Sept. 19, 1933. G. WELTER 1,927,327

BOILER CONSTRUCTION

Filed Dec. 4, 1931 2 Sheets-Sheet 1

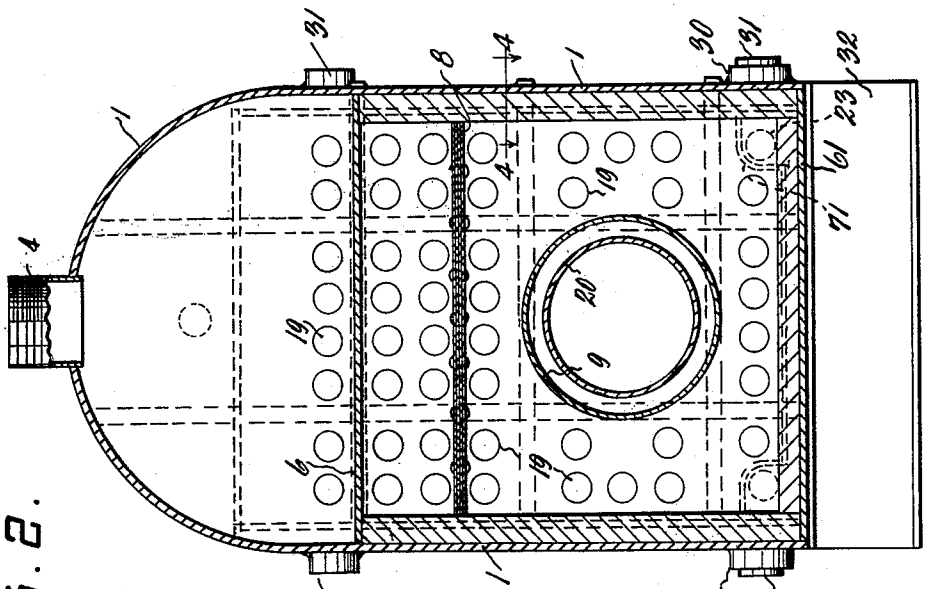


Fig. 2.

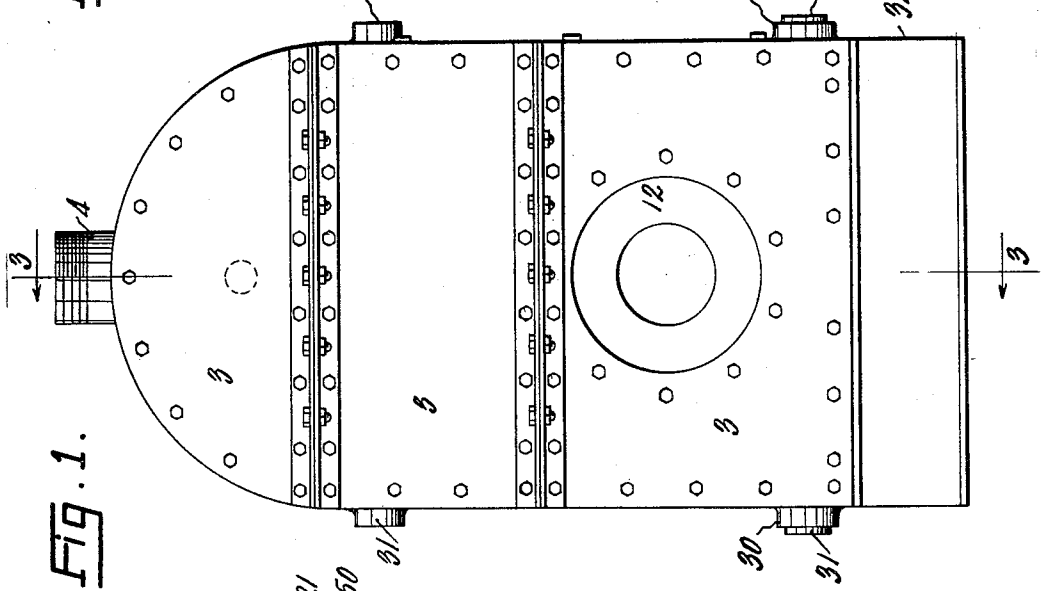


Fig. 1.

