Feb. 28, 1956 F. SMITH 2,736,298

WELDED STEEL BOILER

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FIG. 1.

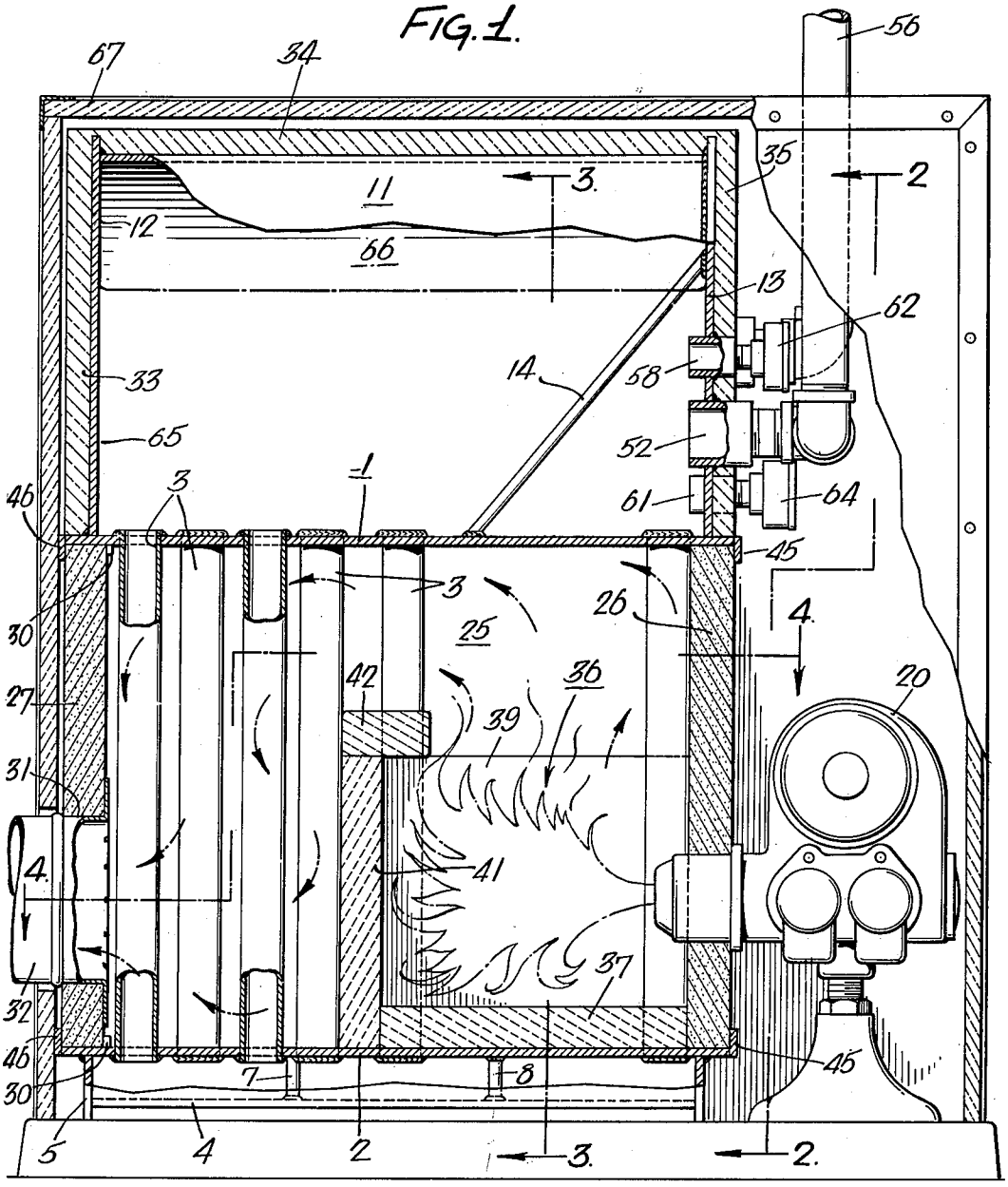
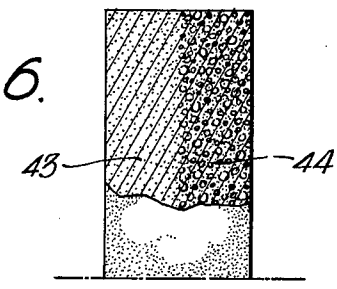


FIG. 6.



