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VAPOR GENERATOR AND FURNACE WALL THEREFOR

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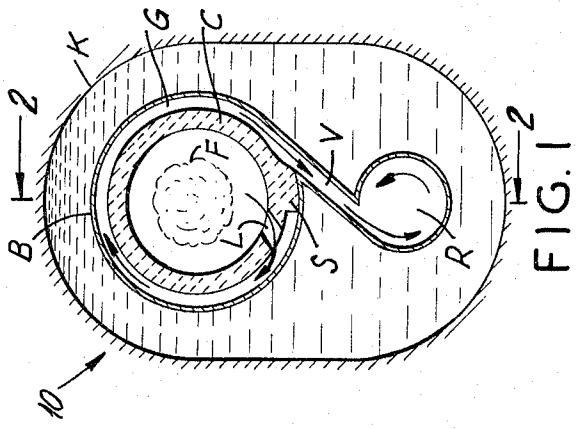

FIG. 1

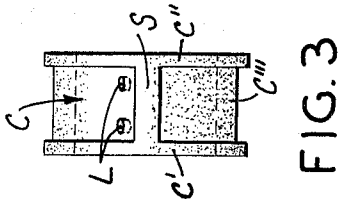

FIG. 3

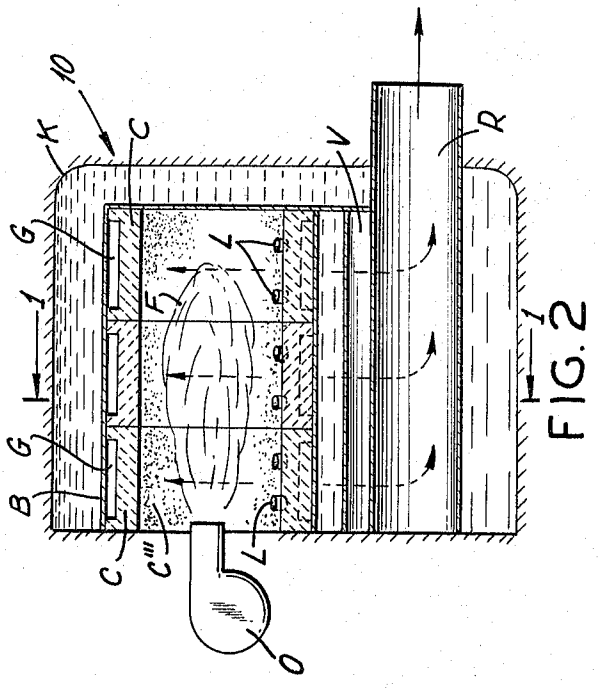

FIG. 2

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VAPOR GENERATOR AND FURNACE WALL THEREFOR

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This invention relates in general to furnace constructions for fluid heaters and the like, and in particular to a new and useful furnace construction with means for circulating combustion gases around a curved path in heat exchange relationship with a fluid to be heated, and to an improved furnace wall construction for such fluid heaters.

In heavy-duty boilers the specific heat exchange on the heating surfaces must be great and this can be achieved by high velocities of the combustion gases or flue gases. In order to achieve such high velocity, small flow cross sectional areas must be provided and the small cross sections of such areas increase the pressure loss of the flue gases. In order to reduce the pressure loss, the passages for the combustion gases and the flue gases should be without sharp bends or breaks which will tend to create the formation of eddies and stagnations.

The present invention is an improvement over the prior art constructions particularly in the provision of a vapor generator which includes a substantially cylindrical furnace or combustion chamber with means therein for conducting the combustion gases around in an annular circulation passage in heat exchange relationship with the surrounding liquid to be vaporized. The construction includes a flue which is tangentially connected to the annular circulation passage arranged to receive the gases from the discharge thereof in tangential whirling manner, with at least a portion of the flue being located in the boiler in heat exchange relationship with the liquid to be vaporized.

The invention further includes a furnace wall construction which comprises a cylindrical or tubular furnace with at least one ring-shaped lining or fire brick element which is adapted to be positioned within the furnace to define with the interior furnace wall an annular flow space of relatively small cross section for the combustion gases. The annular flow passage is formed around the interior of the furnace wall, which wall is in direct heat exchange contact with the liquid to be vaporized. The furnace wall element or fire brick advantageously includes a central hollow portion for the generation of combustion gases having a connection outwardly to the annular flow space for eventual discharge of the combustion gases after making a substantially complete annular pass. The combustion gases are then delivered tangentially into a cylindrical flue member which extends through the boiler substantially parallel to the tubular furnace portion but at a spaced relation therefrom. The flue defines a second heat exchange passage for the combustion and flue gases connected to the first annular pass in a tangential manner to form an overall S-shaped flow for the combustion gases.

