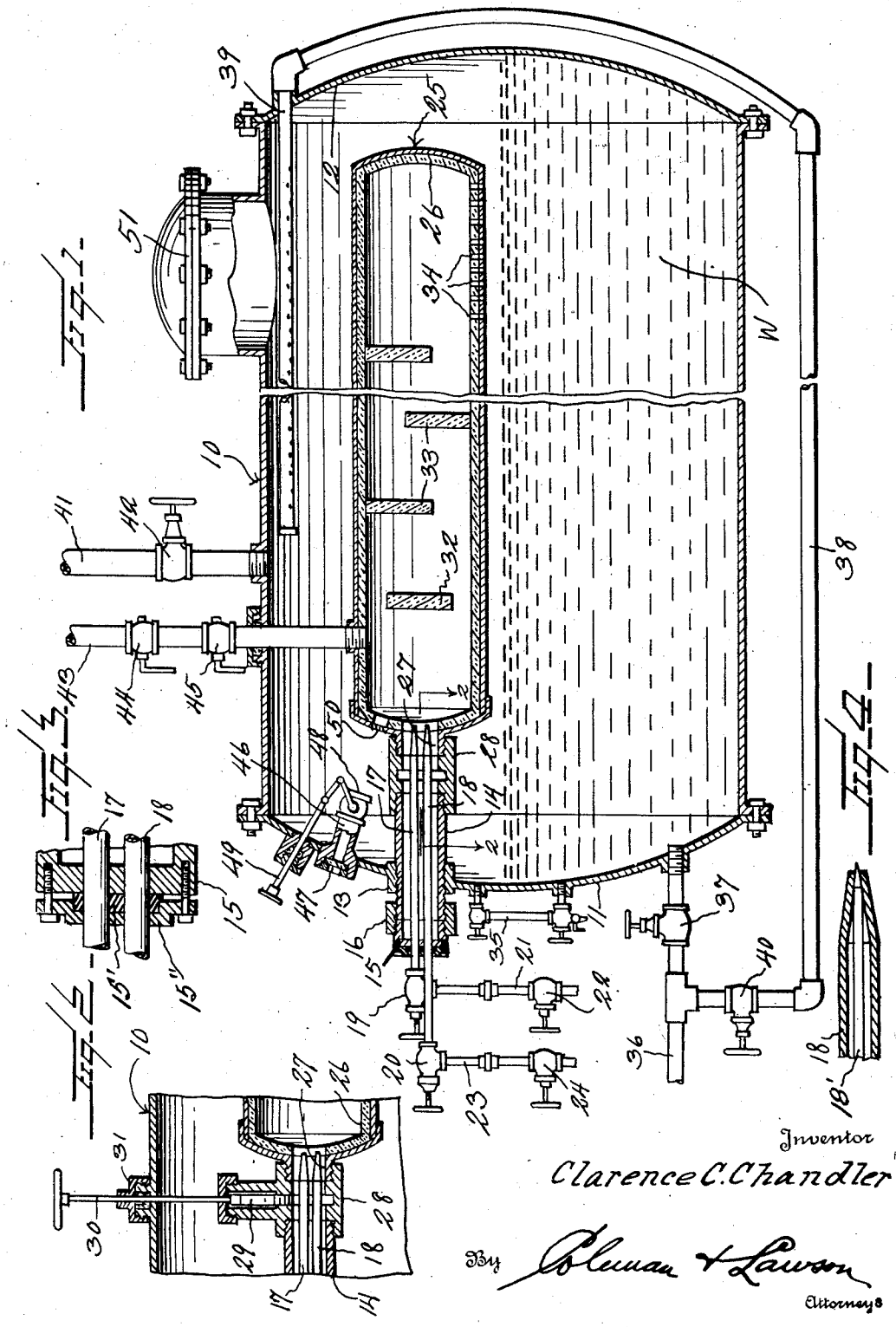
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STEAM GENERATOR

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STEAM GENERATOR

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4 Claims. (Cl. 60—45)

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This invention relates generally to the class of power plants and pertains particularly to improvements in steam generators.

In the external combustion type of steam boiler or steam generator foaming occurs because of the application of heat to firebox sheets and flues, resulting in evaporation taking place beneath the layer or column of water which causes bubbles to form and rise rapidly to the surface. This produces a violent turbulence that varies directly with the rate of heat transfer. When using water having considerable dissolved solids therein this disturbance often progresses to the point where bubbles will stack up and pass out with the steam that is being used from the boiler.

