June 16, 1931. D. S. JACOBUS 1,810,178

HEAT TRANSFER DEVICE

Original Filed Sept. 4, 1918 3 Sheets-Sheet 1

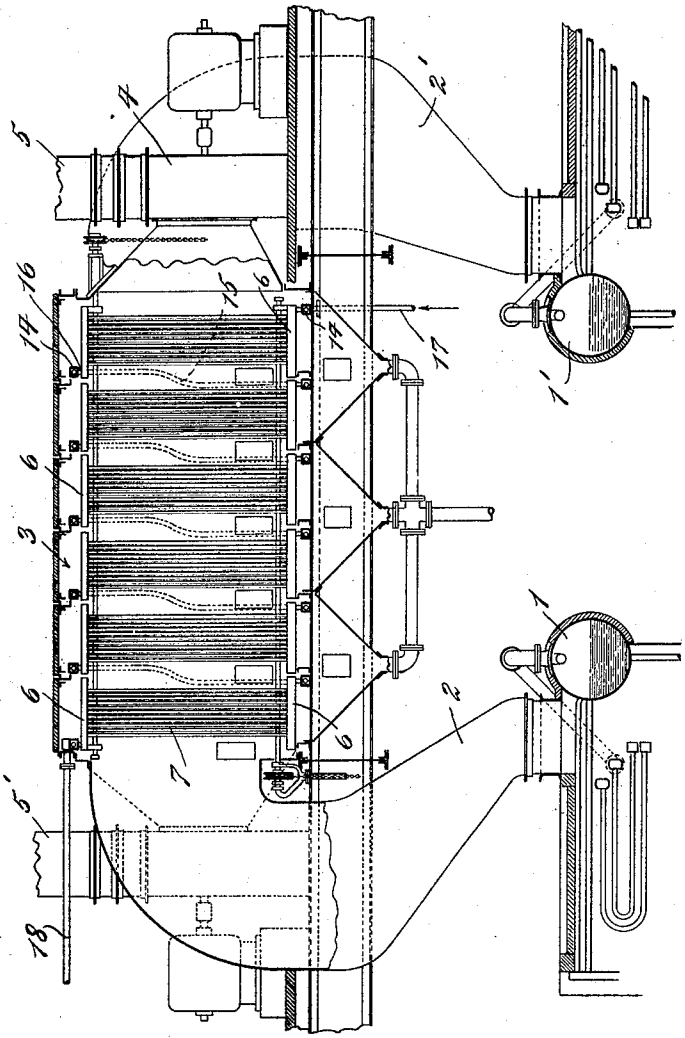


Fig. 1.

