

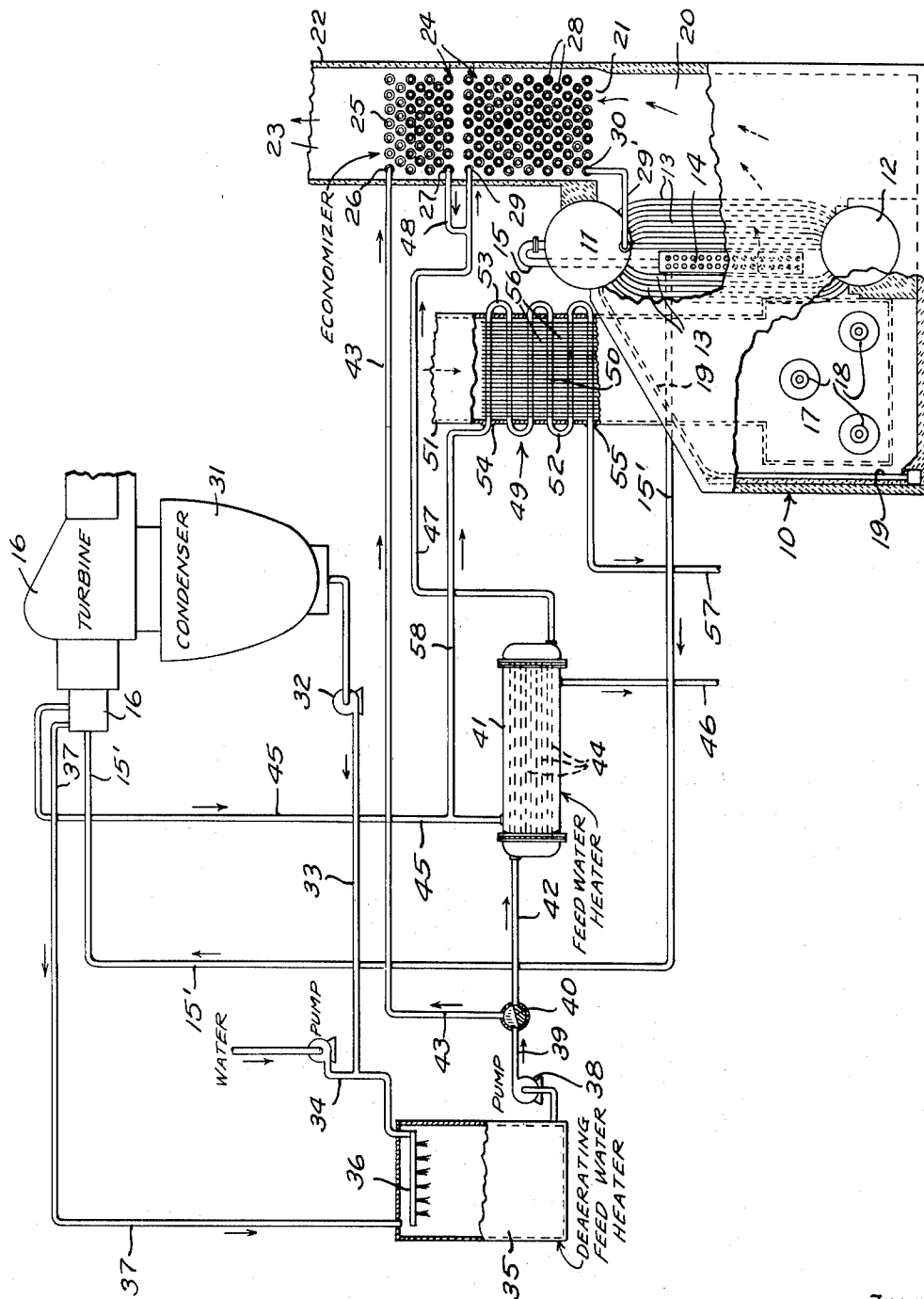
May 1, 1956

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2,743,583

HEAT EXCHANGE SYSTEM FOR POWER GENERATORS

Filed April 22, 1950



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2,743,583

HEAT EXCHANGE SYSTEM FOR POWER GENERATORS

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Application April 22, 1950, Serial No. 157,543

6 Claims. (Cl. 60—67)

This invention relates to heat exchange systems and more particularly to a heat exchange system for power generators.

