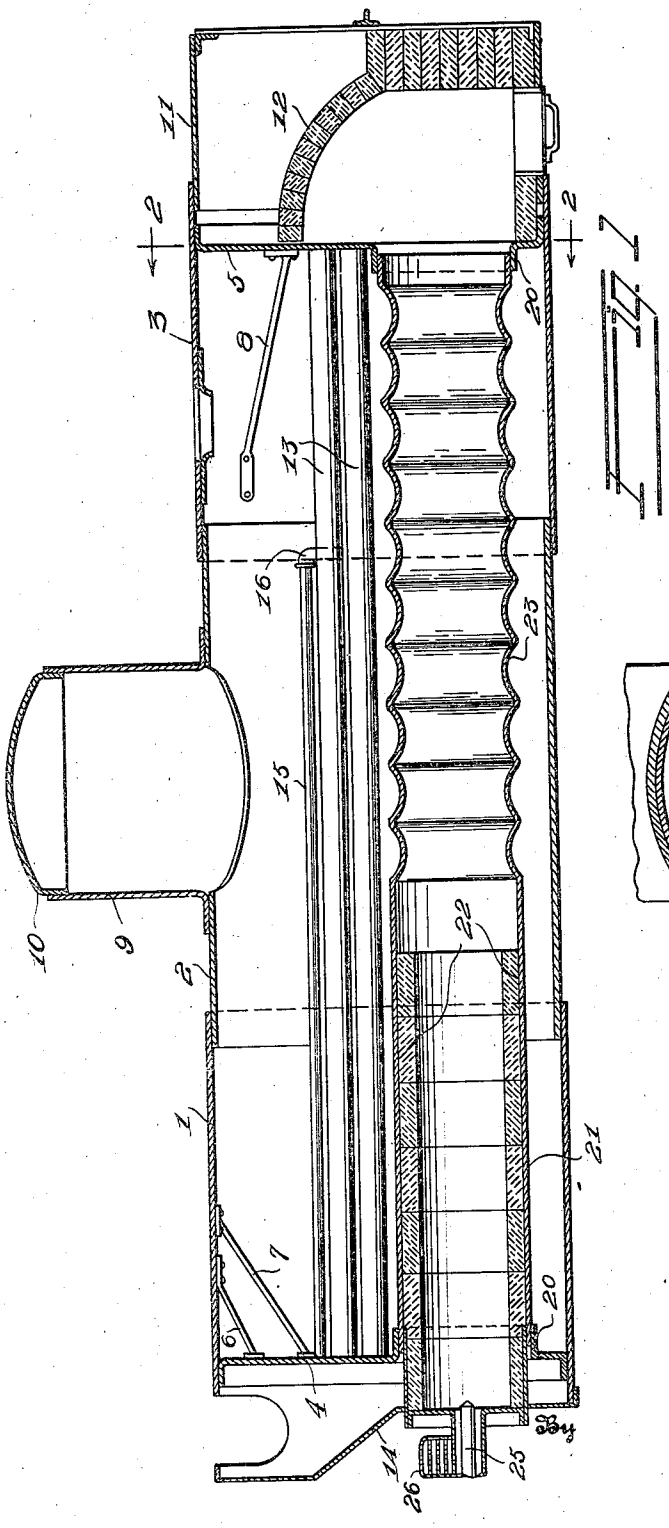
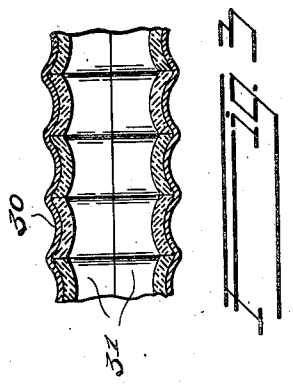
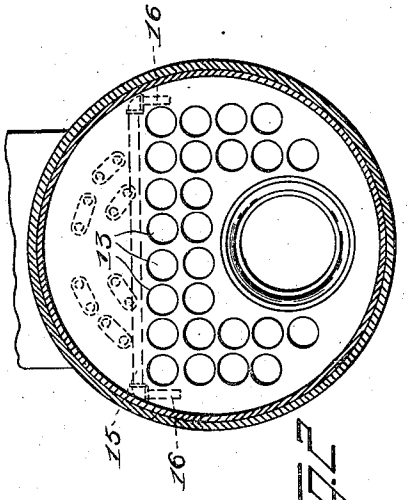
March 25, 1930. H. TAYLOR 1,751,534

BOILER

Filed May 22, 1929







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UNITED STATES PATENT OFFICE

HUSTON TAYLOR, OF PITTSBURGH, PENNSYLVANIA

BOILER

Application filed May 22, 1929. Serial No. 365,137.

