

Nov. 5, 1929.

H. TAYLOR

1,734,310

BOILER

Filed Feb. 2, 1926 3 Sheets-Sheet 1

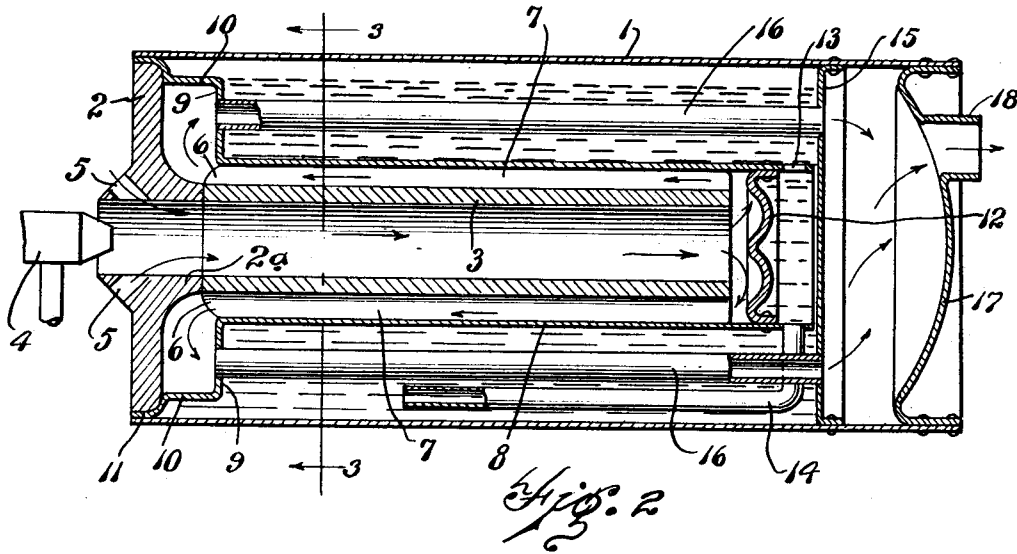
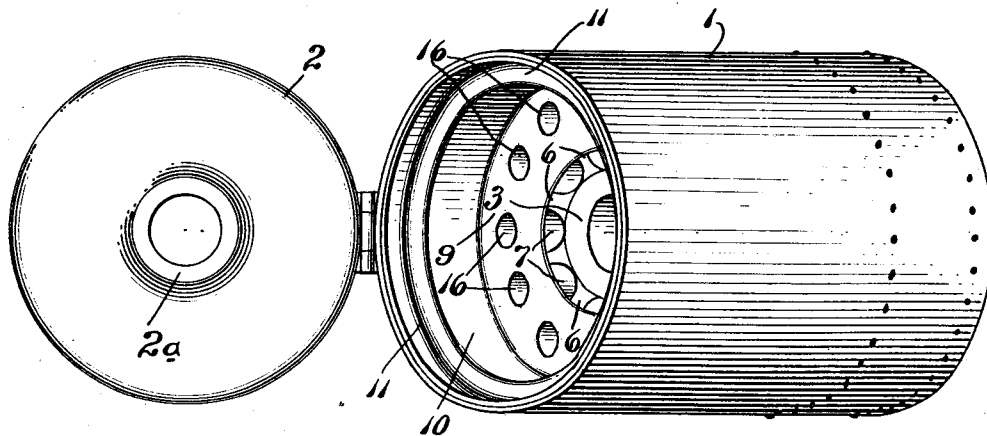
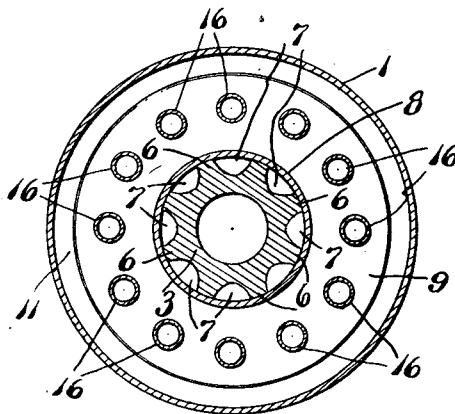


Fig. 3.

Fig. 1.

