Sept. 12, 1933. R. E. PETERSON 1,926,958

STEAM GENERATOR

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Fig. 1.

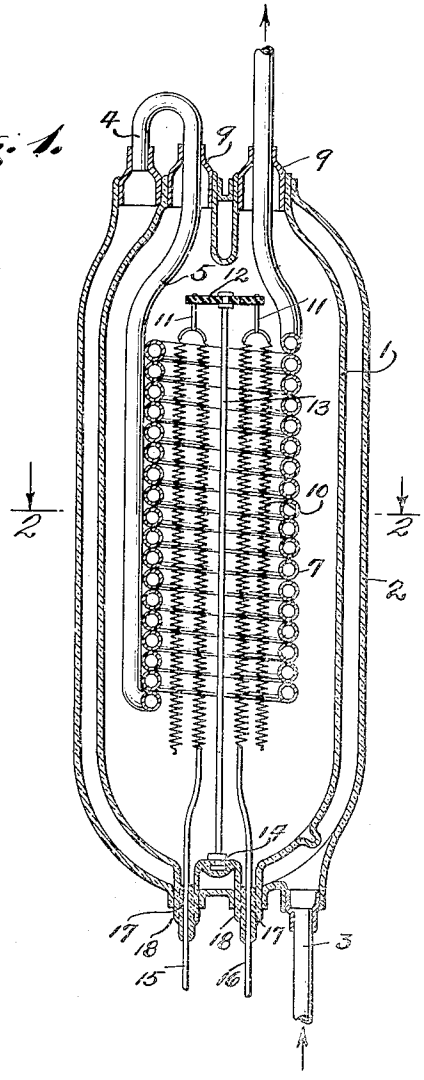
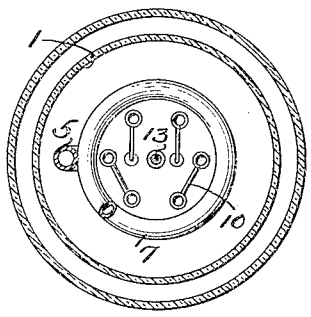


Fig. 2.



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STEAM GENERATOR

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26 Claims. (Cl. 219—38)

My invention is directed to the provision of a steam generator which is simple in construction, inexpensive to manufacture, and highly efficient and practically instantaneous in operation, my invention providing a construction such that the rapidity of heat transferred is materially increased as compared with existing devices.

From a broad standpoint the present invention comprises a hermetically sealed casing providing a heating chamber for a coil containing the liquid to be heated and an electrically operated heating element for the coil, the casing being free of gases (oxygen for instance) capable of having a deleterious effect on the heating element and on the coil.

More specifically the present invention provides a heat exchanger of the type briefly outlined above in which the terminals of the heating element, as well as the terminals of the coil, extend to the exterior of the casing and are hermetically sealed thereto.

My device as will be brought out hereinafter is adapted for the quick and continuous generation of superheated steam and hence is well adapted for sterilizing purposes, for example, where a high heat is essential and where a dry steam is desirable, thus insuring sterilization and inasmuch as the steam is highly superheated the use of a drying cloth, for instance, for drying purposes is avoided.

In the drawing:

Fig. 1 is a sectional elevational view of an embodiment of my invention; and

Fig. 2 is a section on the line 2—2 of Fig. 1.

Referring to the drawing in detail, 1 designates the casing of my improved apparatus, this casing being composed of material which is free of occluded gases and capable of withstanding high temperatures without disintegration. Glass, pyrex or other vitreous materials, quartz, etc. are examples of materials having the above mentioned characteristics. If it be desired to employ a metallic or other material which contains or may contain occluded gases, and/or which may give off or liberate deleterious gases when heated, such material must first be treated to prevent such gases entering the heating chamber, the desideratum being operation of the elements sealed in the heating chamber under conditions which will insure preservation and proper functioning of the apparatus.

The casing 1 may be jacketed, if desired. For example a water jacket may be employed, the water to be heated passing through this jacket before entering the coil in the heating chamber. If other liquids are being heated then it will be understood such liquids will be passed through the jacket before entering the coil. A jacket is shown at 2 in the drawing, this jacket being provided with inlet 3 and outlet 4.

Where no jacket is employed then I propose plating or otherwise treating the inside of the casing 1 so that the same will function as a reflector.

Within the casing 1 is a metallic pipe or tube 5 of copper, nickel or other suitable material for the water or other liquid to be heated. If the jacket 2 above mentioned is employed the inlet end of the tube 5 is connected to the outlet 4 of the jacket. On the other hand, if no jacket is employed then it will be understood that the inlet end of the tube 5 will be connected to a liquid supply source.