A primary object of the present invention is to provide an improved steam generator by means of which efficient generation of steam is possible and at the same time the disadvantages above set forth as associated with the external combustion type of boiler are completely avoided, and heat units commonly lost in gases of combustion, escaping through the smoke stack, are saved.

Another object of the invention is to provide an improved steam generator wherein the usual firebox, stay bolts, flues and flue sheets, dome, smoke box, nozzle and stack are eliminated with a resultant lower initial cost and greatly reduced cost of upkeep.

A still further object of the invention is to provide an improved steam generator which is designed to have greater durability than the commonly used external combustion type of generator, and to furnish a greater amount of power per unit of area.

Still another object of the invention is to provide a steam generator having a novel method of heating the water therein and generation of steam so that the disturbance of the water in the tank during the steam generating period is avoided, and there is also avoided the formation and deposition of scale upon surfaces where it would operate to reduce the transfer of heat units from the furnace to the water, and thus interfere with the operating efficiency of the generator.

The invention will be best understood from a consideration of the following detailed description taken in connection with the accompanying drawing, it being understood, however, that the invention is not to be considered as limited by the specific illustration or description but that such illustration and description constitute a preferred embodiment of the invention.

In the drawing:

Figure 1 is a vertical longitudinal section

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through a steam generator constructed in accordance with the present invention, the tank length being reduced by the breaking away of the central portion thereof for the purpose of illustrating the construction of the two ends.

Figure 2 is a sectional view taken substantially on the line 2—2 of Figure 1, and looking in the direction of the arrows.

Figure 3 is a sectional view on an enlarged scale through the outer end of the tubular housing for the fuel and air nozzles showing a form of packing around the nozzles.

Figure 4 is a longitudinal section through the forward end of one of the nozzles showing the action of the valve needle.

Referring now more particularly to the drawing, the numeral 10 generally designates a water container or tank which is here illustrated as being of circular cross-section and having the domed ends or heads 11 and 12, the tank being disposed horizontally, as illustrated, and supported in any suitable manner for operation. However, it will be readily apparent that a tank of this specific design does not necessarily have to be employed for the proper working of the invention and, therefore, the invention is not confined to the use of a tank of this particular type.

One end wall of the tank, here indicated as the wall 11, has a threaded opening 13 formed therethrough above the axial center of the tank as shown, and threaded through this opening is a tubular housing 14, the outer end of which is closed by the cap 15 which is connected with the end of the housing by the collar 16.

The cap 15 has suitable apertures for the extension therethrough of the two needle valve nozzles 17 and 18 which extend, respectively, from the valve bodies 19 and 20. These nozzles extend through the tubular housing and into the end of the furnace, as hereinafter described. These nozzles upon the outer side of the cap are encircled by a suitable packing material 15' which is secured in place by the compression plate 15'' and by loosening this plate and the packing the nozzles may be withdrawn or partly withdrawn from the tubular housing for the purpose hereinafter set forth.

One of the valves, for example the valve 19, controls the flow of fluid fuel through the tip or inner end of the nozzle 17, while the other valve, the valve 20, controls the flow of air through the tip of the nozzle 18.

As shown in Figure 4, the flow controlling needle, illustrated in association with the nozzle 18 and indicated by the reference character 18',

has its point extended into and through the tip of this nozzle and, consequently, when the needle is retracted, the nozzle tip will be opened and the fluid, in this case the air, will be introduced into the furnace. It will be understood from the description of this nozzle 18 that the nozzle 17 is of exactly the same construction for controlling the introduction of fuel into the furnace.

The fuel pipe line 21 leading to the valve 19 has a shut-off valve 22 therein, while the compressed air pipe line 23, leading to the control valve 20, has a shut-off valve 24 therein.

Within the tank or receptacle 10 is disposed the furnace which is indicated generally by the numeral 25. This is in the form of an elongated housing having a suitable refractory lining 26 and at one end having the threaded neck 27. The neck 27 of the furnace is coupled with the inner end of the nozzle housing 14 by the gate valve 28. When this gate valve has the gate 29 thereof in open position the discharge ends of the nozzles 17 and 18 can be moved into the inner end of a passage for discharge into the interior of the furnace, as is clearly shown in Figure 1. The gate 29 of the gate valve is operated by the stem 30 which extends laterally through a suitable packed guide 31 carried by the wall of the tank, to the exterior of the tank. By means of this gate valve communication between the tubular nozzle housing 14 and the interior of the furnace may be cut off, this being effected by first loosening the packing plate 15'' sufficiently to permit the nozzles to be drawn back to the position where the tips will be out of the path of movement of the gate valve, after which the valve can be completely closed, as will be readily apparent. Complete removal of the nozzles may then be effected by disconnecting the cap from the tubular housing to which it is attached by means of the coupling ring 16.