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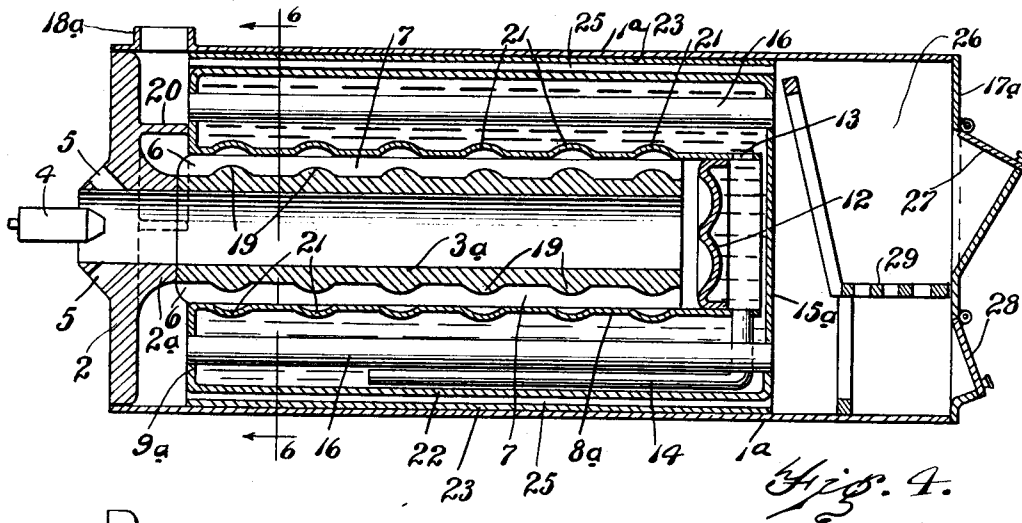
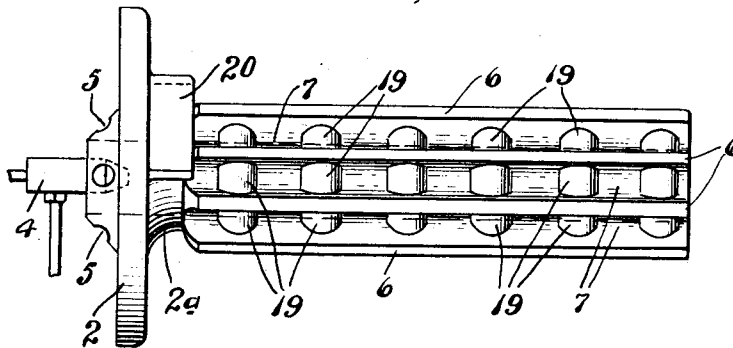
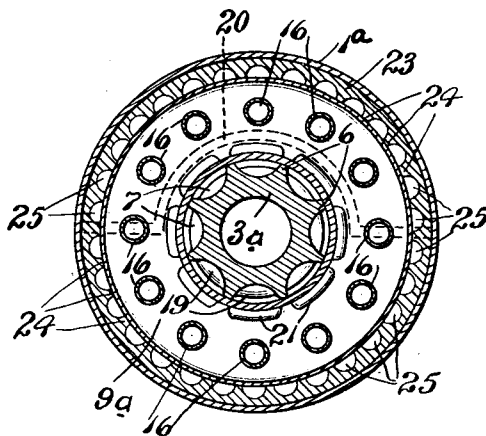
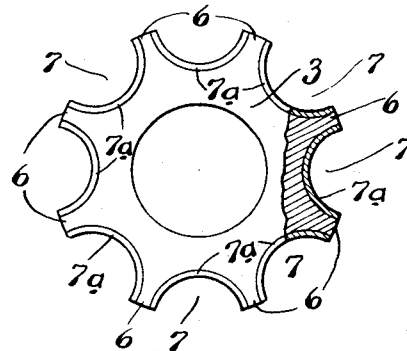
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