

June 9, 1953

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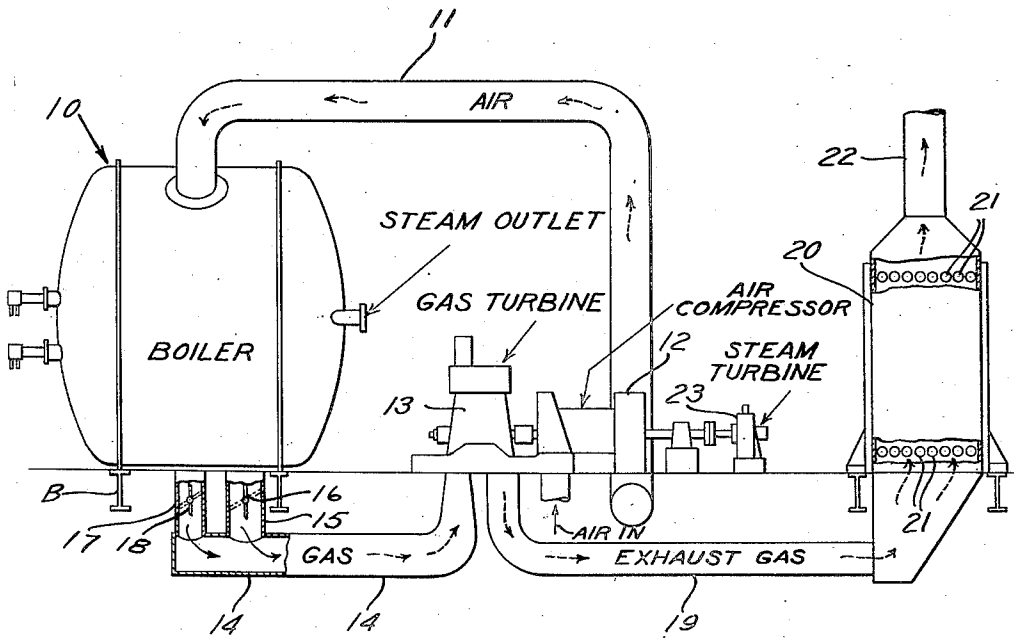
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VAPOR GENERATOR

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4 Sheets-Sheet 1

Fig. 1.