The tube 5 is closely coiled helically within the casing 1, the coils 7 thus provided abutting each other. The outlet of the tube is open ended and passes to the exterior of the casing. Inasmuch as one of the objects of this invention is to provide against the presence of deleterious gases within the heating chamber provided by the casing 1, the tube 5 will be of such material or so treated as to be incapable of liberating injurious gases when the device is in operation. For example, the tube could be heated initially so as to drive out any occluded gases.

The inlet and outlet portions of the tube 5 are hermetically sealed to the casing 1. This hermetic seal is conveniently provided by brazing a copper bushing or apron 9 to the tube 5 and annealing the same to the casing 1, when the latter is of glass, for instance. If a metallic casing 1 is employed then any of the many well known methods of obtaining a hermetic seal may be employed.

The coils 7 of the pipe or tubing 5 surround and are in close proximity to a heating element designated 10. This heating element, for purposes of illustration only, has been shown in the form of a filament, but may take other forms as is to be understood.

The filament of the heating element 10 is conveniently supported by wires 11 on an insulator 12. This insulator may be supported on a suitable standard or post 13 mounted in any suitable fashion in the bottom of the casing 1 as shown at 14. The heating element 10, wires 11 and post 13 are preferably of the same material, or if of different materials they will have certain char-

acteristics in common, all of which will be brought out hereinafter.

The terminals 15 and 16 of the heating element 10 extend to the outside of the casing 1 and are provided with collars 17 of insulating material such as pyrex, for example, annealed to the projections 18 on the bottom of the casing 1 to provide a hermetic seal.

As above pointed out one of the objects of my invention is to provide a heat exchanger which is capable of operating practically instantaneously. To this end, therefore, I employ materials for the heating element 10, wires 11 and post 13 which are capable of being heated to high temperatures without detrimental deterioration, and inasmuch as the tubing coils 7 surround and are in close proximity to the heating element, an ideal construction is provided for absorption by the coils 7 of the radiant heat from the heating element. A material which I have employed successfully for the heating element 10, wires 11 and post 13 is tungsten, which is capable of operation at high temperatures without detrimental deterioration. For example, in actual practice and employing tungsten as the heating element, I have successfully employed a 3000 watt current at 110 volts carrying the temperature of the heating element to 5000° F.

The casing 1 is exhausted of air and, as above explained, hermetically sealed, and inasmuch as the heating element and the coils 7 are incapable of liberating injurious gases during operation of my device or apparatus oxidation and hence destruction from this cause of the heating element and tube 5 is successfully avoided.

In addition to the foregoing I may further increase the efficiency and prolong the life of the apparatus by placing an inert gas or gases in the casing 1. Such gases which may be hydrogen, nitrogen, argon, for example, not only act as a heat conductor for conducting heat from the heating element to the coils 7, so that the coils are heated by conduction as well as by radiant heat, but convection currents are set up further to assist in the heating operation. Finally by employing an inert gas in the casing thereby creating a slight pressure therein I provide a construction where the heating element is not operating in a vacuum and hence evaporation of the heating element is retarded, and its life prolonged, and inasmuch as the gas employed is free of oxygen I am able to make use of the same with its attendant advantages without detriment to the heating element.

It will be appreciated from all of the foregoing that I have provided a heat exchanger so constructed as to enable the same to be operated most efficiently and at high temperatures for continuous and practically instantaneous heating of the water, or other liquid being treated, for the continuous generation of superheated steam at substantially atmospheric pressure, all without sacrifice of the operating life of the heating element.

As a practicable demonstration of the merits of my device, I have successfully operated a device, constructed substantially as above described, probably thousands of times, and produced steam at 400 to 600° F., at substantially atmospheric pressure, (superheated steam) from water at a temperature of around 50 to 60° F. in not over three seconds and without any apparent drop in the efficiency of the apparatus or deterioration of any of the parts thereof.

This application is a continuation in part of my application Serial No. 477,433, filed August 23, 1930, for an Improvement in steam generators and hot water heaters.

What I claim is:—

1. In an instantaneous continuous flow steam generator comprising in combination a hermetically sealed casing, a water coil and an electrically operated heating element therefor within said casing, said water coil having an open ended discharge terminal extending through the casing, said heating element having terminals extending through the casing, said casing being free of gases capable of having a deleterious effect on the heating element, said heating element being so disposed relatively to said water coil that the latter is subjected to the radiant heat from the heating element for the continuous generation of superheated steam.

