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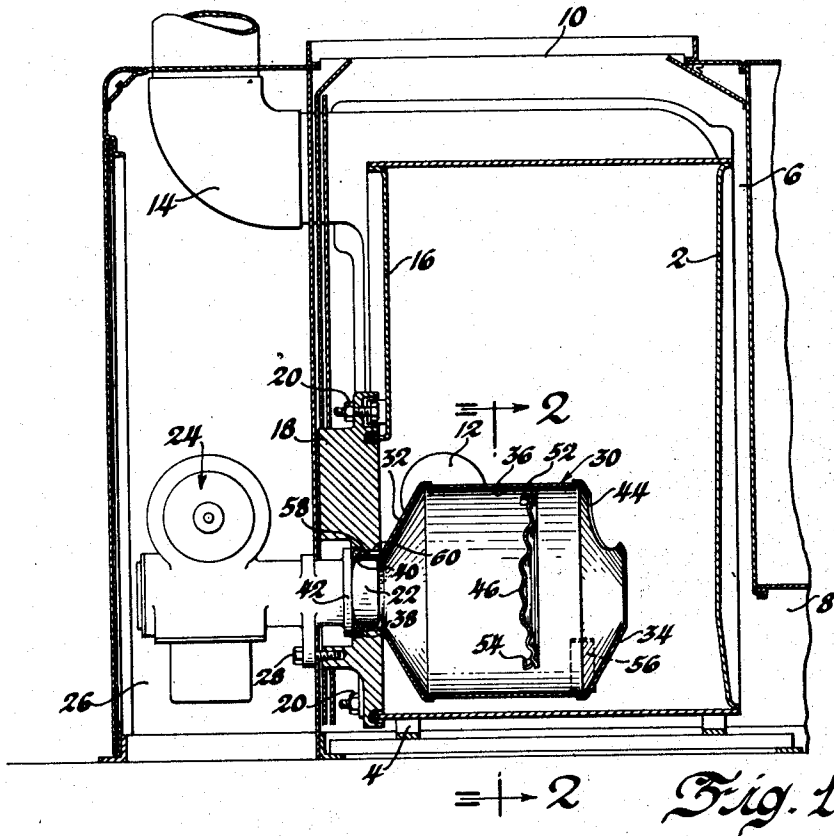
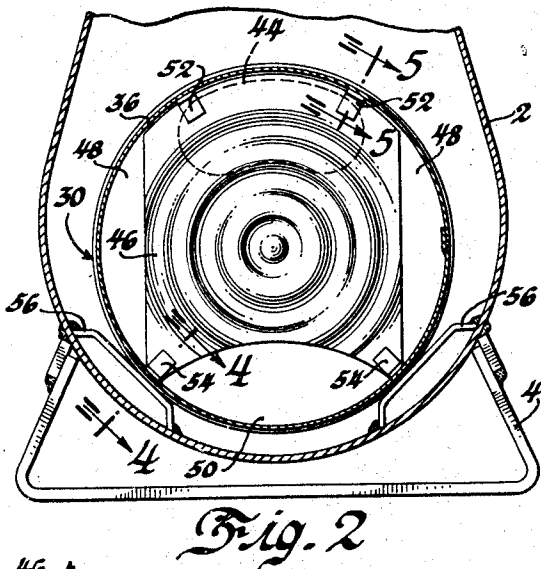
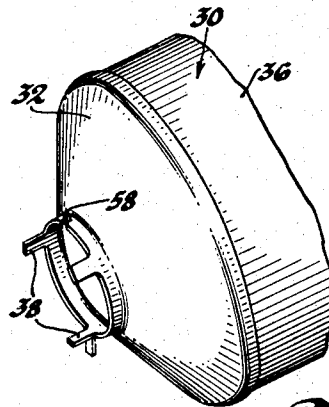
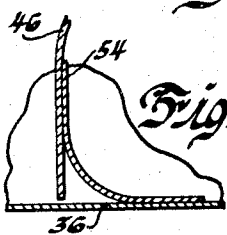
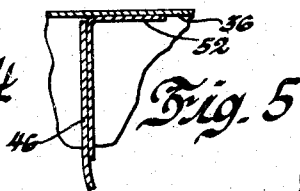
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2,329,271