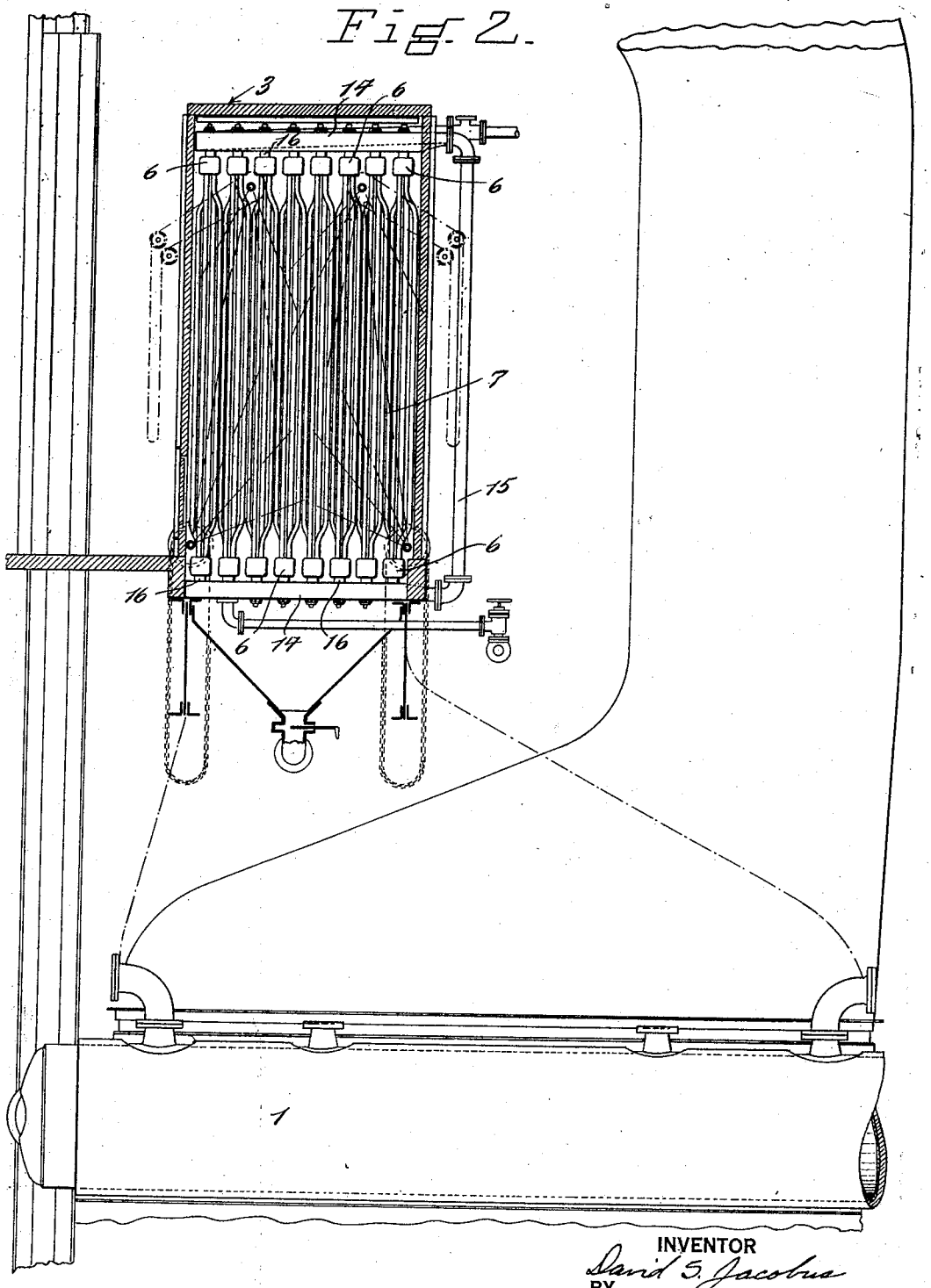
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Fig. 2.



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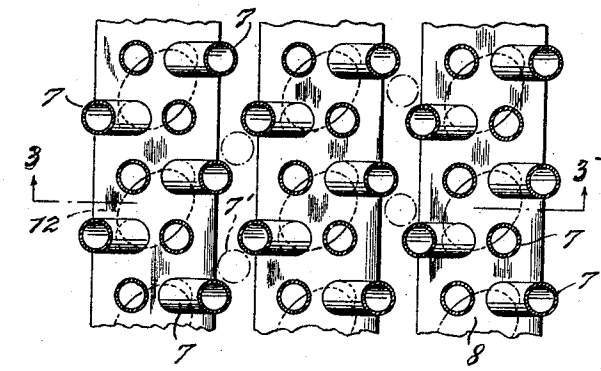


Fig. 4.