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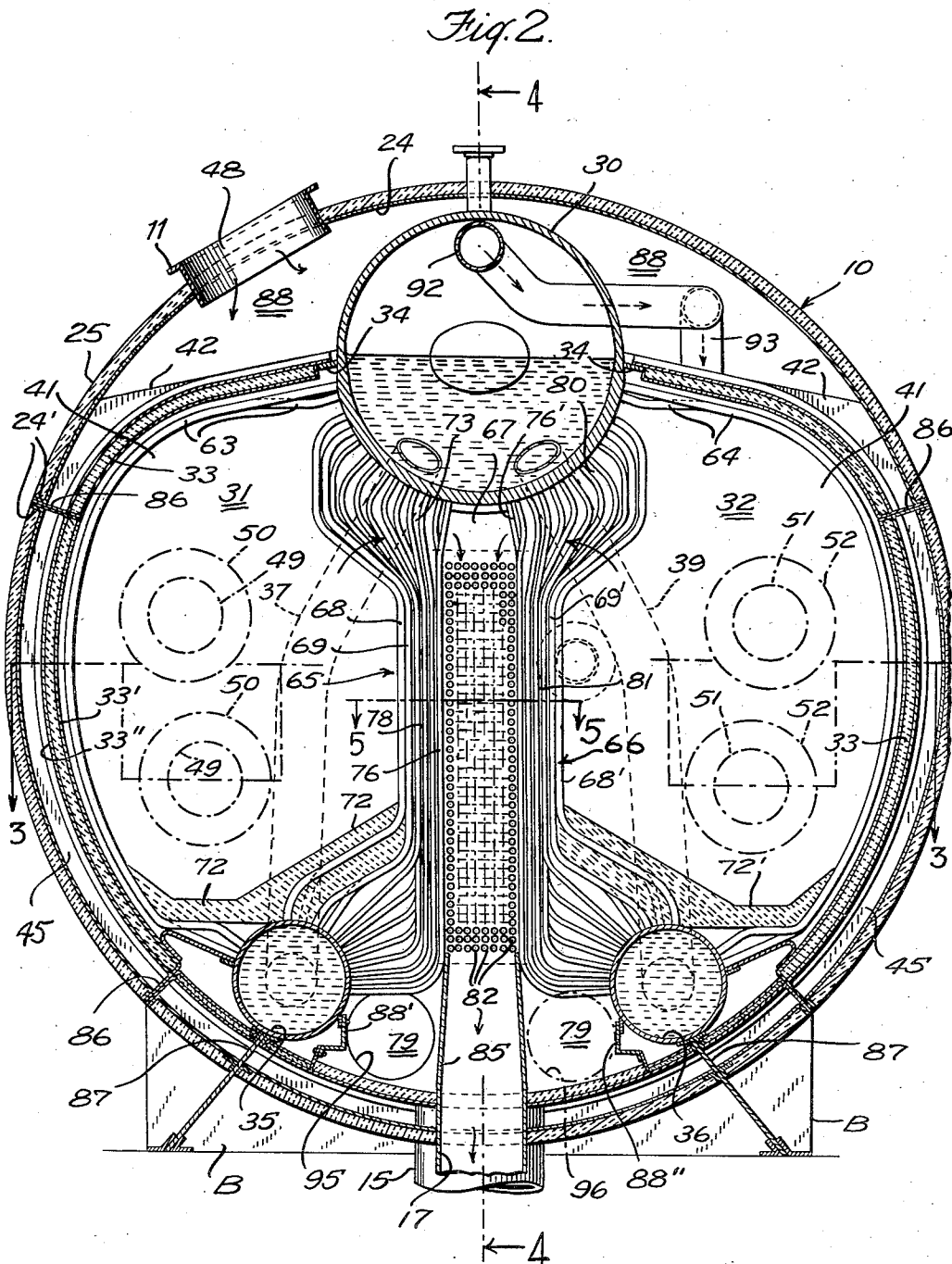
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