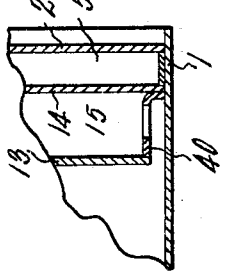


Fig. 4.

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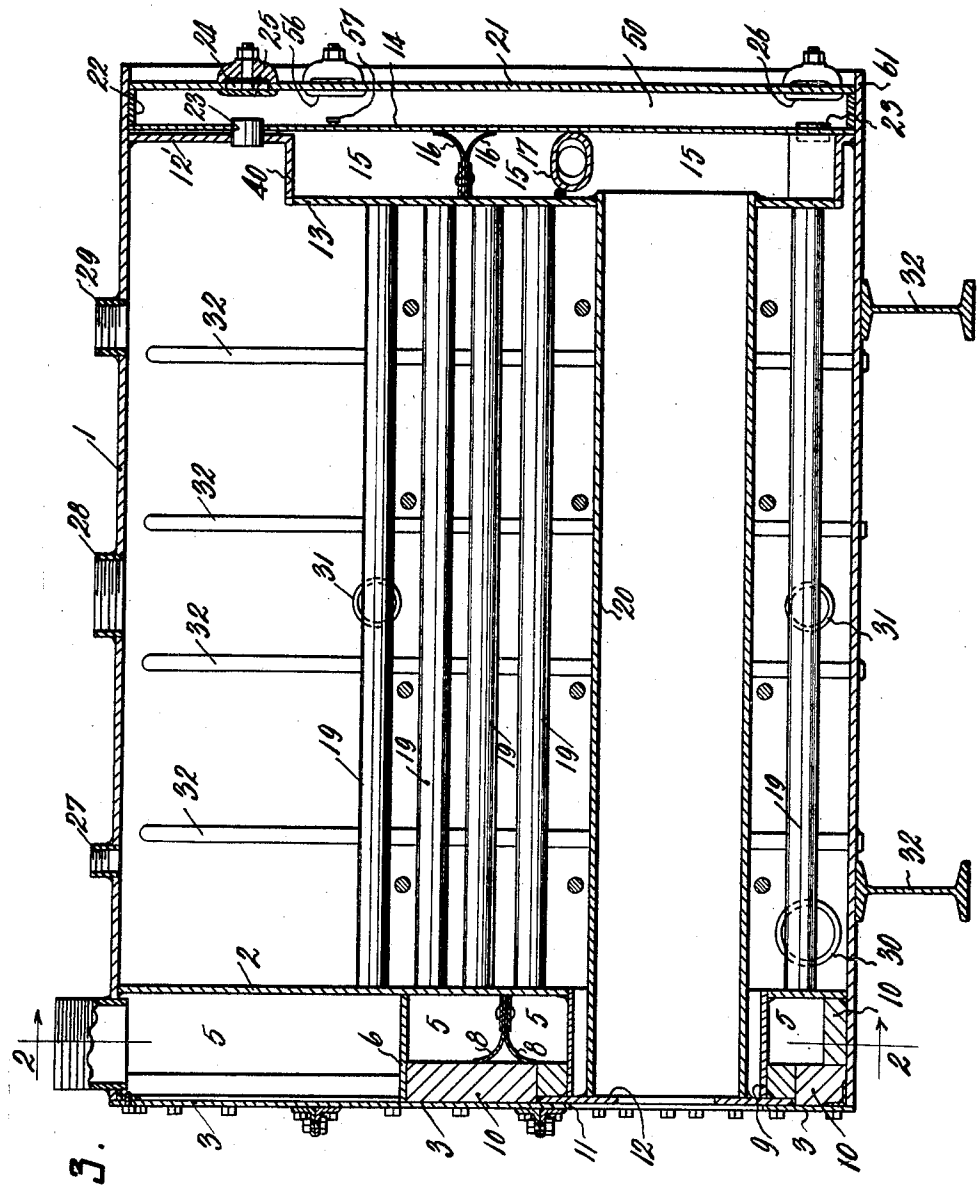


Fig. 3.