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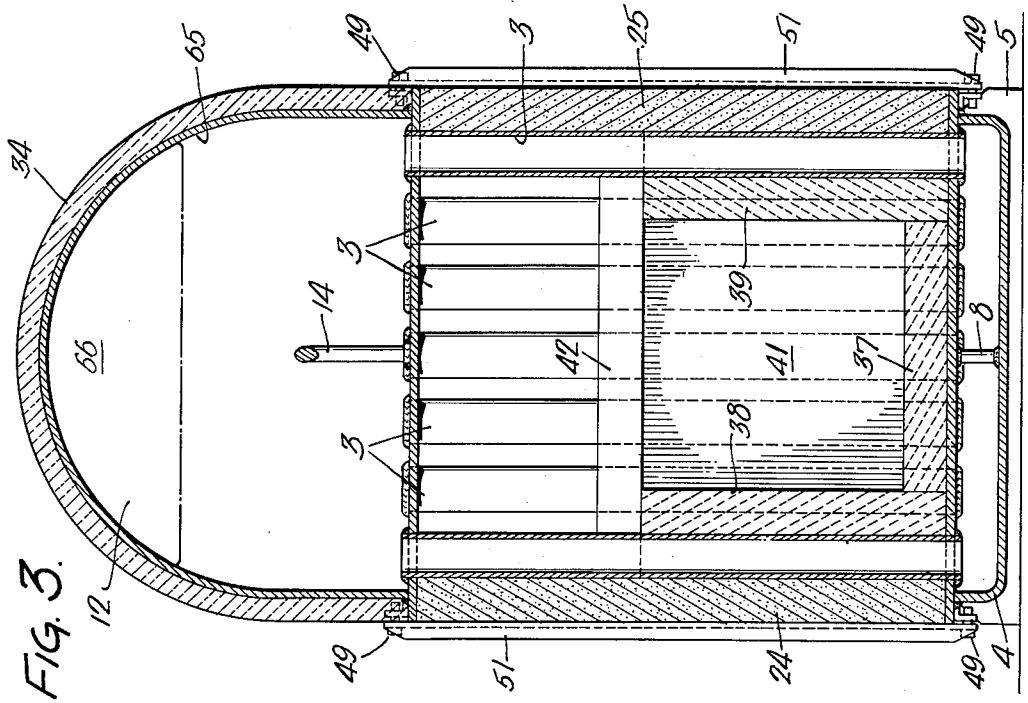


FIG. 3.