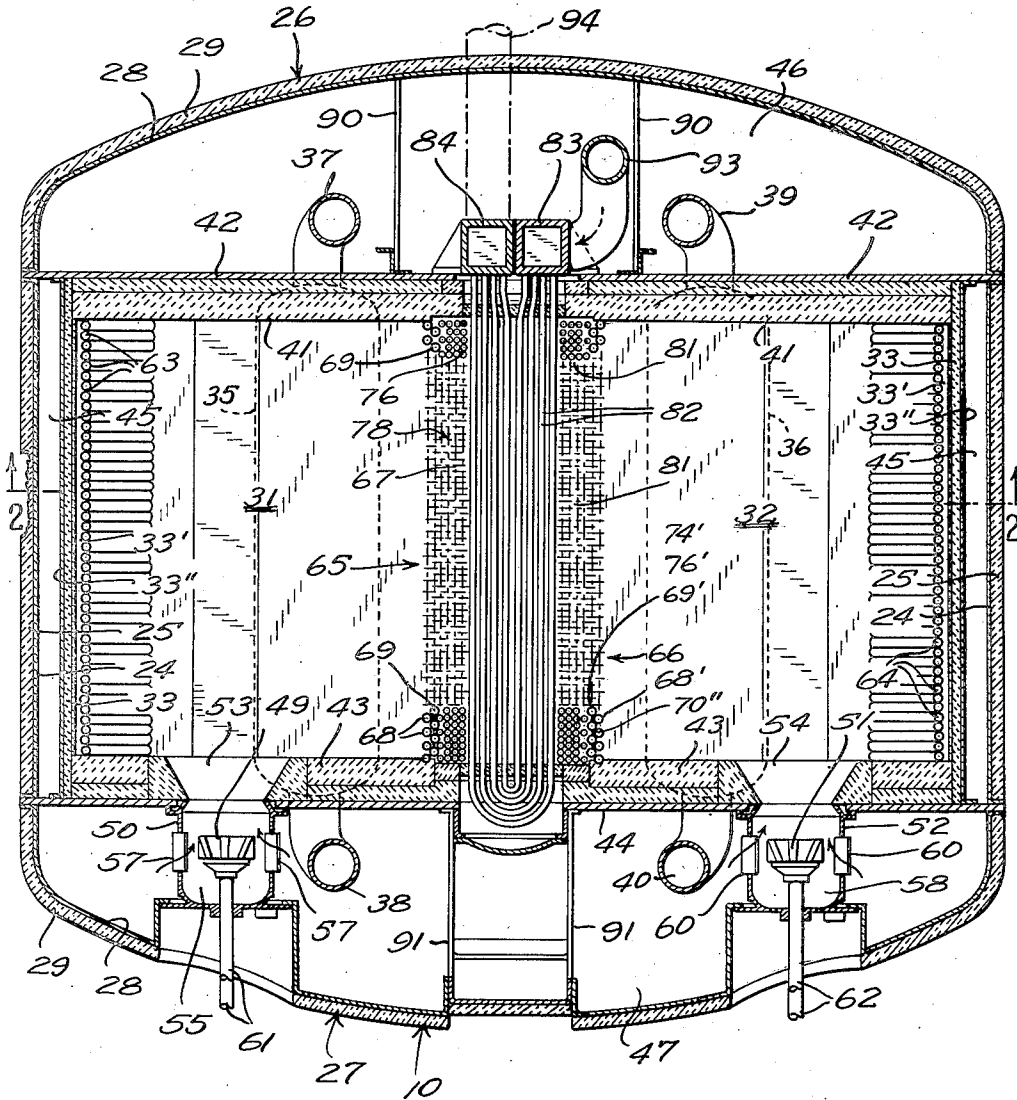
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4 Sheets-Sheet 3