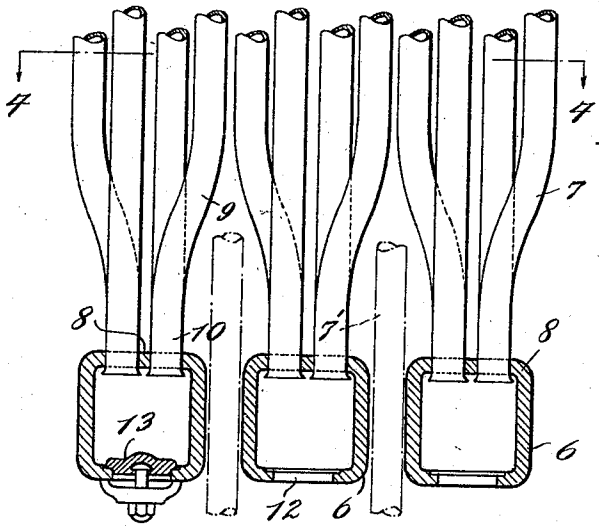


Fig. 3.

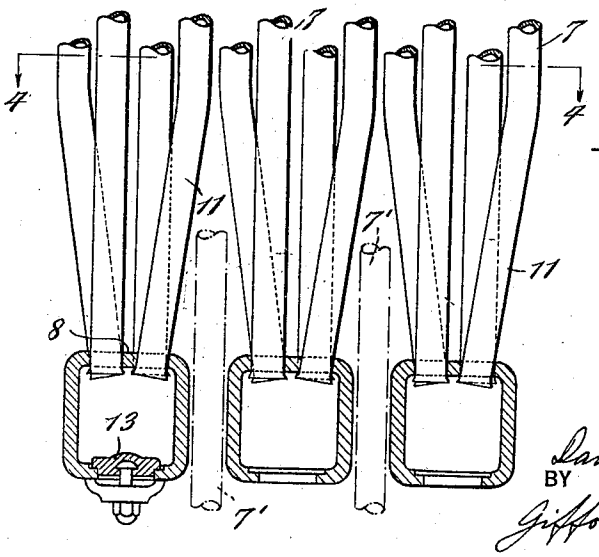


Fig. 5.

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UNITED STATES PATENT OFFICE

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HEAT TRANSFER DEVICE

Original application filed September 4, 1918, Serial No. 252,550. Divided and this application filed June 22, 1929. Serial No. 372,940.

This application is a division of my copending application, Serial No. 252,550, filed September 4, 1918, which has since matured into Patent No. 1,729,259 dated September 24, 1929.

The invention relates to a novel and improved form of heat transfer device shown herein in connection with an economizer structure, and the novel features will be best understood from the following description and the annexed drawings, in which a selected embodiment of the invention is shown, and in which;

Fig. 1 is a sectional side elevation of an economizer having my invention applied thereto.

Fig. 2 is a vertical sectional view through the economizer appearing in Fig. 1.

Fig. 3 is a detailed view showing fragmentary portions of headers and tubes constructed according to the invention, this view being taken on the line 3—3 of Fig. 4.

Fig. 4 is a view taken on the line 4—4 of Figs. 3 and 5.

Fig. 5 is a view corresponding to Fig. 3, but showing another form which the invention may take.

Referring now to the drawings, I have illustrated the invention as applied to an economizer, here shown as disposed above a boiler, the drum of which is shown at 1. The hot gases after passing over the heat absorbing surfaces of the boiler pass through a flue 2 to an economizer 3, from which they are discharged by a fan 4 into a flue 5.

The invention is shown as used in connection with a double boiler, which has a second steam and water drum 1′ from which the hot gases flow upwardly to a flue 2′, and are discharged through a second economizer disposed back of the economizer 3, and finally pass out of a flue 5′. The heat transfer device exemplified by the economizer, comprises a plurality of sections arranged side by side. Each of these sections is shown as having a pair of headers 6 disposed substantially parallel to each other, and on the opposite sides of the gas pass through the economizer. In the form shown, the headers are disposed parallel to the direction of flow of the gases.

Connecting the headers of each pair is a plurality of tubes 7 which, as plainly shown in Fig. 2, form a continuous bank across the gas pass. In this bank it will be seen that the tubes are substantially uniformly spaced. The headers 6 are shown spaced apart, thus decreasing the weight of metal required for headers, and this spacing may be of an amount sufficient to provide for the removal of tubes, as plainly shown in Figs. 3, 4 and 5. In these views the headers are shown as spaced apart a distance greater than a tube diameter, so that individual tubes indicated at 7′, may be removed between the headers.

