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APPARATUS FOR GENERATING AND SUPERHEATING VAPOR

Filed March 27, 1951

2 Sheets-Sheet 1

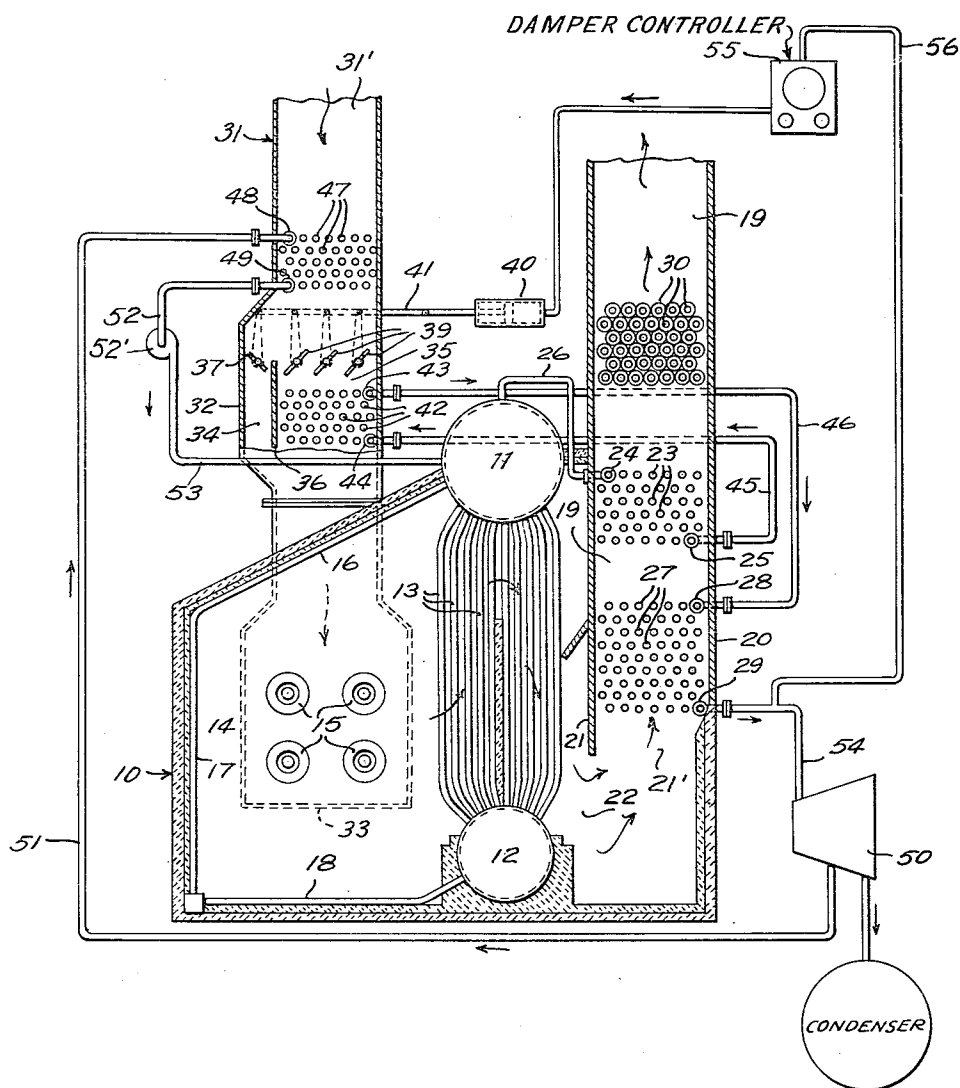


Fig. 1.