Fig. 3.



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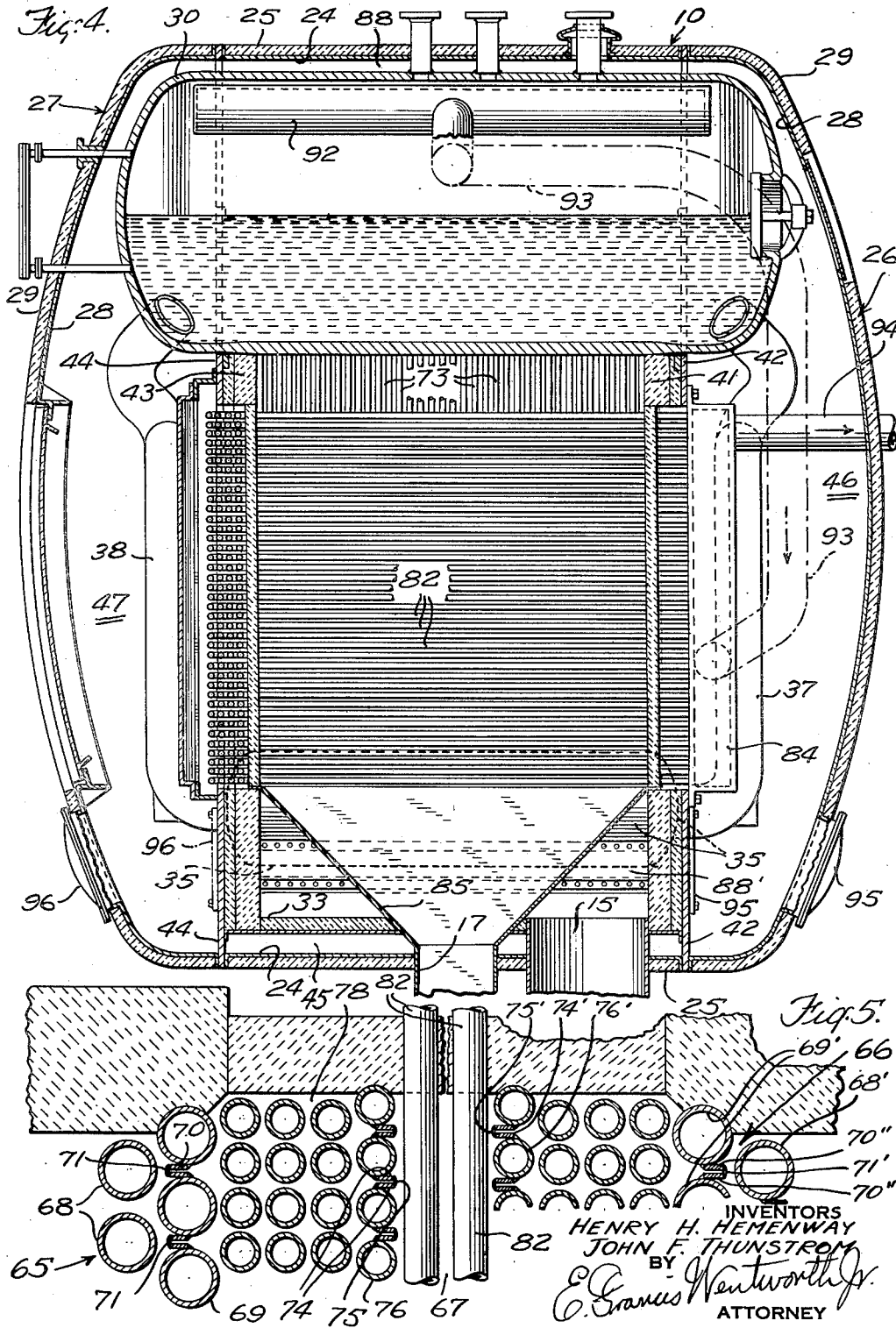
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VAPOR GENERATOR

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4 Sheets-Sheet 4



UNITED STATES PATENT OFFICE

2,641,233

VAPOR GENERATOR

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12 Claims. (Cl. 122-240)

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This invention relates to vapor generators.

The present invention provides a vapor generator having furnaces each with a combustion chamber provided with air under pressure for combustion so that the size of the combustion chambers and the amount of heating surface required for a given capacity may be reduced because of the increased density of the air and combustion gases.

The invention also provides a vapor generator in which the air under pressure for combustion in a combustion chamber of the generator is provided through power obtained by utilizing thermal energy of the gases of combustion from said chamber.

The present invention further provides a vapor generator in which the parts thereof are so constructed and arranged that a minimum amount of heating surface is required for a given vapor generating capacity.

The invention also provides a vapor generator in which air for combustion is supplied under pressure and in which vapor temperature control is obtained by varying the relative amount of combustion gas flow over vapor generating and superheated vapor generating means.

The present invention further provides baffle means which includes vapor generating tubes of the vapor generator.

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

Fig. 1 is a diagrammatic view of the arrangement of apparatus associated with the vapor generator of the present invention;

Fig. 2 is a transverse sectional view of the vapor generator of the present invention taken on the line 2-2 of Fig. 3;

Fig. 3 is a sectional view taken on the line 3-3 of Fig. 2;

Fig. 4 is a longitudinal sectional view taken on the line 4-4 of Fig. 2; and

Fig. 5 is an enlarged fragmentary view taken on the line 5-5 of Fig. 2.

