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STEAM GENERATOR

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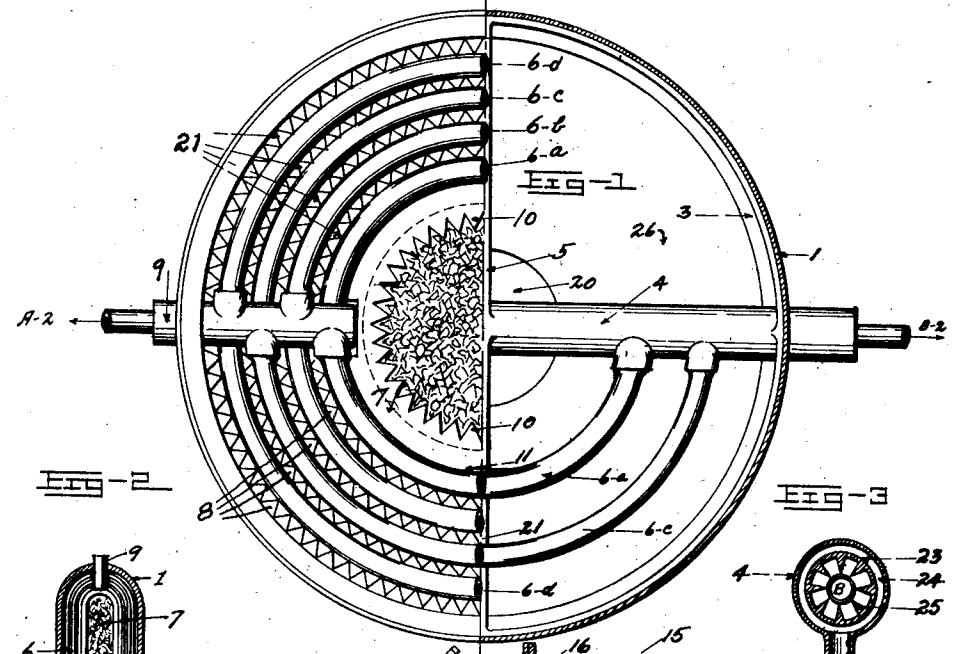


Fig-1

Fig-2

Fig-3

Fig-4

Fig-5

WITNESS

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UNITED STATES PATENT OFFICE.

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STEAM GENERATOR.

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(GRANTED UNDER THE ACT OF MARCH 3, 1883; 22 STAT. L. 625.)

The invention described herein, if patented, may be used by the Government, or any of its officers or employees in prosecution of work for the Government, or by any other person in the United States, without the payment to me of any royalty thereon.

My improvements in steam and vapor generators apply to the type known as water tube boilers, particularly that type of steam-generator used in automobiles, steam vehicles, small boats, and aeroplanes.

An object of the invention is to provide a steam-generator which shall have a large generating capacity as compared with its bulk, and which at the same time may be easily and quickly repaired.

Another object of my invention is to provide a steam-generator in which the heat of the burning fuel is efficiently and rapidly transferred by radiation as well as by conduction to the heat absorbing medium containing the water or other liquid to be vaporized.

Another object of my invention is to provide a steam-generator for producing superheated steam without the additional use of a superheater.

Other advantages of my invention will be apparent from the following detailed description, when taken in connection with the accompanying drawings; in which:—

Figure 1 is a plan view of the steam-generator, with the top removed, parts being cut away to more clearly illustrate the invention.

Figure 2 is a plan view of a modified form showing a suitable arrangement for large units.

Figure 3 is a cross-sectional view on line 3—3, Fig. 4, of the lower header showing feed-water heater incorporated therein.

Figure 4 is a vertical sectional view of my steam-generator, showing the general arrangement of the combustion chamber, water tube coils, headers, etc.; and,

Figure 5 is an enlarged view of the heat absorbing vanes inserted between the coils to radiate heat to the coils.