It is usual in vapor generators to heat feed water therefor in an economizer positioned in heat exchange relationship with gases from the furnace of the vapor generator which, in turn, lowers the temperature of said gases. If the temperature of the feed water entering the economizer is of such degree that the heat removed from the gases does not lower the gas temperature to the desired degree an air heater is positioned in heat exchange relationship with gases beyond the economizer in the direction of flow of the gases. Since the specific heat of the exhaust gases in relationship to the air is low, the size of the air heater is normally very large.

In accordance with the present invention, feed water for a vapor generator is heated and deaerated in a deaerating feed water preheater to a degree less than the desired final temperature at which the feed water enters the vapor generator by flowing said feed water in heat exchange relationship with steam, for example, from the exhaust of a turbine. After being heated in the deaerating feed water preheater, the feed water is passed into a valve controlled feed line to a feed water heater and to a section of an economizer which section is positioned beyond another economizer section in the direction of flow of gases of combustion from a vapor generator. The valve in the feed line controls the portions of water flowing to said one economizer section and to the feed water heater. The portion of the feed water flowing to the feed water heater is heated in said heater by indirect heat exchange relationship with steam, for example, from the exhaust of a turbine, and after heating is passed into said other section of the economizer. The water heated in the one economizer section is passed into the other economizer section and the feed water heated in both economizer sections is passed to the vapor generator. Air to support combustion in the vapor generator is heated by passing it in heat exchange relationship with steam flowing through a tubular flow path which flow path receives a portion of the steam flowing to said feed water heater.

The present invention provides a heat exchange system for power generators in which feed water and air for a vapor generator is preheated and in which the temperature of the flue gases of the vapor generator is controlled and expansion tanks and the like are not necessary.

This invention also provides a heat exchange system for power generators which system has a tubular air heater of relatively small size and in which air is heated by flowing it in heat exchange relationship with tubular members through which steam at relatively low pressure passes.

The present invention further provides apparatus for preheating air and feed water for a vapor generator in which the possibility of air heater fires are greatly reduced and in which the air heater may be positioned in any desired location.

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The invention will be understood from the following description when considered in connection with the accompanying drawing forming a part thereof and in which the single figure is a diagrammatic view of the arrangement of apparatus in the system of the present invention.

Referring to the drawing, the apparatus of the present invention is illustrated as embodied in a vapor generator having a setting 10 with vapor generating surface therein which comprises an upper steam and water drum 11, a lower water drum 12 which drums are connected by a bank of vapor generating tubes 13. Saturated steam from the drum 11 is conducted to a superheater 14 through steam line 15. Steam superheated in the superheater 14 is passed therefrom through a conduit 15' into the intake of a turbine 16. At one side of the bank of tubes 13 is a furnace chamber 17 fired, as shown, by firing means comprising a plurality of burners 18. The roof and side wall of chamber 17 are lined by water tubes 19. At the opposite side of tube bank 13 is a gas outlet passage 20 which communicates with gas inlet 21 of flue or stack 22 which flue has a gas outlet 23, said gas outlet being the gas outlet for setting 10.

An economizer 24 having an upper or one section 25 with a feed water inlet 26 and a feed water outlet 27 is positioned in flue 22. Economizer 24 has a lower or other section 23 over which gases from gas passage 20 pass prior to flowing in heat exchange relationship with upper section 25. Lower section 28 of the economizer has a feed water inlet 29 and a feed water outlet 30 which feed water outlet is in communication with the water space of drum 11 through conduit 29'.

As illustrated in the drawing, feed water to be used in the vapor generator, which feed water may be, in part, condensate pumped from a condenser 31 by pump 32 and fresh feed water entering condensate line 33 which communicates with said pump through valve controlled fresh feed water line 34. Line 33 communicates with a source of preheated feed water which comprises deaerating feed water preheater 35 into which the feed water from line 33 is sprayed through distributor 36. The spray in preheater 35 passes in heat exchange relationship with steam which enters preheater 35 through steam line 37 which steam line, as shown, receives steam from the exhaust of turbine 16.