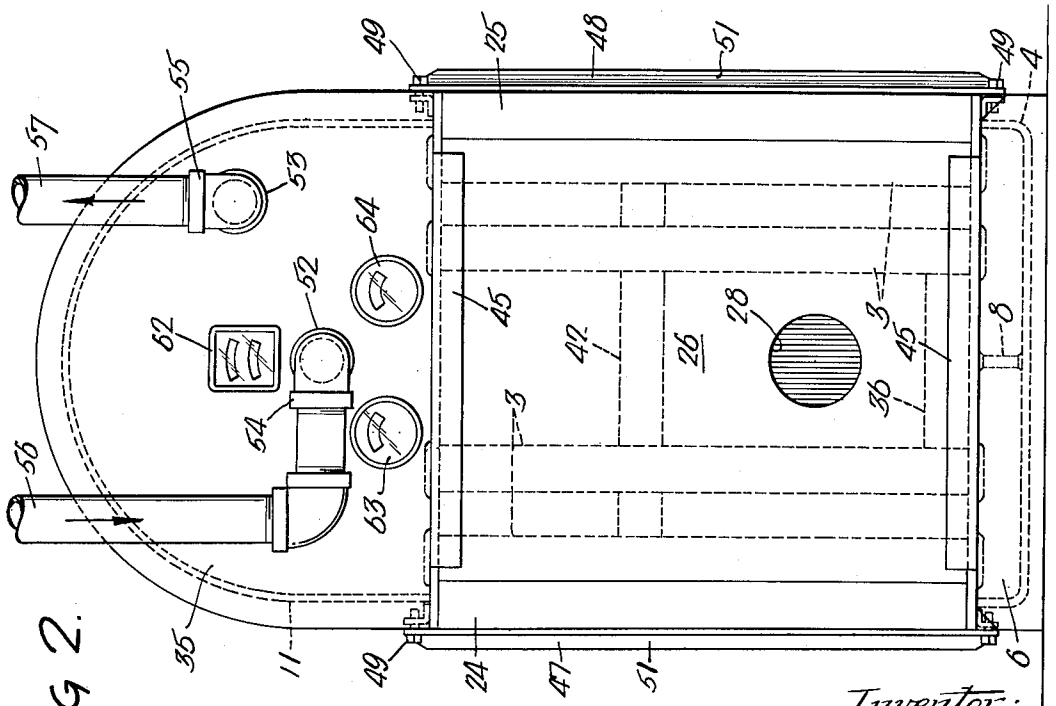


FIG 2.

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WELDED STEEL BOILER

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FIG. 4.