Referring to the drawings more in detail, the steam generator consists of a suitable metallic casing 1, with a suitable heat insulating lining 2; the bottom part of said casing being attached to and reinforced by an angle bar 3 which is welded to the lower water header 4 and a reinforcing cross member 5, which act as supports for cylindrical helical coils of piping 6^a, 6^b, 6^c, 6^d, suitably arranged within the compartment formed by the casing and around a combustion chamber 7. The cylindrical helical coils of piping 6^a, 6^b, 6^c, 6^d, are arranged concentrically, with passages between each to permit the passage of hot gases, and are securely connected at the lower end to a water header 4 and at the upper end to a steam header 9. Arranged within the circle of the inner coil of piping 6^a and running from the top of the coil to the bottom and resting upon the lower header 4, is a bucket shaped combustion chamber 7 formed of any suitable refractory material or other material with a high melting point. The interior wall of the combustion chamber is fluted from top to bottom, thereby forming heat absorbing vanes 10 which absorb the heat of combustion and conduct it to the outer wall of the combustion chamber where it is radiated to the inner coil pipe 6^a. The upper part of the outer wall of the combustion chamber 7 terminates in a shoulder or projecting wall 11 that fits snugly within the coil pipe 6^a, thereby preventing the gases passing between the outer wall of the combustion chamber and the inner surface of the coil pipe 6^a. Should the gases pass between the combustion chamber and the coil they would be discharged at a higher temperature than they had upon entering the passage, due to the high radiant heat in the passage, and would thus lessen the efficiency of the steam-generator. On the bottom of the combustion chamber is placed some broken refractory material which is raised to a white heat in the combustion of the gases and thereby assists in the proper combustion of the incoming cold gaseous mixture, and also acts as an insulator to prevent the radiant heat escaping through the bottom of the combustion chamber.

Instead of making the combustion chamber of an opaque refractory material it may be made of a transparent or translucent material with a high melting point such as quartz. The use of such a material will permit more radiant heat reaching the water containing element than would be the case should an opaque material be used.

A top 12 for the generator lined with suit-

able insulating material 13 is securely but detachably fastened to the casing or wall 1 so that it may be readily removed for inspection of the interior, or for other purposes.

The gases or fuel for combustion are introduced into the combustion chamber by a blower or other suitable means through the nozzle or fuel burner 14, placed in an opening in the top 12 and directly over the center of the combustion chamber. The gases are ignited by a spark plug 17 or other suitable means for ignition arranged within the walls of the nozzle, and then pass on to the primary combustion chamber where they are thoroughly mixed and combustion is partly completed. The hot gases in process of combustion give off a considerable quantity of heat to the combustion chamber which radiates the heat to the inner coil pipe. After combustion is mostly completed the hot gases pass into the upper or secondary combustion chamber where combustion is completed; the gases then passing down between the coil pipes and discharging through the opening 19, as indicated by the heat arrows.

To prevent the flames igniting the incoming gases in the supply pipe 15 a wire mesh 16 is inserted in the line between the nozzle and the supply pipe. It may happen that the gases entering the combustion chamber are not ignited immediately and will accumulate to such an extent that an explosion may take place upon ignition which is liable to damage the generator. To guard against any damage being done in case of an explosion I provide a relief valve 20 preferably mounted in the bottom of the casing; said valve adapted to open and release any excessive pressure to the atmosphere.

The time it takes for a heat absorbing element to absorb heat from hot gases depends to a great extent upon the velocity of the gases past the element and the amount of radiant heat impinging upon the element. In the steam-generator described herein the water tubes will absorb just so much heat from the passing gases, depending upon the velocity of the gases, in a given length of time and no more. In order to transmit a greater amount of heat to the tubes I provide V-shaped vanes 21 in the gas passages between the tubes to absorb heat from the gases and transmit it by radiation and conduction to the tubes. In the walls of the vanes 21 are projections 22 which cause eddies in the gases in order to cause every particle of gas to make contact with the tubes and vanes.

Inside the water header 4 I provide a feed-water heating unit consisting of a tube 23, with heat absorbing vanes 25 on the interior surface, running the full length of the header to transmit heat from the exhaust steam of the engine or other form of power plant, which steam enters the feed water heater at B^1 and exhaust at B^2 into a condenser, to the feed-water in the water passage 24 between the outer wall of the tube 23 and the inner wall of the header 4. The water for generating steam enters the lower header 4 through an intake pipe A^1 and passes through the passage 24 to the water tubes 6^a, 6^b, 6^c, and 6^d, where it is converted into steam. The steam passes into the steam header 9 as superheated steam and from there to the engine or other power unit, through the opening A^2. By observing the flow of gases through the tubes and the flow of water within the tubes it will be seen that the water and gases go in an opposite direction. In this arrangement only the water at the top in the tubes is evaporated into steam as it has a higher temperature than the water in the lower part of the tubes.