The furnace 25 may be of any desired cross-sectional contour, but it is of substantial length as illustrated and extends longitudinally within the tank above the longitudinal center thereof, as shown. Within the furnace adjacent the fuel inlet end is a target wall 32 against which the burning fuel impinges when discharged into the furnace and between this target and the opposite or far end of the furnace from the nozzles, are baffles 33 which cause the burning fuel to be buffeted about within the furnace and follow a tortuous pathway to the opposite end of the furnace.

At the end of the furnace remote from the nozzles, the underside or lower side of the furnace wall is provided with a plurality of discharge or exhaust apertures 34 through which the burning fuel and gaseous products of combustion pass to impinge against the underlying surface of the water W with which the tank or receptacle is charged.

One end wall of the tank is provided with a water gauge 35 and this is arranged so that the water when being charged into the tank can be brought to a level at substantially the longitudinal center of the tank and just below and in close proximity to the furnace, as illustrated. As a result, when the burning fuel and products of combustion discharge through the openings 34 the heat therefrom will be directly transferred to the surface of the water and the water will be heated and caused to turn to steam at the surface. As a result, there will be no disturbance of the body of water during the formation of the steam as there would be if the water were heated from the under side of the tank and the development of steam causing bubbles to rise through the water.

The numeral 36 designates the water supply pipe having a control valve 37 therein and leading off from this supply pipe upon the side of the control valve opposite from the tank, is a pipe line 38 which is connected, through the end wall 12, with a spray pipe 39 which is disposed lengthwise within the top of the tank above the furnace 25. This pipe 38 has a valve 40 therein for the control of water flow therethrough to the spray pipe, the purpose of which will be hereinafter described.

Connected with and leading off from the top of the steam generator tank 10 is the steam and gas outlet or lead-off pipe 41, through which the flow of steam and gases is controlled by the valve 42.

Also extending through the top of the generator tank is a starting pipe which is indicated by the numeral 43 and which extends to and opens into the furnace 25, as shown. This starting pipe 43 has therein the two spaced valves 44 and 45. The starting pipe, as shown, opens into the furnace between the target 32 and the fuel inlet.

Secured in the end wall 11 and directed toward the adjacent end of the furnace, is a sight tube 46, in the outer end of which is secured a window of suitable heat resisting glass 47, while at the inner end the sight tube carries a sight control valve 48, the opening and closing of which valve is under the control of the stem 49 which is slidably mounted in the end wall of the tank so as to be conveniently actuated from the outside of the tank. This sight tube 46 is aligned with a sight window 50 in the adjacent end of the furnace and thus when the valve 48 is opened, the operator of the steam generating plant can view the interior of the furnace to determine whether or not the correct type of heating flame is being employed for the operation of the plant with maximum efficiency.

In order to facilitate the making of repairs when necessary and otherwise properly operating the generating plant, the tank structure is provided with a suitable manhole 51 so that an attendant can enter the tank when and if necessary.

In starting the operation of the steam generator when the latter is cold, the tank is first filled with water to the proper level, as illustrated and as is shown by the water gauge 35. The air and fuel pipe lines 23 and 21, respectively, are under sufficient pressure to drive the air and fuel from the nozzles into the furnace when the control valves are open. The inspection or sight valve 48 and the valves 44 and 45 of the starting pipe are then opened and an ignition fusee is then lighted and dropped through the starting pipe 43 to pass through the valves 44 and 45 into the furnace. The lower valve of the starting pipe, valve 45, is then closed and the air is then turned on by the needle valve 20 for discharge through the air nozzle 18, after which the fuel needle valve 19 is opened to allow the fuel to discharge from the nozzle 17 and pass with the air into the furnace. The fuel control valve 19 is then regulated until a white heat is observed in the furnace through the inspection or sight tube 46.