COMBUSTION CHAMBER

Filed March 20, 1940

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

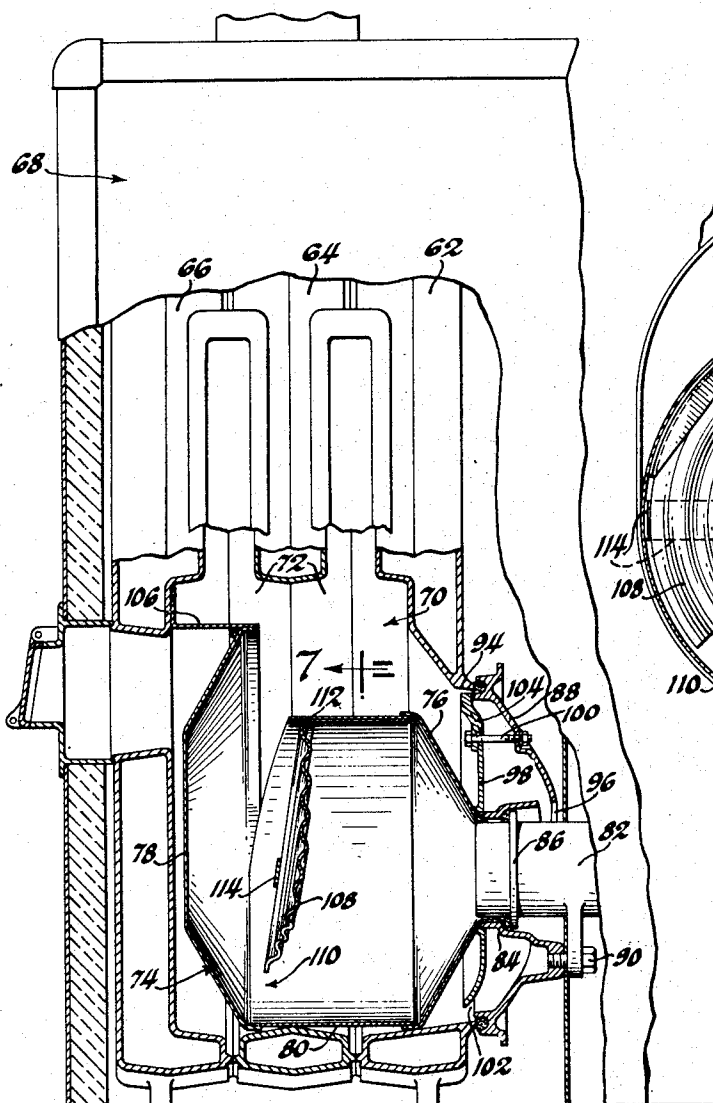
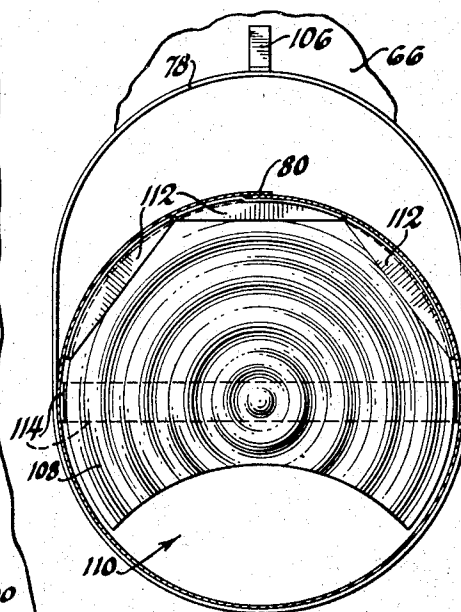


