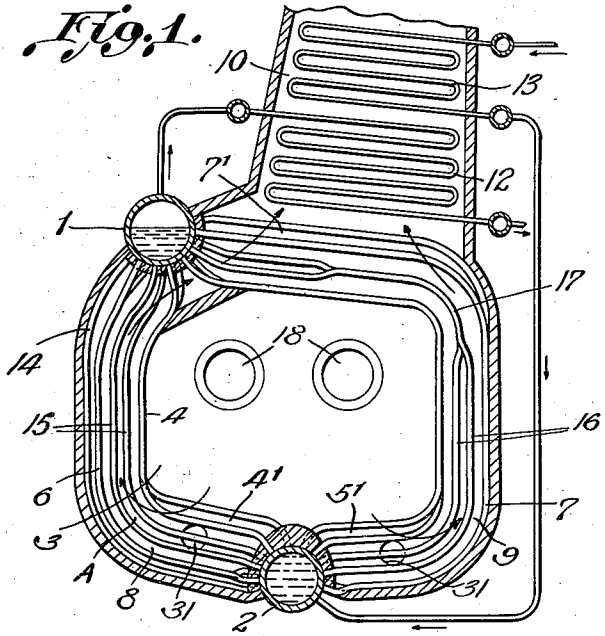
March 7, 1939. H. TREDE 2,149,477

MARINE WATER TUBE BOILER

Filed Nov. 16, 1936

Fig. 1.



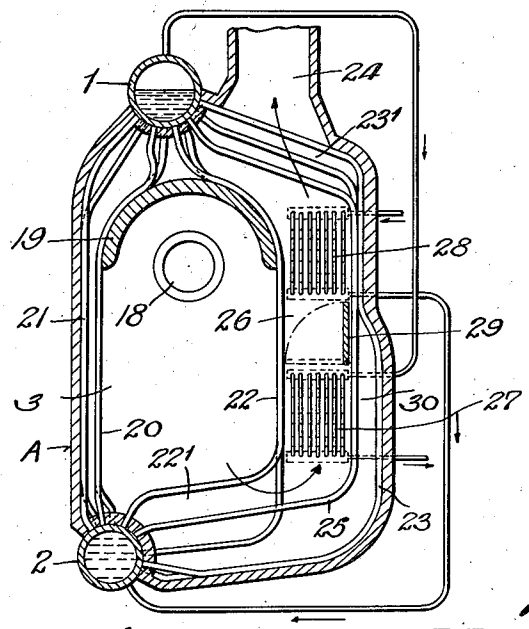


Fig. 2.

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MARINE WATER TUBE BOILER

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11 Claims. (Cl. 122—236)

The invention relates to marine water tube boilers with upper and lower drums or headers and a combustion chamber which is disposed between the vaporizer tubes connecting the drums and from which the combustion gases are passed off at the bottom.

It is an object of the invention to provide an arrangement of tubes in a marine boiler so as to obtain a more efficient heating thereof.

The invention resides in the fact that heating flues are provided at one or both sides of the combustion chamber by walls formed of the vaporizing tubes in which heating flues the heating gases from the combustion chamber ascend behind a tube wall which encompasses said chamber, said wall being heated on one side by the fire in the chamber and on the other side by the gases in the flue. The heating gases coming from the combustion chamber pass into the heating flue at a very high temperature, and, if necessary, subsequent combustion may take place in the heating flue. Vaporizing tubes placed adjacent the rear of the boiler are also heated by the gases which ascend behind the inner tube wall. The vaporizing heated surfaces thus consist of intensely heated tubes, which are especially highly heated in their lower part. As a result very great vaporizing efficiency can be attained with relatively small heating surfaces. This is particularly advantageous for marine boilers by reason of the economy of space and weight obtained.

As the vaporizer tubes are more highly heated in the lower than in the upper part the water circulation is promoted and maintained during sea travel because the water, notwithstanding any retardations arising from the movement of the ship, is nevertheless carried upwardly by the steam bubbles forming in the lower part of the tube. The upper parts of the tubes are thereby well cooled from the interior, so that unpermissibly high tube wall temperatures do not arise, as the ascending combustion gases are relatively cooled when they pass over these parts of the tubes.