Accordingly, it is an object of this invention to provide an improved furnace construction.

A further object of the invention is to provide a vapor generator having a substantially cylindrical furnace which includes a ring lining or ring-shaped fire brick adjacent the interior of the furnace wall defining along with the interior circumference of the cylindrical furnace an annular gas pass for the combustion and flue gases, with a hollow central portion provided for the burning of the combustion products, and which is connected to the annular gas pass for the circulation of the gaseous products of combustion around the annular gas pass.

A further object of the invention is to provide a boiler having a container defining a reservoir for liquid to be vaporized with a substantially cylindrical furnace portion for the generation of high temperature combustion gases which is tangentially connected to a substantially cylindrical flue arranged at a spaced location from the furnace, with means defined in the furnace for effecting the annular movement of the combustion gases around the interior circumference of the furnace in heat exchange relationship with the liquid to be vaporized and thereafter the tangential discharge into the flue.

A further object of the invention is to provide a vapor generator and an improved combustion gas pass for vapor gas generators and the like which are simple in design, rugged in construction and economical to manufacture.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which there are illustrated and described preferred embodiments of the invention.

In the drawings:

FIG. 1 is a transverse sectional view taken on the line 1—1 of FIG. 2 of a vapor generator constructed in accordance with the invention;

FIG. 2 is a longitudinal section of a vapor generator taken along the line 2—2 of FIG. 1; and

FIG. 3 is a side elevational view of a ring element for defining an annular gas flow pass in the vapor generator.

Referring to the drawings in particular, the invention comprises a vapor generator or steam boiler generally designated **10** having a burner O arranged to discharge a fuel centrally within a cylindrical furnace B which is ignited to form a flame and high temperature combustion gases F. The vapor generator **10** includes an outer casing K in which the cylindrical furnace B is mounted, the space surrounding the cylindrical furnace B containing the liquid to be vaporized.

In accordance with the invention, the cylindrical furnace B is lined with ring elements or ring-shaped fire brick members generally designated C which include end wall portions C′ and C″ having exterior annular peripheries in close contact with the furnace B. At one location around the periphery of each ring C there is provided a web or partition S. Openings L adjacent the partition S extend into the central combustion chamber formed in a center C‴ of the ring element C. Combustion gases which are formed in the center C‴ may thus flow outwardly through the openings L around a first gas passage or annular space G defined between the central exterior portion C⁗ of the rings C and the interior of the furnace wall B. The openings L advantageously are made so that they extend tangentially into the annular flue gas or combustion gas passage G so that a uniform whirling movement of the combustion gases around the annular spaces G in close heat exchange contact with the liquid in the boiler K adjacent the furnace wall B will take place.

In accordance with a further feature of the invention, a cylindrical flue generally designated R is arranged with its longitudinal axis extending substantially parallel to the axis formed by each of the three rings C in the embodiment illustrated. Means are provided within the boiler K defining a second gas passage V which connects to the annular passage G at a location adjacent the opposite end of the partition S from the openings L. Combustion gases are directed through the passage V and into the flue R. The means defining the passage V is

arranged to tangentially receive the gases from the annular first gas passage G and then direct them tangentially into the flue R which forms a third gas passage or pass for heat exchange purposes. The passageway V is formed preferably by parallel plates so that a rectangular cross sectional flow area is provided for the flue gases in a manner similar to the passages defined at G. The first and third gas passages thus defined and interconnected by the second flow passage defined by V are substantially of S-shape and result in a relatively even flow path for the gases so that there is very little pressure drop.

It should be appreciated that a number of rings C more or less than the indicated number 3 may be employed. In addition, the fire box or furnace B and the rings C may be of any tubular configuration such as annular and similarly define an annular flow passage but the flow characteristics of the gases would be less desirable. In some instances it may also be desirable to connect the passage V between the fire box and the flue in a manner different than tangentially, but such an arrangement would also increase the pressure drop. A particular advantage of the circular configuration of the ring C is that if radial cracks should appear in the rings, the various parts support each other in the manner of a vault and they will not fall into the flame chamber.

With the flame burning, the hot flue gases flow from the furnace C''' through the hole L into the gas duct G and around the gas duct in an annular flow pattern hugging the wall of the fire box or furnace B due to the outward centrifugal force exerted thereon accorded by their tangential admission and annular flow direction. The velocity of the combustion gases will be sufficiently high to cause excellent heat transfer to the liquid surrounding the fire box B, and further heat transfer will occur through the passage V as the gases are moved to the flue R. A further advantage of the construction is that the gases will be directed through the flue R in a cyclonic whirling movement causing further excellent heat transfer with the surrounding liquid. The flue R is advantageously arranged at the lower portion of the furnace so that the relatively lower temperature gases which are circulated therethrough will contact the normally colder portions of the liquid contained in the boiler K.