2. An instantaneous continuous flow steam generator comprising in combination a casing, a coil for a liquid to be heated and an electrically operated heating element within said casing, said coil having an open discharge end extending through the casing to the exterior thereof, said coil surrounding said heating element in close proximity thereto whereby the coil is subjected to the radiant heat from the heating element for the continuous generation of superheated steam, said heating element extending to the outside of said casing, said casing being hermetically sealed and free of gases capable of having a deleterious effect on the heating element, said casing being constructed of a material incapable, under operation of the device, of liberating such deleterious gases.

3. An instantaneous continuous flow steam generator comprising in combination a hermetically sealed casing of vitreous material, a metallic coil for a liquid to be heated and a metallic electrically operated heating element within said casing, an inlet terminal and an open ended outlet terminal for said coil extending to the exterior of the casing, the coils of the coil abutting each other and surrounding said heating element in close proximity thereto whereby the coil is exposed to the radiant heat of the heating element for the continuous flow generation of superheated steam, terminals for the heating element extending to the exterior of the casing and sealed thereto, said casing being hermetically sealed and free of gases capable of having a deleterious effect on the heating element.

4. An instantaneous continuous flow steam generator comprising in combination a casing of vitreous material, a pipe coiled within said casing for a liquid to be heated, said pipe having an inlet terminal and an open ended outlet terminal extending to the exterior of the casing, a tungsten heating element within the casing and surrounded by the coils of said pipe so that the coiled pipe is subjected to the radiant heat from the heating element for the continuous generation of superheated steam, terminals for the heating element extending to the exterior of the casing and sealed thereto, said casing being hermetically sealed and exhausted of gases capable of having a deleterious effect on said heating element.

5. In an instantaneous steam generator, a casing having its interior free from a chemically active gas, a tube coiled within the casing and having terminals, aprons on the tube terminals, the tube terminals and the aprons extending through the casing with the aprons sealed to the casing, a heating filament within the casing dis-

posed adjacent the coiled tube so that the coiled tube is subjected to the radiant heat from the heating filament, said heating filament having terminals, collars on said heating filament terminals, the heating filament terminals and the collars extending through openings in the casing and the collars being sealed to the casing.

6. In an instantaneous steam generator, a hermetically sealed casing having its interior free from a chemically active gas, a tube coiled within the casing, terminals for said tube, aprons on said terminals, said terminals and aprons extending through the casing with the aprons sealed to the casing, a heating element within the casing and surrounded by the coiled tube and so disposed relatively thereto that the tube is subjected to the radiant heat from the heating element for the continuous generation of superheated steam, said heating element being mechanically disconnected from the tube, terminals for the heating element, collars on said heating element terminals, said heating element terminals and collars extending through the casing with the collars sealed to the casing.

7. In an instantaneous steam generator, a hermetically sealed casing having its interior free from a chemically active gas, a tube coiled within the casing, adjacent terminals for said tube, aprons on said terminals, said terminals and aprons extending through the casing with the aprons sealed to the casing, a heating element disposed within the casing and surrounded by the coil of said tube, said coiled tube and heating element being so disposed relatively that the former is subjected to radiant heat from the latter, adjacent terminals for the heating element spaced from the tube terminals, collars for said heating element terminals, said heating element terminals and collars extending through the casing with the collars sealed to the casing.

8. In an instantaneous steam generator, a casing having its interior free from a chemically active gas, a tube coiled within the casing, terminals for said tube, aprons on said terminals, said terminals and aprons extending through the casing with the aprons sealed to the casing, a standard in the casing disposed within the coil of the coiled tube and provided with a support, a looped heating filament within the casing between the standard and coiled tube and secured to the support and so disposed relatively to said tube that the latter is subjected to the radiant heat therefrom, terminals for the heating filament, collars on said filament terminals, said filament terminals and collars extending through the casing and said collars being sealed to the casing.

9. In an instantaneous steam generator, a casing having a water jacket with an inlet and an outlet, the interior of the casing being free from a chemically active gas, a tube coiled within the casing and having an inlet terminal connected with the water jacket outlet, an outlet terminal for the tube, aprons on the tube terminals, the tube terminals and said aprons extending through the casing with the aprons sealed to the casing, a heating filament in the casing adjacent the coiled tube, said heating filament having terminals, collars on the heating element terminals, the heating filament terminals and the collars extending through the casing with the collars sealed to the casing, the coiled tube and heating filament being so disposed relatively that the former is subjected to the radiant heat from the latter.