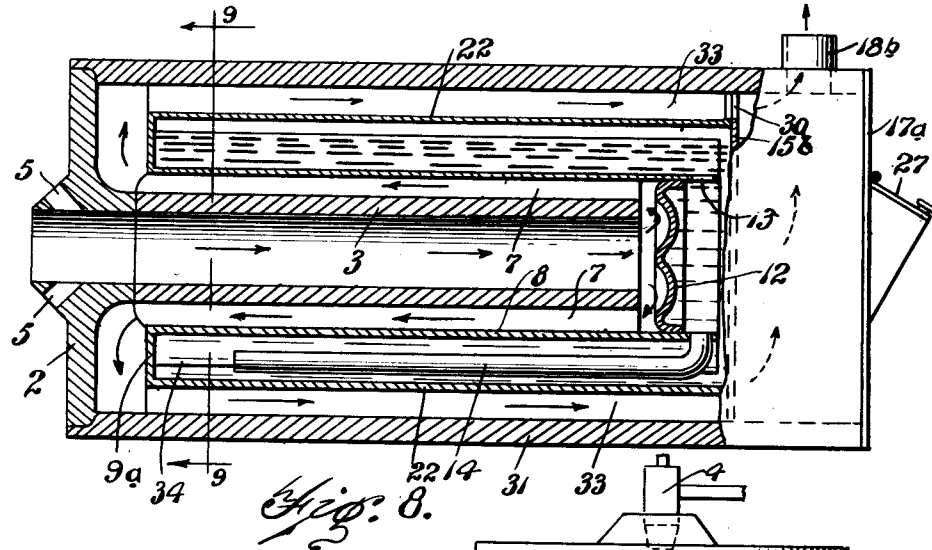
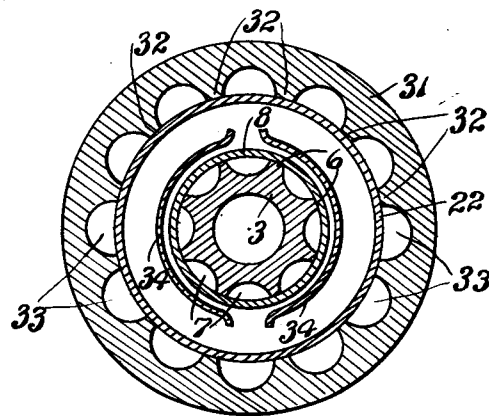
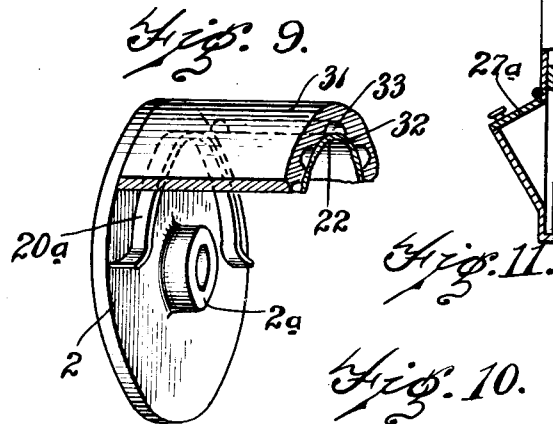
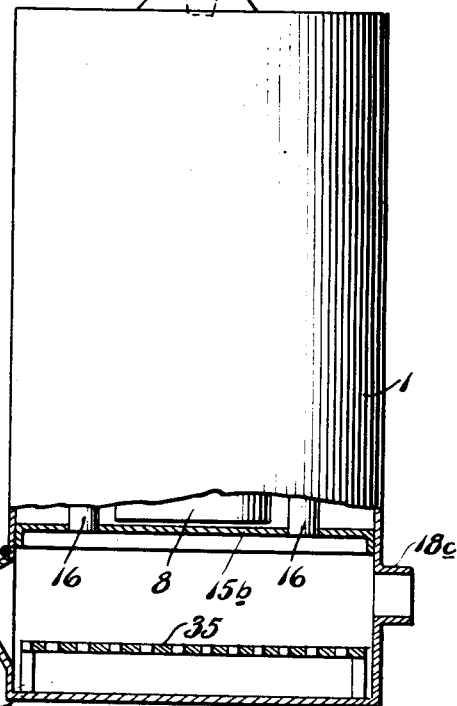
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UNITED STATES PATENT OFFICE