The feed water heated in deaerating feed water preheater 35 is pumped therefrom by a pump 38 into a main feed water line 39 which communicates with a control or proportioning valve 40. The control or proportioning valve 40 has one outlet thereof in communication with feed water heater 41 through conduit 42 and a second outlet in communication with feed water inlet 26 of upper economizer section 25 through conduit 43. Control valve 40 is operable to proportion the feed water between conduits 42 and 43. The portion of the feed water flowing through line 42 to other feed water heater 41 is heated by passing through a tube bundle 44 over which tube bundle steam passes. The steam flowing in heat exchange relationship with tube bundle 44 enters said heater through steam line 45 which, as illustrated, receives steam from the exhaust of turbine 16. The condensate formed in heater 41 by the flow of steam in heat exchange relationship with tube bundle 44 is thereafter passed to a drain cooler, not shown, through outlet conduit 46. After heating in feed water heater 41, said portion of the feed water is passed through conduit 47 to inlet 29 of lower section 28 of economizer 24. As shown, the feed water heated in upper economizer section 25 is passed into conduit 47 through connection 48.

An air heater 49 comprises a plurality of tubes 50 extending transversely of air conducting means or air conduit 51. Adjacent tubes of the air heater are connected by return bends 52 and 53 so that steam which enters

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inlet 54 of the air heater passes in a continuous path of flow from said inlet 54 to outlet 55 of the air heater. As shown, tubes 50 have extended surface members 56 thereon. Air conduit 51 is in communication above the heater 49 with a source of air to be heated and extends below said air heater and into communication with furnace 17 through burners 18. Condensate formed in tubular members 50 by heat exchange of the air and steam in air heater 49 passes from the air heater through outlet conduit 57 into a drain cooler, not shown.

In operation, gases of combustion from furnace chamber 17 flow therefrom in heat exchange relationship with bank of tubes 13 and superheater 14 thence into gas outlet passage 20. From gas outlet passage 20, the gases enter flue or stack 22 through gas inlet 21 thereafter to pass in heat exchange relationship with lower economizer section 28 thence in heat exchange relationship with upper economizer section 25. After flowing over both economizer sections, gases pass from flue 22 through gas outlet 23.

Feed water to be heated for the vapor generator passes into deaerating feed water preheater 35 through spray distributor 36 and is heated therein by direct heat exchange relationship with steam entering said heater through steam line 37. Heated water from deaerating feed water heater 35 is pumped therefrom by pump 38 into main feed water line 39. Proportioning control valve 40 is set so that the desired proportion of the heated feed water passes directly to upper economizer section 25 through conduit 43 and another desired proportion of the heated water flows to feed water heater 41 through conduit 42. By controlling the proportion of feed water passing through heater 41 and directly to economizer section 25, the temperature of the flue gases flowing from the setting through gas outlet 23 of flue 22 is controlled.

The portion of the feed water passing into feed water heater 41 is heated therein to a degree higher than the temperature of the feed water leaving deaerating feed water heater 35 by flowing said portion of the feed water in heat exchange relationship with steam which enters feed water heater 41 through steam line 45. The feed water heated in heater 41 is thereafter passed into inlet 29 of lower economizer section 28 through conduit 47 and passes into said economizer section together with water heated in upper section 25 which enters conduit 47 through connection 48.

The part of the steam which would normally be used to heat that portion of the feed water which by-passes feed water heater 41 through feed line 43 to the upper economizer section 25 is passed from line 45 to air heater 49 through steam conducting line 53 and passes through tubular members 50 of air heater 49 thereby heating air flowing to burners 18 through air conduit 51.

With the heat exchange system of the present invention, heated feed water is proportioned between the upper and lower economizer sections so that the gas temperature from flue or stack 22 is controlled. For example, the temperature of feed water entering deaerating feed water heater 35 would be approximately 100° F. and would be heated in said heater to approximately 240° F. at which temperature the water would enter proportioning valve 40. The proportion of feed water entering upper economizer section 25 through conduit 43 and the proportion entering feed water heater 41 through conduit 42 would, therefore, both be at approximately 240° F. In feed water heater 41, the portion of water entering said heater through conduit 42 is heated to approximately 390° F. by steam which enters through line 45 at approximately 400° F., said heater water thereafter entering lower economizer section through conduit 47 at approximately 390° F. The portion of the feed water entering upper economizer section 25 is heated therein to approximately 390° F. and enters conduit 47 from connection 48 at that temperature. Exhaust gases entering flue gas inlet 21 of

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flue 22 would be, for example, 600° F. and would be cooled to approximately 325° F. by passage over economizer sections 28 and 25. By controlling the amount of feed water flowing into upper section 25 through conduit 43 and into lower section 28 through conduit 47, the temperature of the exit gases flowing from stack 22 through outlet 23 is controlled. The proportion of the steam flowing from steam line 45 through line 53 to air heater 49 is also at approximately 400° F. and will heat the air passing over tubes 50, which enters the air heater at 100° F., to approximately 350° F.