10. In an instantaneous steam generator, a casing having opposed heads, an inner and an outer wall extending to said heads and forming therebetween a water jacket, the chamber defined by the inner wall being free from a chemically active gas, each end of said chamber having a pair of openings and each end of the water jacket being provided with a single opening, a coiled tube within the said chamber, terminals for said tube, aprons on said terminals, said terminals and aprons extending through one pair of the first mentioned openings in the end of said chamber with the aprons on the terminals secured to the casing end at the openings, the inlet terminal of said tube being connected to the water jacket at one of said water jacket openings, a heating filament within the said chamber, terminals for said filament, collars on said filament terminals, said filament terminals and collars extending through the said pair of openings in the head of said chamber opposite the tube terminals, said collars being secured to the filament and sealed to the casing head at the last mentioned openings.

11. In an instantaneous steam generator, a hermetically sealed casing having a water jacket, the interior of the casing being free from a chemically active gas, a tube having a coiled portion within the casing, inlet and outlet terminals for the tube, aprons on said terminals, said terminals and aprons extending through the casing with the aprons sealed thereto, a heating element in the casing for heating the coiled tube, said heating element being so disposed relatively to the coiled tube that the latter is subjected to the radiant heat from the former, terminals for said heating element, collars on said heating element terminals, said heating element terminals and collars extending through the casing with the collars sealed to the casing.

12. In an instantaneous steam generator, a casing containing an inert gas and provided exteriorly with a water jacket having an inlet and an outlet, a coiled tube within the casing having an inlet terminal connected with the water jacket outlet, an outlet terminal for said tube, aprons on the tube terminals, said terminals and aprons extending through the casing with the aprons sealed to the casing, a bare wire heating filament in the casing adjacent the coiled tube, terminals for said heating filament, collars on the heating filament terminals, the heating filament terminals and said collars extending through the casing, the collars being sealed to the casing.

13. In a generator for continuously generating superheated steam, the combination of a hermetically sealed casing containing an inert gas and provided exteriorly with a water jacket having an inlet and an outlet, a water tube coiled within the casing and having an inlet terminal connected with the water jacket outlet and an open ended outlet terminal, the said two terminals extending through the casing and being sealed thereto, a heating element in the casing, terminals for said heating element, said terminals extending through the end of the casing opposite to the water tube terminals and being sealed thereto, said tube surrounding the heating element so as to be exposed to the radiant heat therefrom for the continuous generation of superheated steam in said water tube.

14. In an instantaneous steam generator, a hermetically sealed casing containing an inert gas, a tube coiled within the casing and having terminals, aprons on the tube terminals, the tube terminals and aprons extending through the cas-

ing with the aprons sealed to the casing, a standard within the casing surrounded by the coiled tube and provided with a support, a looped heating filament within the casing between the said standard and the said coiled tube, said filament being secured to said support, terminals for the heating filament, collars on the filament terminals, said collars and terminals extending through the casing, the collars being sealed to the casing.

15. In an instantaneous steam generator, a casing containing an inert gas, a tube disposed within the casing and having terminals, aprons on the tube terminals, the tube terminals and the aprons extending through openings in the casing with the aprons sealed to the casing at the openings, a heating filament within the casing, terminals for the heating filament, collars on the heating filament terminals, the heating filament terminals and the collars extending through openings in the casing with the collars sealed to the casing at the last mentioned openings.

16. In an instantaneous steam generator, a hermetically sealed casing containing an inert gas, a tube coiled within the casing, terminals for said tube, aprons on said terminals, said terminals and aprons extending through the casing and sealed thereto, a heating filament within the casing disposed adjacent the said coiled tube, terminals for said filament spaced from the tube terminals, and collars for said filament terminals, said filament terminals and collars extending through the casing with the collars sealed to the casing.

17. A steam generator for continuously generating superheated steam and comprising in combination a casing, a water coil within said casing with an open discharge end, an electrically operated heating element within said casing, said casing being hermetically sealed and free of gases capable of having a deleterious effect on the heating element, said coil surrounding said heating element so as to be exposed to the radiant heat therefrom continuously to generate superheated steam.

18. In a steam generator for continuously generating superheated steam, the combination of a hermetically sealed casing, an inert gas within the casing, a water tube in the casing provided with an inlet terminal and an open ended discharge terminal extending through the casing, and a heating element within the casing having terminals extending through the casing, said heating element being so disposed relatively to the said tube that the latter is subjected to the radiant heat thereof for the continuous generation of superheated steam.