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

Referring to the drawings, the vapor generator of the present invention comprises a cylindrically-shaped setting 10 mounted on a base B and disposed so that the longitudinal axis thereof extends substantially horizontally. As shown in Fig. 1, the vapor generator receives air through an air inlet conduit 11 from an air compressor 12, driven during normal opera-

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tion of the vapor generator by a gas turbine 13. Gas turbine 13 is actuated by gases of combustion from the vapor generator, the gases entering the turbine through gas conduit 14 communicating with the vapor generator through gas outlet conduit 15 controlled by damper 16 and through gas outlet conduit 17 controlled by damper 18. Exhaust gases from the turbine 13 pass through conduit 19 into an economizer 20 wherein said gases pass in heat exchange relationship with tubes 21 through which feed water for the vapor generator flows. After passing in heat exchange relationship with the tubes 21, the gases flow into the flue 22 and thence to a stack, not shown. During the starting up of the vapor generator, the air compressor 12 is driven by an auxiliary steam turbine 23 or an electric motor.

Setting 10, as shown more particularly in Figs. 2 to 4, comprises a cylindrical metallic casing 24 formed of sections 24' and covered on the outside thereof by a covering of insulation 25. Cylindrical casing 24 is closed at opposite ends thereof by dished heads 26 and 27, respectively, secured to said casing. The heads also comprise an inner metallic housing 28 covered on the outside thereof by an insulating covering 29.

A steam and water drum 30 is positioned within the cylindrical casing 24 at the upper part thereof and extends longitudinally of said casing. Combustion chambers 31 and 32 are provided within the casing 24 and have an outer wall 33 of insulating material extending substantially parallel throughout the greater portion of its length to and in spaced relationship with the casing 24 thereby forming an air space 45 between casing 24 and wall 33. Wall 33 is formed in sections corresponding to sections 24' of the casing, the sections of the wall being lined on the inner surface with a metal lining 33' and on the outer surface with a metal lining 33''. The linings 33' and 33'' are flanged at opposite longitudinal sides thereof at 36, the flanges being discontinuous longitudinally thereof so that air may flow through passage 45, the flanges projecting across the space 45 and between adjacent longitudinal side edges of adjacent sections 24' of the casing where they are secured by welding or otherwise. In this manner, the wall 33 is supported within the casing. Wall 33 extends from a point closely adjacent one side of the drum 30 approximately centrally of the upper and lower extremities of said drum to a similar point on the opposite

side of the drum. The space between the end of the refractory wall and the outer periphery of the drum is sealed by plates 34 (Fig. 2). Lower drums 35 and 36 extend longitudinally of the casing 24 in the lower portion thereof and are supported therein by supports 37. The drums are spaced apart and positioned on opposite sides of a vertical plane extending through the longitudinal axis of the setting and drum 30. The drum 35 is in communication with the steam and water drum 30 through downcomers 37 and 38, the downcomers 37 being connected at opposite ends thereof to one end of the drum 35 and to the corresponding end of drum 30 while the downcomer 38 is in communication at opposite ends thereof with the opposite end of the drum 35 and the corresponding end of the drum 30. Lower drum 36, like drum 35, is in communication at opposite ends thereof with the drum 30 through the downcomer 39 and through downcomer 40.

The combustion chambers 31 and 32 are closed at the rearward end thereof by an end wall 41 of insulating material extending transversely of the casing 24 between the inner periphery of wall 33 on one side thereof and the inner periphery of said wall on the opposite side thereof and extending substantially vertically in said casing between the inner periphery of wall 33 at the top thereof and the inner periphery of said wall at the bottom. The wall 41 has a metallic lining 42 on the side thereof outwardly of the combustion chambers which lining 42 extends transversely of the setting from the inner periphery of casing 24 at one side thereof to the inner periphery of said casing at the opposite side and also extends substantially vertically in the setting from the inner periphery of casing 24 at the bottom thereof to a point short of the inner periphery of the casing at the top thereof. At the opposite end of the casing 24, the chambers 31 and 32 are closed by a front wall 43 similar to rear wall 41 which also is lined on the side thereof outwardly of the combustion chamber by a metallic lining 44 similar to metallic lining 42. The plates 34 extend between the inner periphery of the head 26 and lining 42 while the plates 31 extend between the inner periphery of head 27 and lining 44.