The supply and control system for the liquid to be evaporated and the fuel for combustion is not shown herein as they will be shown in a subsequent application, but any one familiar with steam generating plants will understand how the various systems of water and fuel supply may be applied and used with the steam or vapor generator described herein.

In accordance with the patent statutes, I have described what I now believe to be the best embodiment of my invention, but I do not wish to be understood thereby as limiting myself or the scope of my invention, as many modifications may be made without departing from the spirit of my invention, and all such I aim to include in the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent is:—

1. In a steam or vapor generator, a combustion chamber, a burner adjacent the upper end of the combustion chamber, a coil encircling the combustion chamber and spaced therefrom, said coil containing the liquid for evaporation, heat absorbing vanes carried by the combustion chamber walls and projecting into the combustion chamber, said vanes adapted to absorb the heat from the hot gases and conduct it to the outer wall of the combustion chamber, the heat being then radiated to the walls of the encircling coil, and an impact surface at the lower end of the primary combustion chamber against which the incoming gases impinge and rebound in moving contact with the walls thereof.

2. In a steam or vapor generator, a primary combustion chamber, a burner adjacent the upper end of the primary combustion chamber, a liquid containing element surrounding the primary combustion chamber, a secondary combustion chamber, communicating with the primary combustion chamber and arranged to guide the combustion gases into contact with the liquid containing

element, and an impact surface at the lower end of the primary combustion chamber against which the incoming gases impinge and rebound in moving contact with the walls thereof.

3. In a steam or vapor generator, a primary combustion chamber open at the top thereof, a burner adjacent the upper end of the primary combustion chamber, a series of liquid containing coils surrounding the combustion chamber and a secondary combustion chamber communicating with the primary combustion chamber, and with the spaces between the series of coils, and an impact surface at the lower end of the primary combustion chamber against which the incoming gases impinge and rebound in moving contact with the walls thereof.

4. In a steam or vapor generator, a primary combustion chamber, a liquid containing coil encircling the primary combustion chamber and spaced therefrom, a second coil encircling the first coil and spaced therefrom, a secondary combustion chamber communicating with the primary combustion chamber and the space between the two coils, and means for preventing the entrance of combustion gases from the secondary combustion chamber into the space between the primary combustion chamber and the first mentioned coil.

5. In a steam or vapor generator, a combustion chamber, a coil surrounding the combustion chamber, a liquid header communicating with the coil, and a feed-water heater associated with the header and comprising a tube mounted in the header and spaced thereform, the incoming liquid adapted to flow through the space between the header and the tube, inwardly projecting vanes carried by the tube and adapted to absorb heat from the heating medium, such as exhaust steam, and transmit it to the incoming liquid.

6. In a steam or vapor generator, a primary combustion chamber, a plurality of spaced coiled tubes arranged concentrically around the combustion chamber, a liquid header communicating with the lower ends of the tubes and forming a support for the tubes, a radial header communicating with the upper ends of the tubes and functioning as a receiving chamber for the steam generated, a fuel nozzle located centrally above the primary combustion chamber, a secondary combustion chamber located over the coiled tubes and communicating directly with the primary combustion chamber, and an impact surface at the lower end of the primary combustion chamber, the construction and arrangement being such that the incoming gases for combustion strike the bottom of the primary combustion chamber and are thoroughly mixed by the eddying motion imparted to the gases, thence passing in a state of combustion to the secondary combustion chamber and thence down the passages between the coils in a direction opposite to the flow of the liquid in the coils.

7. In a steam vapor generator, a liquid container element surrounding a combustion chamber adapted to prevent the gases in process of combustion coming into contact with the liquid containing element, said combustion chamber being a heat absorbing and heat radiating element in the form of a receptacle open at one end, a burner adjacent the open end of the combustion chamber, said combustion chamber having an impact surface at the other end against which the incoming gases impinge and rebound in moving contact with the walls thereof, said walls being adapted to radiate the heat absorbed from the gases of combustion to the liquid containing element.

8. In an apparatus for generating vapor, the combination of a combustion chamber, a cylinder of coils associated with the combustion chamber, said combustion chamber extending downwardly into the central space inclosed by the said cylinder of coils, said combustion chamber having a closed end acting as an impact surface against which the incoming combustible mixture impinges, and a burner adjacent the opposite end of the combustion chamber.

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