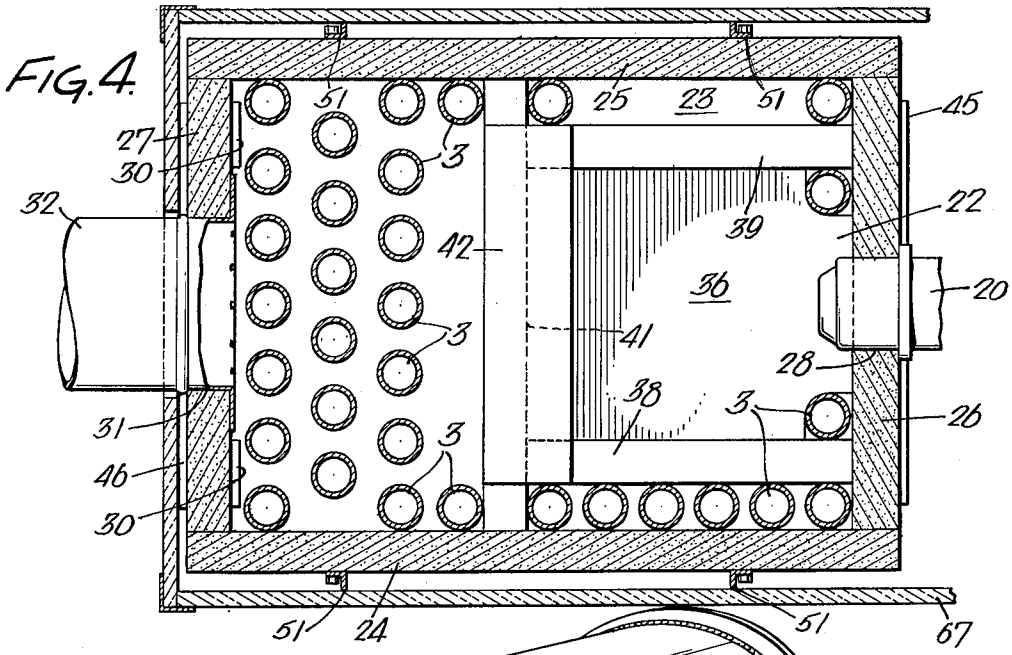
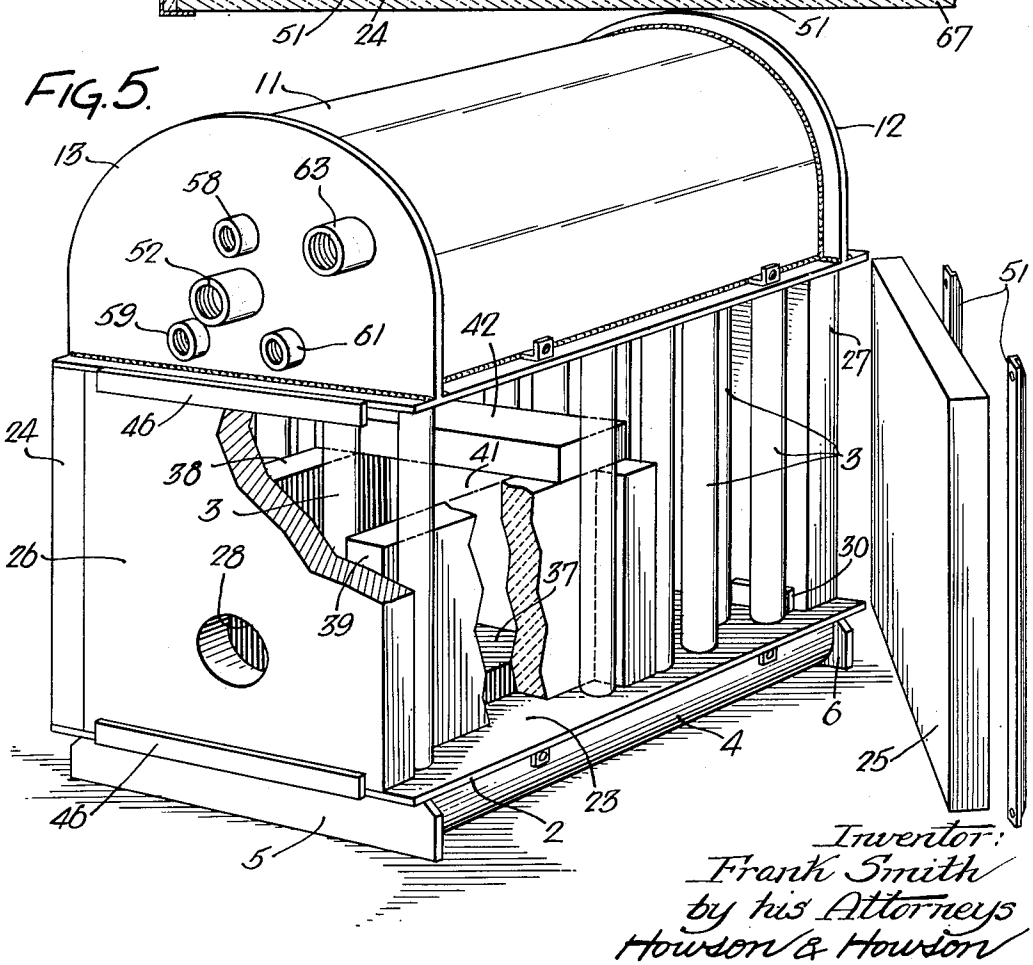


FIG. 5.



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WELDED STEEL BOILER

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Application July 23, 1952, Serial No. 300,553

6 Claims. (Cl. 122—145)

This invention relates to boilers or hot water heaters, and a primary object of the invention is to provide a heater or boiler, primarily for domestic heating purposes, of generally improved characteristics. The term "boiler" will be understood to include water heating units of the characters used with the several types of domestic heating systems such as "steam," "hot water," "vapor," and the like.

More specifically, the invention has for an object the provision of a boiler of simple and economical construction, having an inherently high functional efficiency and an extremely low cost of maintenance.

Another object of the invention is to provide a boiler which by reason of certain novel design features will exhibit economy both of construction and operation.