An air chamber 45 is formed between the outer wall 33 of the combustion chambers and the casing 24 in which chamber cool air is heated and acts to insulate casing 24 from heat from the combustion chambers. The air chamber 45 communicates at the top thereof on opposite sides with upper air space 46 in the upper part of casing 24. The dish heads 26 and 27 form air spaces 46 and 47, respectively. Air from the air inlet conduit 11 flows into the air space 46 in casing 24 through air inlet 43 thence into the air spaces 46, 46 and 47 to thereby cool the casing and the dish heads and heat said air.

Combustion chamber 31 is fired by burners 49 each enclosed by a housing 50 while combustion chamber 32 is fired by burners 51 each of which is enclosed in a housing 52. Front wall 43 has burner openings 53 therein each of which communicates with a burner 49 and is in communication with the chamber 31, while each burner opening 54 through wall 43 communicates with a burner 51 and with chamber 32. Burner housings 50 and 52 extend into air chamber 47 in head 27, and are mounted therein. The housing 50 has a plurality of dampers 57 (Fig. 3) in opposite sides thereof by means of which the flow of air from the space 47 to the burners is con-

trolled. Similarly, the burner housing 52 has dampers 60 which controls the flow of air from the space 47 to the burners. Burners 49 receive fuel through fuel inlet conduits 61 while burners 51 receive fuel through conduits 62.

The outer wall 33 adjacent the combustion chamber 31 is lined along its inner periphery by a plurality of water wall tubes 63 which tubes are connected at one end thereof with the lower portion of the drum 30 at one side of the drum and at the opposite ends thereof with the lower drum 35, while the wall 33 of combustion chamber 32 is lined along its inner periphery by a plurality of water wall tubes 64 which tubes are connected at one end to the lower portion of the drum 30 on the side thereof opposite that to which the tubes 63 are connected. The opposite end of the tubes 64 are connected to the lower drum 35.

A substantially generally vertically extending bank 65 of spaced vapor generating tubes communicates at one end thereof with the lower portion of drum 30 and with the lower drum 35 at the opposite end, while a similar bank 66 of generally vertically extending spaced tubes communicates with the lower portion of the drum 30 and the lower drum 35. A bottom 72 of insulating material extends transversely of the chamber 31 above drum 35 and between water wall tubes 63 and bank 65 and longitudinally of said chamber between end wall 41 and front wall 43 while a similar bottom 72' extends transversely of chamber 32 above drum 36 and between water wall tubes 64 and bank 66. Bottom 72, like bottom 72', also extends longitudinally between walls 41 and 43. Bank 65 and bank 66 are spaced apart to form a central vertically extending passage 67. As shown more particularly in Fig. 5, bank 65 of tubes comprises an inner row of spaced tubes 68 positioned in heat exchange relationship with the gases of combustion in the chamber 31 and a second row of spaced tubes 69 adjacent the tubes 68 and arranged so that the tubes 69 are in alignment with the spaces between the tubes 68. Adjacent tubes 69 have longitudinally extending metallic strips 70 welded to the outer periphery thereof adjacent the space between said adjacent tubes. Strips 70 extend substantially tangentially of tubes 69 and are welded together at 71 so that the tubes and the strips together form a fluid-tight baffle. The strips 70 extend from bottom 72 of combustion chamber 31 to a point short of the bottom of the drum 30 thereby forming a space which provides a gas outlet 73 for combustion chamber 31. Innermost row of tubes 76 of bank 65, which tubes extend along the central passage 67, also has longitudinally extending metallic strips 74 similar to strips 70 welded to the outer periphery of adjacent tubes and extending substantially tangentially of the tubes in the space between adjacent tubes. The strips 74 are welded together at 75 so that the strips and the tubes together form a fluid-tight baffle between the central passage 67 and the tube bank 65. The strips 74 extend from a point short of the drum 30 to a point short of the drum 35. Row of tubes 69 of the tube bank 65 and row of tubes 76 of said bank provide fluid-tight baffles which form a vertically extending gas passage 78 through the tube bank. This passage communicates at the top thereof with the gas outlet 73 and at the bottom thereof with a space 79 adjacent the bottom of the wall 33.