Each header is provided with a flat wall portion 8 extending longitudinally thereof, and this flat wall portion 8 is provided with sets of holes. Each set is disposed in a band extending transversely to the length of the header, and in this illustration each set is seen to comprise two holes, into which tubes are entered. The sets are shown as being spaced apart uniformly, lengthwise of the headers, and this spacing may be the same as the spacing between the adjacent tubes in a set.

Referring next to Fig. 3, it will be seen that in each set of tubes in the transverse band, one tube enters the flat wall portion without being bent, while the other is supplied with a reverse bend 9 which terminates in a straight portion 10 parallel to the other tube in the set, so that both tubes enter the wall portion normal thereto. In this arrangement the tubes are brought close enough together to be secured to relatively small headers, while the major portions of the tubes are spaced further apart. The result is that the weight of metal needed for the headers is greatly reduced, and at the same time space may be provided for the removal and insertion of tubes between the headers.

Referring now to Fig. 5, an arrangement somewhat similar to that of Fig. 3 is shown, except that here the tubes which are bent at their ends, are provided with portions 11 which enter the holes in the wall portions of the headers at an angle to the normal. In

both forms shown, as will be seen in Fig. 4, the sets of holes form a plurality of longitudinal rows extending lengthwise of the headers, and in these longitudinal rows alternate holes are used to receive a tube which is unbent at its end, and the other alternate holes are used to receive tubes which are bent at their ends. The result is that the tubes in successive sets are staggered with respect to each other. The headers are provided with openings 12 having a suitable closure 13, and these openings are so arranged that access to the tubes can be had, as plainly shown in Fig. 4.

The headers are arranged in groups, as shown in Fig. 1. The headers at the end of each group are connected to water compartments 14, and the water compartments of adjacent groups are connected by pipes 15. Suitable pipes 16 connect each water compartment to the end portions of adjacent groups of headers. Water is supplied through an inlet 17, and after passing through the various groups of sections, leaves at an outlet 18.

I claim:—

1. In a heat transfer device, a plurality of sections arranged side by side, each section having a pair of headers with longitudinally extending flat wall portions provided with sets of holes, each arranged in a transversely extending band, tubes secured in said holes and connecting the two headers of each pair, at least some of said tubes being bent at their ends to enter said holes, the headers of adjacent sections being spaced apart and the tubes of the sections forming a bank, the tubes in the bank being spaced substantially uniformly across the bank in a direction transverse to the length of said headers, a compartment common to a group of headers at each end of the sections, and pipes connecting the end portions of said headers to said compartment.

2. In a heat transfer device, a plurality of sections arranged side by side, each section having a pair of headers with longitudinally extending flat wall portions provided with sets of holes each arranged in a transversely extending band, tubes secured in said holes and connecting the two headers of each pair, at least some of said tubes being bent at their ends to enter said holes, the headers of adjacent sections being spaced apart a distance greater than a tube diameter and the tubes of the sections forming a bank, the tubes in the bank being spaced substantially uniformly across the bank in a direction transverse to the length of said headers, a compartment common to a group of headers at each end of the sections, and pipes connecting the end portions of said headers to said compartment.

3. In a heat transfer device, a plurality of sections arranged side by side, each section having a pair of headers with longitudinally extending flat wall portions provided with sets of holes each arranged in a transversely extending band, tubes secured in said holes and connecting the two headers of each pair, at least some of said tubes being bent at their ends to enter said holes, the headers of adjacent sections being spaced apart, the nest of tubes connecting each pair of headers being wider than the outside dimension of one of said headers, a compartment common to a group of headers at each end of the sections, and pipes connecting the end portions of said headers to said compartment.

