July 21, 1936. G. WELTER 2,048,308

WASTE HEAT BOILER

Filed Aug. 1, 1935

Fig. 1.

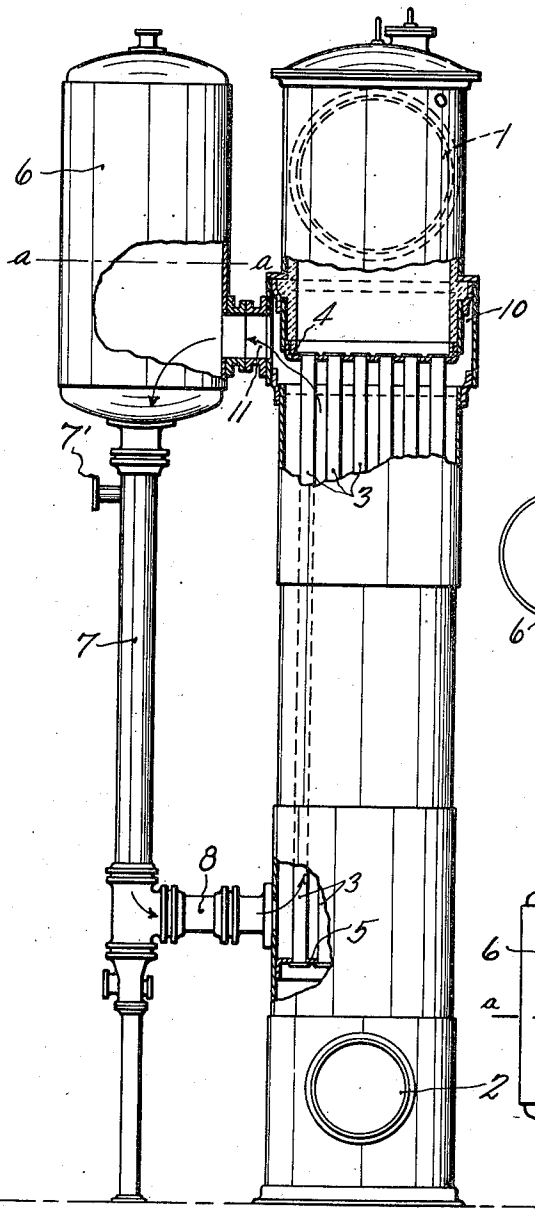


Fig. 2.

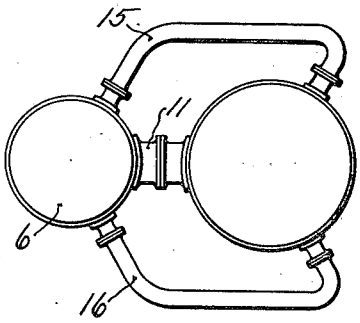
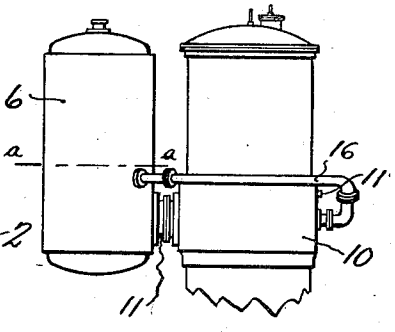


Fig. 3.



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Patented July 21, 1936 2,048,308

UNITED STATES PATENT OFFICE

2,048,308

WASTE HEAT BOILER

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Application August 1, 1935, Serial No. 34,250

4 Claims. (Cl. 122—7)

This invention relates to an improvement in waste heat boilers. In their general aspects such boilers are well known. The improvement relates to novel modifications of the known structure. These modifications are planned to bring about a new mode of boiler operation, particularly in the transfer of the steam from the boiler to the steam drum. One advantage is that the new construction avoids the breaking down of the joints between the tubes and the upper tube sheet from which region the made steam escapes to the steam drum.

This will be explained in connection with the disclosure and description of the accompanying drawing, in which—

Fig. 1 is a general view of a waste heat boiler with parts broken away to show the embodiment of the improved structure;

Fig. 2 is a diagrammatic view of steam connections between the boiler and the steam drum of Fig. 1 which are desirable to use in some cases, as will be pointed out; and

Fig. 3 is a side view on a reduced scale of the boiler, the steam and water drum at the top ends and the manner of connecting an additional cross connection.

The known details of this boiler are shown only generally. Gas, say from a gas plant, enters at the top opening 1 and leaves at the bottom opening 2. Fire tubes 3 are connected between upper and lower tube sheets 4 and 5 and are surrounded with water. The general circulation through the boiler is indicated by the arrows. The water to be added enters at 7' at the top of pipe 7. The latter has a cross connection 8 to the boiler, just above the bottom tube sheet. A suitable water level for the water and steam drum 6 is indicated at line *a—a*. The top connection between the boiler and steam drum, as shown in the drawing, will be explained later. It is to this top connection 11 and its environment that my invention is particularly directed.