Fig. 7

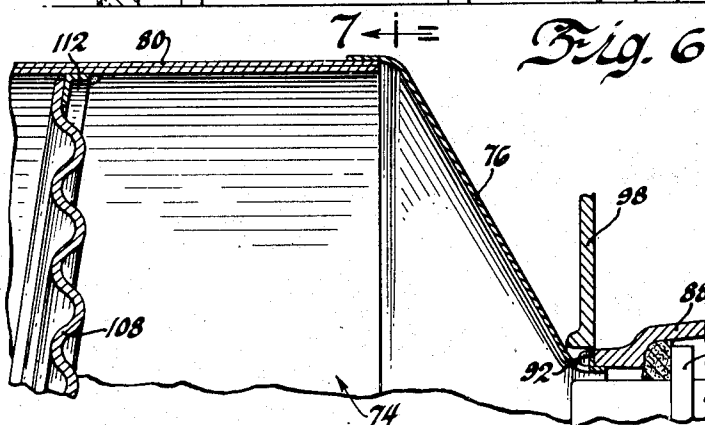


Fig. 8

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COMBUSTION CHAMBER

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3 Sheets-Sheet 3

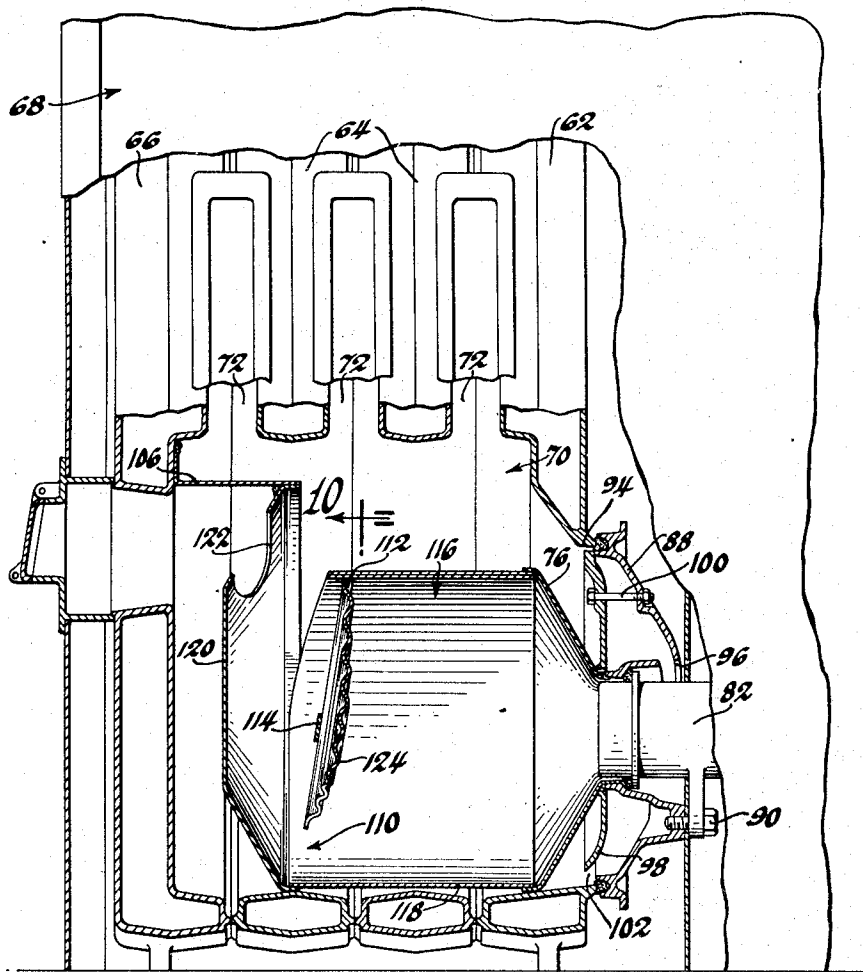


Fig. 9

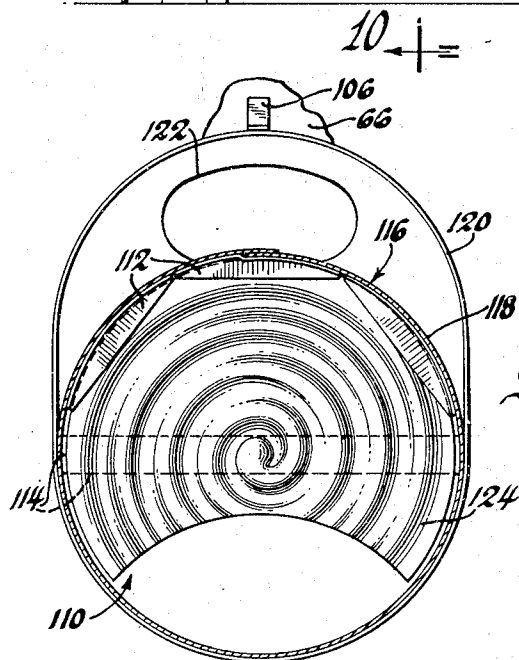


Fig. 10

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UNITED STATES PATENT OFFICE

2,329,271

COMBUSTION CHAMBER

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Application March 20, 1940, Serial No. 324,907

6 Claims. (Cl. 158-4)

This invention relates generally to domestic boilers and furnaces which are adapted for use with fluid fuel burners and more particularly to improvements in the construction of the combustion chambers thereof for use with conventional gun or pressure atomizing types of burners.

The principal object of the invention is to provide a combustion chamber construction which will afford both a highly efficient combustion of the liquid fuel and a highly efficient transfer of heat to the heat-absorbing surfaces of the boiler or furnace.

One of the principal features of the invention is the construction of the combustion chamber, which is preferably of relatively thin sheet metal, as a substantially closed chamber to provide a relatively confined space in which practically complete combustion occurs before the combustion gases escape through a relatively restricted outlet into the combustion space or primary heating chamber of the boiler or furnace with the heat-absorbing walls thereof primarily heated directly by radiant heat from the combustion chamber.