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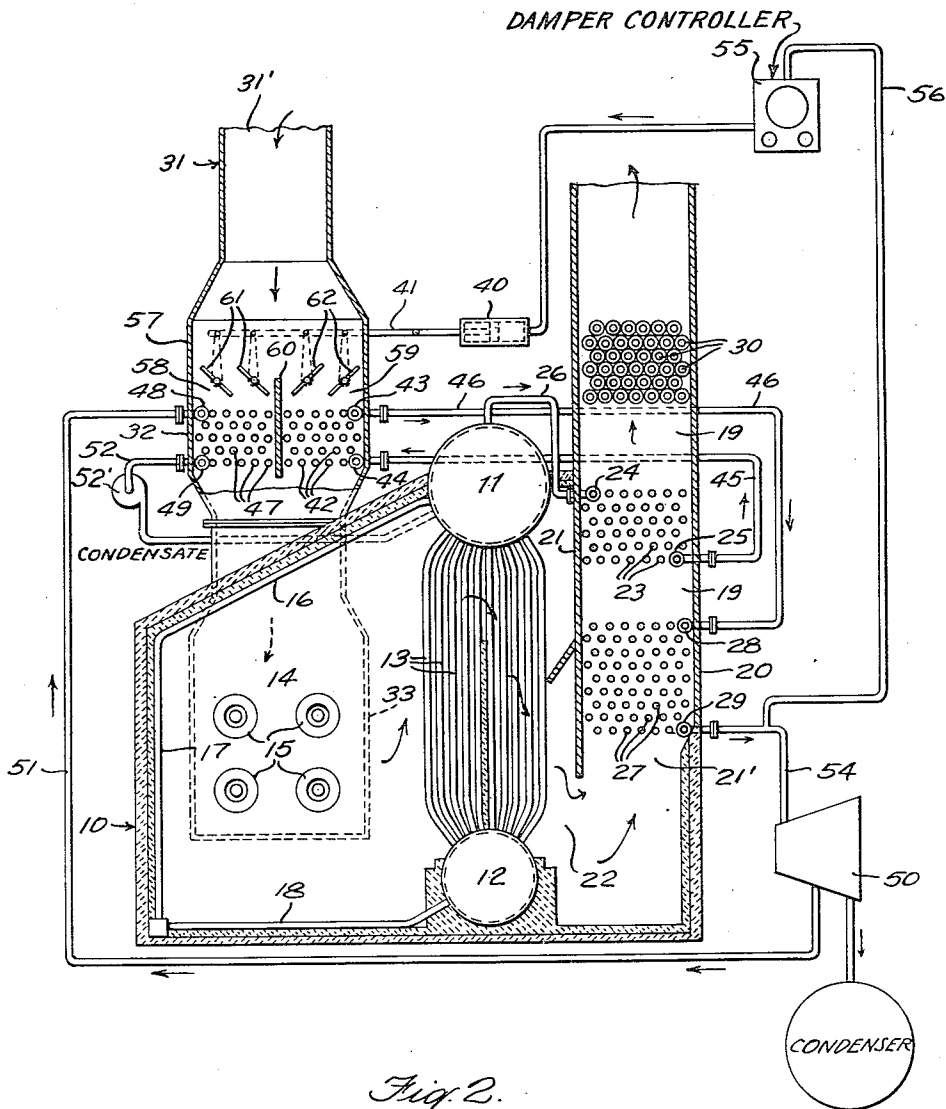


Fig. 2.

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APPARATUS FOR GENERATING AND SUPERHEATING VAPOR

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6 Claims. (Cl. 60—67)

This invention relates to power plants comprising a vapor generator feeding superheated steam to a turbine.

The thermal efficiency of such plants can be increased by preheating the combustion air for which purpose, low pressure steam is sometimes bled from the turbine and made to give up some of its heat to the air.

In accordance with the invention, the air is preheated not only by such bled steam but also by superheated steam and thus serves also to control the final steam temperature.

The superheated steam can be drawn from an intermediate point in the superheater or from the outlet from the superheater; the air can be passed in heat exchange with the bled steam and the superheated steam either in series or in parallel.

The invention will be understood from the following description when considered in connection with the accompanying drawing forming a part thereof, and in which:

Fig. 1 is a diagrammatic transverse section of the apparatus of one embodiment of the invention; and

Fig. 2 is a view similar to Fig. 1 but of another embodiment of the invention.

Like characters of reference refer to like parts in both views of the drawing.

Referring to the drawing, Fig. 1, the apparatus of the present invention is disclosed as embodying a vapor generator comprising a setting 10 having vapor generating surface therein with an upper steam and water drum 11 associated therewith together with a lower water drum 12 in the lower part of the setting in substantial vertical alignment with said upper drum. Drums 11 and 12 are connected by a substantially vertical bank of steam generating tubes 13.

