United States Patent

[11] **3,536,049**

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[54] **BOILER**
6 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **122/235,** 110/28
[51] **Int. Cl.** **F22b 21/22**
[50] **Field of Search** ..... 110/28(F); 122/235(P)

[56] **References Cited**
UNITED STATES PATENTS

2,573,910	11/1951	Kreisinger	122/235X
3,172,395	3/1965	Kidwell et al.	122/235

Primary Examiner—Kenneth W. Sprague

ABSTRACT: This invention relates to a boiler design, for burning pulverized or granulated solids industrial refuses, liquid and gaseous fuels in a step wise way, in which the horizontal axis quasi cylindrical gasification and combustion chamber, including an outlet restriction is formed by unprotected, exposed to radiation, duly shaped vaporizing tubes, including an ash discharge and having between them a multiplicity of tangential tuyeres all along and around its periphery, supplied from surrounding air plenum.

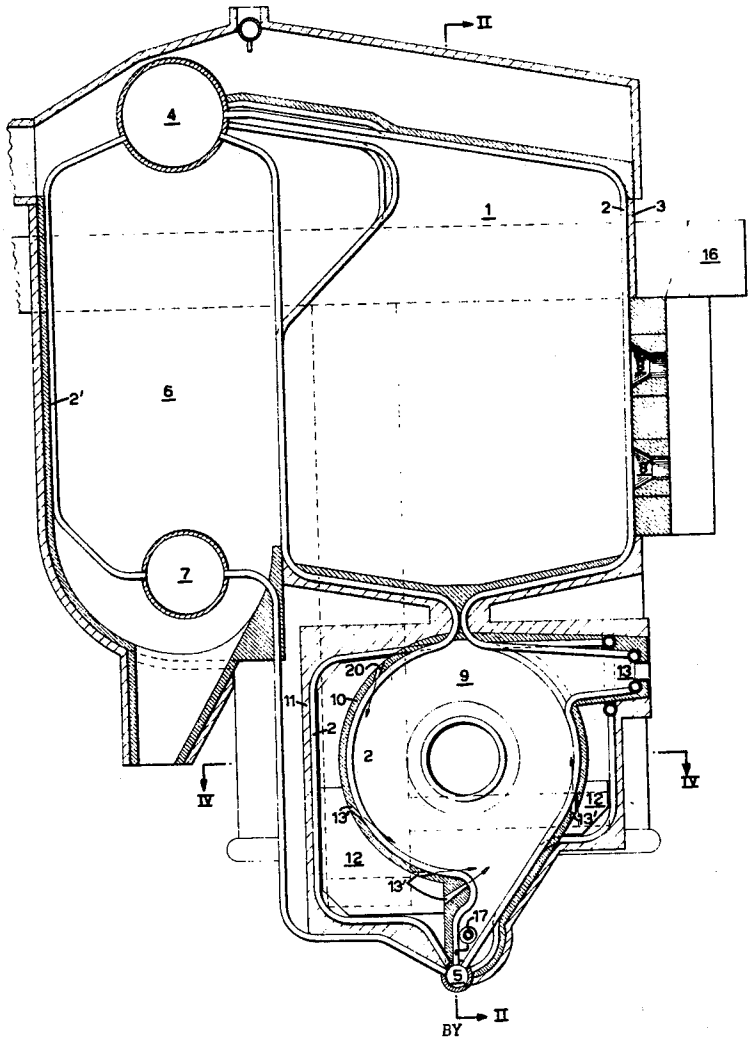
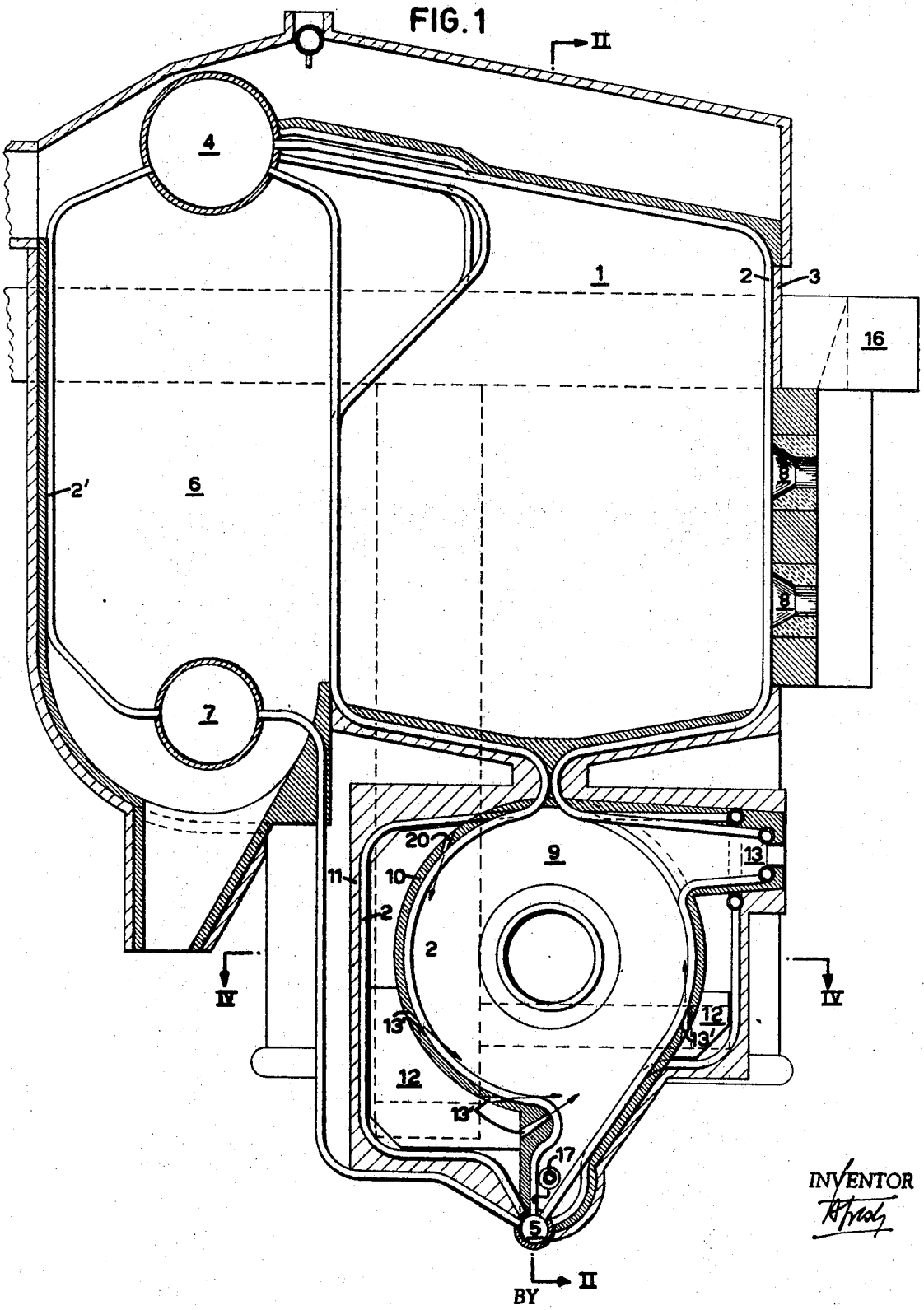