Still another object of the invention is to provide a fabricated steel boiler affording exceptionally high economy of that material.

To this latter end, the invention contemplates provision of boiler of the water tube type wherein the combustion and heat exchange chambers are encased by non-metallic refractory walls, said walls being inexpensive and durable and functioning both to conserve heat and fuel and to minimize operating noises of the furnace.

A further object of the invention is to provide an oil fired boiler wherein the boiler noises and the noises generated by the oil burner are reduced to a practical minimum.

Still another object of the invention is to provide a boiler of the stated type wherein ready access is afforded for cleaning and repair purposes and for installation and removal of the refractory elements of the combustion chamber.

A further object of the invention is to provide a welded steel water tube boiler wherein by reason of novel design access is afforded to all welded joints of the structure for inspection and possible repair.

Still another object of the invention is to provide an oil fired water tube boiler wherein access may be had to the combustion chamber without dismounting the oil burner unit.

Still another object of the invention is to provide a boiler of the stated character employing refractory side panels and provided with simple and practical means for mounting said panels in the boiler structure.

Another object of the invention is to provide a novel refractory wall panel for boilers of the stated type.

The invention resides also in certain other novel structural details hereinafter described and illustrated in the attached drawings, wherein:

Figure 1 is a vertical sectional view of a boiler made in accordance with the invention;

Figure 2 is a front elevational view of the boiler with the burner unit and casing removed, as reviewed from the line 2—2, Figure 1;

Figure 3 is a sectional view on the line 3—3, Figure 1;

Figure 4 is a sectional view on the line 4—4, Figure 1;

Figure 5 is a view in perspective of the boiler unit with a side panel displaced and a portion of the front panel broken away to show the details of construction; and

Figure 6 is a fragmentary elevational and partial sectional view of one of the refractory side wall panels.

As previously stated, the boiler is of the water-tube type and is fabricated from steel plate by welding. The body of the boiler comprises two flat tube plates 1 and 2 in the apertures of which the ends of tubes 3 are secured by welding or if preferred by expansion. The boiler comprises also a lower shallow U-shaped member 4 which is secured by welding to the underside of the lower tube plate 2; and the respective open ends of this member 4 are closed by flat substantially rectangular plates 5 and 6 which are secured at their upper edges by welding to the underside of the lower tube plate 2 and also the end edges of the member 4. A sealed chamber is thus formed between the member 4 and the lower tube plate with which the lower ends of the tubes 3 are in communication.

In the present instance the plates 5 and 6 extend below the bottom of the member 4 (see Figure 3) so as to form a support for the boiler, the bottom of the member 4 being thus elevated above the underlying supporting or floor surface. It is preferred also to provide reinforcing or staying members 7 and 8 (see Fig. 1) in the form of stays which are secured by welding to the inner lower surface of the member 4 and to the underside of the lower tube plate 2.

The boiler body also comprises an inverted U-shaped or dome-like member 11 of relatively great depth which seats upon the upper surface of the upper tube plate 1 and is secured by welding to the latter. Flat end plates 12 and 13, secured by welding to the upper surface of the plate 1 and to the respective end edges of the member 11, form with the latter a sealed chamber at the top of the plate 1 which is in communication with the upper ends of the tubes 3. If desired, a strut member 14, welded at its ends to the upper surface of the tube plate 1 and to the inner surface of the plate 13, extends diagonally between these plates to afford reinforcement for the plates 1 and 13 against distortion due to pressure. Plate 12 may be likewise strengthened.

A preferred arrangement of the tubes 3 is best illustrated in Figure 4. As shown in that figure as well as in the other figures, the tubes are arranged in a bank of transverse rows at one end of the above described structure, which end constitutes the back of the combustion or heat exchange chamber of the boiler. The tubes also extend forwardly along the sides of the chamber and across the front so as to leave an open space in the forward part of the structure for reception of the elements of the hearth or fire box hereinafter described. The tubes are spaced so as to provide a central opening 22 at the front of the boiler through which the flame from a burner 20 may be projected into the combustion chamber; and a gap 23 is also provided at one side between the tubes to afford access to the interior of the structure for purposes hereinafter set forth.

