This invention relates to improvements in the generation of steam under stationary boilers, and is especially useful where the fuel is to be burned in suspension, as, for example, in the form of pulverized coal, carbonated oil or gas.

The nature and objects of my invention will be best understood from the following brief statement of stationary boiler practice.

In the designs of previous standard boilers, it has not been found practicable to obtain very high rates of firing, such, for example, as are obtained in locomotive practice. It is, therefore, one of the primary objects of my invention to increase the rates of firing; and, therefore, the capacity of stationary boilers.

It is another object of the invention to obtain this result with what constitutes a relatively small amount of evaporating surface as compared to standard practice. It is still another object of the invention to provide a simple arrangement whereby ordinary existing boilers may be readily converted into high capacity boilers.

My invention also contemplates the simplification of engineering work and manufacture by providing a novel arrangement of a boiler combustion chamber unit which can be used singly or in parts to construct boilers of varying size in accordance with the ultimate capacities desired.

How the foregoing, together with such other objects and advantages as are herein-after pointed out, or may be incident to my invention, are realized, is illustrated in preferred form in the accompanying drawings, wherein—

Fig. 1 is a longitudinal vertical section through a boiler combustion chamber unit made in accordance with my invention.

Fig. 2 is a section taken on the line 2—2 of Fig. 1, and Figs. 3 to 7, inclusive, are sectional views illustrating the application of my invention considered as a boiler combustion chamber unit to stationary boilers of various types, either existing or new.

Referring now to Figs. 1 and 2, it will be seen that I have constructed a boiler combustion chamber unit indicated as a whole by the reference letter A, which unit is in the form of a fire box. The unit is constructed as follows: Headers 7 and 8 are arranged at the ends of the units, the headers being of the shape most clearly disclosed in Fig. 2, i.e., there are top and bottom sections 9 and 10, side sections 11 and 12, and an intermediate cross section 13. A row of tubes 14 connect the lower portions of the side sections 11 and 12, and a row of tubes 15 connect the bottom sections of the headers. The tubes 14 and 15 constitute what may be termed a fire pan portion which may have a refractory lining 16.

A row of tubes 17 connect the upper portions of the side sections of the headers, these tubes being provided with longitudinally extending fins 18 whereby such tubes constitute, in effect, the vertical side walls of the combustion space above the fire pan. A row of vertically disposed finned tubes 19 close one end of the combustion space above the fire pan, and a row of bent finned tubes 20 close the opposite end of the combustion space above the fire pan. These tubes 20 carry a refractory wall portion or flash arch 21.

The rear end of the fire pan is formed by a row of vertical finned tubes 22, and there are similar tubes 23 at the opposite end, which latter, however, are spaced apart to provide an opening 24 for the burner mechanism 25.

Finned tubes 26 extend from the rear section 13 of the rear header upwardly and forwardly to the section 9 of the front header. These tubes 26 carry a refractory arch 26 which extends partway from the rear header to the front header.

From the description thus far given, it will be seen that the fuel is introduced in the fire pan portion and is subjected to radiant heat from the refractory lining of the fire pan, and to radiant heat from the flash arch 21 and from the arch 26. The fuel and flame stream bends from a horizontal direction upwardly, and then turns underneath the arch toward the outlet or throat portion 21 provided by the main arch and the flash arch 21. On leaving the throat B the gaseous products of combustion may be directed in any one of a number of different ways, as illustrated in Figs. 3 to 7, inclusive. A row of relatively widely spaced tubes 27 connect the upper sections of the headers 7 and 8, these tubes being sufficiently widely spaced apart to permit the gaseous products of combustion to flow relatively freely therebetween.
The total combustion space presented by the unit described is relatively small, but since the fuel and flame stream takes a somewhat sinuous course whereby adequate length of flame travel is provided, and since the fuel is preferably admitted with a large portion of the air for combustion under conditions to produce violent and intense combustion, and since the fuel and flame stream is subjected to radiant heat from the refractories, the combustion is completed within the combustion space afforded by the unit. The tubes 20, 22, 23, 26 and 27 are subjected to radiant heat, and since the fuel is burned with a violent flame of intense temperature, heat is transmitted at a very high rate indeed, and thus a large capacity for a relatively small amount of evaporating surface is obtained.

