June 30, 1953 T. KLEINEN 2,643,645

HORIZONTAL FLUE BOILER WITH COMBUSTION PREHEATER

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Fig. 1

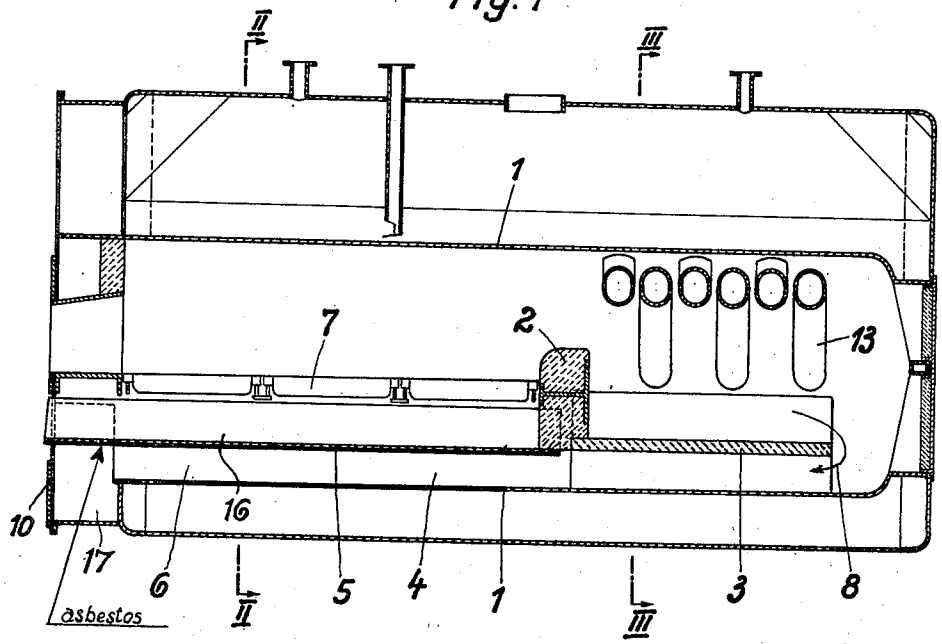


Fig. 2

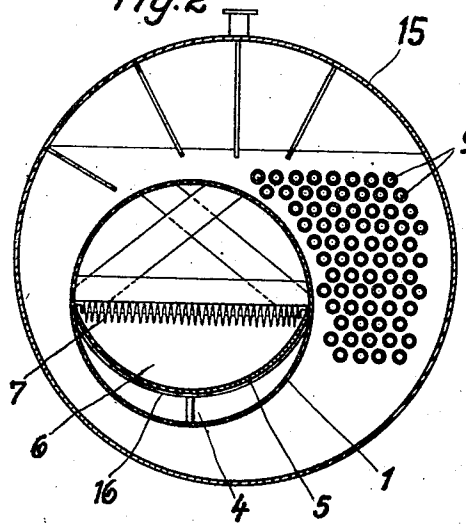
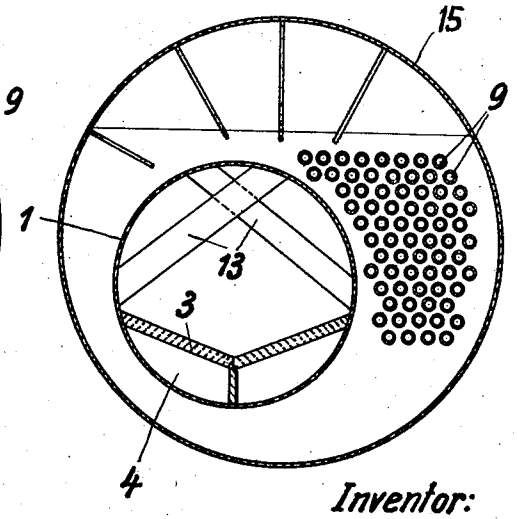


