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STEAM BOILER

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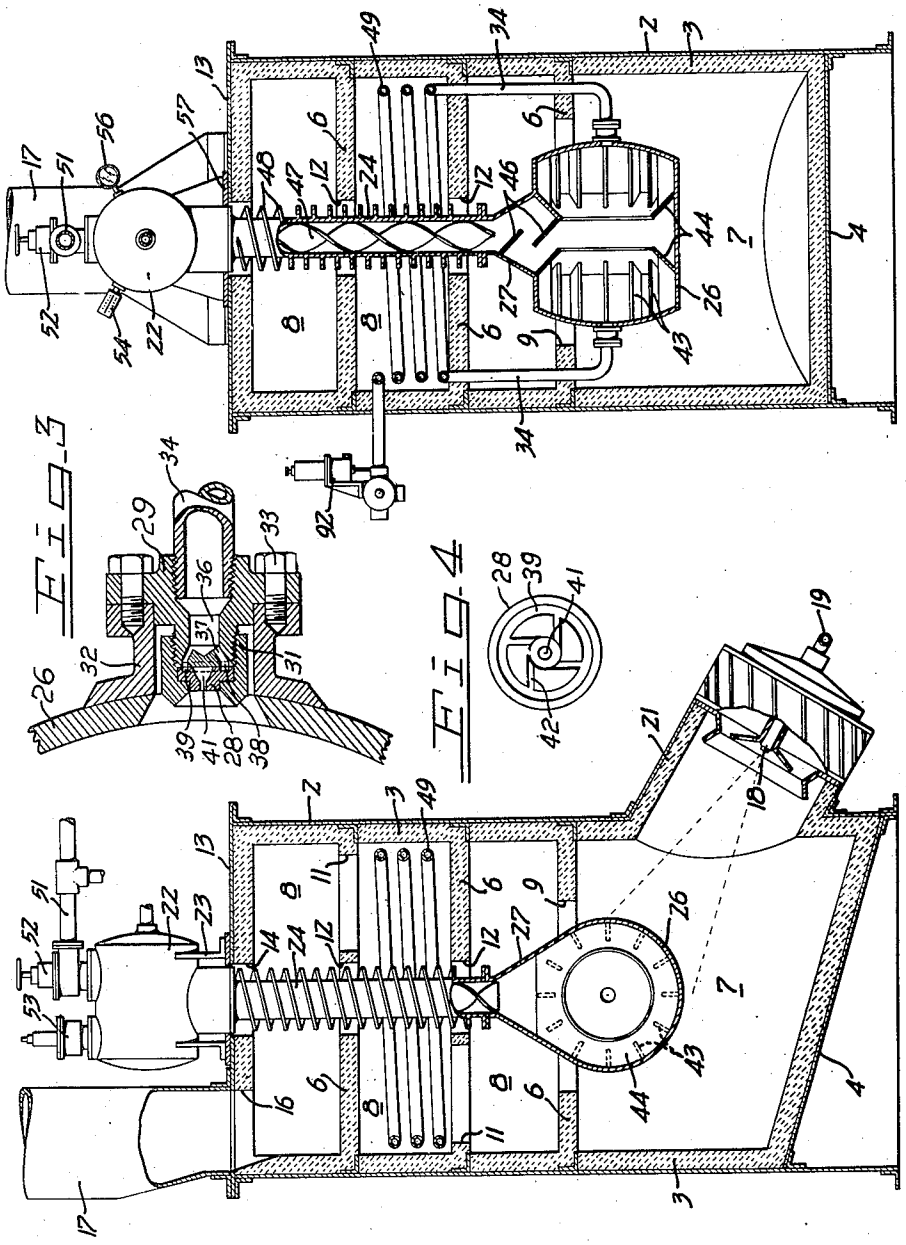


FIG. 2

FIG. 3

FIG. 4

FIG. 1

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STEAM BOILER

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8 Claims. (Cl. 122—41)

My invention relates to a steam generating unit; and more particularly to a boiler for engines, turbines, and other machines utilizing steam as a pressure fluid.

It is among the objects of my invention to provide a boiler for generating steam more efficiently to reduce fuel costs.

Another object is to provide a boiler by which a given head of steam may be obtained more quickly.

Another object is to provide improved means for controlling the rate of steam generation.

Another object is to provide a boiler which is safer to operate.

Still another object is to provide effective and economical means for superheating steam.

A further object is to provide an improved feed water and fuel supply system.