Additional air for combustion is admitted through inlets 28 arranged at opposite sides of the fire pan near the top thereof, such inlets being supplied with air from the air spaces 29 to either side of the fire pan. The air, in passing through the channels 29, becomes highly preheated, thus adding to the furnace temperature head, and assisting in obtaining more perfect and complete combustion within the combustion space. Such air also enters at right angles to the path of flame and serves to set up eddying tending to produce violent combustion and to improve combustion.

It will be seen that the unit may be connected by tubes 30 to drums or to any other adjoining boiler part or structure in any one of the ways indicated in Figs. 3 to 7 inclusive. As indicated in dot and dash lines in Fig. 2, the units may be placed side by side to vary the size of the installation as may be required. In Fig. 3 I have shown the unit applied to a horizontal boiler C of the cross drum type. In this case the bank of tubes of the cross drum boiler would be baffled to give a flow such as indicated by the arrows. When one or more units is associated with a boiler of this type, it will be seen that a very high capacity installation of very small size results. When applying the unit to a boiler of the horizontal type it is preferable to incline the tubes of the unit in the same general fashion as the remaining boiler tubes.

In Fig. 4 I have shown a unit applied to a stationary boiler D of the fire tube type. In this case the products of combustion take the path indicated by the arrows into the stack 31.

In Fig. 5 another adaptation of a unit to a fire tube boiler is illustrated. Fig. 6 illustrates the application of the invention to what may be termed a vertical boiler E. According to this arrangement the tubes 30 connect the upper portion of the header 7 with the upper or steam drum 32.
of one header with the top portion of the other header, and tubes connecting said cross connecting portion with said top portion.

3. A boiler unit including front and rear headers each having connected top, bottom and side portions substantially in the form of a hollow rectangle, with cross connecting portions between the side portions of each header intermediate the top and bottom portions thereof, tubes connecting the side and bottom portions of one header with the corresponding portions of the other header, and tubes connecting a cross connecting portion of one header with the top portion of the other header, together with an arch carried on said last tubes.

4. A boiler unit including front and rear headers each having connected top, bottom and side portions substantially in the form of a hollow rectangle, with cross connecting portions between the side portions of each header intermediate the top and bottom portions thereof, tubes connecting the side and bottom portions of one header with corresponding portions of the other header, and tubes connecting a cross connecting portion of one header with the top portion of the other header, together with an arch carried on said last tubes, tubes connecting said cross connecting portion with the said top portion, and an arch carried on said tubes.

5. A stationary boiler unit of substantially greater length than height, having a header at each end thereof, tubes connecting said headers and arranged to form a box-like combustion chamber having a fire pan portion in the lower part thereof, a refractory lining for the fire pan portion extending substantially from header to header, means for introducing fuel into one end of said fire pan to be burned in suspension in said chamber, the tubes of the boiler unit not associated with the fire pan being exposed to the radiant heat of the flame and other tubes extending diagonally across a substantial part of the combustion chamber, said latter tubes also being exposed to the radiant heat of the flame.

7. A stationary boiler unit of substantially greater length than height, having a header at each end thereof, tubes connecting said headers and arranged to form a box-like combustion chamber having a fire pan portion in the lower part thereof, a refractory lining for the fire pan portion extending substantially from header to header, means for introducing fuel into one end of said fire pan to be burned in suspension in said chamber, the tubes of the boiler unit not associated with the fire pan being exposed to the radiant heat of the flame and other tubes extending diagonally across a substantial part of the combustion chamber, said latter tubes also being exposed to the radiant heat of the flame and carrying a refractory baffle.

8. A stationary boiler unit of substantially greater length than height, having a header at each end thereof, tubes connecting said headers and arranged to form a box-like combustion chamber having a fire pan portion in the lower part thereof, a refractory lining for the fire pan portion extending substantially from header to header, means for introducing fuel into one end of said fire pan to be burned in suspension in said chamber, the tubes of the boiler unit not associated with the fire pan being exposed to the radiant heat of the flame and other tubes extending from the middle portion of one header to the upper portion of the other header and diagonally bisecting the combustion chamber.

In testimony whereof, I have hereunto signed my name.

VIRGINIUS Z. CARACRISTI.