

April 16, 1935.

W. MECHELKE

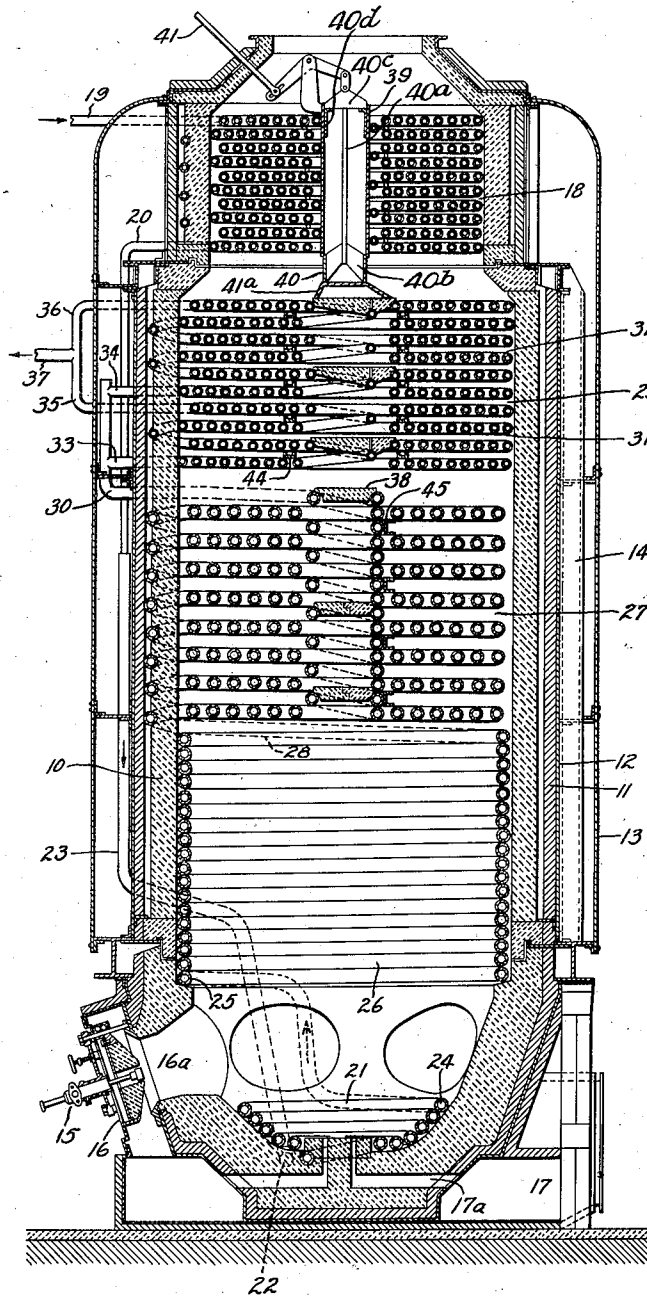
1,998,329

ELASTIC FLUID GENERATOR OR BOILER

Filed Dec. 29, 1933

2 Sheets-Sheet 1

Fig. 1.