19. In a steam generator for continuously generating superheated steam, the combination of a hermetically sealed casing containing an inert gas, a water tube coiled within the casing and provided with an inlet terminal and an adjacent open ended outlet terminal extending through the casing and sealed thereto, and a heating element within the casing, adjacent terminals for said heating element spaced from the tube terminals and extending through the casing and sealed thereto, said coiled tube surrounding said heating element so as to be exposed to the radiant heat therefrom, continuously to generate superheated steam from water flowing through said tube.

20. In an instantaneous steam generator, a casing having a water jacket with an inlet and an outlet, a tube coiled in the casing and having a terminal connected with the water jacket outlet, the tube having another terminal, aprons on the tube terminals, the two terminals of the tube and the aprons extending through the casing with the aprons sealed to the casing, a heating element in the casing within the coil of the coiled tube, said heating element having terminals, collars on the heating element terminals, the heating element terminals and the collars extending through the casing with the collars sealed to the casing, said tube and heating element being so disposed relatively that the former is subjected to the radiant heat from the latter.

21. In an instantaneous steam generator, a casing having opposite heads and an inner wall and an outer wall forming therebetween a water jacket and with the inner and outer walls extending to the heads, each head of the casing being provided with two openings leading to the chamber provided by the inner wall, each end of the casing being provided with a single opening leading to said water jacket, a tube coiled within said chamber, said tube having terminals, aprons on the tube terminals, the terminals and aprons extending through two of the first mentioned openings with the aprons sealed to the casing at said openings, a heating element surrounded by the coil of the coiled tube and having terminals, collars on the terminals, said terminals and collars extending through two of the first mentioned openings in one head of the casing, said collars being sealed to the said head.

22. In an instantaneous steam generator, a casing having opposite heads, said casing having an inner wall and an outer wall forming therebetween a water jacket, said inner and outer walls extending to said heads, the chamber provided by the inner wall being free from a chemically active gas, each head of the chamber provided by the inner wall being provided with two openings and a single opening in each head of the casing communicating with the water jacket, a coiled tube within the chamber provided by the inner wall, terminals for said tube, aprons on said terminals, said terminals and aprons extending through the two openings in one head of the chamber provided by the inner wall, with the aprons sealed to the casing at said openings, one of the terminals being connected with one of the single openings communicating with the water jacket and being sealed to the head at the said opening, a heating element surrounded by the coil of the coiled tube, terminals for the heating element, collars on said terminals, said collars and heating element terminals extending through the head of the casing opposite to the terminals of said tube, said collars being sealed to the said head at the last mentioned openings.

23. In an instantaneous steam generator, a casing having opposite heads, said casing having an inner wall and an outer wall forming therebetween a water jacket, said inner and outer walls extending to said heads, each head of the chamber defined by the inner wall being provided with two openings, each head of the water jacket being provided with a single opening, a coiled tube within the casing in the chamber defined by the inner wall, terminals for said tube, aprons on the tube terminals, said tube terminals and aprons extending through one pair of the first mentioned openings in the chamber head, a heating filament in said chamber, terminals for said heating element, collars on said heating element terminals, said heating element terminals and collars extending through the other pair of the first men-

tioned openings in the chamber head, said collars being sealed to the head at the last mentioned openings.

24. In an instantaneous steam generator, the combination of a hermetically sealed casing, a coiled water tube disposed within the casing and having inlet and outlet terminals, aprons on the tube terminals, the tube terminals and the aprons extending through openings in the casing with the aprons sealed to the casing at said openings, a standard in the casing surrounded by the said coiled tube, a support carried by said standard, a looped heating filament within the casing secured to said support and disposed between the said standard and said tube, terminals for said heating filament, collars on said filament terminals, said filament terminals and collars extending through the casing and said collars being sealed to the casing.

25. In an instantaneous steam generator, a hermetically sealed casing, a tube coiled within the casing and having an outlet terminal, an apron on the said outlet terminal, the said outlet terminal and apron extending through the casing with the apron sealed to the casing, a heating filament within the casing disposed adjacent the coiled tube so that the coiled tube is subjected to the radiant heat from the heating element, said heating filament having terminals, collars on said heating filament terminals, the heating filament terminals and the collars extending through openings in the casing, and said collars being sealed to the casing.

26. In an instantaneous steam generator, a hermetically sealed casing, a coiled tube disposed within the casing, terminals for said tube, means secured to the tube terminals, extending, together with the tube terminals, through said casing, said means being sealed to the casing, a heating element within the casing surrounded by the coiled tube and so that the tube is subjected to the radiant heat from the heating element, terminals for the heating element, and means sealed to the filament terminals, extending, together with the filament terminals, through said casing with said last mentioned means sealed to the casing.

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