It will be noted that the tubes are spaced inwardly from both the side, front, and rear edges of the upper and lower tube plates 1 and 2, thus affording flat shelf-like extensions at the edges of the plates for mounting side panels 24 and 25 and front and rear panels 26 and 27. These panels fit closely between the confronting edge portions of the tube plates and enclose the tubes. The panels in effect constitute the side walls of the combustion chamber of the boiler and the structure of these panels, which constitute an important element of the invention, will be hereinafter described.

It will be noted by reference to Fig. 4 that in the present instance the side panels 24 and 25 and the front panel 26 seat against the sides of the adjoining tubes 3,

whereas the rear panel 27 is spaced rearwardly from the rear row of the tubes by abutment strips 30 on the tube plates. If desired, the side and front panels may be spaced by similar means from the tubes which they respectively confront. As illustrated, the panel 26 is provided with an opening 28 for reception of the tubular end of the burner 20, shown in Fig. 1; and the rear panel 27 is provided with an opening 31 for reception of a flue pipe 32.

It will be noted also by reference particularly to Figs. 1, 3 and 5 that the member 11 is inset from the edges of the upper tube plate 1. The end plates 12 and 13 while extending the full width of the tube plate 1 are spaced inwardly from the front and rear edges of the latter. The projecting edge portions of the tube plate provide support for suitable insulation encasing the dome 11 as indicated by the reference numerals 33, 34 and 35 in Figs. 1 and 3.

Located within the forward part of the combustion chamber of the boiler in the tubeless area is a fire box or hearth structure designated generally by the reference numeral 36. This fire box, into which the flame of the burner 29 is projected, is composed of suitable high refractory material and consists in the present instance of a base or floor slab 37 which rests upon the lower tube plate 2, side slabs 38 and 39, respectively, the lower edges of which also seat upon the tube plate 2, and a rear wall slab 41, the lower edge of which seats upon the tube plate 2 and which is of the same height as the side slabs 38 and 39. The slabs 37, 38, 39 and 41 are in engagement with each other to form a tight open-top box, the forward wall of which is formed by the front panel 26 of the combustion chamber. In the present instance a refractory cross-member 42 is provided at the top of the rear wall which overhangs the back of the fire box to afford a desirable corbelling effect as illustrated in Fig. 1.

As also illustrated in Fig. 1 and in Fig. 5, the rear slab 41 is fitted between adjoining pairs of the tubes 3 at each side of the boiler and is thereby supported securely in the upright position. This slab may be readily inserted between the supporting tubes and may readily be withdrawn after removal of one of the side panels 24 and 25. Sidewise displacement of the slab 41 is prevented by the last named panels. The side slabs 38 and 39 bear against the inner sides of the tubes which lie at the opposite sides of the combustion chamber and find support against these tubes. The floor slab 37 fits closely between the side slabs 38 and 39 and thereby in effect locks the side slabs in the upright positions. Forward displacement of the side slabs 38 and 39 is prevented by engagement of the forward edges thereof with the front panel 26 of the furnace structure. It will be noted also that the forward edge portions of the side slabs 38 and 39 are fitted between adjoining pairs of the tubes 3 at the forward end of the boiler structure so that the slabs are positively supported in the upright positions. The transverse member 42 rests upon the upper edge of the rear slab 41 and upon the upper edges and rear portions of the slabs 38 and 39 and is confined at the ends between two of the tubes 3 disposed at opposite sides respectively of the combustion chamber. The elements of this fire box or hearth structure may be further united by suitable cement if desired. It will be apparent that these elements are readily accessible for inspection, cleaning and repair after removal of the side panel 25 through the space 23 between the spaced tubes referred to above. Removal of the side slabs may be effected also from the front by removal of the front panel 26.