A further feature of the invention resides in a sheet metal target and baffle plate within the combustion chamber which is located intermediate the ends of the combustion chamber between the burner nozzle and outlet opening from the chamber and functions to promote complete combustion by vaporization of unatomized fuel and increased turbulence of the fuel mixture and also restricts the free passage of flame and combustion gases to the outlet opening to provide practically complete combustion within the chamber and cause the flame and combustion gases to contact all walls of the combustion chamber to heat the same to maximum temperature almost immediately when the burner is started.

Other objects and features of the invention, such as the location and mounting of the combustion chamber in the boiler or furnace and the novel arrangement, construction and combination of parts together with the advantages thereof, will be apparent from, or specifically pointed out in the following description and accompanying drawings in which:

Fig. 1 is a vertical sectional view, with parts in elevation, of a furnace embodying my improved combustion chamber.

Fig. 2 is a fragmentary enlarged transverse sectional view taken substantially on line 2-2 of Fig. 1.

Fig. 3 is a fragmentary enlarged perspective view of the burner end of the combustion chamber of Fig. 1.

Figs. 4 and 5 are fragmentary enlarged sectional views of the connection of the target or baffle plate to the combustion chamber taken respectively on lines 4-4 and 5-5 of Fig. 2.

Fig. 6 is a fragmentary vertical sectional view, with parts in elevation, of a boiler embodying a modified form of combustion chamber.

Fig. 7 is an enlarged transverse sectional view of the combustion chamber of Fig. 6 taken substantially on line 7-7 of Fig. 6.

Fig. 8 is a fragmentary enlarged vertical sectional view similar to Fig. 6 of a portion of the combustion chamber and adjacent parts.