Fig. 3



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Fig. 4

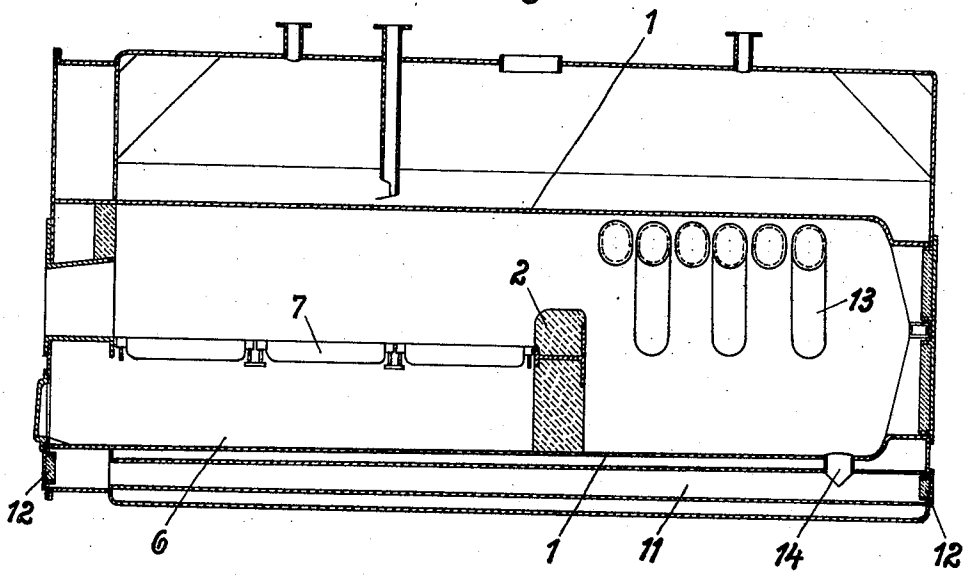
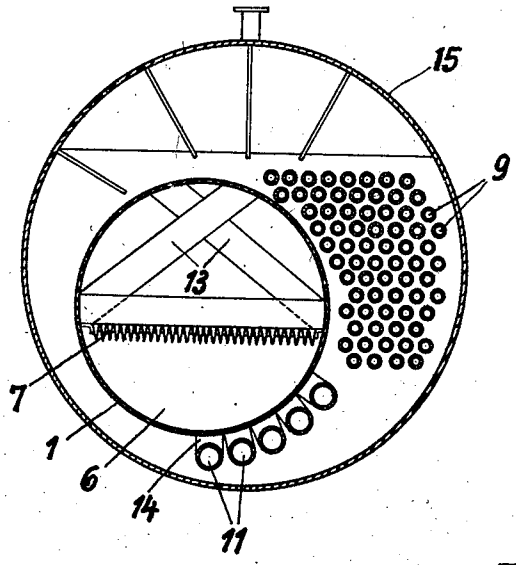


Fig. 5



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HORIZONTAL FLUE BOILER WITH COMBUSTION PREHEATER

Theodor Kleinen, Duisburg, Germany

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In Germany August 4, 1950

1 Claim. (Cl. 122—1)

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The present invention relates to fire tube boilers, more particularly to boilers of the return-tubular type.

It is customary in such boilers to provide at the rear end thereof a header or flow-reversing chamber with refractory lining, usually in combination with a removable tubular grate adapted to serve as a heating surface and to cool the refractory lining; the gases emerging from the flue are turned around in this chamber and pass, in a second traverse, through a bank of tubes toward the forward boiler end and to the exhaust.

An object of the present invention is to simplify the construction of a boiler of this description by eliminating the flow-reversing chamber or header referred to above, together with its refractory lining and cooling tubes, thereby reducing manufacturing costs as well as maintenance expenses.

This object is accomplished, in accordance with the invention, by the provision of a boiler of the character referred to wherein, however, the reversal of the flow direction of the gases occurs inside the flue through which the gases pass during their first traverse; the return of the gases then takes place below the grate of the flue either outside the latter or within the flue itself. In the first instance the flue communicates at a point just ahead of its rear end with fire tubes serving for the return of the flue gases at their second traverse; by this arrangement, in accordance with another object of the invention, the water present in the boiler zone below the flue is subjected to intense heating, thereby greatly improving the water circulation in the boiler tank. In the second instance there is provided within the flue, back of the usual fire bridge, an axially extending baffle or partition which constitutes the lower part of the flue itself a channel for the return of the gases in a second traverse; in that case, according to a still further object of the invention, the air flowing under the grate is preheated by the returning gases, thereby dispensing with the need for any separate air preheater. Moreover, objectionable accumulation of fly ash in the rear of the flue will be avoided since this ash will be entrained toward the front by the returning gases, which results in a very high efficiency of the boiler.

With either of the above-described embodiments the advantage of a shortened boiler tank is realized, which facilitates the complete thermal insulation of the boiler, and cleaning, inspection and maintenance will be greatly simplified.

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Preferably, a boiler according to the invention is designed as a double-return, or triple-traverse, tubular boiler, with the flue gases upon returning to the front of the boiler caused to traverse same a third time, in a rearward direction, by way of a bank of tubes leading, in a manner known per se, to the exhaust.