At one side of the bank of tubes 13 is a furnace or combustion chamber 14 fired, as shown, by a plurality of burners 15. The roof, side wall and floor of chamber 14 are lined by water tubes 16, 17, and 18.

At the side of the tube bank opposite to that on which the chamber 14 is located is a substantially vertically extending gas passage 19 having an outer side wall 20 and an inner side wall 21. Passage 19 has a lower gas inlet 21' at the bottom thereof which receives gases through a furnace gas outlet 22.

A superheater having an upper or one section 23 with a saturated steam inlet 24 and a steam outlet 25 is disposed in the upper part of passage 19. Upper section 23 receives steam from drum 11 through saturated steam conduit 26 which communicates at the inlet end thereof with drum 11 and at the outlet end with saturated steam inlet 24 of the upper superheater section. The superheater also has a lower or other section 27 having a desuperheated steam inlet 28 and a steam outlet 29. Lower section 27 is disposed below and in spaced relationship with upper section 23. As shown, gas passage 19 has economizer section 30 positioned above superheater section 23.

An air duct 31 is disposed at the furnace chamber side of setting 10 and has an enlarged portion 32 in the upper part thereof and communicates with burners 15 through an enlarged portion 33 at the bottom thereof. The en-

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larged portion 32 of air duct 31 is divided into a vertically extending by-pass passage 34 and a main passage 35 by a vertically extending baffle 36. By-pass passage 34 is controlled by a by-pass damper 37, while main passage 35 is controlled by a plurality of dampers 39. As shown, by-pass damper 37 and dampers 39 are actuated by an actuator 40 through a lever 41, the dampers being so connected to lever 41 that as by-pass damper 37 is actuated into a closed position, dampers 39 are actuated into an opened position and as damper 37 is actuated into an opened position, dampers 39 are actuated into a closed position. A tubular coil 42 forming a flow path for steam is positioned in main passage 35 below dampers 39, said coil having an inlet 44 and an outlet 43. The inlet 44 is in communication with steam outlet 25 of the upper superheater section 23 through steam conduit 45, while outlet 43 is in communication with desuperheated steam inlet 28 through a conduit 46.

A tubular fluid flow path 47 is positioned in air duct 31 above dampers 37 and 39 and toward the air inlet 31' of said duct. Tubular flow path 47 has an inlet 48 and an outlet 49. Inlet 48 is in communication with the low pressure stage of a turbine 50 to receive bled steam therefrom through line 51, while outlet 49 communicates with a conduit 52 which conduit receives condensate from tubular flow path 47 which condensate is delivered by a pump 52' through a conduit 53 to upper drum 11 so that the condensate is used for boiler feed. The condensate pressure is raised by pump 52' so that the condensate pressure in conduit 53 is higher than the pressure within drum 11 thereby effectuating the introduction of condensate into the drum. Turbine 50 receives superheated steam from superheater section 27 through steam pipe 54 which communicates with the turbine at the outlet end thereof and with steam outlet 29 of superheater section 27.

Actuator 40 is operated by a damper controller 55 which is responsive through thermostatic connection 56 to the outlet temperature of steam flowing from lower section 27 of the superheater through steam outlet 29.

In operation, when the apparatus of the present invention is working under normal temperature and a predetermined degree of superheat is required, the damper controller 55 is set to the final steam temperature desired. By-pass damper 37 and dampers 39 are partially open so that a portion of the air for supporting combustion in the furnace passes over tubular coil 42 thereby heating the air and desuperheating steam which flows into the coil from upper superheater section 23 through steam conduit 45. After the steam is desuperheated in coil 42, it flows through conduit 46 into inlet 28 of lower superheater section 27. Prior to the passage over coil 42 and through by-pass 34, the air flowing through conduit 31 from inlet 31' passes in heat exchange relationship with tubular flow path 47 which condenses bled steam passing into said tubular flow path through line 51. The condensate so formed flows through conduit 52 and other conduit 53 into upper drum 11 wherein it is used as feed water.