4. In a heat transfer device, a plurality of sections arranged side by side, each section having a pair of headers with longitudinally extending flat wall portions provided with sets of holes each arranged in a transversely extending band, tubes secured in said holes and connecting the two headers of each pair, at least some of said tubes being bent at their ends to enter said holes, the headers of adjacent sections being spaced apart and the tubes of the sections forming a bank, the tubes in the bank being spaced substantially uniformly across the bank in a direction transverse to the length of said headers and in a direction lengthwise of said headers, a compartment common to a group of headers at each end of the sections, and pipes connecting the end portions of said headers to said compartment.

5. In a heat transfer device, a plurality of sections arranged side by side, each section having a pair of headers with longitudinally extending flat wall portions provided with sets of holes each arranged in a transversely extending band, tubes secured in said holes and connecting the two headers of each pair, at least some of said tubes being bent at their ends to enter said holes and the other tubes having their ends unbent, the headers of adjacent sections being spaced apart and the tubes of the sections forming a bank, the tubes in the bank being spaced substantially uniformly across the bank in a direction transverse to the length of said headers, a compartment common to a group of headers at each end of the sections, and pipes connecting the end portions of said headers to said compartment.

6. In a heat transfer device, a plurality of sections arranged side by side, each section having a pair of headers with longitudinally extending flat wall portions provided with sets of holes each arranged in a transversely extending band, tubes secured in said holes and connecting the two headers of each pair, at least some of said tubes being bent at their ends to enter said holes at an angle to the normal to said wall portion, the headers of adjacent sections being spaced apart and the tubes of the sections forming a bank, the tubes in the bank being spaced substantially uniformly across the bank in a direction transverse to the length of said headers, a

compartment common to a group of headers at each end of the sections, and pipes connecting the end portions of said headers to said compartment.

7. In a heat transfer device, a plurality of sections arranged side by side, each section having a pair of headers of rectangular cross section, one of the walls of each header being provided with sets of holes, each arranged in a transversely extending band, tubes secured in said holes and connecting the two headers of each pair, at least some of said tubes being bent at their ends to enter said holes, the headers of adjacent sections being spaced apart and the tubes of the sections forming a bank, the nest of tubes connecting each pair of headers being wider than the outside dimension of one of said headers, a water compartment common to a group of headers at each end of the sections, and pipes connecting the end portions of said headers to said compartment.

8. In a heat transfer device, a plurality of sections arranged side by side, each section having a pair of headers of rectangular cross section, one of the walls of each header being provided with sets of holes, each arranged in a transversely extending band, tubes secured in said holes and connecting the two headers of each pair, at least some of said tubes being bent at their ends to enter said holes, the headers of adjacent sections being spaced apart and the tubes of the sections forming a bank, a water compartment common to a group of headers at each end of the sections, pipes connecting the end portions of said headers to said compartment, and means causing hot gases to flow across said tubes, the spacing of said tubes being substantially uniform across the gas stream.

9. In a heat transfer device, a plurality of sections arranged side by side, each section having a pair of headers of rectangular cross section, one of the walls of each header being provided with sets of holes, each arranged in a transversely extending band, tubes secured in said holes and connecting the two headers of each pair, at least some of said tubes being bent at their ends to enter said holes, the headers of adjacent sections being spaced apart and the tubes of the sections forming a bank, a water compartment common to a group of headers at each end of the sections, pipes connecting the end portions of said headers to said compartment, and means causing hot gases to flow across said tubes, the spacing of said tubes being substantially uniform across the gas stream and in the direction of flow of said stream.

10. A heat transfer device comprising groups of headers disposed on opposite sides of a gas pass, the headers of both groups having flat wall portions provided with sets of holes, each arranged in a transverse band of said wall portion, a substantially continuous bank of tubes extending across said pass and having the tubes therein secured in said holes to connect the headers of opposite groups, at least some of said tubes being bent at at least one end to enter said holes, adjacent headers being spaced apart, a compartment common to each of said groups of headers, and pipes connecting the end portions of said headers to said compartment.

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