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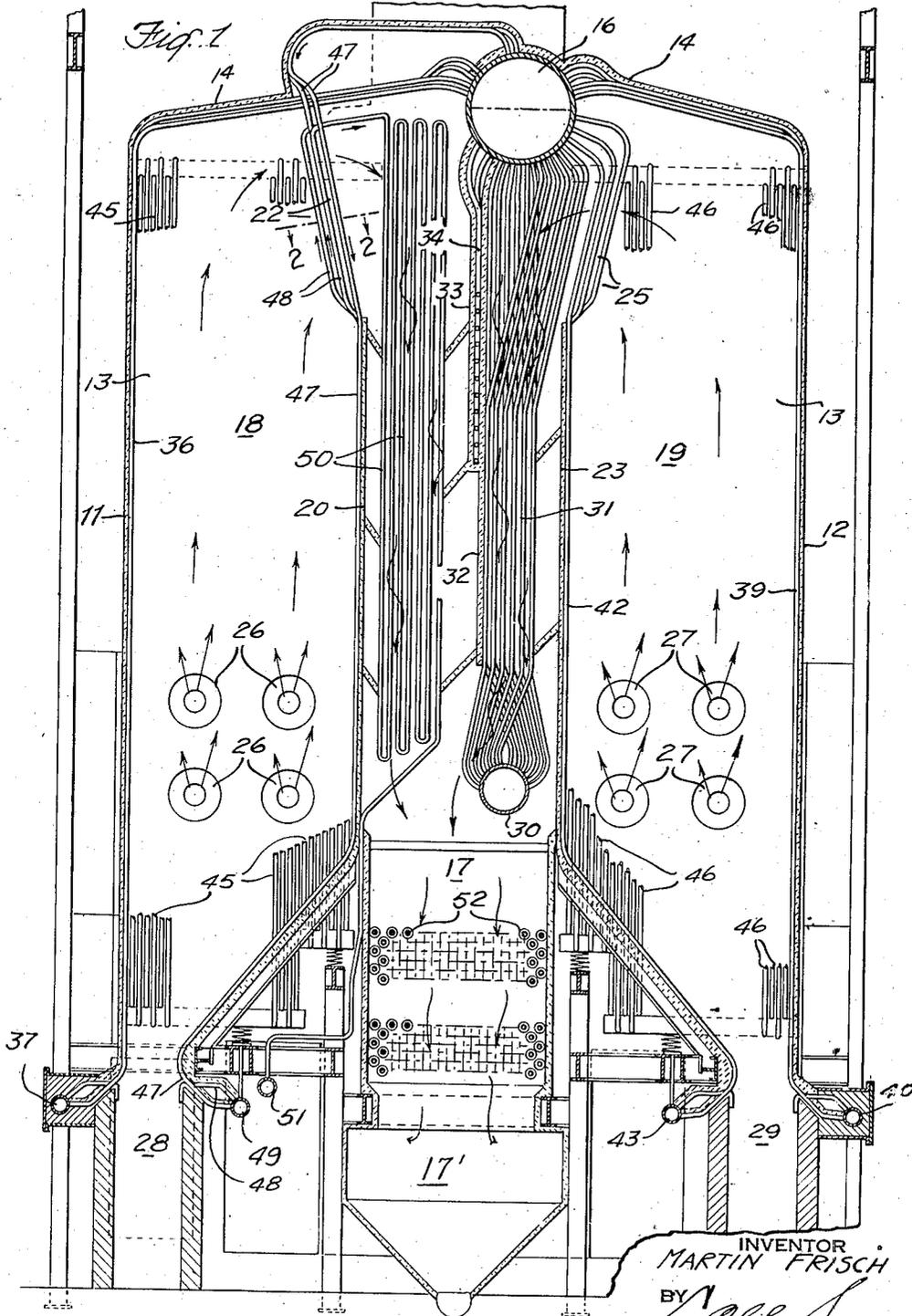
M. FRISCH