The embodiment of the invention disclosed in Fig. 2 is similar to that shown in Fig. 1 except that tubular flow path 47 and coil 42 are arranged side by side or in parallel in respect to the flow of air instead of in series in respect to the flow of air as shown in Fig. 1. Referring to Fig. 2, conduit 31 has an enlarged portion 57 disposed below air inlet 31'. The enlarged portion is divided into two laterally adjacent passages 58 and 59 by a vertically extending baffle 60. Coil 42 is disposed in passage 59, while tubular flow path 47 is disposed in passage 58. The flow of air through passage 58 is controlled by dampers 61, while the flow of air through passage 59 is controlled by dampers 62.

The operation of the embodiment of the invention illustrated in Fig. 2 is similar to the operation of the embodiment disclosed in Fig. 1, except that in the Fig. 2 embodi-

ment the air supply is split into two streams, the streams passing in parallel and individually over the two coils thereafter joining before entering the furnace. The two air passages in the duct 31 can thusly be controlled by dampers which allow the air supply to the one coil to be varied independently from that to the other.

Inasmuch as changes may be made in the form, location and relative arrangement of the several parts of the apparatus disclosed without departing from the essential characteristics of the invention, it will be understood that the invention is not to be limited excepting by the scope of the appended claims.

What is claimed is:

1. A vapor generating power plant wherein vapor is fed to a turbine, comprising a setting having a combustion chamber therein, firing means in said combustion chamber to provide combustion gases therein, a combustion gas outlet being provided in the setting, a vapor generating surface disposed between said setting gas outlet and said combustion chamber in heat exchange relationship with combustion gases flowing from said combustion chamber to said combustion gas outlet, an air duct communicating with a source of air to be heated and the combustion chamber for conducting air from the source thereof into the combustion chamber to support combustion therein, baffle means disposed in said air duct and dividing the duct longitudinally thereof into laterally adjacent air passageways, damper means for each of said air passageways for controlling the flow of air therethrough, actuating means connected to said damper means for simultaneously moving the damper means of one of the air passageways in a direction opposite to the direction of movement of the damper means of the other air passageway, tubular means forming a first tubular flow path, other tubular means forming a second tubular flow path, said first and said second tubular flow paths being disposed in said air duct in heat exchange relationship with air flowing through said air duct and at least one of said tubular flow paths being disposed in one of said air passageways, a superheater disposed in heat exchange relationship with combustion gases flowing from the combustion chamber to said combustion gas outlet, the superheater having a first section and a second section, said first section being in communication with the vapor generating surface to receive saturated vapor therefrom and with said first tubular path of flow to discharge superheater vapor thereinto, said second section being in communication with said first tubular path of flow to receive desuperheated vapor therefrom, a turbine, said second section being in communication with the turbine to discharge superheated vapor into said turbine, a bled vapor conduit in communication with said turbine to receive vapor from

the turbine and with the second tubular flow path to discharge bled vapor into the latter, a conduit in communication with said second tubular flow path to receive condensate therefrom, and control means acting on said damper actuating means and responsive to the temperature of the superheated vapor flowing from said second superheating section.

2. The power plant of claim 1 wherein the conduit in communication with said second tubular flow path to receive condensate therefrom is in communication with the vapor generating surface to conduct condensate thereto as feed water.

3. The power plant of claim 1 wherein a combustion gas passage forming means having a gas inlet and a gas outlet is disposed in said setting with the gas inlet thereof in communication with the combustion chamber to receive combustion gases and the gas outlet in communication with the setting gas outlet, said superheater being disposed in said combustion gas passage in heat exchange relation with combustion gases flowing therethrough, said first superheater section being disposed beyond the second superheater section in relation to the direction of flow of combustion gases through said combustion gas passage.

4. The power plant of claim 1 wherein the air duct has a portion undivided by said baffle means which undivided portion is ahead of said air passageways in the direction of flow through said duct and wherein said first tubular path of flow is disposed in one of the air passageways in the duct and the second tubular path of flow is positioned in said undivided portion of the air duct.

5. The power plant of claim 1 wherein said first tubular flow path and said second tubular flow path are each disposed in separate air passageways in the air duct.

6. The power plant of claim 1 wherein said first tubular flow path and said second tubular flow path are each disposed in separate air passageways in the air duct and wherein the conduit in communication with the second tubular flow path to receive condensate therefrom, is in communication with the vapor generating surface to conduct condensate thereto for use as feed water.

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