Still further objects include the provision of a boiler of the character described which is simple, compact and of less costly design; having substantially no soot or scale problems; and embodying an evaporator unit adapted for multiple use to increase boiler capacity.

The invention possesses other objects and features of advantage, some of which, with the foregoing, will be set forth in the following description of my invention. It is to be understood that I do not limit myself to this disclosure of species of my invention, as I may adopt variant embodiments thereof within the scope of the claims.

Referring to the drawing:

Figure 1 is a vertical sectional view of a boiler embodying the improvements of my invention; and

Figure 2 is a similar view taken at right angles to the section of Figure 1.

Figure 3 is a fragmentary sectional view of the feed water nozzle; and

Figure 4 is a detail view looking at the inside face of the nozzle head.

Various types of steam generating units have been developed in the past, such as Scotch boilers, water tube boilers and flash boilers. These boilers all embody tubes and differ principally in whether the latter conduct the water to be evaporated or the gases of combustion. In each case the boiler operation depends upon a transference of heat through metal tubes to a body of water contained either internally or externally of the tubes. Such boilers are comparatively inefficient thermodynamically; are generally slow in building up steam pressure; have no means for readily controlling the rate of steam generation; are relatively dangerous to operate; have aggravating soot and scale problems; require considerable auxiliary equipment; and are generally heavy, inflexible and expensive both to install and operate. My improved boiler construction largely eliminates these problems and disadvantages.

In terms of broad inclusion, my boiler comprises an evaporating chamber, means for introducing finely divided water into the chamber, and means for heating the chamber. The evaporating chamber is preferably in the form of a relatively small drum disposed directly in a combustion chamber, and is designed for maximum inward radiation of heat to cause substantially instantaneous evaporation of the atomized feed water. A superheating chamber is preferably formed as a tubular extension of the main evaporating portion of the unit, and is arranged to absorb heat from the flue gases to insure complete evaporation and superheat the steam. This superheater is also designed for maximum heat absorption by the steam. Means also disposed to absorb heat from the flue gases is preferably provided for preheating the feed water. Regulating means may be provided to control the feed water and fuel to the furnace; and safety devices may also be provided in the system as required.

In greater detail, and referring to Figures 1 and 2 of the drawing, my boiler comprises a cylindrical casing 2 lined with refractory material 3 for insulation and heat reflection. The lining is preferably of sectional structure to facilitate construction and assembly. An inclined bottom 4 is provided for the casing and is also covered with the lining material. A plurality of say three partitions 6 of refractory material are arranged in the casing and function as baffles to divide the casing into a lower combustion chamber 7 and a series of upper flue passages 8.

The lower partition has a central opening 9 while the upper partitions have offset flue openings 11 as well as smaller central openings 12. The top lining and plate 13 have an aperture 14 aligned with the central partition apertures, and also have an opening 16 communicating with smoke stack 17. Openings 11 and 16 are alternately disposed on opposite sides of the flue passages to give a zig-zag path for the flue gases. The furnace is preferably fired by an oil burner having a head 18 fed from an oil line 19. This burner may be of any suitable construction and further details will not be given as to the burner structure per se. The burner is preferably mounted on a neck portion 21 of the casing, disposed at an angle to the vertical axis of the unit to direct the flame upwardly into the combustion

chamber 1. Bottom 4 is preferably sloped at the same angle.

The evaporating unit of my improved boiler comprises a steam reservoir 22 mounted centrally on the top of the casing by suitable brackets 23. Depending from this reservoir and supported thereby is a tubular superheating chamber 24 communicating at its upper end with the reservoir and extending downwardly through openings 14 and 12. Tube 24 has a flanged upper end bolted to a saddle flange on the reservoir. Supported at the lower end of tube 24 in opening 9 is a relatively small drum 26 forming the main evaporting chamber of the unit. This drum has a flanged top neck 27 bolted to the lower flanged end of tube 24 so that drum 26, tube 24 and reservoir 22 are connected as a structurally integral unit, all supported by brackets 23 at the top of the boiler.

Evaporating drum 26 lies principally within combustion chamber 7 and is disposed to receive the full benefit of the flame from inclined burner head 18. The flue gases in traversing passages 8 envelope the superheating tube or chamber 24, as will be readily appreciated from the construction shown. An important feature to be noted is that tube 24 and drum 26 of the evaporating unit are freely suspended and therefore are free to expand and contract under changing temperature conditions.