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VAPOR GENERATOR

Filed Nov. 22, 1941

2 Sheets-Sheet 1



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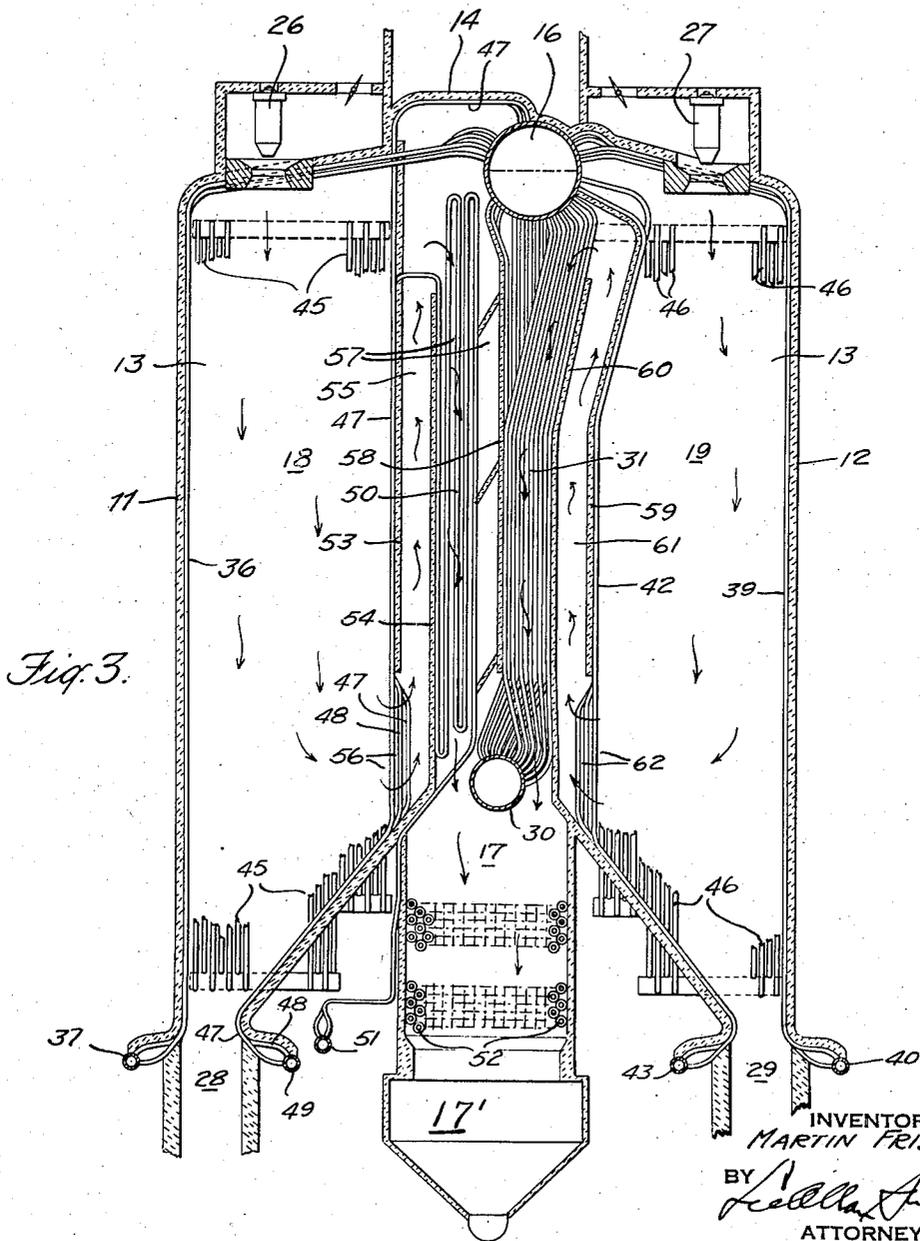
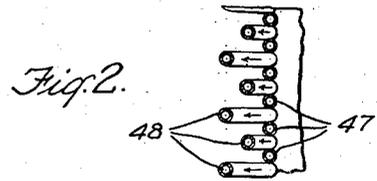
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# UNITED STATES PATENT OFFICE

2,366,719

## VAPOR GENERATOR

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6 Claims. (Cl. 122-477)

This invention relates to vapor generators and more particularly pertains to apparatus for generating and superheating steam.

The invention provides a multiple furnace superheating steam generator of novel and compact arrangement with which superheat control at all loads on the generator is obtained.

The features and advantages which characterize the invention will be understood from the following description considered in connection with the accompanying drawings forming a part thereof, and in which:

Fig. 1 is a vertical sectional view of a steam generator embodying the invention;

Fig. 2 is a horizontal sectional view taken on line 2-2 of Fig. 1, and

Fig. 3 is a view similar to Fig. 1, showing another form of the invention.

Like characters of reference refer to the same or to similar parts throughout the several views.