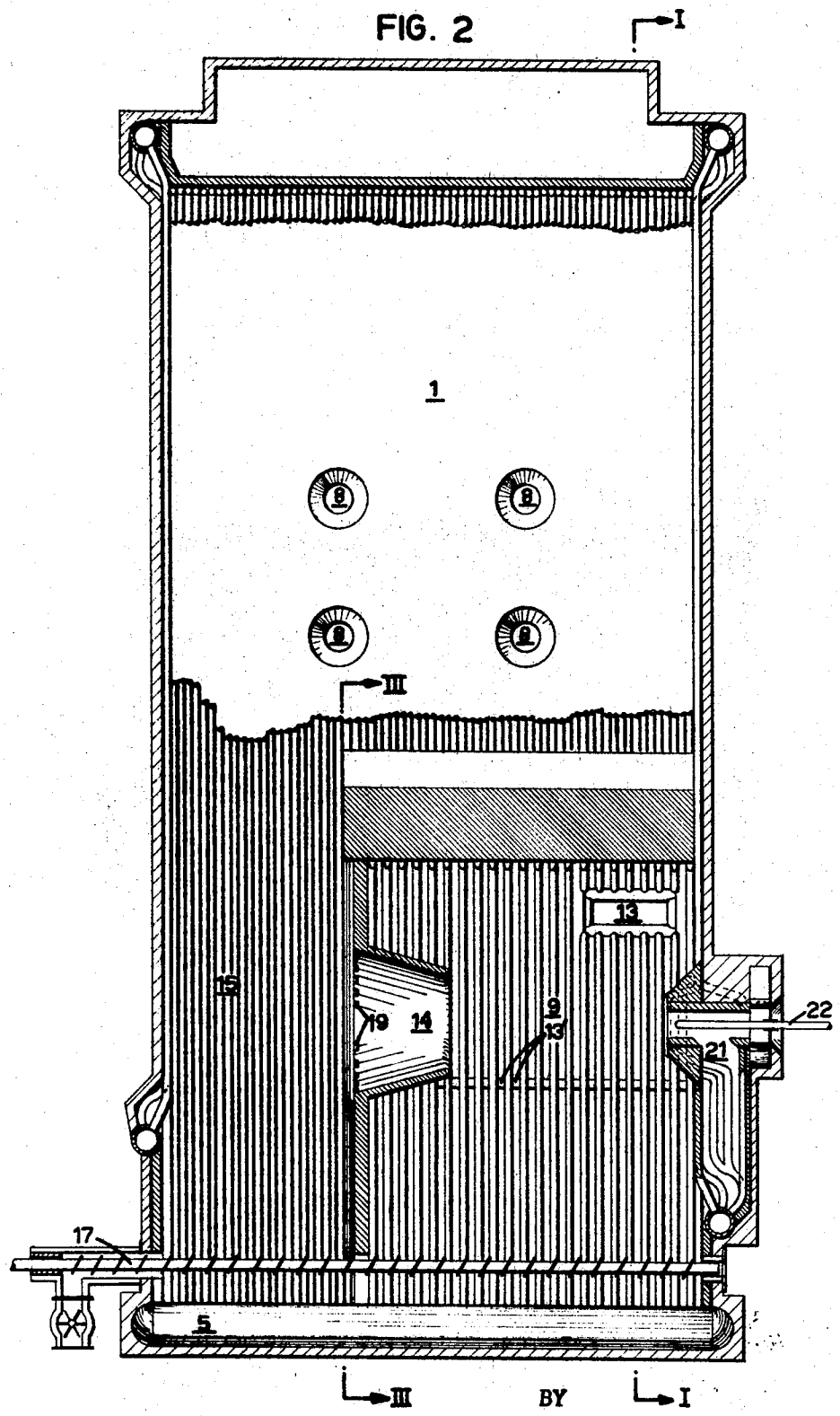
FIG. 1



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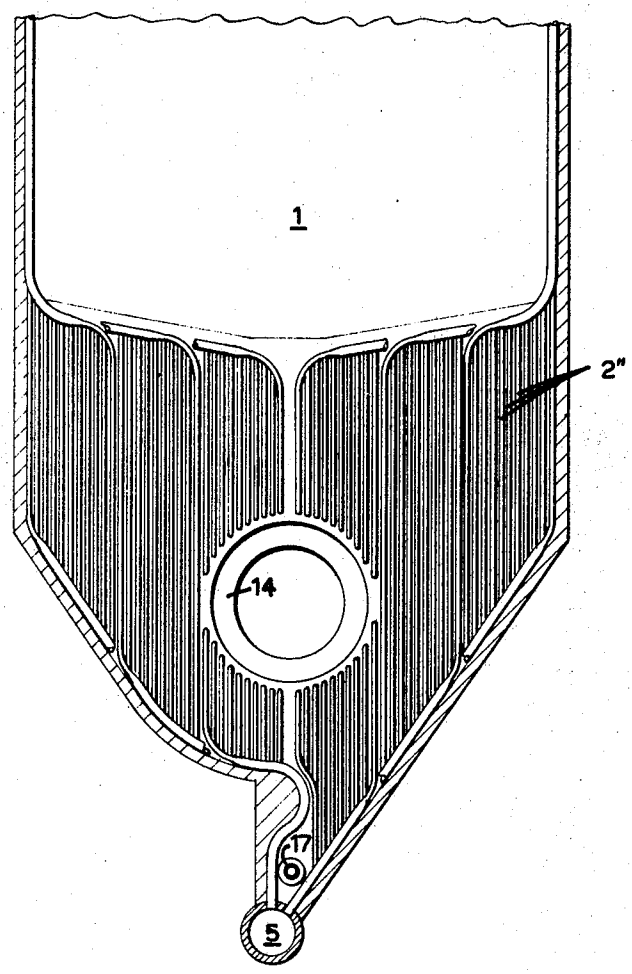
FIG. 2



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FIG. 3

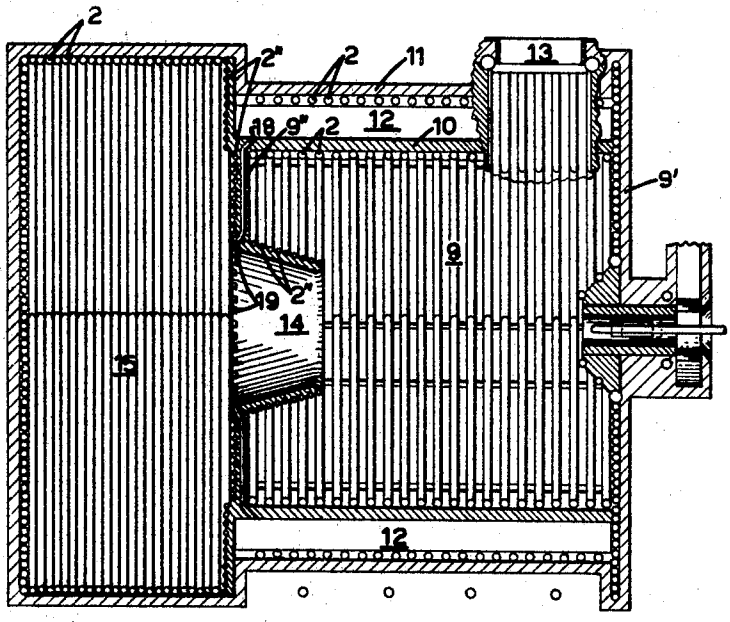


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FIG. 4



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BOILER

SPECIFICATION

This invention relates to boilers of the type having a radiation chamber, surrounded by boiler tubes, tangent one to the neighbour one, forming the walls and ceiling of said chamber, at the bottom of which is the customary ash disposal system. At least one of said walls is perforated by the fuel burners, to which effect the boiler tubes are deviated somewhat.

With the present boiler design of voluminous parallelepipedical radiation combustion chambers, for burning simultaneously small size solids, liquid and gaseous fuels, fired from front, side or corner openings, in the periphery of the enclosure, it is difficult to obtain a high degree of combustion completion of the order of 99.9 percent.

This situation arises from the insufficient concentration of reactants in the last stages of combustion for the harder to burn combustible particles remaining in zones where nitrogen and products of earlier combustion and least oxygen prevails.