The structural elements of the hearth structure described above are preferably composed on a suitable high temperature refractory composition, such compositions being well known and readily available in the art.

The side, front and rear panels 24, 25, 26 and 27 do not require a material of the same high service temperature as the hearth structure elements described above. These panels are relatively remote from the flame of the burner 20 and are shielded to a degree by the interposed water tubes 3. The side panels have an important functional purpose however and are required to have a composition capable of withstanding substantially higher than atmospheric temperatures over an extended period of time without material loss of inherent strength and insulating properties. We have found it of advantage to form these panels of an integral body of material consisting of an outer layer 43 of Portland cement and an aggregate such as expanded shale affording a relatively strong and rigid structure, and an inner layer 44 of a refractory material of higher service temperature but lesser inherent strength composed, for example, of a mixture of Portland or other cement and a light weight heat resisting aggregate such as perlite or vermiculite. The two layers simultaneously cast unite to form an integral body having the desired strength and rigidity conferred by the outer layer 43 and the thermal resistance characteristic of the refractory inner layer 44. The two layers having substantially the same coefficient of expansion, do not tend to separate and the composite structure exhibits a substantial freedom from internal stresses of a character tending to crack or fracture the panel.

The front and rear panels 26 and 27 may be held in place by means of flanges 45, 45 and 46, 46 on the front and rear edges respectively of tube plates 1 and 2. The flanges are welded to the plates and the panels may be slid into place edgewise behind these retaining flanges. The panels 24 and 25 may be held in place by clamps of the character illustrated at 47 and 48 in Figure 2, said clamps consisting of an angle welded to the plate 1 or 2, as the case may be, a bolt or stud 49 passing through the angle, and a clamping angle bar 51 secured by said bolt at the outer face of the panel. There may be two or more of these clamps at each side of the boiler, and they may be readily released by removal of the studs 49, 49 for removal of the panel when required. Obviously, the panels may be of sectional form, if desired, for convenience of handling.

In producing the metal body of the boiler, the ends of the tubes are first welded in the tube plates at the top of the upper plate and bottom of the lower plate respectively, the plates having been drilled or punched with the necessary tube holes. The member 4 may then be welded at its edges to the underside of the lower tube plate, and the end plates 5 and 6 then welded to the tube plate and to the ends of member 4. Prior to the latter operation the stays 7 and 8 may be welded to the tube plate 2 and the member 4. The member 11 is now welded at its lower edges to the upper surface of the upper tube plate 1, and thereafter the front plate 13 is welded to the tube plate and to the forward edges of the member 11. After the strut 14 is attached to the inner face of the plate 13 and to the tube plate 1, the back plate 12 may be welded to the tube plate and to the rear edge of the member 11 to complete the assembly.

It will be noted that the front plate 13 is provided with opening 52 and 53 for reception of fittings 54 and 55 for the inlet and outlet pipes 56 and 57 of the external heating system; and openings 58, 59 and 61 are also provided for the required instruments such as the pressure and temperature gauge 62, and aquastats 63 and 64. If provision is to be made for domestic hot water supply from the boiler, means (not shown) will be provided either in the front plate 13 or rear plate 12 for supporting a suitable coil within the chamber 65 formed by the member 11 and to connect this coil to the domestic water system. The outlet port 53 is located in a position below the top of the member 11 so as to afford an air space 66 in the chamber 65 above the level of the water in the latter. This space functions, in the case of the hot water system illustrated, as an expansion chamber in lieu of the separate chamber conventionally employed.