Fig. 9 is a fragmentary vertical sectional view, with parts in elevation, of a boiler of greater capacity than the boiler of Fig. 6 with a further modified form of combustion chamber.

Fig. 10 is an enlarged transverse sectional view of the combustion chamber of Fig. 9 taken substantially on line 10-10 of Fig. 9.

Referring first to the form of the invention illustrated in Figs. 1 to 4, there has been shown rather diagrammatically in Fig. 1, a portion of an air heating and conditioning unit such as is disclosed in my Patent No. 2,160,269, granted May 30, 1939, but it will be obvious that my improved combustion chamber may be used with various other types of air heating units or furnaces and boilers.

For the purposes of the present invention only so much of the air heating unit has been shown as is necessary for an understanding thereof. The combustion space or primary heating chamber of the furnace is formed by the sheet metal combustion shell 2 which may be supported as by spaced brackets 4 within a compartment 6 in spaced relation to the walls of such compartment. The compartment 6 is provided adjacent its lower end with an air inlet opening 8 and adjacent its upper end with a hot air outlet opening 10 which is adapted to be connected to the usual air distributing ducts. It will be understood that the air inlet opening 8 may be associated, if desired, with an air circulating blower connected to return air ducts to provide for a positive circulation of the air to be heated during its passage through the compartment 6 by contact with both the heated walls of the shell 2 and the walls of such other flue passages as may be provided between outlets such as 12 in the shell 2 and the exhaust stack 14.

One of the walls of the combustion shell 2, such as the front wall 16, is provided with a relatively large opening which is adapted to be closed by the cover or burner mounting plate 18 secured to the

shell as by bolts 20. The cover or plate 18 is provided with a suitable opening to receive the burner tube 22 of the oil burner 24 which may be located within a compartment 26 and secured to such plate 18 as by bolts 28. The oil burner 24 has not been shown in detail but it will be understood that the same is generally of the pressure atomizing type in which liquid fluid is discharged under pressure through an atomizing nozzle in the burner tube 22 and adapted to mix with air supplied through such tube to form the combustible mixture.

The fuel mixture issuing from the burner nozzle and tube 22 is projected into the sheet metal combustion chamber indicated generally at 30 in which practically complete combustion occurs before the combustion gases escape into the combustion shell 2. This chamber 30 is made of relatively thin sheet metal of such material as certain chrome steel alloys which have been found to withstand the high temperatures encountered and attain a maximum temperature and become practically incandescent almost immediately upon starting the burner to transmit radiant heat directly to the walls of the combustion shell 2 from which the heat is efficiently absorbed by the air being circulated over such shell.

The combustion chamber 30 shown in Figs. 1 to 4 may be readily constructed with substantially conical end portions 32 and 34 which are welded to an intermediate cylindrical portion 36. The front end portion 32 is formed with a central opening to receive and fit around the burner tube 22 and is provided at this opening with spaced, projecting tongues 38 which, as indicated in Fig. 3, are adapted to be bent outwardly and clamped with a suitable gasket 40 between the flange 42 on the burner tube 22 and the mounting plate 18 as shown in Fig. 1. The rear end portion 34 is closed except for an outlet opening 44 adjacent the upper portion thereof through which the combustion gases escape into the combustion shell 2.

A transverse, sheet metal target and baffle plate 46 is provided within the combustion chamber 30 intermediate the ends thereof but preferably closer to the rear end than to the front end as shown in Fig. 1. This plate 46 is directly in the path of the fuel mixture from the burner and substantially divides the combustion chamber into two compartments which communicate through the side spaces 48 and bottom space 50 provided between plate 46 and the wall of the cylindrical chamber portion 36. The plate 46 is also preferably made of special heat-resisting chrome steel to withstand the intense heat to which the same is subjected and to stiffen the plate against permanent distortion due to repeated expansion and contraction on heating and cooling, it is preferably formed with a plurality of corrugations such as the circular corrugations shown in Figs. 1 and 2. The plate 46 may be secured within the chamber portion 36 by means such as the spaced upper angle members 52 and spaced lower angle members 54 which are welded to both the chamber portion and the plate. As shown in detail in Figs. 4 and 5, the lower members 54 are preferably formed on a larger radius than the upper members 52 whereby such lower members can more readily bend to some extent to provide, in effect, a flexible connection for the plate 46 which will permit the expansion and contraction thereof without buckling such as might occur if the plate were rigidly fixed to the combustion chamber.

