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;

Fig. 3 is a horizontal sectional view taken on line 3--3 of Fig. 1;

Fig. 4 is a horizontal sectional view taken on line 4--4 of Fig. 1, and

Fig. 5 is a horizontal sectional view taken on line 5--5 of Fig. 1.

Like characters of reference refer to the same part throughout the several views.

Referring to the drawings, the steam generator illustrated has vertical refractory side walls 11 and 12, a rear wall 13, a front wall not shown, and roof portions 14 and 15. Adjacent the roof portion 15 is a steam and water drum 16, and between the latter and roof portion 14 is 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 vertical baffle walls 20 and 21 which are in vertical alignment with, but spaced from, each other to provide a gas outlet 22 in the lower portion of the furnace. The inner boundary of the furnace 19 is similarly defined by vertical baffle walls 23 and 24 which also are spaced to provide a gas outlet 25 in the lower portion of the furnace. One or more fuel burners 26, which are disposed in the roof portion 15 of the setting, fire the furnace 18, and one or more similar burners 27 disposed in the roof portion 15 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 side walls 11 and 12 are inclined inwardly 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 baffles 32 and 33. The baffle 32 extends downwardly from the drum 16, parallel with the tubes 31, to a point adjacent the furnace gas outlet 25, where it is joined to the baffle 33 by a horizontally inclined baffle 34. The baffle 33 extends upwardly from a scoop hopper 35 below the drum 30, to a point adjacent the upper ends of the tubes 31.

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 alternately connected to headers 31 and 38 which are 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 alternately to headers 40 and 41 which are connected into the boiler circulation. The furnace side of the baffle walls 23 and 24 are lined by vertical water wall tubes 42 which extend to the drum 16 from lower headers 43 and 44 which are connected into the boiler circulation. Adjacent the gas outlet 25, the tubes 42 are spread apart to provide a passageway for the gases. That part of the inner surface of the rear wall 13 which is at the rear end of the furnace 18 is lined with water wall tubes 45, and the inner surface of the wall 13 at the rear 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 front wall, not shown, which are at the front 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 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 walls 20 and 21 are lined with vertical radiant heat superheater tubes 47 and 48, which are alternately disposed, and tangent to each other, as shown in Fig. 3, 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 as shown in Fig. 4. The tubes 47, which are connected to the steam space of the drum 16 in two spaced longitudinal rows as shown in Fig. 5, 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 top of the baffle wall 20, where they pass through the baffle 20 and are formed into a plurality of return bend loops of a convection superheater section 90, which is vertically disposed in the space between the baffles 20 and 33 forming a gas passage for the gases flowing from the furnace 18 to the flue gas outlet 17. As shown, the tubes 48 of the radiant heat superheater section, and the tubes 90 of the convection section 90 which are arranged for series flow of steam therethrough, are continuous with each other, and no intermediate header connections are required. The convection elements 90 are connected to a superheater outlet header 91 which is fixed in position adjacent the bottom of the furnace setting and from which the superheater steam is conducted to the point of use. The outlet end portions of the convection superheater tubes are formed into a loop to provide for expansion of the tubes.

In operation, the gases produced in the saturated steam furnace 19 flow downwardly through the furnace and out thereof through the outlet 25 and upwardly over the steam generating tubes 31 to the outlet 17. Saturated steam is conducted from the upper drum 46 and flows downwardly through tubes 47 and upwardly through tubes 46, 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 90 in convection heat exchange relationship with the gases flowing from the furnace 18 through outlet 22 and upwardly over the convection section and out the outlet 41. The quantity of steam produced will be determined largely by the rate at which the furnace 19 is fired, although 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 free 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, and the vertically downward firing of the fuel burners, results in low temperature in the ash ejecting zones of the furnaces and thus ensures dry ash removal.

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

What is claimed is:

1. Vapor generating apparatus comprising a setting, spaced furnaces in the setting, means in the upper part of each furnace for firing the furnace, each furnace having an outlet in the lower part of the furnace in communication with the space between the furnaces, said firing means being arranged to direct the gases of combustion toward said outlets, the setting having a gas outlet in the upper portion thereof in communication with said space, means forming one gas passage in said space extending between the outlet of one furnace and the gas outlet of the setting and through which gases flow in one direction from the furnace outlet to the outlet of the setting, vapor generating surface in said gas passage, means forming another gas passage in said space extending between the outlet of another furnace and the gas outlet of the setting and through which gases flow in one direction from the other furnace outlet to the outlet of the setting, and a superheater in said other gas passage.