Means are associated with my evaporating unit for admitting finely divided water into drum 26. For this purpose a pair of nozzles are provided, one at each closed end of the drum, for atomizing the feed water and injecting it into the hot evaporating chamber. As best shown in Figure 4, the nozzle preferably comprises a head 28 held on a studded plate 29 by a cap 31; the plate being secured to a boss 32 at the end of the drum by studs 33. A pipe 34 feeds water to the nozzle, into a cavity 36 of the stud, from which the water flows through outwardly extending passages 37 to a peripheral groove 38 in the face of the stud.

Nozzle head 28 also has a groove 39 in its back face, registering with groove 38 to provide a water channel from which the fluid is directed inwardly to nozzle orifice 41 through passages 42 disposed tangentially of the orifice bowl. See Figure 4. By this arrangement the water is well broken up and is given a whirling motion that insures thorough atomization, so that the water is introduced into the evaporating chamber in a finely divided state of subdivision. By changing the size of passages 42 the maximum amount of water admitted by the nozzle may be varied. Arranging the nozzles at the ends of the drum provides two feed water sprays, each directed toward the center of the chamber. While the nozzle structure shown is preferred, it is understood that other suitable types of nozzles may be employed.

Means are also provided for enhancing inward radiation of heat within the evaporating chamber. As shown in Figures 1 and 2, a plurality of radial fins 43 are preferably arranged in the drum to function as heat conductors and provide additional internal radiating surfaces. Baffle means are also provided in the drum and disposed in the path of the projected water particles to give added turbulence and furnish additional heat radiating surfaces. For this purpose a pair of conical plates 44 are arranged circumferentially of the drum adjacent its central portion, the opening between these converging plates leading to the drum outlet through neck 27. A pair of baffle plates 46 at the outlet function to further impede the egress of steam from the evaporating chamber.

By this arrangement, the fine particles of water injected into the hot drum are converted substantially instantaneously into steam. This conversion is not only practically instantaneous, but it is also substantially complete. The efficiency of this steam generator is materially greater than boilers heretofore developed, not only because it utilizes heat of radiation as well as that of conduction, but also because the finely divided fluid particles offer a much larger water surface for heat absorption. In previous boiler constructions where a comparatively large body of water lies adjacent a hot metal surface, the heat transfer is principally by conduction and only the layer of water contiguous to the metal gets the full benefit of the conducted heat. On the other hand, in my steam generator a large water surface per unit volume of fluid is presented to the combined influences of conducted and radiated heat. While a water particle is traveling in a free path in my evaporating chamber it is absorbing radiated heat, and when it strikes a hot surface of the chamber it additionally absorbs heat by conduction. Therefore, when a minute water particle is injected into the intense heat zone in the evaporating chamber the conversion into steam is substantially instantaneous.

Steam from the main evaporating chamber 26 passes upwardly through superheating tube 24, wherein means are preferably arranged to provide a tortuous path for the steam and any unevaporated water particles. As shown in Figure 2, a helical strip 47 is disposed in the tube to provide a spiral path for the steam. This strip performs the dual function of a baffle plate and means for amplifying the radiation of heat inwardly of the tube. In addition, helical fins 48 are preferably provided externally of the tube for additionally absorbing heat from the flue gases enveloping it. If desired these fins could simply be annular, radially projecting plates. This arrangement effectively superheats the steam by utilizing flue gas heat that would otherwise be lost, thus adding further to the economy of my unit. From tube 24 the superheated steam passes directly into reservoir 22.

Means also utilizing heat from the flue gases is preferably provided for preheating the feed water. As also shown in Figures 1 and 2, a pipe coil 49 is arranged in one of the flue passages 8. Pipes 34 leading to the atomizing nozzles at the ends of drum 26 depend from the lower convolution of the coil. The temperature of the feed water is thus elevated without requiring an additional source of heat, thereby adding still further to the economy and efficiency of my unit.

Steam from reservoir 22 is led off through a pipe 51 controlled by a suitable valve 52. A safety valve 53 is also provided on the reservoir, along with thermometer 54 and pressure gauge 56 shown in Figure 2. An apertured cover plate 57 on the top of the furnace is disposed under the reservoir to form a seal at opening 14.

It is to be understood that in practice suitable means are also provided for supplying feed water under pressure to the furnace. Further, suitable safety controls may be used as desired. A safety device is indicated at 92 in Fig. 2.