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BOILER

Application filed February 2, 1926. Serial No. 85,521.

This invention relates to boilers, and is more particularly concerned with a novel and economically constructed boiler in which the fuel used, preferably, will be a liquid such as oil, but which is also adapted to use gaseous fuel or even pulverized coal, and wherein the transfer of heat units produced by fuel combustion may be made through the heated surfaces of steam boilers, water heaters, stills, and various other similar or allied constructions. It is a primary object and purpose of the present invention to use therein a burner of the so-called "gun" type whereby the greatest possible efficiency may be attained, that is, the greatest absorption of heat units produced by the combustion of the fuel by the water within the boiler or similar construction, said boiler being so designed and constructed in relation to the burner that the heat transmitted and conducted through the walls and tubes of the boiler to the water is a maximum coming, not only from the direct contact of the products of combustion at a very high temperature with said tubes and walls but also through the reflection of heat from red hot heated surfaces to said tubes and walls and also through the jet impact of high temperature gases of combustion against surfaces of metal which on their opposed surfaces are in contact with the water in the boiler.

A further object of the invention is to construct a boiler of high efficiency for domestic use, compact in size and shape and economical to manufacture, being particularly adapted for domestic use in house heating, water heating and garbage incineration.

Involved in the construction are various ways of imparting heat from the products of combustion through the heating surfaces to the adjacent water in a boiler such as jet impact, high speed passing of highly heated gases, reflection from concave refractory surfaces and radiation from heated refractory materials forming a part of the construction, while the proper and efficient heating of the water is further effected by the circulation of the water in the boiler over the heating surfaces.

My invention is capable of embodiment in many forms, some of which are illustrated in

the accompanying drawings. For understanding of the invention reference may be had to the following description in connection with said drawings, in which

Fig. 1 is a perspective view of a boiler made in accordance with my invention, the door at one end thereof being open.

Fig. 2 is a longitudinal vertical section through the boiler construction shown in Fig. 1.

Fig. 3 is a transverse vertical section taken on the plane of line 3—3 of Fig. 2 and looking toward the front end of the boiler, as indicated by the arrows.

Fig. 4 is a longitudinal vertical section similar to that shown in Fig. 2 of a different form of construction embodying the invention and with which an incinerating chamber is combined and also having a corrugated combustion chamber embodied therein.

Fig. 5 is a side elevation of the barrel and the adjacent door into which the fuel is introduced, the barrel being that shown as used in the construction illustrated in Fig. 4.

Fig. 6 is a transverse vertical section on the plane of line 6—6 of Fig. 4 also looking in the direction indicated by the arrows.

Fig. 7 is an enlarged end elevation of the fuel receiving barrel, it being of a form in which reflectors are made elements of the construction.

Fig. 8 is a longitudinal vertical section similar to those shown in Figs. 2 and 4 showing a still further embodiment of the invention in which the flues are all a combination of heating surface and reflecting refractory material.

Fig. 9 is a transverse vertical section on the plane of line 9—9 of Fig. 8.

Fig. 10 is a fragmentary perspective showing details of construction of the boiler, and baffle on the door, and

Fig. 11 is a partial elevation and vertical section illustrating the boiler in vertical position, the other figures of the drawings illustrating the boiler in horizontal position.

Like reference characters refer to like parts in the several figures of the drawings.

It is a well known fact that in burning fuel oil in boilers its combustion must be

practically complete before it comes into contact with the heating surfaces which tend to cool the products of combustion by absorbing heat therefrom and transmitting it to the adjacent water. To complete combustion oil is usually burned in the presence of refractory material. In many instances the flame is directed against and strikes a target of fire brick so that the reflected heat causes a release and combustion of carbon monoxide which otherwise might pass out with the gases of combustion. This secondary combustion produces a greater heat than does the production of carbon dioxide in the first stage of combustion. The heat of the first stage of combustion is not in itself sufficient to cause the second stage without confining and reflecting the heat by a refractory material or its equivalent. I have found by experiment that by directing oil or gas flame through a tube of refractory material the concave walls of the inner side of the tube so reflect the heat inward towards its center that the combustion of the fuel is almost, if not quite instantaneous, complete and is almost of an explosive character.

My invention herein not only combines such construction of combustion barrel or tube with a boiler but also continues the use of refractory material along nearly all of the flues from the combustion chamber to the outlet or stack from which the products of combustion escape. By making use of a concave shape of refractory material at one side of the flues the value of the heating surface for the transmission of the heat to the water in the opposite sides of the flues is greatly increased or multiplied. Nearly the entire surface of the boiler is used as a heating surface and the heat of the passing gases is directed to the heating surfaces of the boiler by use of the principles of reflection in connection with the refractory sides of the flues so that the heat of combustion is absorbed by the water of the boiler rather than being lost in its escape to the outlet or stack. The reflectors used are in the shape of grooves through which the gases may pass to thereby give speed to the gases and advantage be taken of the law that the conduction of heat depends on the speed of the gases and the speed with which the water circulates in the boiler, and the design of the boiler herein is made in conformity to such laws.

It is further designed in a boiler of this invention to take advantage of the fact that gases under pressure or confined burn more quickly and produce a quicker combustion than those which are exposed to little or no pressure. Where the flues are restricted pressure is built up from the jet velocity in a confined chamber and the combustion in such case is practically instantaneous and borders on an explosion. Where the stack or outlet draft relieves the pressure of the com-

bustion chamber a tendency to produce a vacuum rather than pressure occurs. In the present invention the design is such that stack draft and the production of vacuum thereby is obviated and the heat necessary to the production of a stack draft and wasted ordinarily is used herein for the heating of water. In accordance with these principles I have designed and constructed a boiler capable of embodiment of various forms which will now be described:

In the construction of the boiler as shown in Figs. 1, 2, and 3 an outer cylindrical shell 1 of metal is used, at one end of which a door 2 of suitable refractory material or lined with such material is hinged mounted. The door has a central opening through it and at its inner side is formed with a central inwardly projecting portion 2^a, the opening described passing therethrough. This portion 2^a comes into conjunction with the end of an elongated barrel 3 which is also of suitable refractory material capable of resisting great heat without deterioration. The fuel used for heating is projected into the barrel 3 at the outer end of the opening made through the door 2, a suitable nozzle 4 for carrying the fuel being introduced into the outer end of said opening as shown. Passages 5 in the door for air to supply oxygen for the combustion of the fuel are provided. The barrel 3 has a cylindrical opening longitudinally therethrough and around its outer sides is formed with a series of longitudinal ribs 6 with grooves 7 between them. The material of which the barrel is made is high grade refractory material capable of readily conducting heat and the concaved grooves 7 between the ribs 6, preferably, are lined with segments 7^a, as shown in Fig. 7, of reflecting material which is highly resistant to the passage of heat or substantially nonconductive, there being, between the adjacent edges of the reflecting segments 7^a, exposed portions of the ribs 6 through which the transmission of conducted heat may be effected.

The barrel 3 described extends into a combustion chamber which is made by the cylindrical tube 8 of metal, preferably of copper, which surrounds the barrel and at its inner rear end extends a distance beyond the rear end of the barrel. The outer edges of the ribs 6 contact, at spaced apart points, with the inner sides of the tube 8, as fully shown in Fig. 3. The tube 8 at its front end is formed with an outwardly extending annular flange 9, the outer edges of which approach the inner sides of the shell 1 and are then turned in a forward direction, as indicated at 10, until the inner side of the door 2 is reached and are then flared outwardly to make the annular flange indicated at 11, passing between the edges of the door and the inner sides of the shell 1 at its front end, flange 11 being permanently secured to the

shell 1 and a suitable water and steam tight joint made.

Across the tube 8 a short distance beyond the inner end of the barrel 3 a plate 12 of sheet metal is positioned and rigidly secured in place being of disked form with a central substantially conical projection extending toward the inner end of the barrel 3. The inner end of the tube 8 extends a short distance beyond member 12 and in its upper side is provided with an opening 13 while at its lower side a tube 14 is secured which extends downwardly for a short distance and is then turned to extend horizontally toward the front end of the boiler, as fully shown in Fig. 2, 4 and 8. Directly back of the inner or rear end of the tube 8 a cross plate 15 is positioned, it extending entirely across the shell 1 and having a permanent riveted connection thereto, the joint being suitably caulked so that a water and steam tight joint is made. Flues 16 are located horizontally of the boiler around the tube 8 between the plate 15 and the annular flange 9 previously described.

The shell 1 of the boiler extends back of the plate 15 for a short distance and has an end plate 17 fitting therein and permanently secured in place. The plate 17 is provided with an outlet 18 for the products of combustion as they are exhausted from the boiler.

In the operation of the boiler, the fuel projected into the barrel 3 under pressure and mixed with air coming thereto through the passages 5 is burned throughout the entire length of the barrel 3 and the high temperature gases produced by the combustion impact against the corrugated member 12 located against the tube 8 near the inner or rear end of the barrel 3. These products of combustion and burning fuel are then turned back so as to pass forwardly through the grooves 7 lying longitudinally at the outer sides of the barrel, thus passing between the barrel and the tube 8 to the front or into the chamber between the door 2 and the parts 9 and 10, passing then again to the rear through the flues 16, from the rear end of which they pass outwardly through the outlet 18.

The burning of the fuel in the barrel heats the same to a high degree of temperature, in fact to a red heat or beyond. Heat is transmitted through the ribs 6 directly to the metal of the tube 8 and is thus conducted to the water within the boiler. The impact of the gases against the plate 12 and the direct impact striking of the jet of heated gases against this plate induces a very high passage of heat through this plate to the water back of it so that such water back of the plate 12 and within the tube 8 is quickly heated to a high degree of temperature and normally flows upwardly through the opening 13, being replaced by colder water which is drawn in through the pipe 14 to supply the

place of that flowing out, the water in the lower part of the boiler being of lower temperature than that in the upper portion. The heated gases pass back through the grooves 7 and to the front of the boiler through said grooves. The heat directly given off by these hot and burning gases to the tube 8 is delivered to the water and the reflectors 7^a furthermore reflect or radiate heat outwardly against the tube 8 so that it is further heated and may transmit additional heat to the water in the boiler; and finally the completed products of combustion, still at a relatively high degree of temperature, are carried back through the flues 16 and heat these flues directly, they in turn transmitting heat to the water in the boiler.