2. Vapor generating apparatus comprising a setting, spaced furnaces in the setting, means in the upper part of each furnace for firing the furnace, each furnace having an outlet in the lower part of the furnace in communication with the space between the furnaces, said firing means being arranged to direct the gases of combustion toward said outlets, the setting having a gas outlet in the upper portion thereof in communication with said space, means forming one gas passage in said space extending between the outlet of one furnace and the gas outlet of the setting and through which gases flow in one direction from the furnace outlet to the outlet of the setting, vapor generating surface in said gas passage, means forming another gas passage in said space extending between the outlet of another furnace and the gas outlet of the setting and through which gases flow in one direction from the other furnace outlet to the outlet of the setting, and a superheater in said other gas passage.

3. Vapor generating apparatus comprising a setting, spaced furnaces in the setting, means in the upper part of each furnace for firing the furnace, each furnace having an outlet in the lower part of the furnace in communication with the space between the furnaces, said firing means being arranged to direct the gases of combustion toward said outlets, the setting having a gas outlet in the upper portion thereof in communication with said space, means forming one gas passage in said space extending between the outlet of one furnace and the gas outlet of the setting.
setting and through which gases flow in one direction from the furnace outlet to the outlet of the setting, vapor generating surface in said gas passage, means forming another gas passage in said space extending between the outlet of another furnace and the gas outlet of the setting and through which gases flow in one direction from the other furnace outlet to the outlet of the setting, and a superheater having a part thereof disposed adjacent a wall of the other furnace and another part disposed in said other gas passage.

4. Vapor generating apparatus comprising a setting, spaced furnaces in the setting, means in the upper part of each for firing the furnace, each furnace having an outlet in the lower part of the furnace in communication with the space between the furnaces, the outlet of at least one furnace being in the side thereof adjacent said space, said firing means being arranged to direct the gases of combustion toward said outlets, the setting having a gas outlet in the upper portion thereof in communication with said space, means forming one gas passage in said space extending between the outlet of said one furnace and the gas outlet of the setting and through which gases flow in one direction from the furnace outlet to the outlet of the setting, a superheater having a part thereof disposed in the one furnace adjacent said side thereof and extending over the furnace outlet, the superheater having another part in said gas passage, means forming another gas passage in said space extending between the outlet of another furnace and the gas outlet of the setting and through which gases pass in one direction from the other furnace outlet to the outlet of the setting, and vapor generating surface in said gas passage.

5. Vapor generating apparatus comprising a setting, a vapor and liquid drum in the setting, spaced furnaces in the setting, vapor generating surface in each of the furnaces, means in the upper part of each furnace for firing the furnace, each furnace having an outlet opening in the lower part of the furnace in communication with the space between the furnaces, said firing means being arranged to direct the gases of combustion toward said outlets, the setting having a gas outlet in the upper portion thereof in communication with said space, means forming one gas passage in said space extending between the outlet opening of one furnace and the gas outlet of the setting and through which gases flow in an upward direction only from the furnace outlet to the outlet of the setting, vapor generating surface in said gas passage, means forming another gas passage in said space extending between the outlet opening of another furnace and the gas outlet of the setting and through which gases flow in an upward direction only from the other furnace outlet to the outlet of the setting, and a superheater having tubular members connected to the vapor space of the drum, said tubular members extending vertically downwardly within the other furnace adjacent a wall thereof to the lower part of the furnace and in spaced relationship to each other, other tubular members connecting with the lower ends of the first tubular member and extending upwardly within the furnace adjacent said wall thereof and intermediate the first tubular members, said other tubular members connecting with tubular members disposed outside of said furnace and in the path of the gases flowing from the furnace to the gas outlet for the setting in said other gas passage.

MARTIN FRISCH.
CERTIFICATE OF CORRECTION.


MARTIN FRISCH.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, first column, line 56, strike out the word "free"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 17th day of April, A. D. 1945.

Leslie Frazer

(Seal) Acting Commissioner of Patents.