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2 Sheets-Sheet 2

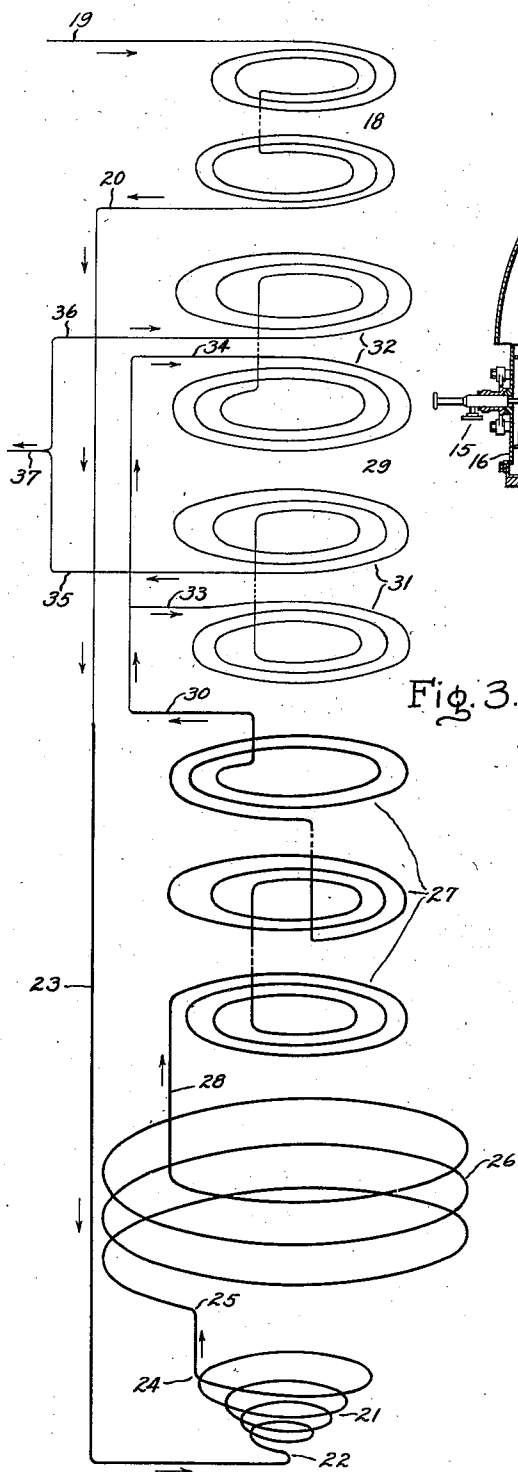


Fig. 3.

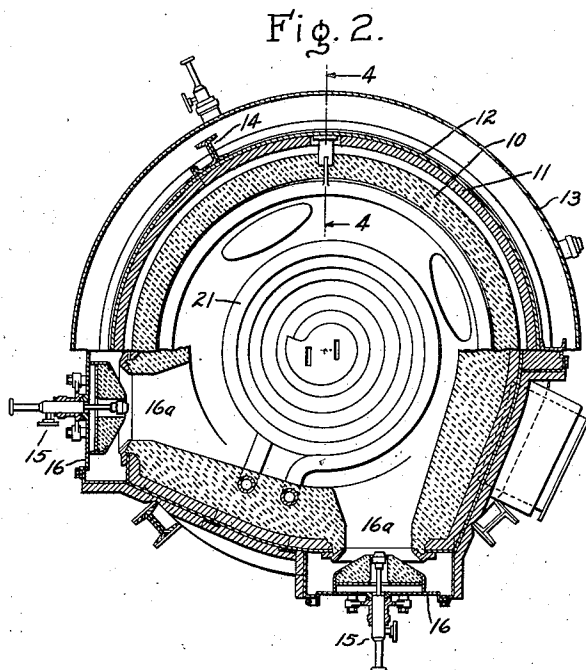


Fig. 2.

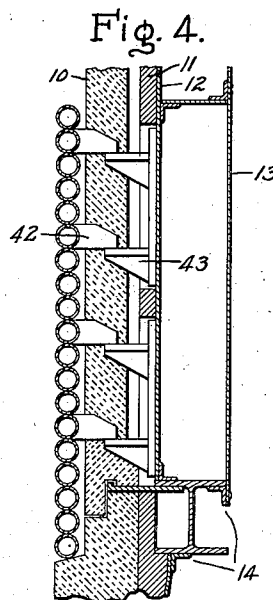


Fig. 4.

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UNITED STATES PATENT OFFICE

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ELASTIC FLUID GENERATOR OR BOILER

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4 Claims. (Cl. 122-250)

The present invention relates to elastic fluid generators or boilers, more particularly to pressure combustion boilers, although it is not necessarily limited thereto.

5 In pressure combustion boilers the air for maintaining the combustion is supplied under pressure by means of a compressor which may be driven by a gas turbine operated by the gases generated in the combustion space. To absorb the great
10 amount of heat produced in the combustion space of these boilers, it is usually necessary to provide forced circulation of the fluid to be heated and evaporated. In boilers of the type specified, especially where the fluid containing and conducting
15 elements comprise primarily helically and spirally wound tubes connected in series (usually termed single tube boilers), difficulties have been experienced in the regulation of the temperature of the discharged fluid.

20 One object of the present invention is to provide an improved construction and arrangement of elastic fluid generators of the type specified in which the fluid temperature may be readily and effectively controlled.

25 Another object of the invention is to provide a boiler with helically and spirally wound tubes in which parts of the tube elements are arranged so that they are accessible and may be easily replaced.

30 Still another object of my invention is to provide a single tube boiler with an improved support of the tubes.

35 For a consideration of other objects and of what I believe to be novel and my invention, attention is directed to the following description and the claims appended thereto in connection with the accompanying drawings.

40 In the drawings, Fig. 1 is a sectional view through an elastic fluid generator or boiler embodying my invention; Fig. 2 is a cross section through the bottom portion of the arrangement shown in Fig. 1; Fig. 3 is a diagram illustrating the connections between the different tube elements used in Fig. 1; and Fig. 4 is a section along
45 line 4-4 of Fig. 2.