A boiler thus constructed is particularly efficient. There is, first, the jet impact of the burning fuel against the plate 12 at the back end of the barrel; second, the heat delivered by the passing gases on all the surfaces with which they come in contact, all of such surfaces being in direct and intimate relation with the water which is to be heated; third, the reflected heat from the passing gases along the reflector grooves 7 at the outer sides of the barrel in the combustion chamber; and fourth, the radiant heat of the red hot refractory barrel of the burner which is transmitted through the tube 8 to the water of the boiler. The absorption of the heat produced by the burning fuel is rapid and the efficiency of the boiler is especially high. This is particularly true in boilers of small size or of the size needed for household heating purposes.

The invention is capable of production in many embodiments and the elements of the construction heretofore described may be varied in several respects. For instance, in Fig. 4 the barrel 3^a is similar in all respects to the barrel 3 first described except that between adjacent ribs 6 outwardly extending transverse projections 19 may be made at spaced apart points in the length of each groove. The door 2 at its inner side is formed with an inwardly extending baffle plate 20 which is of curved form and at its lower ends comes substantially to the central horizontal plane of the boiler. The tube 8^a is formed with outwardly pressed sections 21 in opposition to the parts 19 on the tube 3^a. The tube at its front end is equipped with an outwardly extending annular flange 9^a and the water holding member of the boiler is completed by a shell 22 joining with the flange 9^a at its outer edges and extending to the rear therefrom a short distance beyond the rear end of the tube 8^a, an end closing plate 15^a being provided to close the rear end of the water holding member of the boiler. While the drawing shows the tube 8^a, flange 9^a, shell 22 and rear end 15^a as though integral, it is evident that from

a practical standpoint such water holding member of the boiler would be made of several parts securely riveted and with caulked joints so as to be, to all practical purposes and intents, integral rather than to make this water holding member as a single integral piece.

Around the shell 22 and between it and the inner sides of the outer shell 1^a a member 23 of heat insulating refractory material is placed, lining the inner sides of the shell 1^a and at its inner sides being formed with a consecutive series of alternate longitudinal ribs and grooves 24 and 25, best shown in Fig. 6. The burning fuel at high velocity passing through the barrel 3 strikes the deflecting plate 12, is thence carried to the front through the grooves 7 and by reason of the projections 19 and the corresponding corrugation 21 of the products of combustion are caused to swirl and eddy, in this manner bring substantially all parts thereof into intimate contact with the tube 8^a. The products of combustion then again pass to the rear through the lower flues 16 and through the lower grooves 25, being deflected downwardly at the front end of the boiler by the baffle plate 20. They then pass upwardly from the rear ends of said flues 16 and grooves 25 to pass again to the front through the upper flues 16 and upper grooves 25 to the outlet 18^a which is made at the front end and upper side of the shell 1^a, as shown in Fig. 4.

The shell 1^a is extended back of the plate 15^a for a distance and is closed by an end member or plate 17^a thereby enclosing a chamber 26 (see Fig. 4). An entrance door 27 is provided and a clean out door 28 below it, as shown; and between the openings closed by said doors a grate 29 is located in the chamber 26. Garbage and other waste material may be placed on this grate, passing into the chamber 26 through the opening normally closed by the door 27 and it is evident that such waste will be consumed completely in the operation of the boiler.

In Figs. 8 and 9 a still further form of the invention is illustrated. The outer metal shell is covered by a shell 31 of nonconducting material which, longitudinally thereof on its inner side, is formed with a consecutive series of ribs 32 and grooves 33 between them. The barrel 3 is the same as that first described with reference to Fig. 1 and the tube 8 enclosing the combustion chamber around the barrel is substantially the same, the annular outwardly extending flange 9^a at its front end being continued to the rear in a shell 22 which comes up to and is securely connected with a back plate 15^b making an enclosed water holding space. The plate 15^b is shown as provided with openings 30 near its edges to correspond with the various grooves 33 in the outer shell 31. The incinerating chamber substantially

like that shown in Fig. 4 is located at the rear end of the boiler. There are no flues corresponding to the flues 16 nor is there any baffle plate 20. The gases pass from the barrel 3, being deflected by the plate 12 and passing forwardly through the grooves 7 and thence going to the rear through the grooves 33 in the outer shell and escaping through the outlet 18^b, as shown in Fig. 8. Closely adjacent the drum 8 at each side thereof within the water holding space two curved plates 34 are mounted, it being apparent that the water between the tube 8 and the members 34 will be heated very rapidly and will circulate upwardly between the adjacent edges of the members 34 drawing in cold water between their lower edges. Of course if it is desired to replace the shell 1 and the lining 23 thereof in the construction shown in Figs. 4 and 6 by the single outer shell member 31 the baffle, such as indicated at 20^a in Fig. 10, will be used.