Two embodiments of the new boiler are illustrated in the drawing, in which:

Fig. 1 is a view showing a vertical cross section through the boiler, and

Fig. 2 is a similar view of a modified form of the invention.

As shown, the boiler A has upper and lower headers connected by tubes, and a smoke stack.

In the embodiment of Fig. 1 the upper header 1 and the lower header 2 are connected by two tube groups which encompass the combustion chamber 3, which is of generally rectangular cross section. The tubes 4, 5, positioned next to the combustion chamber, of the two lateral tube groups, form closed tubular walls which are the walls and ceiling of the combustion chamber. On the other hand, the tubes are spaced apart at the bottom of the combustion chamber at 4^1, 5^1 so as to provide passages for the combustion gases therebetween. The outer tube series 6, 7 of the two tube groups form compact tubular walls at the bottom and at the lateral walls of the combustion chamber. At the top of the combustion chamber the tubes 7 of the right group are spaced apart at 7^1 so as to provide passages for the exit of the heating gases. In this manner two heating flues 8, 9 are formed in the two tube groups, which ascend behind the lateral walls of the combustion chamber formed by the tubes 4 and 5 and terminate above in the smoke stack 10, in which heating surfaces, as, for example, a superheater 12 and a feed water pre-heater 13 and, if necessary, also an air preheater can be disposed. Descending tubes or downcomers 14, which are distributed over the entire length of the boiler, are disposed behind the outer tubular wall of the left tube groups formed by the tubes 6.

Subsequent combustion can take place in the heating flues, in which great smoke gas velocities arise. If necessary, air can be passed for this purpose into these heating flues as at 31 by special regulatable devices.

The number of vaporizing tubes may be varied as desired, and additional tubes may be placed in the flue. In the embodiment shown vaporizer tubes 15 are arranged in the left heating flue and vaporizer tubes 16 in the right. The vaporizer tubes 16 are contracted over a portion of their length into a tubular wall 17, so that a portion of the heating gases ascending in flue 9 do not pass directly to the smoke collector, but must flow along on the cover of the combustion chamber to the opposite side.

The burners 18, which may be oil burners, for heating the combustion chamber, project the flame in the direction of the longitudinal axis of the boiler, and are disposed in the upper part of the combustion chamber. The combustion gases are forced to pass off through the passages provided at the bottom of the combustion chamber between the tube rows spaced at 4^1 and 5^1. The gases then rise behind the inner tubular side walls 4, 5 and pass over the ceiling of the combustion chamber to the smoke outlet. In this manner the vaporizer tubes are heated to the

greatest degree at their lower part. The tubes 4, 5 are well heated from two sides, by radiation from the flame in the chamber, and by the hot gases in the flue. As the gases pass uniformly over the length of the boiler and traverse a relatively long path a uniform distribution of the heat to the heating surfaces in contact with the gases is assured.

Fig. 2 shows a boiler about half the size of and intended for less load than that shown in Fig. 1. The combustion chamber 3, in the upper part of which a burner 18 is disposed, is again encompassed laterally by tubular walls which connect the upper header 1 with the lower header 2. The combustion chamber is closed off above by a combustion or ignition arch 19. A heating flue for the combustion gases passing off at the bottom is provided only at the right side of the boiler. At the left side of the boiler vaporizer tubes 20 form a closed tubular wall, outside of which are the downcomers 21. At the right side of the boiler the inner tube rows 22 of the tubular assemblage are contracted into a lateral tubular wall, while they are bent apart from each other at their lower part 22^1, so as to provide passage for the gases. The outer tube series 23 form a closed tubular wall at the bottom and the lateral wall of the combustion chamber. They are spread apart at their upper part 23^1 so that the ascending heat gases can pass off there to the smoke stack 24. A tube series 25, between which gas passages are provided, is arranged between the tube series 22 and 23. The ascending heating flue 26 extends between the tube rows 22 and 25. A superheater 27 and a feed water preheater 28 are built in this heating flue. An air preheater (not shown) may be disposed in the smoke passage 24.