I have described the unitary structure of drum 26, tube 24 and reservoir 22 of the evaporating unit. A feature to be noted in this connection

is that the units are readily adapted to be used in multiple to increase boiler capacity. Thus, a series of units may be mounted in a single boiler with their evaporating drums depending into a common combustion chamber. The evaporating units may therefore be standardized as to size, depending upon multiple arrangement for increased capacity. Whether the units are used singly or in multiple, they have the advantage of centralizing the point or points of steam generation, and do not spread over a large area like the tubes of the Scotch or water tube boilers. This centralization provides greater compactness; reduces weight; and requires less fire.

The simplicity and economy of the preheater for the feed water is also to be noted, compared to the multiple stage steam consuming heaters of ordinary boilers. Likewise the absence of soot and scale problems in my boiler eliminates the auxiliary equipment needed to deal with these problems in ordinary boilers where lengthy tubing is present to collect soot, and accumulate scale. The considerable auxiliary equipment required for ordinary boilers often exceeds the cost of the boiler itself, all of which is eliminated by my improved boiler design.

By the terms "finely divided water" as used throughout the description and claims I mean feed water of particle size that offers a large surface area for heat absorption yet of sufficient mass to be projected into all portions of the evaporating chamber against the pressure therein. This may vary from minutely atomized particles to water particles of considerably larger size, depending upon the size of the evaporating chamber, the pressure therein, and the force with which the particles are injected into the chamber.

I claim:

1. A boiler comprising an evaporating chamber, a superheating chamber communicating with the evaporating chamber to receive steam therefrom, atomizing nozzle means for introducing finely divided water into the evaporating chamber, means providing a tortuous path for steam through the superheating chamber, and means for heating said chambers.

2. A boiler comprising an evaporating chamber, a superheating chamber suspending the evaporating chamber and communicating with the evaporating chamber to receive steam therefrom, means for introducing finely divided water into the evaporating chamber, means for heating said chambers, and heat absorbing fins on the exterior of the superheating chamber.

3. A boiler comprising a combustion chamber having a flue, an evaporating drum disposed in said chamber, a superheating tube leading directly from the drum and extending longitudinally through said flue, a helical baffle in the tube, and means for introducing finely divided water into the drum.

4. A boiler comprising a combustion chamber, an evaporating drum disposed within said chamber, a tube communicating with the drum at a point between the ends of the drum for conducting steam from the drum, atomizing nozzles for introducing finely divided water into the opposite end portions of the drum toward said point, and burner means in said chamber for heating said drum to cause the finely divided water to almost instantaneously change into steam.

5. A boiler comprising a combustion chamber, an evaporating drum disposed within said chamber, a tube communicating with the drum at a point between the ends of the drum for conducting steam from the drum, atomizing nozzles for introducing finely divided water into the opposite end portions of the drum toward said point, baffle means on the inner wall of the drum between the nozzles and the point of communication of the tube with the drum for increasing the turbulence of the finely divided water and presenting heat radiating surfaces in the interior of the drum, and burner means in said chamber for heating said drum to cause the finely divided water to almost instantaneously change into steam.

6. A boiler comprising a combustion chamber, an evaporating drum disposed within said chamber, a tube communicating with the drum at a point between the ends of the drum for conducting steam from the drum, atomizing nozzles for introducing finely divided water into the opposite end portions of the drum toward said point, frusto-conical baffle plates on the interior of the drum at opposite sides of the point of communication of the tube with the drum, heat radiating fins on the interior of the drum between the ends of the drum and the baffle plates, and burner means in said chamber for heating said drum to cause the finely divided water to almost instantaneously change into steam.

7. A boiler comprising a combustion chamber having a flue leading upwardly therefrom, an evaporating unit comprising a superheating tube extending downwardly through the flue to be heated by the gases passing therethrough, an evaporating drum suspended from the lower end of said tube to communicate therewith and to be disposed within the combustion chamber, said suspension of the drum permitting free expansion and contraction of both said tube and drum, and nozzle means introducing atomized water into said drum, and burner means in the combustion chamber for heating said drum to convert the atomized water into steam.

8. In a boiler, a casing providing a combustion chamber at its lower portion and a flue at its upper portion, and an evaporating unit comprising a steam reservoir mounted on the top of said casing, a superheating tube depending from the reservoir through said flue, and an evaporating drum carried on the lower end of the tube in said combustion chamber, the drum being suspended from the reservoir by the tube whereby the tube and drum are free to expand and contract as a unit independently of all other parts of the boiler.

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