Furthermore, the common combustion chamber, being designed with a volume intended to provide a residence time for the biggest particle size, results in more costly construction systems, in spite of what, the wanted results are not really reached in practice, for mere volume increase does not imply the required exitous meeting of fuel particles and oxygen.

The present invention relates to a design able to overcome the present limitations, and basically provides for each of the three types of fuels the required residence time and combustion conditions to reach the desired degree of completation while keeping the water circulation system to be independent of which fuel is being burned, in such a way as to obtain an integral unit instead of a definite separation as applied by the writer in Argentine Pats. Nos. 137,332 and 151,173.

Such a design is able to be applied to the modern boiler furnace constructions such as steel encased, tangent tubes, etc., for pressurized combustion chambers.

The small particle solid fuels, burn in a water cooled vortex chamber placed directly or aside or below the combustion enclosure, for liquid and gaseous fuels and communicating with it through a restriction throat, depending on the site conditions.

The cylindrical geometry of the water cooled vortex chamber for solid fuels is obtained by forming it with tubes which are in series to the ones forming the enclosure of the oil and/or gaseous fuels burning recint.

The vortex chamber, with adequately spaced bare water tubes, is provided with tangential air nozzles, distributed all along in the intertube spaces sized duly to promote a back and forth displacement of the particles while rotating in helical paths.

The fuel particles are so bound to form an "aerodynamical grate" being crossed by the inflow of air and intermediate combustion products, the bars of which are precisely a multiplicity of rotating rings.

The centrifugal forces applied keep the combustible solid particle remainings in the areas with the highest oxygen concentration, in opposition to the traditional solutions, so being able to reach the highest degree of combustion completation.

The vortex chamber is intended to obtain solid powdered ashes, the water tubes being barely exposed to flame radiation, absorbing sufficient heat to avoid the melting of ashes.

The vortex chamber is designed to work under nearly isothermal conditions, and not as in the known cyclone furnace, which tends to high adiabacity in order to obtain molten ashes.

This main difference of approach, results in many differences of design and operation.

The geometry of the tubes in the vortex chamber is such as to provide in their lower part a sink for ashes, which due to their high specific gravity possess a higher centrifugal force and this leads them into a cooled channel from where they are lead out by a rotating screw and discharging valve.

The invention is able to be applied to already existing units, suffering incomplete combustion problems, or in the design of new boilers for different solid fuels in set granulometries hard to reduce economically or for multifuels units, including those just mentioned.

The drawings show the design on the most difficult case of introduction in an existing boiler with above mentioned difficulties, so illustrating its versatility.

The principal object of this invention is to provide a boiler having the form of a combustion chamber able to burn practically any type of fuel, including gaseous, liquid, powder or divided in particles.

Such combustion chambers have a general cylindrical form, and in same the fuel, as well as the air, are injected tangentially as well as axially with adequate swirl. They are provided with a substantially cylindrical hull of refractory material in the inside of which are installed boiler tubes that are tangent to its inside surface but separated between themselves so as to permit the entrance of the tangentially blown fuel and air. One of the bases of the cylinder, which is normally of horizontal axis, is completely closed except for the axial holes for the entrance of rotating air, whilst the other base is closed by a ring leaving a central opening to which a frustro-conical throat, formed of boiler tubes, enclosing the vortex inside the combustion chamber. Its sides are surrounded by a substantially coaxial hull, leaving an annular chamber filled with preheated air, and having tangential fuel and air injection nozzles. In the chamber the mixture of fuel and air rotates and advances from the closed base to the open one, then back to the closed one and finally out of the chamber through the frustro-conical throat.