The mode of operation of the boiler described above

will be apparent to those familiar with the art. As previously indicated, the construction affords valuable characteristics not found in the more conventional boilers of the same class. Among these characteristics are the extreme accessibility for inspection of all welded joints, it being noted that all such joints, including those where the tubes pass through the tube plates, are immediately accessible for rewelding or for repair of leaks; accessibility also for cleaning all combustion chamber surfaces and for inspection, repair and replacement of the elements of the hearth structure by simple removal of one or more of the wall panels; accessibility for all of these purposes without disassembly or demounting of the burner unit; simplicity of fabrication of the metallic body of the boiler utilizing a minimum number of steel elements of simple readily producible shapes and the substantial exclusion of inside welds; the use of refractory non-metallic wall panels which reduces materially the weight of metal in the boiler as a whole and which, by reason of the high sound insulating properties of the panels, reduces the operating noise level to a minimum; the excellent thermal conservation characteristics resulting from the use of the refractory wall panels and the effective insulation of the hot surfaces of the boiler; and the relatively high efficiency arising from the large area of the heat transfer surfaces exposed to the hot combustion gases and the use of both radiation and conduction (by way of the incandescent walls of the hearth structure in contact with the tubes).

While the boiler structure described above constitutes a complete and self-sustained operating unit, it is preferable to encase the said structure and the burner unit in a suitable casing as shown at 67 in Figs. 1 and 4.

I claim:

1. In a welded steel boiler, a metallic structure comprising upper and lower tube plates and a plurality of tubes extending between said plates and having their ends welded in apertures in the latter, a substantially U-shaped plate member welded along its straight edges to the upper surface of the said upper tube plate, a second U-shaped plate member welded along its straight edges to the lower surface of the lower tube plate, and an end plate welded to each end of each of said U-shaped members and to the proximate surfaces of the upper and lower tube plates and forming with said U-shaped plate members enclosed header chambers communicating respectively with the upper and lower ends of said tubes, the edge portions of the upper and lower tube plates extending beyond the welded edges of the respective associated U-shaped member and end plates to provide unobstructed perimetral areas on the tube plates, and wall panels fitted between said edge portions and forming the side walls of an enclosed chamber between the tube plates traversed by said tubes.

2. A tubular boiler consisting of a unitary metallic structure comprising confronting upper and lower tube plates and tubes connecting said plates and confined to areas of the latter spaced from the perimetral edges thereof, a plurality of pre-formed complementary wall panels of non-metallic refractory material removably supported between the perimetral edge portions of said tube plates and forming with the latter an enclosed combustion chamber embracing the said tubes, the tubes being arranged in rows at each side and at the front of said structure and in a plurality of transverse rows at the back of the structure and thereby affording an unobstructed space between said plates toward the front of the structure, and fire box elements supported by the tubes within said space.

3. A boiler according to claim 2 wherein the fire box structure comprises a refractory slab seated upon the lower tube plate together with side and rear refractory slabs having their lower edges seated on the said lower tube plate, each of said slabs having at least one end thereof confined between adjoining tubes and being thereby positively retained in the upright position.

4. A boiler according to claim 3 wherein the series of tubes at one side of the combustion chamber are interrupted to afford an access opening for installation of the elements of the fire box structure.

5. A boiler consisting of a unitary metallic structure comprising confronting upper and lower tube plates and tubes connecting said plates and confined to areas of the latter spaced from the perimetral edges thereof, a plurality of pre-formed complementary wall panels of non-metallic refractory material removably supported between the perimetral edge portions of said tube plates and forming with the latter an enclosed combustion chamber embracing the said tubes, including a hearth structure consisting of refractory elements having thermal contact with certain of said tubes.

6. A tubular boiler consisting of a unitary metallic structure comprising confronting upper and lower tube plates and tubes connecting said plates and confined to areas of the latter spaced from the perimetral edges thereof, a plurality of pre-formed complementary wall panels of non-metallic refractory material removably supported between the perimetral edge portions of said tube plates and forming with the latter an enclosed combustion chamber embracing the said tubes, metallic members secured to the upper surface of the upper tube plate and to the lower surface of the lower tube plate and forming header chambers communicating with the ends of the tubes, said tubes being arranged to afford a space at one end of said chamber unobstructed by the tubes, and a refractory fire box structure within said space.

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