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UNITED STATES PATENT OFFICE

1,927,327

BOILER CONSTRUCTION

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4 Claims. (Cl. 122—149)

This invention relates to an improvement in boiler construction. It is conceived particularly to obtain a steam generating unit that is efficient, compact, and complete in itself to be used for supplying steam for heating and power. The boiler of this invention is particularly intended for oil and gas firing. As is well known, oil burners are now commonly used in boilers that were constructed for burning coal. A lot of the heat produced by the oil burner is wasted in this common practice. Where metered city gas is the heating medium it is more usual to have a boiler construction especially adapted for the gas fuel. As oil and gas burners are being used more and more there is more and more need for a boiler construction adapted to such fuels and one which will be highly efficient, compact, and yet fit the market for heating and power plants.

The general object of the present invention is to provide such a boiler of improved construction. The problem is not solved by merely making the known and highly efficient power boilers in smaller sizes but by bringing together features of construction studied out, experimented with, and observed with relation to the comparatively new market for boilers for heating and power purposes which use oil or gas fuel.

In this market there is a tendency to use higher furnace pressures than were commonly used in the coal burning equipment. And, according to one feature of the present invention, the boiler construction is made to meet the most severe tests for safety and at the same time it is made economically and so as to give easy access to desired parts of the construction for inspection and cleaning.

According to another feature of the invention a combination is made so as to minimize the space or volume required for a boiler construction of given heating capacity. This is important in domestic heating plants, now that the house cellars are being used more and more as a habitable part of the dwelling. Likewise in the industrial plant reducing the space required for boilers allows more space for productive manufacturing.

Detail objects and features of the invention will be made clear in the description of the accompanying drawings of the invention, in which—

Fig. 1 is a front view of one form of my improved construction;

Fig. 2 is a section on line 2—2 of Fig. 3;

Fig. 3 is a section on line 3—3 of Fig. 1; and

Fig. 4 is a section on line 4—4 of Fig. 2.

The boiler as shown is made of steel plate construction with substantially all parts welded at their permanent joints, as indicated at the corners. The shell 1 at the flat longitudinal sides and rounded top is made of a continuous sheet welded to a bottom plate 61. Spaced a little inwardly of the front end, a transverse header plate 2 is welded. Around the inner edge of the front end of shell 1, a flange is welded to which the removable cover plate members 3 are bolted with gaskets to make them tight. These sections are made separate to get at parts of the front boiler construction without removing the whole of the front end, and their construction and fastening means are all clear from the drawings. The smoke pipe or stack connection 4 is welded at the top of the shell in an opening from the top of space 5 between plate members 2 and 3. The space 5 forms a header chamber for the front end of the boiler and it is divided by transverse partitions and baffles. The top partition 6 is welded to plate 2 like a flange; the baffles 8 are riveted to bars welded on plate 2. This form of baffle of two sheets, one curved oppositely to the other so as to make a Y-shaped transverse section, supported in the manner shown, is especially adapted to withstand different gas pressures and temperatures on opposite sides. Heat insulating material 10 extends inwardly from plate 3 to the ends of baffles 8. The lower cover section 3 has a round opening 11 in line with a round tube section 9 and on the back side of this cover section 3 there is a heavy annular plate 12 to which the burner mechanism may be clamped. The tube section 9 is welded to plate 12 and to header plate 2 at the edge of an opening through the latter in line with opening 11 in cover plate 3. Across the lower inside bottom side of the baffle space 5 in the shell and upwardly from the bottom as far as partition 6 heat insulation 10 is placed to protect the surfaces of the header space 5 from excessive heat. Such insulation is preferably placed only at certain critical places as will be referred to in the operation of the boiler. Its location is clearly indicated in Figs. 2 and 3.