This invention relates to the construction of steam boilers especially adapted for liquid or gaseous fuels, and its object is to provide an internally fired, return-tubular boiler of this character with a combined furnace and flue of such small diameter that the combustion of the fuel will be of maximum efficiency, and of such length that a maximum amount of heat can be transmitted to the surrounding water.

In the accompanying drawing, Figure 1 is a longitudinal section of my improved boiler. Figure 2 is a vertical section on the line 2—2 of Figure 1. Figure 3 is a section of a modified type of furnace.

Similar reference characters refer to like parts throughout the several views.

The present boiler has a shell formed of the united cylindrical sections 1, 2 and 3, heads 4 and 5, stay-bolts 6, 7 and 8 for bracing the heads, a steam dome 9 having an end 10, a rear breeching 11 to support the first-brick deflector 12, fire-tubes 13 extending between the heads, a froth breeching 14 onto which a smoke stack may be mounted, and a feed pipe 15 for the water to be evaporated, this pipe having branches 16 to direct the water down between the fire-tubes and the shell.

The heads are shown formed with thimbles 20 to receive the ends of a substantially cylindrical member, the front end 21 of which is lined with refractory material 22, such as cylindrical sections, and the central and rear portion of flue 23 which is preferably circumferentially ribbed, or corrugated. The furnace-flue is unobstructed throughout its length.

The efficiency of this boiler depends upon its peculiar proportions. In a boiler recently constructed the fire-tubes are fourteen feet long, the shell is four feet in diameter, the furnace is eighteen inches in diameter, and its combustion chamber is thirteen inches in diameter and about six feet long. Twenty six four-inch fire-tubes are used, as shown in Figure 2. The length of the furnace-flue is preferably at least eight times the outside diameter of the furnace.

The injector 25 is connected to a source of fuel oil under pressure and a clear blue flame can be freely forced through the furnace-flue and back to the front through the fire-tubes. Under normal conditions this boiler evaporates about fifty per cent more water than boilers of the standard locomotive type and when necessary can be pushed to evaporate one hundred per cent more, but under these conditions the boiler does not operate as economically.

I prefer to employ the muffler 26 for the incoming air as without the muffler the incoming air creates a roar.

The efficiency of this boiler is probably due to the small inner diameter of the lining of the combustion chamber of the furnace which becomes very hot and causes complete combustion of the fuel before it passes from this furnace by reason of the intense reflected and radiated heat. In any event, this type of boiler operates at an efficiency which the ordinary type of Scotch marine boiler with a large diameter furnace is incapable of attaining. The combustion of the fuel is practically instantaneous, resulting in a roaring sound because of the rapidly succeeding explosions.

The rapid rearward movement is somewhat checked by the time the gases reach the deflector 12 because the gases have given off a large proportion of their heat which action is facilitated by the corrugations of the flue 23 which cause eddies to form in the gases as they move rearwardly and thus insure repeated mixing of the hotter inner and cooler outer gases. The gases rise and pass forward along the deflector 12 and pass forward through the fire-tubes 13, giving off heat in the usual manner. But the great proportion of the original heat of the gases is taken up by the corrugated flue 23 and the usual length thereof insures the great evaporating capacity of this boiler.

The American Society of Mechanical Engineers in its boiler code has fixed eighteen inches as the maximum diameter of flues and as the minimum diameter of furnaces. The cylindrical member which receives the fuel is therefore a flue in the present construction. In furnaces of larger diameters, a vortex or whirl of the incandescent gases is usually sought for, but in obtaining this effect, the

gases expand and thereby lose temperature. In the present case, the gases are forced rearwardly by the pressure of the fuel jet and as they give up their heat to the corrugated flue, these gases are compressed to bring up their pressure by the gases that follow. In fact, the pressure of these gases is kept up until the breeching 11 is reached.