Referring to Figs. 1 and 2 of the drawings, the steam generator illustrated has vertical refractory side walls 11 and 12, a front wall 13, a rear wall not shown, and a roof 14. Adjacent the roof is a steam and water drum 16, and adjacent the bottom of the setting and intermediate the side walls 11 and 12 is a flue gas outlet passage 17 in communication with a flue gas outlet 17'. Within the setting are two spaced furnaces 18 and 19 which are disposed adjacent the side walls 11 and 12 respectively. The inner boundary of the furnace 18 is defined by a vertical baffle wall 20 which extends upwardly from the bottom of the furnace and terminates short of the roof to provide a gas outlet 22 in the upper portion of the furnace. The inner boundary of the furnace 19 is similarly defined by vertical baffle wall 23, above which is provided a gas outlet 25 in the upper portion of the furnace. Fuel burners 26, which are disposed in the front wall 13 of the setting, fire the furnace 18, and similar burners 27 disposed in the front wall and operated independently of the burners 26, fire the furnace 19. Each of the burners 26 and 27 may be individually controlled to fire at any intensity from zero to maximum. The inner side walls 20 and 23 of the furnaces are inclined outwardly adjacent their lower ends to provide hopper shaped bottoms for each of the furnaces which discharge into suitable ash pits 28 and 29 respectively. Extending between the upper drum 16 and a lower drum 30, parallel to the upper drum, is a vertical bank of steam generating tubes 31 which are swept by the gases flowing from the furnace 19 to the flue gas outlet 17' through a vertical gas passage provided by

baffle 32 and baffle wall 23. The lower drum 30 is positioned at a point above the gas outlet 17'. The baffle 32 extends downwardly from the drum 16, parallel with the tubes 31, to a point above the drum 30. A chamber is thereby formed between the lower end of the baffle 32 and the outlet 17' in which chamber the passage between the wall 20 and the baffle 32 and the passage between the wall 23 and baffle 32 merge. A baffle 33 cooperates with baffle 32 to enclose the downcomers 34.

The inner surface of the side wall 11 is lined with vertical water wall tubes 36 which extend across the roof portion 14 and are connected at their upper ends to the drum 16, the lower ends being connected to header 37 which is supplied with circulating water by suitable external downcomer connections, not shown. The inner surface of the side wall 12 is similarly lined with vertical water wall tubes 39 which are connected at their upper ends to the drum 16, and at their lower ends to header 40 which is connected into the boiler circulation. The furnace side of the baffle wall 23 is lined by vertical water wall tubes 42 which extend to the drum 16 from lower header 43 which is connected into the boiler circulation. Adjacent the gas outlet 25, the tubes 42 are spread apart to provide a passage for the gases. That part of the inner surface of the front wall 13 which is at the front end of the furnace 18 is lined with water wall tubes 45, and the inner surface of the wall 13 at the front of the furnace 19 is similarly lined by water wall tubes 46. It will be understood that those parts of the inner surfaces of the rear wall, not shown, which are at the rear ends of the furnaces are lined with similar water wall tubes.

In the form shown, a combination radiant and convection superheater is utilized and is so arranged and disposed that it is subject to the heat of the gases produced in one furnace only. In the superheater furnace 18, the furnace side of the baffle wall 20 is lined with vertical radiant heat superheater tubes 47 and 48, which are alternately disposed, and tangent to each other, as shown in Fig. 2, and form a continuous panel or section of radiant heat absorbing surface except at the furnace gas outlet passage 22, where the tubes are spread apart and bent outwardly from the furnace. The tubes 47, which are connected to the steam space of the drum 16 in two spaced longitudinal rows as shown in Fig. 1, conduct steam downwardly in one pass to a lower header 49 from which the steam flows upwardly in one pass through the tubes 48 to a point adjacent the

roof, where they are formed into a plurality of return bend loops of a convection superheater section 50, which is vertically disposed in the space between the baffle wall 20 and baffles 32 and 33, forming a gas passage for the gases flowing from the furnace 18 to the flue gas outlet 17'. As shown, the tubes 47 and 48 of the radiant heat superheater section, and the tubes 50 of the convection section, which are arranged for series flow of steam therethrough, are continuous with each other, and no intermediate header connections are required. The convection elements 50 are connected to a superheater outlet header 51 which is fixed in position adjacent the bottom of the furnace setting and from which the superheated steam is conducted to the point of use. An economizer 52 is disposed in the chamber below the tube bank 31 and convection superheater 50 and between the lower end portions of the furnaces 18 and 19. Other heat recovery apparatus may be disposed in this location if desired.