As noted hereabove, the front end of the com-

bustion chamber 30 is secured between the burner and mounting plate 18 and the chamber is adapted to be supported adjacent its rear end within the shell 2 in spaced relation thereto as by means of the transversely spaced angle brackets 56. These brackets do not have to be secured to both the chamber 30 and shell 2 but may, for ease of assembly and to permit slight relative movement, be welded only to the shell 2 as shown in Fig. 2 or welded only to the chamber 30 prior to installation thereof in the furnace.

The combustion chamber 30 and adjacent parts of the burner 24, mounting plate 18 and shell 2 have been so constructed and arranged as to facilitate the assembly thereof. As will be apparent from Fig. 1, the chamber 30 together with the plate 46 if desired, the support brackets 56, may be fabricated and completely assembled as a unit. Such unit would then be assembled with the mounting plate 18 and the projecting tongues 38 bent outwardly and the burner 24 secured to the mounting plate 18 and this assembly then bolted to the shell 2. To provide for the positioning of the chamber 30 so that the outlet opening 44 will be at the upper side thereof, the front portion 32 may be formed with a vertically extending lug 58 which is adapted to fit within a longitudinal slot 60 in the mounting plate 18.

As has been stated heretofore, the chamber 30 provides a relatively confined space in which practically complete combustion occurs before the combustion gases or products of combustion escape through the relatively restricted outlet 44 into the shell 2. However, it is preferable that the relative dimensions of the chamber 30, the location and dimensions of the target and baffle plate 46, and the dimensions of the outlet 44 be such that this desirable result is attained without any appreciable resistance to the escape of the combustion gases or the development of any appreciable combustion pressure within the chamber 30.

The plate 46 has been referred to as a target and baffle plate. As will be apparent, such plate is positioned, in part, directly in the path of the fuel mixture from the burner to function as a target and not only thereby provide for increased turbulence of the burning mixture but also attain an extremely high temperature and completely vaporize any unatomized oil from the burner nozzle. The plate 46 also functions as a baffle to prevent the burner flame from passing directly to the outlet 44 and by thus increasing the length of flame travel within the chamber 30, it tends to retain the burner flame in the chamber 30 and provide for substantially complete combustion of the fuel mixture therein. In actual practice it has been found that very little, if any, flame ever issues from the outlet 44 and the entire chamber 30 reaches a state of incandescence and maximum temperature and efficiency within a period of less than two minutes from the time when the burner is started from a cold condition.

As has been mentioned, the combustion shell 2 will, therefore, be primarily heated by direct radiation from the chamber 30. The shell 2 is also, of course, heated to some extent by the combustion gases escaping from the chamber 30 into the combustion space provided by the shell 2 and the heat of such exhausted combustion gases may also be extracted by flue passages in the heating compartment which are interposed between the shell 2 and stack 14 as disclosed in my Patent 2,160,269, heretofore mentioned, or in any conventional manner.

Referring now to the modified form of combustion chamber of Figs. 6 to 8, there has been shown rather diagrammatically in Fig. 6 a portion of a boiler of the cast sectional type such as is disclosed in my pending application, Serial No. 295,893, filed September 21, 1939. This boiler construction consists generally of the front, intermediate, and rear hollow sections 62, 64 and 66, respectively, within the insulated casing or jacket 68 with such boiler sections so formed as to provide a combustion space 70 which is substantially surrounded by intercommunicating water spaces in the boiler sections. Above the combustion space 70, the boiler sections are so formed as to provide vertically extending flue spaces 72 between the sections for passage of combustion gases from the combustion space to the usual exhaust stack.