The foregoing and other objects and features of the invention will become more fully apparent from the following description, reference being had to the accompanying drawing in which:

Fig. 1 shows, in longitudinal section, a boiler of the character described representing a first embodiment of the invention, in which the returning gases travel within the bottom portion of the flue itself;

Fig. 2 is a cross section on the line II—II of Fig. 1;

Fig. 3 is a cross section on the line III—III of Fig. 1;

Fig. 4 is a view similar to Fig. 1, illustrating a second embodiment of the invention wherein the returning flue gases pass through tubes connected to the flue; and

Fig. 5 is a view similar to Fig. 2, representing a cross section through the boiler of Fig. 4.

Like elements in the several views (including those relating to different embodiments) have been designated by the same reference numerals. They include the flue 1 within which, in accordance with a feature common to both embodiments, the gases undergo a change of direction prior to being returned toward the front of the boiler in a second traverse. The flue is eccentrically disposed inside a conventional, cylindrical boiler tank 15, as clearly shown in Figs. 2, 3 and 5.

Referring now more particularly to Figs. 1–3, there is provided in the rear part of the flue 1, back of the fire bridge 2, a horizontally disposed, axially oriented baffle 3 arranged in such manner as to constitute the lower portion 4 of the flue 1 itself a channel for the return of the gases, i. e. for their second traverse. The baffle 3 is in line with and forms an extension of a partition 5 which divides the forward portion of the flue 1 into a larger upper compartment, serving as a duct for the first traverse of the gases, and a smaller lower compartment representing a continuation of the channel 4; disposed in the upper compartment is a grate 7 which in turn subdivides the upper compartment so as to form therein a passageway 6 extending below the grate for the purpose of admitting air to the latter. Since the baffle 3 is swept by flue gases on both

of its major surfaces, it should consist of refractory material. The gases travel around the rear end of the baffle 3, in the direction indicated by arrow 8, and entrain the fly ash which is thus prevented from accumulating at the back of the boiler. For the purpose of more effective flow control the baffle 3 is preferably composed of two slightly inclined shelves meeting at an obtuse angle, as clearly seen from the cross-sectional view of Fig. 3, so as to approximate the curvature of the partition 5 to which it is joined at the bridge 2.

The returning flue gases passing through the channel 4 preheat the air in the duct 6. Lest the partition 5 forming the lower boundary of this passageway be scorched by the gases, it is preferably lined with an asbestos layer 16 at its underside, i. e. at the side exposed to the gases. The gases arriving at the forward end of the boiler by way of the channel 4 are caused to traverse the boiler a third time by passing through conventional fire tubes 9 toward the rear and to an exhaust (not shown).

The channel 4 is readily accessible by means of a removable lid 10, which opens into a manifold or header 17 communicating with the tubes 9. Thus there has been provided a triple-traverse, or double-return, tubular boiler of reduced length and high efficiency which may be manufactured and serviced at low cost.

In the embodiment depicted in Figs. 4 and 5 the first change in flow direction also occurs, without intervention of any header, within the flue 1 itself. Here the flue gases pass, however, toward the front of the boiler by way of fire tubes 11 communicating with the flue 1 at 14, a short distance before the rear end of the flue. The tubes 11 extend across the full length of the boiler and are also accessible at either end by means of removable lids 12 provided in the two end walls, which enables their convenient inspection and cleaning. The third traverse occurs, as in the preceding embodiment, through fire tubes 9 of conventional type leading toward the rear of the boiler and to the exhaust. It will be appreciated that the water present in the lower zone of the boiler tank 15, underneath the flue 1, is subjected to a particularly intense heating by the tubes 11 which greatly enhances its circulation. The tubes 11 of the second traverse, as shown in Fig. 5, are less numerous than the tubes 9 of the third traverse but are of larger cross-sectional area than the latter.

Transverse water tubes 13 have been shown in both embodiments. These conventional tubes are not essential for the proper functioning of a boiler according to the invention and may be omitted. Various other modifications or adaptations will likewise be apparent to persons skilled in the art and may be resorted to without constituting a departure from the spirit and scope of the invention as defined in the appended claim.

I claim:

In a fire tube boiler, in combination, an elongated, horizontal tank, a cylindrical flue horizontally disposed inside said tank and extending from the front toward the rear of the latter, said flue having an open front end and a closed rear end, grate means in said flue extending rearwardly from said front end thereof, arcuate partition means inside said flue forming a segmental first duct immediately below said grate means and a crescent-shaped second duct below said first duct, a fire bridge back of said grate means blocking said first duct and deflecting air, entering said first duct from said open front end, upwardly through said grate means, and baffle means back of said fire bridge in line with said partition means and forming a rearward extension thereof, said extension terminating short of said closed rear end, thereby forming a passageway for flue gases returning to said front end by way of said second duct, said flue gases preheating said air upon passing below said arcuate partition means.

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