At the rear end of the boiler shell there is a header plate 12' spaced inwardly from the rear edge of the shell 1 and having an inwardly offset portion 13. The latter forms with the plate 14, of a water wall construction to be described, a header space 15 for the rear of the boiler. This space is divided by baffles 16, constructed, arranged, and supported like baffles 8 at the front end, and by a water arch 17. The latter may be made of a flattened tube extending transversely of header space 15 and welded in place with

a circulating water connection at each end in the side walls 40 of the offset portion of plate 12' and with water space of the boiler. When the plate 14 is fastened back of plate 12', this flattened tube 17 will, with a transverse bar welded on plate 13 as a filler piece, make an effective water-cooled transverse partition or baffle at a place where the heat is intense, as will appear.

Between the header plate 2 at the front end and the offset header plate 13 at the rear end of the boiler, the boiler tubes 19 are mounted. These tubes are rolled into the plates in the usual way. The combustion chamber or firing tube 20 is welded at its front end to heavy clamping plate 12' and at its rear end to plate 13, being suspended from end to end for its entire length so as to be entirely surrounded by the water space of the boiler. The front end of the firing tube extends across the front header space 5 and is water jacketed across such space, as shown. The rear end of tube 20 ends at the plate 13 so as to discharge into header space 15.

This discharge of the firing tube at the rear end into space 15 tends to make the outer wall 14 of this space very hot. There is special construction provided at the rear end of the boiler to take care of this tendency, not only for insulating purposes but for several other important purposes.

This construction includes a water jacket 50 especially designed to be conveniently placed in the rear of the boiler and to be removed therefrom as a unit. It is made up of the rear wall 14 of the header space 15, the rear wall 21 of the boiler construction and the side wall strip 22 which is wrapped around the spaced edges of walls 14 and 21 and welded in place to hold these walls apart. The construction is such that this unit 50 of walls 14 and 21 and side wall 22, can be slid into and out of place to close and open the entire rear end of the boiler as a double walled cover for that end of the boiler shell 1. This removable double walled cover 50 is used as a water jacket for the rear end of the boiler and special provision is made for this purpose by a common means to hold the jacket in place and for connecting the jacket to the water and steam spaces in the boiler.

The jacket is first put in place as indicated in Fig. 3, a nipple 23 is then rolled into aligned openings in plates 12 and 14. This nipple will connect the steam space in the water jacket 50 with the steam space in the main boiler shell 1 and also act to hold the jacket to the boiler. The nipple 23 may be rolled into place to hold the parts together and may be removed by suitable well known tools applied through the aligned hand hole 24. The latter is readily opened and closed by the cover 25 which may be of usual construction, as indicated. Another like nipple 23 having an aligned hand hole and cover is applied in the same manner to connect the water space of the jacket and the water space of the boiler. To make this connection the plates 12, 13, and 40 are formed so as to leave a notch 71 at each corner (see Fig. 2) for the water space of the boiler to extend through to walls 12 and 14 at that corner. The location of one of the lower nipples 23 is shown by the hand hole cover 26 at the bottom of the jacket. These nipples 23 hold the jacket tightly in place and at the same time make the desirable circulating connections for the water and steam between the boiler and its rear water jacket. A hand hole and cover are also shown in water jacket 50 to give access to a fusible safety plug 57 located as shown.

The advantage of this water jacket construction in association with the recessed header plate 12, is that the rear end of the main boiler may be easily exposed for inspection, repair, and cleaning by simply removing the water jacket held in place solely by the short nipples such as 23. These nipples can be easily manipulated into and out of place by tools well known to boiler makers and serve as a simple means for the present purpose. When the jacket 50 is removed the rear ends of all the tubes 19 and the firing tube are completely exposed. The jacket is replaced as a unit, the nipples fastened in place, and then the whole rear end of the boiler is covered and also protected by a water jacket in circulation with the main boiler. This arrangement saves cost in original manufacture, installation of the boiler, and maintenance of the boiler in good operation, and is especially designed with the idea in mind that a domestic heating boiler should be one that an inspector can examine with very little trouble. Such boilers are usually too small for an inspector or repair man to climb around inside of the structure as he can do in large power boilers. Along the top of the boiler shell there is the stack 4, and openings 27, 28, and 29 for water gauge, steam, and safety valve connections respectively. Return pipe connections 30 are on each side at the bottom. Openings 31 are for making connection to a water heater device such as is commonly connected to domestic heating plants. The longitudinal shell of the main boiler is braced by a series of rods 32 arranged in spaced relation from front to rear in two rows, one on each side of the central vertical plane, as indicated in Fig. 3.