In prior art boilers of this kind the connection between the water and steam drum has been made by a horizontally arranged nozzle, the top of which has been in line with inside (lower) face of the top tube sheet. In such constructions, as the boiler makes steam, it collects under this tube sheet. It presses the water down in the boiler and finally escapes through the nozzle on the level of the tube sheet in passing to the drum. As the water is pressed down in the boiler, it uncovers the tube sheet on its lower face. That is, this face is in contact with steam rather than water. In such prior art mode of operation the top tube sheet, receiving the full blast of hot gas from the inlet pipe on its upper surface, is not sufficiently cooled by the steam on its lower surface. The consequence is that the top sheet or plate becomes overheated to such an extent that it is slightly warped due to expansion. This breaks the tube joints enough to leak steam; after the leaking starts it gets worse and worse by erosive action. Steam will not keep the plate cool enough.

My invention is particularly directed to remedy this defect in the prior art operation and to do so in a particularly efficient way. In addition to avoiding the defect mentioned, my arrangement has other advantages, as I will point out.

I provide an annular chamber 10 around the boiler, as shown. I connect this space with the water and steam drum by nozzle 11. As shown, this nozzle has its opening overlapping the upper tube plate. The general idea is to have the nozzle passage extend above the tube plate and in connection with the annular chamber 10 above the tube plate.

As a constructional feature to cooperate with my plan of operation, to be described, I preferably make the top plate 4 slightly convex on the under side. A crown extending downwardly with a difference of one-half inch between sides and center, for example, will avoid the possiblity of any steam pocket forming on the under side of this head.

In this arrangement, as the boiler makes steam, it rises to the top plate 4 but it cannot collect there until under sufficient pressure to press the water down and thus escape to the drum. Instead of the prior art operation, the new arrangement requires the steam to pass, as fast as it is made, to the annular chamber 10. This keeps water against the under side of the tube plate and water acts enough better than steam in cooling the tube plate 4 that the tube joints will not spring a leak in the highly objectionable way and for the reason that they have been doing in the past.

In the construction shown and described steam passes from the convex under side of sheet 4 into chamber 10. It cannot collect on the under side of the sheet 4 but must move to chamber 10. The sides of the upper header member are lined with refractory to avoid the steel at this point being overheated. It would be preferable to make the top of passage 11 level with the very top of annular space 10. But there are constructional objections to this in boiler work. So as shown I have made the passage 11 substantial-

ly up to the top of space 10 and provided an air vent 11' for the very top of said space. The boiler construction indicated in Fig. 1 results in the walls of the annular space 10 extending out from what is ordinarily considered the shell and then extending into what is ordinarily called the header member so that the annular space 10 overlaps the two. So by the term "shell" I refer in the claims to both the tube and header sections of the boiler.

In Fig. 2 I have indicated additional connections between the anular space 10 and the water and steam drum. The two side ones 15 and 16 are made in the same manner and at the same level as the middle one 11. With this arrangement the annular chamber 10 may empty its steam into the drum faster than with a single connection. It makes for a better access from boiler space to steam drum when more than one connection is used. The two shown in addition to connection 11 give a well balanced arrangement but more or less could be used.

As will be seen in Fig. 1, by my arrangement the upper head of the boiler adjacent upper tube plate 4 is kept submerged in the water of the boiler in a particular way to keep the head cool enough to avoid overheating and consequent warping, and to transfer the steam to the drum without trouble.

Having disclosed my improved boiler construction, I claim:

1. A boiler comprising a shell having therein upper and lower tube sheets, tubes connecting said sheets, said shell having an entrance gas chamber above the top sheet and an exit gas chamber below the bottom sheet, an annular chamber around the shell extending from a level below the upper tube sheet to a level slightly above said sheet and in free communication with the interior of said shell, and a water and steam drum adjacent the top of the shell, a cross connection between said annular chamber and said water and steam drum, said cross-connection entering said steam drum at the side of the latter, said cross connection being arranged to enter at about the top of said annular chamber and extending to a point about the level of the upper tube sheet and a down flow connection from the bottom of said drum to the lower portion of the water space between said tube sheets, all for the purpose described.

2. The structure of claim 1 in combination with an additional cross connection between the annular space and the steam and water drum.

3. The structure of claim 1 in combination with an air vent at the very top of the annular space above the cross connection to the steam and water drum.

4. The structure of claim 1 in combination with an additional cross connection between the annular space and the steam and water drum, said additional cross connection being smaller and located at a higher level than the main cross connection.

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