. 2 is a plan view in section along the line 2—2 of Fig. 1;

Fig. 3 is a view in section along the line 3—3 of Fig. 1;

Fig. 4 is an enlarged plan view in section taken along the line 4—4 of Fig. 1;

Fig. 5 is a side view of a detail of the invention;

Fig. 6 is a section taken on line 6—6 of both Figs. 4 and 5;

Fig. 7 is a plan view of a detail of the invention;

Fig. 8 is a sectional view of a detail of the invention taken along the line 8—8 of Fig. 6.

One embodiment of the invention is shown for purposes of illustration in which in Fig. 1 a casing 1 has an upper section 2 riveted thereto. A flange 3 is secured to the upper part of the casing 2 by any well known means, such as by riveting. A head 4 has a similar flange 5 secured thereto and is secured to the upper part of the casing 2 by bolts 6 extending through the flanges 3 and 5. A low pressure steam inlet 7 is located in the lower part of the casing 1 and a low pressure steam outlet 8 is located in the upper part of the casing 2.

Stuffing boxes 10 are secured to the side of the casing 2 and high pressure steam inlet pipes 11 extend therethrough and are secured to horizontally spaced upper headers 12 as shown in Fig. 2. A plurality of secondary headers 14 are connected to each header 12 through connecting pipes 13 as shown most clearly in Figs. 5 and 6. These headers 14 are small box headers and are disposed at an angle to the headers 12 as shown in Figs. 3 and 4. A plurality of tubes 15 having ends of reduced diameter are expanded in the headers 14 and made steamtight by welding. These tubes 15 extend downward through the casing 1 and are expanded and welded in a lower group of secondary headers 16. These headers 16 are connected through steam pipes 17 to lower headers 18 similar in character and arrangement to the headers 12. The headers 14 are so arranged that adjacent headers are in different planes, alternate headers being in the same plane and the lower secondary headers 16 are similarly arranged. By virtue of this arrangement as shown most clearly in Figs. 5 and 6, a space is left between adjacent secondary headers to permit the free passage of a fluid and close spacing of the tubes 15.

Condensate pipes 20 are secured to the lower headers 18 and extend downward through stuffing boxes 21 mounted in the lower part of the bottom head 22. The head 22 is secured to the casing 1 in steamtight relation therewith in any well known manner, as by riveting. Baffles 25 are secured to the sides of the casing 1 between the secondary headers 14 and the lower secondary headers 16 and are so located as to compel any fluid passing through the casing to pass in close contact with the tubes 15 by preventing any by-passing of the fluid outside the rows of tubes.

In the operation of the device high pressure steam is admitted to the headers 12 through the inlet pipes 11 and flows by means of the connecting pipes 13, secondary headers 14 and tubes 15 to the lower secondary headers 16, and from there through the connecting pipes 17 to the lower headers 18.

The steam at relatively low pressure to be reheated comes into the casing through the inlet 7. This steam may be exhaust steam from a high pressure stage of a turbine. The several baffling arrangements 25 direct this steam across the tubes 15 counterflow to the high pressure steam flowing within the tubes.

The high pressure steam admitted to the upper headers 12 may be superheated steam, and in the lower part of the tubes 17 during the normal operation of the device this high pressure steam will have lost its superheat and a certain amount of condensation will have taken place. The low pressure steam to be reheated will first come in contact with the hot water that is formed from the condensation of the high pressure steam, and a certain amount of the sensible heat of this water will be imparted to this low pressure steam and its temperature will be raised. In the condensation resulting within the tubes 15 a much larger amount of heat may be transferred to the low pressure steam as the latent heat of the high pressure steam is here available. In the upper portion of the tubes 15 when high pressure superheated steam is used a further rise in temperature will be imparted to the low pressure steam by virtue of the superheat contained in the high pressure steam.

In the embodiment of the invention here de-

scribed the high pressure steam system is one having a dead end and the amount of flow of the high pressure steam in this system is measured by the amount of condensation of the steam in heating the low pressure steam with the subsequent removal of the water of condensation.

Although high pressure steam has been described as the heating medium and low pressure steam has been specifically designated as the medium to be heated, other mediums such as mercury vapor will function in the disclosed apparatus and their use is contemplated to be within the scope of this invention.

What we claim as new and desire to secure by Letters Patent is—

1. In a heater, a casing, a row of headers located within said casing, a second row of headers spaced apart from said first named headers, connecting pipes having one end of each connected to said headers, secondary headers connected to said pipes at the other ends thereof, a plurality of tubes connected to said secondary headers, said last named tubes connecting certain of said secondary headers in pairs.

2. In a heater, a casing, a row of headers located within said casing, a second row of headers spaced apart from said first named headers, connecting pipes having one end of each connected to said headers, secondary headers connected to said connecting pipes at the other end thereof, adjacent secondary headers being in different planes, a plurality of tubes connecting certain of said secondary headers in pairs.