The combustion chamber of Figs. 6 to 8, indicated generally at 74, is constructed with the substantially conical end portions 76 and 78 welded to the intermediate cylindrical portion 80. The front end portion 76 is provided, as in the form of Figs. 1 to 5, with a central opening to receive and fit around the burner tube 82, with tongues 84 clamped between the burner tube flange 86 and the burner mounting plate 88 to which the burner is secured as by bolts 90, and with the vertical positioning lug 92.

The front boiler section 62 is provided with the relatively large opening 94 which is adapted to be substantially closed by the burner mounting plate 88 bolted to the front face of section 62. The burner mounting plate 88 is spaced slightly from the upper side of the burner tube 82 to provide an arcuate opening 96 to admit air to the combustion space and a baffle plate 98 is secured as by bolts 100 to plate 88 and interposed between the combustion chamber 74 and the plate 88 to prevent excessive heat radiation to the latter. This baffle plate 98 is spaced as shown at 102 from the burner mounting plate 88 substantially throughout its circumference by several spacing ribs such as 104 whereby a small amount of air will be drawn into the combustion space through the opening 96 and through the space between the baffle plate and burner mounting plate to prevent the transmission of excessive heat to the mounting plate.

The rear end portion 78 of combustion chamber 74 is elongated vertically in generally elliptical form so that the same extends above the top of the cylindrical portion 80 as shown in Figs. 6 and 7. To prevent the direct exhaust of combustion gases from the combustion chamber to the closely adjacent water containing space of the rear boiler section 66 such as might cause excessive sooting, the rear end portion 78 is not provided with an exhaust opening such as in the form of Figs. 1 to 5 but the combustion gases escape only through the opening formed by the space between the rear portion 78 and cylindrical portion 80 and are directed forwardly by the conical form of the rear portion to thereby equalize to a substantial degree the upward flow of such combustion gases between the several vertically extending flue spaces between the adjacent boiler sections above the combustion space.

The combustion chamber 74 may rest directly on the bottom of the boiler with a bracket 106 welded to the top of the rear chamber portion 78 and welded or clamped by any suitable means to the rear boiler section 66 to prevent exces-

sive warping and space this portion from the boiler.

In the combustion chamber construction of Figs. 6 to 8, a combined target and baffle plate 108 is provided of substantially the same form and for the same purposes as the plate 46 in Figs. 1 to 5. The plate 108 is, however, shown as inclined to some extent because of the limited space available to position the portion thereof which is directly in line with the oil burner nozzle and burner tube 82 at such minimum distance therefrom as has been found to be most satisfactory. This plate 108 is corrugated similar to plate 46 but is so formed, as shown particularly in Fig. 7, as to provide only a lower space indicated at 110 between the plate and combustion chamber.

The plate 108 is also secured to the combustion chamber in a slightly different manner than the plate 46 in the form of Figs. 1 to 5. Adjacent only the upper part of the plate 108, angle members 112 are secured as by welding to both the plate and combustion chamber and a cross brace 114 is provided with its bent ends welded to the chamber and welded only closely adjacent its ends to the plate 108 so as to permit the expansion and contraction of the center and lower edge of the plate on changes of temperature.

Referring now to Figs. 9 and 10 which show a further modification of the combustion chamber for a boiler of greater capacity than the boiler of Fig. 6, it will be noted that the boiler construction, insofar as is merely generally shown, is the same as that of Fig. 6 heretofore described except that a second intermediate boiler section has been provided. The front end portion of the combustion chamber 116 of Figs. 9 and 10 and the connection of the same to the burner mounting plate are also the same as in the form of Figs. 6 to 8, and to avoid repetition, the same reference numerals have been applied to all those parts in Figs. 9 and 10 which correspond to similar parts in Figs. 6 to 8 which have been heretofore fully described.