Gases are poor conductors of heat and therefore the conduit for the incandescent gases should be as small as possible so that the heat of the interior particles may readily pass to the wall of the conduit. The velocity of the gases in such small conduits is high, which is very desirable as tests have shown that heat is taken up faster under such conditions.

No baffle of refractory material against which fuel is directed is necessary or even desirable in the present boiler and the loss of heat incident to the use of such baffles is avoided. The small cylindrical combustion chamber insures perfect combustion and the production of intensely hot gases which are driven at high velocity through the unlined portion of the flue.

The entire absence of soot and smoke in the unlined portion of the flue and in the fire-tubes, due to the complete combustion of the fuel in the lined or furnace portion, makes for great efficiency. This can be more readily understood when one considers that heat of the burnt gases which is sufficient to readily melt steel at the center of the flue. I believe that this high heat is due largely to the fact that the fuel is injected axially of and into the hollow cylinder of refractory material where it is immediately gasified, and, as it is already mixed with the proper amount of air, it practically explodes and the burnt gases are at the intense heat of explosion.

If desired, the combustion chamber may be formed as shown in Figure 3, where the metal furnace 30 is also corrugated and the refractory lining 31 conforms thereto.

The details of construction and proportions of the parts may all be changed by those skilled in the art without departing from the spirit of my invention as set forth in the following claims.

I claim:

1. A boiler comprising an elongated water-holding shell, a metal tubular member of flue proportions disposed in said shell below the normal water level therein and serving as a combined furnace and flue, the furnace portion of said member being lined with refractory to provide a combustion chamber whose surface area in square feet is equal to three or more times its volume in cubic feet, and of sufficient length to cause efficient combustion of fuel within the combustion chamber when the boiler is operating within its rated capacities.

2. In a liquid heating apparatus, a liquid container, a metal tube of approximately flue proportions disposed within said liquid container below the normal liquid level therein and provided with a fuel inlet end, a lining of refractory material extending from said end inwardly of said tube and of materially less length than said tube to constitute a combustion chamber; said refractory lined portion of said combustion flue being so restricted in bore and of such length that in operation the area of radiant refractory is sufficiently large in proportion to the volumetric combustion space so that combustion of fuel within the rated capacity of the boiler is substantially completed before the products thereof come in contact with the metallic heating surface of said tube; and means for injecting fluent fuel under pressure into the bore of said combustion flue.

3. In a liquid heater, having a liquid heating container, a combination of a metal tube of approximately flue proportions disposed within said liquid container below the normal liquid level therein and having a fuel inlet end, and a combustion apparatus comprising a tube of refractory material, of materially less length than said metal tube, and of sufficient length and so restricted in cross-sectional area that in operation the area of radiant refractory is sufficiently large in proportion to the volumetric combustion space to cause efficient combustion of fuel within the rated capacity of the boiler before the gaseous products of combustion contact with the metallic surface of said tube.

4. A boiler comprising a water heating space, a plurality of tubes extending through said space; and an unobstructed metallic flue of comparatively small water displacement lined with a tube of refractory material of substantially less length than said flue disposed in said space below the normal level of the water contained therein, said refractory lined portion of said combustion flue being of such length and so restricted in cross-sectional area that in operation the area of radiant refractory is sufficiently large in proportion to the volumetric combustion space to cause efficient combustion of fuel within the rated capacity of the boiler before the gaseous products of combustion come in contact with the metallic heating surfaces of the boiler; and means for injecting fluent fuel under pressure into the bore of said combustion flue.

5. In combination, a liquid heating space; and a metallic flue of comparatively small water displacement lined with a tube of refractory material of substantially less length than said flue disposed in said space below the normal level of the water contained therein; the lined section of said flue being proportioned to form a combustion chamber in which the area of the radiant refractory surface in square feet is approximately three or more times the volume of the combustion

chamber in cubic feet, said combustion chamber being of sufficient length to cause efficient combustion of fuel within the rated capacity of the apparatus before the flue gases come in contact with the metallic surface of said flue; and means for injecting fluent fuel under pressure into said combustion chamber.

In testimony whereof I affix my signature.

HUSTON TAYLOR.