The boiler is made gas-tight, including the firing tube. The idea is to feed both gas and air or oil and air to the firing tube under pressure. The common practice is to have the air drawn into an oil or gas fired boiler by the suction of the draft. The boiler shown herein is especially constructed for feeding all the air for combustion as well as the gas under high enough pressure to control the combustion operation in the firing tube 20, without dependence on any air draft induced by the fire. This gives a better control of the fire and leads to other advantages. It is not merely the idea of a forced draft. The oil vapor (if oil is used) or gas is mixed with the air and the two are blown together into the inlet end of the firing tube without any supplementary air supply or draft. By this means the fuel and air are both forced in predetermined measured quantities into the firing tube 20 and with sufficient force to elevate the pressure in the firing tube as much, for example, as two inches of pressure on a water column gauge. Such combustion under pressure has an advantage, among others, in the fact that the hot gases produced by the combustion in the firing tube are under more pressure when they leave the firing tube than they would be under ordinary firing conditions. They are preferably burned out in the firing tube and leave under pressure. At their hottest stage they are passed through the boiler tubes 19 to transfer their heat to the water.

In the boiler shown there are five gas passes through the tubes before the stack is reached. The high pressure will cause a rapid movement of the gases from the firing tube through the boiler tubes to the stack, even though the path

is a long one and even though the stack temperature is quite low.

From the foregoing it will be seen that the burning of gas or oil fuel permits the advantage over burning coal of a substantially higher pressure in the combustion chamber, a smaller combustion chamber and the more rapid combustion of the fuel. Due to these advantages a larger space is available for boiler tubes in a small boiler, and more gas passes can be provided between combustion chamber and stack, than could be efficiently used were a boiler of the same size fired with coal. These advantageous conditions are particularly taken into account by the construction of the boiler shown.

As the hot gases leave the firing tube they are received by the rear header space 15; impinging on wall 14 of the water jacket, they spread outwardly and reverse their flow so as to pass through the boiler tubes 19 shown along the sides, see Fig. 2, and bottom of the firing tube 20. At the front end of the boiler they are received in the header space 5, below the baffle 8, the front, bottom, and side walls of which are insulated. They pass rearwardly through the tubes 19 between the level of baffle 8 and water arch 17, are then passed back and forth through tubes at successive levels, being directed by baffles 16, 8, and partition 6, and the walls of the header spaces until they reach the stack. The firing tube and all the boiler tubes are covered by water in the shell 1.

It will be noted that counting the passage of hot gases through the firing tube 20, there are six longitudinal passes of the gases through the single boiler construction. This is a larger number than it would be feasible to provide for, in any boiler of equivalent size that burned coal. According to one feature of this invention this efficiency is used to reduce the size of the boiler for given heating requirements in the domestic or house heating plants.

The plan of the boiler is to have the gases as cool as possible when they reach the stack and yet maintain the flow through the stack. The high pressure of the burning fuels helps pass the hot gases through the boiler tubes with sufficient velocity to increase the rate of heat transfer. This is assisted also by having the relative areas of successive gas passes, from the hot end of the boiler gas path to the other or cooler end at the stack, decreasing as the stack is approached. As the gases cool, their volume diminishes and if the area of their passage diminishes their velocity will be maintained or increased. This idea is indicated by the larger number of boiler tubes inserted in the first gas pass after the firing tube, that below the level of the water arch 17, as compared to the second gas pass, that single row of tubes below baffle 8. And it is contemplated to carry out this idea in each of the higher rows although this is not shown. In the boiler shown the high pressure of the burned fuel gases will maintain a desired velocity through the boiler tubes, if the largest drop in volume is compensated for by a substantial change in tube area in the first and second gas passes, as has been shown.