50 The elements for containing, conducting, evaporating and superheating fluid comprise tubes which are helically and spirally wound and connected in series or series-parallel as regards the flow of fluid therethrough. Thus, in a single tube boiler, as shown, the tube means forming the fluid-containing elements may be divided into several portions, one portion defining a preheater, another portion defining an evaporator or
55 boiler proper, and a third portion defining a

superheater, the same as in other kinds of boilers. The boiler as shown in the drawings, however, differs from other kinds of boilers in that the elements in which for instance the heating and evaporating of liquid takes place are not as strictly defined. As pointed out above, the fluid is forced through the tubes and the point or points at which evaporation and superheating of the fluid takes place vary in accordance with conditions, particularly the combustion and the load of the
10 boiler. In a preferred embodiment of my arrangement I provide the preheating tubes in the upper part of the boiler and the evaporating tubes in the lower part of the boiler. A portion of the evaporating tubes is preferably helically wound
15 to define a cylindrical combustion space.

Referring now more specifically to the arrangement shown in the drawings, the outer boiler structure comprises a cylindrical wall
20 made of fireproof material. Concentrically arranged with and spaced from this wall is a second wall 11 made of insulating material and covered by a metal sheet 12. As several tube connections are made outside the last mentioned wall, an outer cover or jacket 13 is provided, thus
25 giving the boiler, which may be placed adjacent a turbine, a simple and pleasing appearance. The different walls are united and supported by a frame composed of standard structural forms
30 14. A plurality of burners 15 are arranged in the lower part of the boiler. These burners in accordance with my invention are supported by doors 16 which may be swung out to permit a man to enter through an opening 16^a of the boiler
35 for inspection and repair of the interior thereof. The boiler base portion defines air chambers 17 communicating through channels 17^a with the interior of the boiler.

The heating elements, as shown in Figs. 1 and 3, comprise a plurality of helically and spirally wound tubes. In the upper portion of the boiler space is a preheater 18 having an inlet 19 and an outlet 20. The preheater comprises a plurality of layers of spirally wound tubes connected in series. In the arrangement of Fig. 1, I have
45 shown ten layers of tubes, of which alternate layers extend through the inner wall 10 to permit access to the connections between certain layers of tubes. This facilitates repair and assembly of the preheater. The preheater is connected to a layer of tubes 21 provided on the bottom of the furnace. The inlet 22 of the tubes 21 is connected to the outlet 20 of the preheater by means of a conduit 23 and the outlet 24 of said bottom tubes is connected to the inlet 25 of a tube
55

portion 26 wound helically along the inner surface of the furnace to define a combustion space near the burners 15. A plurality of layers of spirally wound tubes 27 are connected in series to the outlet 28 of the helically wound tube 26. As will be readily seen in the drawings, whereas with respect to the preheating tubes 18 only alternate layers of tubes extend through the furnace wall, each layer of tubes 27 has its outer turn extending through the furnace wall into the space between walls 10 and 11. These tubes being subject to higher temperatures, usually require more repair. A plurality of layers of spirally wound tubes 29 are connected in series and parallel to the outlet 30 of the tubes 27. As best shown in the diagrammatic illustration of Fig. 3, tubes 29, which broadly represent a superheater, comprise two portions 31 and 32 respectively having inlets 33 and 34 respectively connected in parallel to the outlet 30 of the tubes 27. The two superheat portions have outlets 35 and 36 also connected in parallel by a tube 37, for discharging superheated fluid. The connections 33, 34 and also the long connection 23 between the preheater and the bottom tubes are located between the outer cylinder or jacket 13 and the metal sheet cover 12. The inner turns of the layers of spirally wound tubes 27 and 29 form a vertical, channel. In order to prevent the gases escaping from the combustion space from passing directly through this channel, some of the inner turns of the layers are covered by members 38 of fire-proof material. These members cause the combustion gases escaping from the combustion space to flow primarily through the space between adjacent turns of the different layers of tubes.

A similar arrangement is provided with respect to the preheating tubes 18 which differs insofar as it permits adjustability. This is an important feature of my invention. As shown in Fig. 1, a cylindrical member 39 is provided in the channel defined by the inner turns of the preheating tubes. This cylindrical member telescopes another cylindrical member 40 which may be moved up or down by means of a lever and link mechanism 41. The cylindrical member 40 is open at both ends and its wall is secured to a stem 40a by means of a plurality of webs 40b. The upper end of the stem 40a is connected to a spider 40c which in turn is pivotally secured to a member of the link mechanism 41. Fastened to the lower end of the spider 40c is a cylindrical guide member 40d for properly guiding the spider 40c and the stem 40a within a cylindrical member 39. The member 40 is shown in Fig. 1 in its lower end position in which it engages a plate 41a preventing the flow of gases through the cylindrical member 39. In this position all the gases passing from the combustion space through the superheater are conducted through the preheater. In order to reduce the temperature of the preheated fluid the member 40b is moved upward by the actuation of the link mechanism 41 so that a part of the heating gases may flow through the channel defined by the cylindrical member 39. If the adjustment is such that no gases can flow through the inner channel 39, a high preheating temperature is obtained because all the gases then flow through the spaces defined between the preheating tubes. A high preheating temperature of course means a high superheating temperature because the superheating temperature in a single tube boiler depends upon the preheating temperature, that is, the temperature at

which the fluid is fed to the boiler proper. From another viewpoint, the preheating temperature determines the zone or the level at which the evaporation takes place. During high load condition it is desirable to lower the evaporation zone, and vice-versa.