In operation, the gases produced in the lower portion of the saturated steam furnace 19 flow upwardly through the furnace and out thereof through the outlet 25 and downwardly over the steam generating tubes 31 to the outlet 17'. Saturated steam is conducted from the upper drum 16 and flows downwardly through tubes 47 and upwardly through tubes 48, mainly in radiant heat exchange relationship with the gases produced in the superheater furnace 18. From the radiant section of the superheater, the steam flows through the convection section 50 in convection heat exchange relationship with the gases flowing from the furnace 18 through outlet 22 and downwardly over the convection section to merge with gases which have passed over the tubes 31 in the chamber below the lower end of the baffle 32 and thereafter pass over the heat exchanger 52 and out of the setting through the outlet 17'. The quantity of steam produced will be determined largely by the rate at which the furnace 19 is fired, although some steam will be generated in the water walls of the furnace 18. Inasmuch as the gases produced in the saturated steam furnace 19 do not flow in heat exchange relationship with the superheater, the degree to which the steam is superheated will be determined by the degree to which the superheater furnace 18 is fired. Furnace 18 may be fired to obtain the superheat temperature desired at any load on the generator, or it may be fired to obtain and to maintain a substantially constant degree of superheat at all loads on the generator. The superheating characteristics of the combination radiant heat and convection superheater employed, contribute to the maintenance of a constant superheat temperature.

With this arrangement, it will be observed that the steam flow in the convection section of the superheater is from the side near the wall 20 to the side near the steam generating section. Thus the superheater elements at the highest steam temperature are not subjected to the highest temperature gases flowing from the furnace 18 through outlet 22.

Since the superheater sections are shielded from the gases leaving one of the furnaces, the steam generator may be started up by firing that furnace only, thus eliminating any necessity for flooding the superheater during starting up periods. This considerably shortens the time ordinarily required to bring the unit onto the line. Also, if a feed water heater were out of service, a constant steam temperature can be maintained

without the use of a by-pass or any other means of superheat control except for the differential firing provided.

The elimination of intermediate header connections between the radiant and convection sections of the superheater, simplifies and reduces the cost of construction of the superheater and reduces the pressure drop, although intermediate headers may be employed if desired. The relatively large amount of furnace cooling surface possible with the multiple furnace arrangement, results in low temperatures in the ash rejecting zones of the furnaces and thus insures dry ash removal.

The form of the invention shown in Fig. 3 is similar to the form shown in Figs. 1 and 2, excepting that the furnaces are fired from the top and baffles are provided to form a gas passage in each of the furnaces through which gases of combustion flow from the furnaces into the space between the furnaces thereafter to flow over the steam generating tubes and the convection section of the superheater in a downward direction. As shown in Fig. 3, a vertical baffle 53 is spaced from the baffle wall 54, which is similar to wall 20 of Fig. 1, to provide a vertical gas passage 55 along one side of the combustion chamber of the superheater furnace 18 which passage connects at its lower end with a gas inlet 56 and connects through a gas outlet at its upper end with a gas passage 57 between baffle 54 and a baffle 58 at one side of the bank of steam generating tubes 31, and through which gases from passage 55 flow downwardly over the convection section 50 of the superheater to the gas outlet 17'. A vertical baffle 59 is spaced from the baffle wall 60, which is similar to wall 23 of Fig. 1, to provide a gas passage 61 along one side of the combustion chamber of the boiler furnace 18 which passage connects at its lower end with a gas inlet 62 and connects through a gas outlet at its upper end with a gas passage between the baffles 50 and 58 in which the steam generating tube bank 31 is disposed.

In operation, the gases produced in the upper portion of the boiler furnace 18, flow downwardly and enter the passage 61 through the inlet 62 thereafter flowing upwardly through passage 61. The gases from the furnace 18 are discharged from the passage 61 through the outlet at the top thereof and flow downwardly over the steam generating tubes 31 to the setting outlet 17' through the chamber below the lower end of the baffle 58 and over the tubes of the economizer 52. The gases produced in the upper portion of the superheater furnace 18, flow downwardly through the furnace, enter passage 55 through inlet 56 and flow upwardly through passage 55. The gases from the furnace 18 are discharged from passage 55 through the outlet at the top thereof and flow downwardly over the tubes of the convection section of the superheater to the setting outlet 17' through which outlet the gases flow after merging in the chamber below the lower end of the baffle 58 with the gases which have passed over the tubes 31 and flowing over the economizer 52.