The external adaptation of such a combustion chamber to most of the known boilers having radiation chambers is practically impossible for two main reasons. First there is ordinarily no room for the bulky vortex combustion chamber in an already existing boiler house, and even in the ones not yet installed, since space is at premium or simply not existing. Secondly, the provision of an entrance of the combustion gases in the radiation chamber, which is quite large, cannot be made with the expedient used for giving way for the considerably smaller fuel injection devices. The crowding of the tangent boiler tubes, deviated so as to make room for the bigger hole, would compel to bunch them together in such a way that a lot of practical reasons forbid it.

The object of this invention is accomplished by means of such a structure and relative arrangement of parts as will fully appear by perusal of the following specifications, drawings and claims.

In the drawings, similar characters of reference indicate corresponding parts in the several views.

FIG. 1 is a vertical section, on line 1–1 of FIG. 2, through a boiler radiation chamber and attached elements, showing the cylindrical combustion chamber installed therein.

FIG. 2 is a similar section but on line II–II of FIG. 1.

FIG. 3 is a view of the output throat of the combustion chamber, as seen on line III–III of FIG. 2.

FIG. 4 is a cross section, on line IV–IV of FIG. 1, showing the distribution of the boiler tubes in and outside the combustion chamber.

Referring to FIG. 1, the radiation chamber 1 is lined, integrally, by boiler tubes 2 which are tangent to the inside of its walls 3 and connected to a drum 4 at their upper end and to a header 5 at their lower end. Drum 4 tops a heating chamber 6, totally filled with boiler tubes 2, the last row, to the right, being said boiler tubes 2 lining the left wall of the radiation chamber 1. Said tubes 2' are connected, at their upper end, to upper drum 4 and, at their lower end, to a lower drum 7. All this arrangement, together with circunvalating insulation and resistance walls is known, so that not further detail of its construction will be described except that at the right wall of radiation chamber 1, the resistance and insulation walls show holes 8 for the installation of liquid or gaseous fuel burners, also of known construction.

Inside the lower part of said radiation chamber 1 is installed a cylindrical combustion chamber 9, having an (see FIG. 4) inner wall 10 and an outer wall 11, between which is formed an air preheating chamber 12. Both walls 10 and 11 are lined, on their inside surfaces, by tubes 2, the ones lining the inside of wall 10 being, say, the odd tubes 2 that line touching one the other, the side walls of radiation chamber 1, whilst the tubes 2 lining the interior surface of wall 11 are the even tubes 2 of the same walls. This way, as can be seen in FIGS. 2 and 4, the distance between the axis of tubes 2 lining the inside of both walls 10 and 11 is twice their diameter, the distance between the axis of tubes 2 lining the inside of radiation chamber 1 being only one diameter, since they touch one another.

As can be seen in FIGS. 2 and 4 the length of the combustion chamber 9 is about two-thirds the width of the radiation chamber 1 so that the hot combustion gases, coming out of it, enter the radiation chamber 1 practically at the same place they are formed by the fuel burners installed in holes 8 (if they are ignited). Said combustion chamber 9 could, therefore, either substitute said burners in holes 8 or work together with them.

As can be seen in FIGS. 1 and 2, the combustion chamber 9 has tangential injection nozzles 13 and 13' by means of which fuel, including powdered or particled fuel, as well as air is injected into it, the air being preheated in the surrounding preheating chamber 12. Said nozzles 13 and 13' are distributed radially, as seen in FIG. 1, but also longitudinally, along different generatrixes of wall 10 so as to produce a spiral flow of burning gases going from nozzle 13 (FIG. 4) to the opposite end of chamber 9 where they are reflected and travel spirally back from wall 9'' to wall 9', where they are again reflected and travel spirally close to the throat diameter of chamber 9 emerging from it through throat 14, formed frustro-conically with tubes 2 bent, as can be seen in FIGS. 2 and 4, into back chamber 15, which is open at its roof, so that they can enter the radiation chamber 1. Back chamber 15 is lined, the same as radiation chamber 1 by tubes 2, being a mere prolongation of same. FIG. 3 shows how tubes 2 are bent so as to make place for the opening to which is attached throat 14. Hole 15, at the bottom of chamber 9, serves for the usual ash removal operations, where the usual ash disposal devices are provided. These, as well as other auxiliary devices such as air preheating duct 16, are the normal ones used in boilers and therefore not described in detail.