In Fig. 3, at plate 12 I have indicated where a fuel and gas inlet pipe can be made to tightly fit at the inlet end of the firing tube 20 to make the boiler embody that one feature of being gas-tight for burning all fuel and air under gas-tight and high pressure conditions in the firing tube 20. Of course there are some features of my invention that are not dependent on this feature I have emphasized. The boiler shown could be used with an ordinary oil burner where the chief air supply is sucked in suitable draft openings to mix with the vaporized oil. This will be apparent to any one skilled in the art.

The boiler shown is in the preferred form of the invention for carrying out the idea of saving space, in the overall dimensions, and particularly with respect to simplicity of construction whereby everything may be compacted into small volume and yet provide for all desired functions as well as ease in the inspection, repair, and cleaning of the boiler. The boiler is adapted for heating a larger than ordinary house, and yet its actual size may be no larger than 2 feet 3 inches wide, 4 feet 5¼ inches high, and 5 feet 2 inches long for 2000 feet steam radiation, for example. It is made much smaller than the ordinary boiler for this purpose. It is made up in welded form at the factory and may be set down in the home on spacing rails 32 in the home. It does not need to be taken apart for repair. The simple removal of the water jacket unit at the rear exposes all parts at that end. The unbolting of the front wall exposes all parts at that end. The condition of the boiler tubes is the chief thing to inspect and by making the end covers of the boiler the outside walls of the header spaces at each end of the tubes, this inspection is made most conveniently. This is greatly assisted by the particular construction for the baffle space 15 in association with the water jacket at the rear of the boiler.

Having disclosed the invention, what I claim is:

1. A boiler construction comprising a shell for holding water, having a transverse plate at each end spaced a short distance inwardly from the edge, one of said plates having an inwardly offset portion to provide a header space when suitably covered, a water jacket cover for said space and all of one end of the boiler, such cover being constructed as a unit to be removably fastened to the transverse plate with the offset portion, removable means to cover the other end of the boiler shell in spaced relation to the transverse plate at that end so as to form a header space, a firing tube extending from an opening through one cover to an opening into one of said header spaces, boiler tubes extending between said transverse plates, baffles in the header spaces to direct hot gases from the firing tube back and forth between the header spaces through different boiler tubes, a stack connected to one of the header spaces, said shell and transverse plates supporting the firing tube and boiler tubes with all ends fully exposed for inspection, repair, and cleaning upon the mere removal of the end covers of the boiler shell.

2. A steam boiler constructed for gas or oil firing as a domestic heating plant, having in combination a horizontally arranged shell divided by transverse partitions into two header spaces at opposite ends with the main water space between, boiler tubes suspended between the inside walls of the header spaces, a firing tube suspended between the outside wall of one header space and the inside wall of the other header space, a water jacket for that part of the firing tube extending through the header space, horizontal baffles in said header spaces to direct gases from the firing tube, back and forth through successive sets of boiler tubes, the outside walls of said header spaces being insulated and readily removable for inspection, repair and cleaning purposes.

3. In a steam boiler construction, a water-tight shell having one end closure made up of a transverse plate member provided with an inwardly offset plate portion and side wall portions connecting the two, boiler tubes and a firing tube connected through the offset plate portion, a cover plate for the space formed by the offset plate portion and the side walls, a water tube arranged transversely of said space adjacent the firing tube and connecting with the interior of the said shell below the water line, said construction forming a header or manifold means for guiding burned gases from the firing tube to the boiler tubes, said water tube serving as a baffle or partition in said header.

4. In a steam boiler construction a manifold member including two spaced plates to one of which the boiler tubes are attached for the passage of hot gases, the other plate being removable to expose the ends of the boiler tubes, a baffle device for the manifold space comprising a transverse partition made up of two metal strips each having one edge portion curved substantially through a ninety-degree angle, said strips being fastened together and to one of the spaced plates so as to provide a Y-shaped cross-section, the spaced ends of the strips being left free to make spring contact with the plate opposite to their attached parts, whereby the baffle device is braced to withstand differential gas pressures and temperatures on opposite sides of the spaces in the manifold without permanent distortion.

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