To start the fire in the furnace with pressure in the tank after the fire has gone out, requires a slightly different procedure. A thermit fusee may be used for igniting the fuel in the furnace, in which case the valve 45 is kept closed, while the valve 44 in the starting pipe is opened. The

fusee is then ignited and dropped through the pipe 43 into the area between the valves 44 and 45. The upper valve 44 is then quickly closed and the lower valve 45 simultaneously opened to let the lighted fusee fall into the furnace in front of the target 32, after which the air and then the fuel valve is opened and the fuel supply is regulated, as previously described. A thermit fusee will give four to six thousand degrees of heat and furnishes its own oxygen so that it will consume little or no oxygen from the air. If a magnesium fusee is used it may be necessary to turn the air supply on first and then insert the fusee in the same manner as explained for the thermit fusee.

Where electric power is available, it will be readily apparent that ignition of the fuel may be accomplished in any of the well-known ways employed for starting fuel oil furnaces.

In passing around the target 32 and between the baffles 33 the air and fuel will be thoroughly combined and have plenty of time for complete combustion in the furnace to develop a very high temperature. The products of combustion will escape through the openings 34 at the end of the furnace and will strike the surface of the water. If this does not produce enough evaporation the end of the furnace may be partly submerged and the gases forced to pass between the surface of the water and the bottom of the furnace to the back of the generator tank. To assure that the gases will not be too hot for use when forcing the generator, water may be admitted through the sprinkler pipe 39 and will fall in a spray around the furnace, causing rapid evaporation and, consequently, absorption of the excess heat in the gases above the water level as well as absorbing heat from the wall of the furnace.

I claim:

1. A steam generator, comprising a tank designed to be partially filled with water, an elongated furnace housing disposed longitudinally in the tank above the water level, a tubular housing extending through a wall of the tank and connected with and opening into the furnace housing, said tubular housing having a portion exteriorly of the tank screw-threaded, a cap adapted for connection with the outer end of the tubular housing, means having threaded connection with the outer end of the housing and with the cap for maintaining the latter in position upon the end of the housing, a fuel injection nozzle carried by said cap and extending therethrough through the tubular housing toward the interior of the furnace, valve means for closing the tubular housing adjacent the end which is connected with the furnace, said fuel nozzle being coupled with said cap whereby the nozzle may be partially withdrawn through the tubular housing before the cap is removed to facilitate closing the tubular housing by the valve before the outer

end of the tubular housing is opened, said furnace having means for discharging heated gases against the surface of the water, and means for withdrawing steam from the tank.

2. A steam generator comprising a tank, the tank being designed to be partially filled with water during the operation of the generator, an elongated furnace housing disposed within the tank above but in close proximity to the water level, a fuel injection nozzle extending through an opening in the wall of the tank and directed into the furnace through a suitable opening in the wall of the furnace, means supporting said fuel nozzle in mounted position upon the tank, which is so constructed and arranged that the fuel nozzle may be partially withdrawn from the furnace without establishing communication between the interior of the furnace and the outside atmosphere, and means for closing off the said opening in the wall of the furnace when said nozzle has been partially withdrawn.

3. A construction as set forth in claim 2, in which the said mounting means for the fuel nozzle comprises a tubular housing extending through and mounted in the said wall of the tank and joined at one end to and opening through the said wall of the furnace, and the said means facilitating the partial withdrawal of the nozzle comprising a cap upon the outer end of the tubular housing having an aperture therethrough for reception of the nozzle and a packing secured to the cap and encircling the nozzle and adapted when loosened to permit the stated partial withdrawal of the nozzle without establishing communication between the outside atmosphere and the interior of the furnace.

4. A steam generator comprising a tank, a tube secured in and extending through a wall of the tank, a cap detachably attached to the outer end of the tube, a slide valve unit connected to the inner end of the tube and having a slide valve member movable transversely to close the inner end of the tube, a shaft connected with the slide valve member and extending transversely through a wall of the tank for actuation of the member from outside the tank, a furnace housing within the tank and connected with said slide valve unit for communication with said tube, a fuel injection nozzle carried by the cap and extending longitudinally through the tube and through the valve unit for discharge into the furnace at the inner side of the valve unit, and means forming a fluid tight connection between said nozzle and the cap by means of which the nozzle may be partly withdrawn through the cap without establishing communication between the interior of the tube and the outside atmosphere to a position where said slide valve member may be shifted to closed position across the inner end of the tube.

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