It will be understood that changes may be made in the form, location and relative arrangement of the several parts of the steam generators disclosed without departing from the principles of the invention. Consequently, the invention is not to be limited excepting by the scope of the appended claims.

What is claimed is:

1. Vapor generating apparatus comprising a setting, walls so positioned within the setting as to form spaced furnaces therein, means for firing each furnace, a gas outlet leading from each furnace to the space between the furnaces near one end of the space, an outlet for the setting near the other end of said space, a partition between said walls positioned to divide said space into two passages each of which connects to a furnace gas outlet and merges with the other passage short of the setting outlet so as to form a chamber between the point of merger and the setting outlet, vapor generating surface in one of said gas passages, vapor superheating surface in the other gas passage, and a heat exchange device in said chamber.
2. Vapor generating apparatus comprising a setting, walls so positioned within the setting as to form spaced furnaces therein, means for firing each furnace, a gas outlet leading from each furnace to the space between the furnaces near one end of the space, an outlet for the setting near the other end of said space, a partition between said walls positioned to divide said space into two passages each of which connects to a furnace gas outlet and merges with the other passage short of the setting outlet so as to form a chamber between the point of merger and the setting outlet, vapor generating surface in one of said gas passages, a superheater having a part thereof disposed in the other gas passage and another part in the furnace adjacent said other passage, and a heat exchange device in said chamber.
3. Vapor generating apparatus comprising a setting, walls so positioned within the setting as to form spaced furnaces therein, the lower portion of said walls being vertically inclined away from each other thereby forming an inclined bottom for the furnaces with which the wall is associated and providing an enlarged portion for the space between the furnaces at the lower end thereof, means for firing each furnace, a gas outlet leading from the upper part of each furnace to the space between the furnaces near the top of the space, an outlet for the setting near the bottom of the space, a partition between said walls positioned to divide the space into two passages each of which connects to a furnace gas outlet and merges with the other passage short of the setting outlet, means forming a chamber in the enlarged portion of said space between the point of merger of said passages and the setting outlet, vapor generating surface in one of said gas passages, vapor superheating surface in the other gas passage, and a heat exchange device in said chamber.
4. Vapor generating apparatus comprising a setting, walls so positioned within the setting as

to form spaced furnaces therein, means for firing each furnace at the lower portion thereof, a gas outlet leading from the upper part of each furnace to the space between the furnaces near the top of the space, an outlet for the setting near the bottom of said space, a partition between said walls positioned to divide said space into two passages each of which connects to a furnace gas outlet and merges with the other passage short of the setting outlet so as to form a chamber between the point of merger and the setting outlet, vapor generating surface in one of said gas passages, vapor superheating surface in the other gas passage, and a heat exchange device in said chamber.

5. Vapor generating apparatus comprising a setting, walls so positioned within the setting as to form spaced furnaces therein, means for firing each furnace, baffle means forming a gas outlet passage in the furnaces extending along one of said walls, the gas outlet passage being in communication with the furnace near one end of the furnace chamber and in communication near the opposite end of the furnace with one end of the space between the furnaces, an outlet for the setting near the other end of said space, a partition between said walls so positioned as to divide the space into two passages each of which connects to a furnace gas outlet passage and merges with the other short of the setting outlet to form a chamber between the point of merger and the setting outlet, vapor generating surface in one of said gas passages, vapor superheating surface in the other gas passage, and a heat exchange device in said chamber.

6. Vapor generating apparatus comprising a setting, walls so positioned within the setting as to form spaced furnaces therein, burner means positioned at the top of each furnace to direct a stream of gases of combustion in a substantially vertical direction toward the bottom of the furnace, baffle means forming a gas outlet passage in the furnaces extending along one of said walls, the gas outlet passage being in communication with the furnace near the bottom of the furnace chamber and in communication near the top of the furnace with the upper portion of the space between the furnaces, an outlet for the setting near the bottom of said space, a partition between said walls so positioned as to divide the space into two passages each of which connects to a furnace gas outlet passage and merges with the other short of the setting outlet to form a chamber between the point of merger and the setting outlet, vapor generating surface in one of said gas passages, vapor superheating surface in the other gas passage, and a heat exchange device in said chamber.

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