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 apparatus comprising a setting having a combustion chamber, firing means provided in said chamber for producing gases of combustion, a combustion gas outlet in said setting, vapor generating surface within said setting and in heat exchange relationship with gases of combustion flowing from said chamber to said gas outlet, an economizer disposed in heat exchange relationship with combustion gases flowing from the setting gas outlet, said economizer having a first section and a second section, each of said economizer sections having a liquid inlet and a liquid outlet, the outlet of said second economizer section being in communication with the vapor generating surface for supplying liquid thereto, a source of feed liquid, a heater having an inlet in communication with said source of liquid for receiving and heating the liquid and having an outlet for discharging the heated liquid from the heater, the outlet of said heater being in communication with the liquid inlet of said second economizer section for providing heated feed liquid thereto, means receiving a portion of the feed liquid from said source for by-passing said portion of liquid around the heater and conducting it to the inlet of said first economizer section, feed liquid control means for proportioning the relative amounts of feed liquid to the heater and to the inlet of the first economizer section, and means communicating the outlet of said first economizer section with the inlet of said second economizer section.

2. The apparatus of claim 1 wherein the feed liquid control means comprises a feed liquid proportioning control valve positioned between the source of feed liquid and the heater inlet.

3. The apparatus of claim 1 wherein the means for receiving a portion of the feed liquid from said source for bypassing said portion of liquid around the heater comprises a feed liquid conduit and wherein the feed liquid control means comprises a feed liquid proportioning valve having an inlet and a plurality of outlets, said inlet being in communication with the source of feed liquid, one of said outlets being in communication with the liquid inlet of said heater, another of said outlets being in communication with the feed liquid conduit, a valve member mounted to co-act with said inlet and outlets of said valve to proportion the liquid flowing into the valve, through the valve inlet, and out of the valve through the outlets thereof.

4. The apparatus of claim 1 wherein one economizer section is disposed beyond another economizer section in respect to the flow of gases therethrough.

5. A vapor generating apparatus comprising a setting having a combustion chamber, firing means disposed in said combustion chamber to produce gases of combustion, a combustion gas outlet in said setting, a vapor generating surface disposed in said setting between said combustion chamber and said gas outlet and in heat exchange relationship with gases of combustion flowing from said chamber to said gas outlet, an economizer having a first section and a second section being disposed in heat ex-

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change relationship with gases of combustion flowing through said combustion gas outlet, said first economizer section being disposed beyond the second economizer section in respect to the flow of gases of combustion passing from said setting gas outlet, each economizer section having a liquid inlet and a liquid outlet, the outlet of said second economizer section being in communication with the vapor generating surface for providing liquid to said vapor generating surface, a source of feed liquid, a heater having an inlet for receiving feed liquid to be heated from said source and a second inlet for receiving heated vapor to heat the feed liquid, said heater being provided with a feed liquid outlet conduit communicating with the liquid inlet of said second economizer section for conducting heated liquid to the second economizer section, a second feed liquid conduit communicating with the source of feed liquid and by-passing the heater and in communication with the inlet of said first economizer section for delivering feed liquid thereto, feed liquid control means in communication with said liquid inlet of the heater and said second feed liquid conduit for proportioning the flow of feed liquid to said heater and through said second feed liquid conduit, a vapor turbine in communication with said vapor generator to receive vapor therefrom to drive the turbine, a vapor bleed line in communication with said turbine to receive bleed vapor therefrom and with said heater vapor inlet to deliver bleed vapor to the heater, and the outlet of said first economizer section being in communication with the

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inlet of said second economizer section to conduct the heated feed liquid from said first economizer section into admixture with the heated feed liquid from the heater before passage through the second economizer section.

5 6. The apparatus of claim 5, wherein the means for receiving a portion of the feed liquid from said source for bypassing said portion of liquid around the heater comprises a feed liquid conduit and wherein the feed liquid control means comprises a feed liquid proportioning valve 10 having an inlet and a plurality of outlets, said inlet being in communication with the source of feed liquid, one of said outlets being in communication with the liquid inlet of said heater, another of said outlets being in communication with the second feed liquid conduit, a valve member 15 mounted to co-act with said inlet and outlets of said valve to proportion the liquid flowing into the valve, through the valve inlet, and out of the valve through the outlets thereof.

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