In Fig. 11 a vertical boiler is shown having an outer shell 1 and with the fuel entered at the upper end of the boiler. This boiler may be of the construction shown in Fig 2, being positioned vertically instead of horizontally. The only modification required is in the positioning of the outlet 18^c and of the door 27^a, while a grate 35 is located a distance below the member 15 on which the garbage and other waste may be placed for incineration.

This invention, as is evident, results in the production of a boiler of simple construction but one in which the quick heating of water for the production of hot water or steam is attained. The fuel is consumed and thereby produces heat units which are directed and controlled in such a manner as to be quickly absorbed by the water so that only a relatively small percentage of the heat units will pass from the boiler through the outlet, such as indicated at 18, 18^a, 18^b or 18^c in the various embodiments of the invention. A boiler is produced wherein greatly increased absorption of heat by conduction is attained due to the heated products of combustion coming into intimate contact with the metal with which the water is in contact, by the radiation of heat from surfaces heated to or beyond a red heat to said metal, the reflection of heat from reflector surfaces thereto and the jet impact of the heated gases against certain portions of the boiler which are in direct contact with the water to be heated, all combining to make the boiler one of high efficiency operating at low cost in respect to fuel consumption. The invention is defined in the appended claim and is to be considered as comprehensive of all forms of structure coming within their scope.

I claim:

1. A boiler furnace comprising a centrally located elongated barrel, said barrel being of

refractory material and formed at its outer surface with a plurality of spaced apart longitudinally located and radially projecting ribs separated by a longitudinal relatively narrow concaved grooves, a plurality of reflectors disposed one in and lengthwise of each groove, a tube enclosing said barrel, the outer faces of the ribs directly engaging with the inner side of said tube, and a plate secured across the tube a short distance beyond the inner end of the barrel, said plate being formed so as to deflect burning fuel projected against it to said grooves at the outer side of the barrel, a water holding enclosure located around the tube and extending a short distance beyond its inner end.

2. A boiler furnace comprising an elongated barrel of refractory material, formed at its outer side with a plurality of spaced apart longitudinally located ribs with grooves between said ribs, a tube surrounding said barrel with portions of its inner surface in contact with the edges of said ribs, said tube at its inner end extending a distance beyond the inner end of the barrel, a plate positioned across and secured to the tube a short distance beyond the inner end of the barrel and a distance from the inner end of the tube, a water holding enclosure surrounding the tube and having one end located closely adjacent the inner end of said tube, said tube at one side beyond said plate therein having an opening through it, and a pipe connected to the tube substantially opposite said opening and extending a distance into the water holding space around the tube.

3. A boiler comprising an outer shell, a door closing one end of the shell, enclosing means within the shell for containing a quantity of water, said means lying lengthwise of the shell and including a centrally disposed tube of metal, and a plate across the inner end portion of the tube and secured thereto, a barrel of refractory material extending into said tube and formed at its outer surface with radially projecting ribs separated by grooves, said ribs and grooves extending longitudinally of the barrel and said barrel at its inner end terminating short of the plate across the inner end of the tube, means on the door having an opening therethrough adapted to come into conjunction with the outer end of the barrel when the door is closed whereby fuel and air may be injected into said barrel, burned therein and the products of combustion carried forwardly along the grooves of said barrel, means located lengthwise of said water holding space through which the products of combustion may be again carried rearwardly and in intimate contact with the enclosure holding said water, and an end member closing the rear end of the shell, substantially as described.

4. A boiler comprising a cylindrical shell, a door for closing the front end of said shell, means for containing water within the shell including a central tube, a plate located across the shell adjacent its rear end and enclosing means between the front end of the tube and said plate, a barrel disposed lengthwise of the tube and terminating at its inner end a distance short of the inner end of said tube, a plate located across said tube adjacent its inner end a short distance beyond the inner end of the barrel, means on the door at its rear side having an opening therethrough disposed when the door is closed in close conjunction with the forward end of said barrel, ribs projecting from said barrel at spaced apart intervals and located longitudinally thereof so as to bear against the inner sides of the tube at their outer edges, flues located lengthwise of the water holding means within the shell, and an end member located at the rear end of the shell and secured thereto a distance from the said plate located across the shell and secured thereto whereby an enclosed space or chamber is provided between the rear end member and said plate.