The support of the outer tubes is shown in Fig. 4. The outer tubes or turns are provided with lugs or projections 42 which rest on brackets 43 fastened to the furnace wall. The support of the inner tubes is accomplished by structural forms such as U-irons 44 and 45 (Fig. 1) having ends supported on the outer turns. During operation, liquid is conducted to the preheater 18 whence it is forced successively through the tubes 21, 26, 27 and 29. The evaporation takes place primarily in the tubes 26 and 27 and the superheating takes place in the tubes 29 which comprise the two sub-groups 31 and 32. The regulation of the superheat temperature of elastic fluid discharged through the conduit 37 is accomplished by moving the cylindrical member 40 up or down. This cylindrical member, together with the member 39 forms an adjustable by-pass for combustion gases escaping from the space defined between the layers of spirally wound tubes 29. In other words, gases flowing through the cylindrical members 39 are by-passed with respect to the preheating layers. If a substantial amount of gases is thus by-passed, the preheated temperature will be low, resulting in a low superheat temperature and if no gases are by-passed through the members 40 and 39 with respect to the preheating layers, the preheat temperature will be comparatively high, resulting in a high, superheat temperature.

With my invention I have accomplished an improved design and arrangement for elastic fluid generators, particularly of the single tube pressure combustion type. In a boiler according to my invention the superheat temperature can be readily controlled.

Having described the method of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof, I desire to have it understood that the apparatus shown is only illustrative and that the invention may be carried out by other means.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In an elastic fluid generator, a helically and spirally wound tube for heating and evaporating liquid, a portion of the tube defining a preheater for liquid, a second portion of the tube defining a combustion chamber, a third portion of the tube defining a superheater, the inner turns of the third portion defining a channel, means preventing the flow of combustion gases from the combustion chamber through said channel, and means for regulating the fluid temperature in the superheater comprising means for by-passing combustion gases at the preheater without affecting the flow of gases through the superheater.

2. In an elastic fluid generator, a helically and spirally wound tube for heating and evaporating liquid, said tube having a portion defining a cylindrical combustion chamber, a plurality of spirally wound layers forming a superheater connected to the outlet of the portion and receiving heating gases from the combustion chamber, upper spiral layers of the tube defining a preheater for liquid and being connected to the inlet of said portion, the inner turns of the superheater forming a channel, means secured to at least one of the

inner turns for preventing the flow of gases through said channel, and means for controlling the flow of gases through a central path defined by the inner turns of the upper spirally wound preheater layers to control the fluid temperature.

3. In an elastic fluid generator, a helically wound tube defining a cylindrical combustion chamber, a plurality of layers of spirally wound tubes connected in series to the helically wound tube and being in the path of combustion gases escaping from said chamber, said layers of spirally wound tubes defining a superheater with the inner turns of said layers forming a channel, means preventing the flow of gases from the combustion chamber through said channel, other spirally wound tubes for preheating a liquid to be conducted to the helically wound tube, said other tubes being located in the path of combustion gases escaping from the space defined between said layers of tubes and having inner turns defining a by-path through which combustion gases may escape, and means for controlling the superheat temperature of generated elastic fluid comprising means for regulating the resistance to

flow of gases through the by-path without affecting the flow of gases through the superheater.

4. In an elastic fluid generator, a wall, a tube for producing elastic fluid, a plurality of helically and spirally wound tubes connected to said tube and supported by the wall for heating fluid, said tubes defining a superheater, a plurality of covers secured to the inner turns of the superheater to prevent the flow of gases through the channel defined by said inner turns, a preheater for liquid to be conducted to said tube, the preheater comprising a plurality of layers of spirally wound tubes with the spaces between the tubes receiving combustion gases escaping from the spaces between the first mentioned tubes, a cylindrical member movable in a channel defined by the inner turns of the preheating tubes, a plate disposed near one end of the channel, and means connected to the cylindrical member for moving the cylindrical member relative to the plate to control the relative amount of combustion gases flowing through said channel in order to regulate the temperature in the preheater and the temperature of the generated elastic fluid.

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