3. In a heater, a casing, a row of headers located within said casing, a second row of headers spaced apart from said first named headers, connecting pipes having one end of each connected to said headers, secondary headers connected to said connecting pipes at the other end thereof, a plurality of tubes connected to said secondary headers, said tubes being of reduced diameter at the point where they are connected with the secondary headers, said tubes connecting certain of said secondary headers in pairs.

4. In a heat transfer device, a pressure retaining casing, primary fluid distributing headers disposed within said casing, secondary fluid distributing headers connected to said primary headers located within said casing, and a plurality of tubes connecting said secondary headers in pairs so positioned with respect to each other that equispaced gas paths are provided between tubes.

5. In a heat transfer device, a pressure retaining casing, primary fluid distributing headers disposed within said casing, a plurality of secondary fluid distributing headers connected to said primary headers and disposed at an angle thereto located within said casing, and a plurality of tubes connecting said secondary headers and so positioned with respect to each other that equispaced gas paths are provided between tubes.

6. Apparatus for effecting heat transfer between fluids at different temperatures comprising a casing, means providing a closed flow path for one of the fluids through said casing including inlet and outlet rows of primary headers spaced axially of said casing, inlet and outlet groups of secondary headers spaced axially of said casing between said rows of primary headers, tubes connecting certain secondary headers in each group to corresponding primary headers, and a tube bank formed by a plurality of tubes connecting corresponding secondary headers of said groups, and inlet and outlet connections to said casing for the passage of the second fluid therethrough in contact with the tubes in said tube bank.

7. Apparatus for effecting heat transfer between fluids at different temperatures comprising a casing, means providing a closed flow path for one of the fluids through said casing including inlet and outlet rows of primary headers spaced axially of said casing, inlet and outlet groups of secondary headers spaced axially of said casing between said rows of primary headers, said secondary headers being arranged in rows extending longitudinally of said primary headers, tubes connecting the secondary headers in each row to a corresponding primary header, and a tube bank formed by a plurality of tubes connecting corresponding secondary headers of said groups, and inlet and outlet connections to said casing for the passage of the second fluid therethrough in contact with the tubes in said tube bank.

8. Apparatus for effecting heat transfer between fluids at different temperatures comprising a casing, means providing a closed flow path for one of the fluids through said casing including inlet and outlet rows of primary headers spaced axially of said casing, inlet and outlet groups of secondary headers spaced axially of said casing between said rows of primary headers, said secondary headers being arranged in rows extending longitudinally of said primary headers, tubes connecting the secondary headers in each row to a corresponding primary header, the secondary headers in each row being staggered sufficiently to provide flow passages therebetween, and a tube bank formed by a plurality of closely spaced tubes connecting corresponding secondary headers of said groups, and inlet and outlet connections to said casing for the passage of the second fluid therethrough in contact with the tubes in said tube bank.

9. Apparatus for effecting heat transfer between fluids at different temperatures comprising a casing, means providing a closed flow path for one of the fluids through said casing including inlet and outlet rows of primary headers spaced axially of said casing, inlet and outlet groups of secondary headers spaced axially of said casing between said rows of primary headers, said secondary headers being arranged with their axes oblique to the axes of said primary headers and in rows extending longitudinally of said primary headers, tubes connecting the secondary headers in each row to a corresponding primary header, the secondary headers in each row being staggered sufficiently to provide flow passages therebetween, and a tube bank formed by a plurality of closely spaced tubes connecting corresponding secondary headers of said groups, and inlet and outlet connections to said casing for the passage of the second fluid therethrough in contact with the tubes in said tube bank.

10. Apparatus for effecting heat transfer between fluids at different temperatures comprising a casing, means providing a closed flow path for one of the fluids through said casing including inlet and outlet rows of primary headers spaced axially of said casing, inlet and outlet groups of secondary headers spaced axially of said casing between said rows of primary headers, said secondary headers being arranged in rows extending longitudinally of said primary headers, tubes connecting the secondary headers in each row to a corresponding primary header, the secondary headers in each row being staggered sufficiently to provide flow passages therebetween,

and a tube bank formed by a plurality of closely spaced swaged ended tubes connecting corresponding secondary headers of said groups, and inlet and outlet connections to said casing for the passage of the second fluid therethrough in contact with the tubes in said tube bank.

11. Apparatus for effecting heat transfer between a high temperature high pressure fluid and a low temperature low pressure fluid comprising a casing, means providing a closed flow path for the high temperature fluid through said casing including inlet and outlet rows of horizontally spaced primary headers spaced axially of said casing, inlet and outlet groups of secondary headers spaced axially of said casing between said rows of primary headers, said secondary headers being arranged with their axes at an angle to the axes of said primary headers and in rows extending longitudinally of said primary headers, tubes separately connecting the secondary headers in each row to a corresponding primary header, the secondary headers in each row being staggered sufficiently to provide flow passages therebetween, and a tube bank formed by a plurality of closely spaced swaged ended tubes connecting corresponding secondary headers of said groups, and inlet and outlet connections to said casing at opposite sides of said rows of primary headers for the passage of the low temperature fluid through said casing in contact with the tubes in said tube bank.

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