A regulating valve 29 is provided above the superheater 27 in heating flue 26. Extending between the tube row 25 and the tube row 23 is a by-pass 30, which terminates in the flue 26 above superheater 27. When the valve 29 is opened, the gases pass through the superheater. When the valve 29 is closed as in the dotted position of Fig. 2, the superheater is cut out of the heat gas current. The gases then pass through the by-pass 30 and to the feed water heater in flue 26. The lower parts of the vaporizer tubes are very highly heated in both embodiments as they receive radiation heat from the flame and are also washed by the hottest gases.

Use can be made of pulverised coal burners as well as of oil burners. When pulverised coal burners are used the slag is collected below. The tube rows must then be sufficiently spaced apart to prevent sintering.

Instead of placing the burners in the upper part of the front or rear wall of the combustion chamber, they may also be built, for example, in the cover of the combustion chamber or in the upper part of the side wall thereof. It is essential for the invention that the heating gases flow to the buttom of the combustion chamber distributed as uniformly as possible over its length and intensely heat the lower parts of the vaporizer tubes.

I claim as my invention:

1. A marine water tube boiler having upper and lower headers, vaporizer tubes connecting said headers, a series of said tubes forming side walls and a floor of a combustion chamber, said tubes closing said side walls against the passage of combustion gases, and being separated on said floor to form a downward passage for said gases, and another series of said tubes being spaced from said first series to form at least in part a flue rising behind at least one side of said chamber, said flue communicating with said passage, and said side wall adjacent said flue being heated on one side by radiant heat from said chamber and on another side by said gases.

2. A marine water tube boiler according to claim 1, in which a heating flue is located on both sides of the combustion chamber and is continued parallel to the ceiling of said chamber, a gas outlet, the heating flue under the gas outlet being provided with tube rows which form in part a horizontal tubular wall which subdivides the ascending gas current.

3. A marine water tube boiler having a combustion chamber, upper and lower headers, vaporizer tubes extending between said headers to form walls of a single tube thickness encompassing said chamber, and outer walls spaced from said tube walls to form flues therebetween, said tubes being spaced from one another adjacent the lower header to form passageways from said chamber into said flues.

4. A marine water tube boiler as in claim 3, in which the outer walls are formed of a second series of vaporizer tubes.

5. A marine water tube boiler as in claim 3, in which the outer walls are formed of a second series of vaporizer tubes, said second named tubes being spaced from one another adjacent said upper header to form an exit for said combustion gases from said flue.

6. A marine water tube boiler comprising a casing rectangular in section and a stack, headers in the upper and lower sides of said casing, a combustion chamber, tubes connecting said headers extending parallel to but spaced from the walls of said casing to form combustion chamber walls of a single tube thickness and so as to form at least one flue between said tubes and one of said walls, and means for allowing combustion gases to pass said tubes into said flue adjacent said lower header.

7. A marine water tube boiler as in claim 6, in which a second series of tubes extends parallel to the walls of the casing between said headers to form a second wall for said flue, and means adjacent the upper header to allow the combustion gases to pass by said second tubes into said stack.

8. In a marine water tube boiler as in claim 6, a feed water heater and a superheater arranged in said stack.

9. In a marine water tube boiler as in cleaim 6, a feed water heater and a superheater arranged in said flue.

10. A marine water tube boiler having upper and lower headers with vaporizer tube connected therebetween, said tubes forming at least two walls of a heating flue adjacent a side of said boiler, and said tubes being spaced for passing all the combustion gases transversely of said tubes into said flue at the bottom of said boiler, whereby combustion gases ascend said flue behind the tubes adjacent the combustion chamber.

11. A marine water tube boiler as in claim 1, said upper header being on the side of said boiler opposite said flue, said flue being continued across the top of said combustion chamber to a point adjacent said upper header, and secondary vaporizer tubes partitioning said continued flue.

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