5. A construction containing the elements in combination defined in claim 4 combined with a grate located in said chamber, and a door to said chamber through which material may be supplied to said grate for incineration of waste by the heat produced by the combustion of fuel used in said boiler.

6. In a horizontal boiler having an outer shell and means disposed within the shell for enclosing a water holding space said means including a horizontal and centrally located elongated tube and a deflecting plate located across the inner end portion of the tube, a barrel of refractory heat conducting material located within said tube centrally and longitudinally thereof, its inner end terminating a short distance from said deflecting plate and its outer end having an opening for injection of fuel under pressure, said barrel at its outer side being formed with a plurality of longitudinally extending radially projecting ribs separated from each other by relatively narrow longitudinal grooves, the outer faces of said ribs contacting with the inner side of the tube whereby to form a plurality of constricted longitudinal conduits, means adjacent the outer end of the barrel for injecting fuel and air into said opening whereby the fuel may be burned in said barrel and the burning fuel and products of combustion deflected by said plate for passage into and through said constricted conduits, and means for further conducting the products of combustion again longitudinally of the water holding space in the boiler, substantially as described.

7. In a boiler furnace, a combustion chamber including an elongated tube of metal and a deflecting plate across said tube near one

end thereof, a barrel of the refractory heat conducting material located lengthwise of the tube and having its inner end terminating short of said deflecting plate, said barrel being
 5 formed at its outer side with a plurality of radially projecting and longitudinally extending ribs with relatively narrow grooves between the ribs, said grooves being lined with a material of low heat conductivity and said
 10 ribs at their outer faces engaging against the inner sides of the tube throughout a substantial portion of their length.

8. In the construction defined in claim 7, the linings for the grooves being provided
 15 with heat reflecting surfaces.

9. A boiler furnace construction comprising an elongated cylindrical combustion chamber formed of refractory material, a tube surrounding said chamber and having
 20 spaced longitudinal portions of its interior surface in contact with spaced longitudinal portions of the exterior surface of the chamber, longitudinal conduits formed by the surfaces of the tube and chamber which lie be-
 25 tween said contacting longitudinal portions, means to cause the products of combustion to flow from the combustion chamber to said conduits, reflective material secured within said conduits on the sides thereof next to the re-
 30 fractory chamber to reflect the heat towards the tube, and a water casing surrounding said tube.

10. A boiler furnace comprising a casing, a tube longitudinally arranged within said
 35 casing and spaced from the walls thereof, a barrel of refractory material longitudinally arranged within said tube having a smooth elongated cylindrical combustion chamber formed therein and having relatively closely
 40 and substantially equally spaced portions of its exterior surface in contact with said tube, other portions of the external surface of said barrel between said first named portions and said tube forming a plurality of conduits,
 45 other longitudinal conduits arranged in the space between said casing and tube, means to cause the products of combustion to flow successively in opposite directions through said conduits, and a door swingingly mounted on
 50 the casing and adapted to fit within the end thereof, said door being provided with an aperture which aligns with the combustion chamber in closed position.

11. A boiler construction comprising an
 55 elongated tubular open-ended member formed of refractory material, said member defining on its interior a combustion chamber, a fluent fuel burner arranged to inject a jet of fuel under pressure into one end of said
 60 chamber, a second tube of high heat conductivity surrounding said member and in contacting relation thereto at a plurality of points so closely spaced as to provide for rapid heat transfer from said member to said
 65 tube, and so positioned as to provide relative-

ly restricted passageways for the longitudinal flow of gases between said tubes; the aggregate cross-sectional areas of said passageways with respect to the dimensions of the combustion chamber being such as to enable the
 70 burner by its supplied fuel to build up a combustion pressure in said combustion chamber and means at the end of said chamber opposite said burner to cause the products of combustion to flow from said combustion
 75 chamber through said passageways.

12. A boiler furnace comprising an elongated barrel of refractory material having a relatively smooth inner surface, said barrel being open from end to end and being pro-
 80 vided with a plurality of longitudinally extending grooves of relatively narrow width in its exterior surface forming ribs between said grooves, a tube surrounding said barrel and contacting throughout a substantial por-
 85 tion of said ribs whereby passages are formed by said grooves and the portions of said tube between adjacent ribs, concave reflectors fitted within said grooves, and means disposed
 90 across the end of said tube but spaced therefrom to deflect the products of combustion from said barrel in a reverse direction through said passages, said barrel and tube being dis-
 95 posed within a casing providing a water circulating space surrounding said tube and means.

In testimony whereof I affix my signature.
 HUSTON TAYLOR.

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