The bank 66 of tubes is arranged in a manner similar to the bank 65 having a row of tubes 68' similar to tubes 68 of bank 65, a row of tubes 69'

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similar to the row 69, said tubes 69' having strips 70'' extending longitudinally thereof and welded together at 71', the strips 70'' being arranged in a manner similar to the strips 70 of the bank 65 to form a fluid-tight baffle, while the inner row of tubes 76' of the bank 66 has longitudinal strips 74' thereon welded at 75' to form therewith a fluid-tight baffle similar to that formed by the tubes 76 and strips 74 in the bank 65. In this manner, a gas outlet passage 80 is provided for the chamber 32 through which gases flow from said chamber into a vertically extending passage 81 in the tube bank 66. Passage 81 communicates with gas outlet 80 at the top thereof and with space 79 at the bottom. Gas outlet passages 73 and 80, for combustion chambers 31 and 32 respectively, communicate with central passage 67. The space 79 is sealed along drums 35 and 36 by sealing strips 88' and 88'' which extend longitudinally of drums 35 and 36 respectively between walls 41 and 43. The sealing strips are mounted in fluid-tight relationship with said drums and walls and the inner periphery of wall 33.

A bank of horizontally extending superheater tubes 82 is disposed in central passage 67. The superheater tubes 82 are connected at one end thereof to an inlet header 83 which extends substantially vertically in space 46 within dished head 26. Superheater inlet header 83 is connected to a dry pipe 92 by a steam conduit 93 is indicated in dot and dash lines in Fig. 4. Tubes 82 extend horizontally through rear wall 41, the passage 67, and front wall 43, then through a return bend thereafter to pass through wall 43, passage 67 and wall 42 to an outlet header 84 which extends parallel to and adjacent the inlet header 83. Tubes 82 are, therefore, supported in the front wall 43 and rear wall 41. Outlet header 84 is in communication with an outlet conduit 94.

Superheater passage 67 communicates at the bottom thereof through a hopper-shaped conduit 85 with the gas outlet conduit 17 (Fig. 1), while the gas space 79, which is in communication with the passages 78 and 81 at the bottom thereof, communicates with combustion gas outlet conduit 15 (Fig. 1).

Clean-out doors 95 and 96 extend through heads 26 and 27 respectively adjacent the space 79 at the bottom of the setting 10 so that said space may be cleared of ash particles.

In operation, air under pressure from the air inlet conduit 11 enters space 88 at the top of the casing 24 through air inlet 48. Some of the air passes to the air chamber 45 and flows there-through to insulate the casing from the heat of furnace chambers 31 and 32. Other of the air flows into the air spaces 46 and 47 in the heads 26 and 27. Burners 49 and 51 receive air from space 47 through dampers 57 and 60 respectively which dampers are regulated to admit the proper amount of air.

Gases of combustion in chamber 31 flow in heat exchange relationship with water wall tubes 63 and tubes 68 and 69 of the tube bank 65 thereafter passing outwardly of chamber 31 through gas outlet 73 over the upper part of the tubes of tube bank 65. Gases flowing through gas outlet 73 pass downwardly in the passage 78 into space 79 whence they flow into gas outlet conduit 15. Other of the gases flowing through outlet 73 pass into the superheater passage 67 thence flow downwardly over tubes 82 to enter hopper-shaped conduit 85 whence the gases pass into gas outlet conduit 17.