Wall 9'' is provided with channels 18 which supply tertiary air injected tangentially through tuyeres 19 disposed between tubes forming the throat 14. Back chamber 15 is lined, as same as radiation chamber 1 by tubes 2, being a mere prolongation of same. FIG. 3 shows how tubes are bent so as to make place for the opening to which is attached screw 17, at the bottom of chamber 9, serves for the usual ash removal operations, where the usual ash disposed devices are provided. In the front end, of chamber, in FIG. 2, it can be seen how the ash carrying gaseous recirculation duct 21 is placed to connect periphery of chamber lower channel with the center of said chamber.

Fuel oil atomizing device in same front end wall is indicated at 22.

From the foregoing description it will be readily seen that I have produced such a device as substantially fulfills the object of the invention *i.e.*, a boiler able to burn any type of fuel, including solid fuel reduced to small particles, which can be burnt in the combustion chamber 9 together with, or apart from, the gaseous or liquid fuels, without increasing the normal size of the boiler that otherwise could not burn the solid fuels efficiently.

While the specification sets forth in detail the present and preferred construction of the device, still in practice its deviations from such detail may be resorted to as do not form a departure from the spirit of the invention, as defined by the appended claims.

Having thus described this invention, what is claimed as new and useful meriting a letters patent is:

I claim:

1. A boiler for particulated solid, liquid or gaseous fuels, separated or simultaneously, and solid pulverulent ash extraction, having front, rear and side walls forming a radiation chamber, a substantially cylindrical gasification and combustion chamber horizontally disposed in the lower portion of the radiation chamber in spaced relationship to the front and rear walls of the radiation chamber, said gasification and combustion chamber having a shaped closed front end and a rear end having a restricted outlet, a frustro-conical shaped throat extending from said outlet into said gasification and combustion chamber, a first group of bare vapor generating tubes extending from the bottom header of the radiation chamber and lining the side walls of the radiation chamber and the front end, rear end and throat of the gasification and combustion chamber, a second group of bare vapor generating tubes lining the front and rear walls of the radiation chamber and said cylindrical gasification and combustion chamber, the tubes of the second group of vapor generating tubes being arranged with the odd tubes lining the cylindrical gasification and combustion chamber and the even tubes lining the front and rear walls of the radiation chamber whereby the tubes lining the cylindrical gasification and combustion chamber are separated one from another, and tangential injection nozzles disposed between the spaced tubes that line the cylindrical gasification and combustion chamber for introducing fuel and air into the cylindrical gasification and combustion chamber, and between throat forming tubes for introducing tertiary air, the lowest point of said gasification and combustion chamber being formed as water tube cooled channel, carrying a water cooled screw conveyor and sealing valve for ash extraction, and having in the front wall a water tube cooled vertical channel for gases recirculation to the center part of said gasification and combustion chamber.

2. A boiler according to claim 1, wherein the plenum chamber between the cylindrical gasification and combustion chamber and the front and rear walls of the radiation chamber forms a preheated air and an air preheating chamber.

3. A boiler according to claim 1, wherein the rear end of the gasification and combustion chamber is spaced from the adjacent side wall of the radiation chamber to form a back chamber, and means forming an opening in the top of said back chamber to conduct gases from the combustion chamber into the upper portion of the radiation chamber.

4. A boiler according to claim 1, wherein air injection tangential nozzles from plenum are provided in gasification and combustion upper part in opposition to the axis of fuel suspension in primary air.

5. A boiler according to claim 1, having air injection tangential nozzles supplied from plenum placed in the lower part of the cylindrical gasification and combustion chamber, all along the generatrices in each intertube space.

6. A boiler according to claim 1, wherein the fuel suspension in primary air injection nozzles extend tangentially through the front wall of the radiation chamber.