To provide for the proper distribution and substantial equalization of the flow of combustion gases from the combustion chamber 116 to the flue spaces between the several boiler sections shown in Fig. 9, the intermediate cylindrical portion 118 of chamber 116 is slightly longer than the corresponding portion of the chamber for the boiler of Fig. 6, and the rear end portion 120 is not only extended above the intermediate portion to provide an exhaust opening to direct combustion gases forwardly over the chamber as in the form of Figs. 6 to 8 but is further provided with the additional exhaust opening 122 adjacent the upper end thereof to permit some of the combustion gases to escape rearwardly and upwardly.

The combined target and baffle plate 124 is secured to the combustion chamber 116 in the same manner as heretofore described with reference to plate 108 of Figs. 6 to 8, but as shown particularly in Fig. 10, this plate 124 is provided with spiral corrugations which provide slightly less resistance to expansion and contraction than the circular, concentric corrugations in the prior forms. It will of course be understood that spiral corrugations could be used, if desired, in the forms of Figs. 1 to 8.

It will be apparent that many changes and modifications may be made in the detailed construction and arrangement of parts within the

scope of my invention and that many advantages of the several novel features thereof in addition to those mentioned herein will be obvious to those skilled in the art.

I claim:

1. In a heating apparatus, a heat exchange unit having walls defining a hollow combustion space, a combustion chamber within said space in spaced relation to the walls thereof, said chamber having an inlet opening adjacent the front end thereof, a liquid fuel burner associated with said inlet opening to project a fuel mixture through said opening into said chamber, and said chamber having an outlet opening adjacent the rear end thereof with the portion of said chamber adjacent said outlet opening so formed as to direct the combustion gases upwardly and forwardly over said chamber into said space.

2. In a heating apparatus, a heat exchange unit having walls defining a hollow combustion space, a combustion chamber within said space having an inlet opening adjacent the front end thereof, a liquid fuel burner associated with said inlet opening to project a fuel mixture through said opening into said chamber, said chamber having an outlet opening adjacent the upper portion of the rear end thereof to permit the escape of combustion gases rearwardly and upwardly into said combustion space, and said chamber having a second outlet opening adjacent the rear end thereof with the portion of said chamber adjacent said second outlet opening so formed as to direct a portion of the combustion gases upwardly and forwardly over said chamber into said space.

3. In a heating apparatus, a heat exchange unit having walls defining a hollow combustion space, a liquid fuel burner, a burner mounting plate

secured to one of said walls, a combustion chamber having an inlet opening for said burner, and means for securing said chamber in said combustion space including means on said chamber adapted to be clamped between said burner and said mounting plate.

4. In a heating apparatus, a heat exchange unit having walls defining a hollow combustion space, a liquid fuel burner, a burner mounting plate, a combustion chamber within said space having an inlet opening adjacent its front end, said burner being associated with said inlet opening to project a fuel mixture through said opening into said chamber and a baffle plate interposed between the front end of said combustion chamber and said burner mounting plate to prevent excessive heat radiation to the latter from said chamber.

5. The combination set forth in claim 4, in which said baffle plate is spaced from said burner mounting plate and means is provided for the admission of air from outside of said combustion space between said plates.

6. In a heating apparatus, a heat exchange unit having walls defining a hollow combustion space, a sheet metal combustion chamber within said space in spaced relation to the walls thereof, said chamber having a fuel inlet adjacent one end and an outlet adjacent the opposite end thereof opening into said space, a liquid fuel burner associated with said inlet to project a fuel mixture across said chamber, and a sheet metal baffle in said combustion chamber extending across the line of projection of the fuel mixture to deflect the flow thereof between said inlet and said outlet and to prevent the passage of unburned liquid to said combustion space.

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