The web S prevents any possible passage of flue gases from the holes L directly into the passageway V. A renewed circulation around the pass G is also not possible since the gases will be directed outwardly by centrifugal force into the passageway V. Because of the high velocity of the gases, however, they will exert a suction effect on the gases in the vicinity of the web S. The boiler is advantageously operated so that the blower of the burner O produces a slight overpressure in the flame chamber C''' so that all of the combustion gas passages are, to a great extent, independent of the chimney draft.

While specific embodiments of the invention have been shown and described in detail to illustrate the application of the inventive principles, it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. A vapor generator comprising a container for liquid to be vaporized, a tubular furnace portion within said container positioned in said container with the liquid to be vaporized disposed in said container around said tubular furnace, means for directing high temperature gases centrally into said furnace, at least one ring member in said furnace coextensive in length with said furnace and spaced closely to the interior thereof and defining a central burning space for the high temperature gases and a narrow annular high velocity flow path for said gases between said ring member and the interior circumference of said tubular furnace, inlet passage means tangentially connecting into said annular flow path from said central burning space for receiving the high temperature gases from said burning space and directing them tangentially against the interior of said tubular furnace and around said flow path, outlet passage means adjacent the opposite end of said annular flow path from said inlet passage means, said inlet and outlet passage means being located so that flow is in one direction around said annular flow path from said inlet to said outlet.

2. A vapor generator comprising an outer container for liquid to be vaporized, a tubular furnace formed within said container with the exterior walls in direct contact with the liquid to be vaporized, at least one ring coextensive in length with the length of said furnace positioned with said tubular furnace and having a hollow central portion for the burning of combustion gases and defining with the tubular furnace interior at least one annular narrow high velocity flow passage adjacent the interior wall of said furnace, said ring having a tangential inlet opening connecting the interior of said hollow central portion of said ring member to the annular portion, an outlet flow passage, said inlet opening and said outlet being oriented for the flow of gases adjacent the interior of said tubular furnace from said inlet to said outlet in one flow direction and for the discharge of combustion gases through said outlet from said annular portion, and a flue connected to said outlet for receiving said gases therefrom, said flue having a portion located within said container in contact with the liquid to be vaporized therein.

3. A vapor generator according to claim 2, wherein said ring comprises a ring member with a hollow central portion for the burning of combustion gases in said portion with axially spaced end walls adapted to bear against the interior walls of said furnace and defining between said end walls and with said furnace an annular flow space for combustion gases, a web extending axially between said annular end walls, inlet openings adjacent said web permitting inflow of said gases from the central portion of said ring member.

4. A furnace wall construction comprising a cylindrical furnace, an annular ring member of refractory material with interior walls defining a central combustion chamber, said ring member having exterior increased dimension wall portions spaced apart axially positioned in close contact with the inner walls of said furnace and with a reduced dimension annular wall located between said increased dimension wall portions forming with the interior wall of the furnace a shallow depth high velocity annular gas pass, a web portion extending between said end wall portions of said ring member of substantially the same exterior dimension as said end wall portions for blocking gas flow at such locations between said ring member and the furnace wall, and tangentially disposed passage means defined in said ring member extending from the interior of said ring member to the annular passage adjacent one side of said web portion.

5. A vapor generator comprising a container for a liquid to be vaporized, a substantially cylindrical furnace wall within said container and surrounded on the exterior by liquid to be vaporized, an annular wall spaced inwardly from said furnace wall and coextensive in length with said furnace wall and defining a high velocity narrow flow path for gases around the interior of said furnace wall and the exterior of said annular wall and a combustion gas chamber on the interior of said annular wall, an inlet passage tangentially connecting said gas chamber and said annular flow path at one end thereof and an outlet at the opposite end of said flow path, means for introducing high temperature gases into said gas chamber, said inlet and outlet being located to receive gases from said gas chamber for flow around said annular flow path from said inlet to said outlet in one direction, a tubular flue within said container at a spaced location from said cylindrical furnace wall connected to said outlet for receiving gases after they are moved around the interior

of said furnace wall and directing them tangentially into said flue.

6. A vapor generator according to claim 5, wherein said outlet is of substantially the same depth as said narrow flow path and connects said narrow flow path tangentially.

7. A vapor generator according to claim 5, wherein the flow of gases around said narrow flow path through said outlet and said flue traverses a path which is substantially S-shaped.

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