Gases of combustion in the chamber 32 flow in

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heat exchange relationship with the water wall tubes 64 and with tubes 68' and 69' of tube bank 66 thereafter to pass from chamber 32 through gas outlet 80 where the gases flow over the upper part of the tubes of tube bank 66. Gases from passage 80 flow downwardly in gas passage 81 thereafter to enter space 79 at the bottom of casing 24 whence said gases pass into gas outlet conduit 15. Other of the gases from outlet 80 enter superheater passage 67 thereafter to flow downwardly in said passage over the tubes 82 to enter outlet conduits 85 and 17.

It will be noted that the gases from both combustion chambers 31 and 32 pass through the superheater passage and through the passage in each of the banks 65 and 66 in parallel at a high rate of speed and with a high pressure drop so that a high rate of heat transfer is obtained. Superheating of the steam in tubes 82 is controlled by differentially firing furnaces 31 and 32. By controlling the flow of gases of combustion through passage 67 and over superheater tubes 82 through adjusting dampers 17 and 18 superheating of the steam in tubes 82 may also be controlled.

Since the baffles formed by the tubes 69 and strip 70 and tubes 76 and strip 74 are fluid-tight, gases from combustion chamber 31 cannot by-pass into the passage 78 or into superheater passage 67, nor can the gases in passage 67 by-pass into passage 78. Likewise, the gases in chamber 32 cannot by-pass into passage 81 nor can the gases in passage 81 by-pass into superheater passage 67.

Steam temperature is controlled in the vapor generator of the present invention by adjusting dampers 16 and 18 in gas outlet conduits 15 and 17 respectively. In this manner, the relative amount of gas flowing over the superheater and the banks of tubes 65 and 66 may be varied to control the final steam temperature. Also, steam temperature may be controlled by controlling the firing rate of burners 49 and burners 51 so as to differentially fire furnaces 31 and 32.

While the invention has been shown and described as used for the generation of steam from water, it will be understood that it is capable of use in generating vapor from liquids in general.

Inasmuch as changes may be made in the form, location and relative arrangement of the several parts of the invention without departing from the principles thereof, 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 natural circulation vapor generator comprising a setting having laterally spaced furnaces therein, means for separately firing each furnace, a vapor generating tube group in the space between said furnaces, the tube group comprising a plurality of spaced tubes arranged in laterally adjacent tube banks spaced from one another to provide a passage therebetween, a superheater in the passage, an upper vapor and liquid drum in the setting communicating with the upper ends of the tubes of said group, spaced lower drums in the setting, said drums respectively being in communication with the lower ends of the tubes of said tube banks, baffle means separating the passage from each of said banks, other baffle means associated with each of said banks and positioned in spaced relationship with said first-mentioned baffle, said baffle and other baffle thereby forming a gas outlet flow path through the banks, the furnaces each having a gas opening in communica-

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tion with the gas outlet flow path of a tube bank and with the passage between said banks, the passage between the banks and the gas outlet flow paths having separate gas outlets located to respectively receive gases after said gases have passed through said passage and through said flow paths, and means for separately controlling the flow of gases through said passage and the flow of gases through said gas outlet flow paths.

2. A natural circulation vapor generator comprising a setting having laterally spaced furnaces therein, means for separately firing each furnace, a generally vertically extending vapor generating tube group in the space between said furnaces, the tube group comprising a plurality of spaced tubes arranged in laterally adjacent tube banks spaced from one another to provide a vertically extending passage therebetween, a superheater comprising a plurality of horizontally extending tubes disposed in the passage, an upper vapor and liquid drum in the setting communicating with the upper ends of the tubes of said group, spaced lower drums in the setting located on opposite sides of said passage, said drums respectively being in communication with the lower ends of the tubes of said tube banks, baffle means separating the passage from each of said banks, other baffle means associated with each of said banks and positioned in spaced relationship with said first-mentioned baffle, said baffle and other baffle thereby forming a gas outlet flow path through the banks, the furnaces each having a gas opening in communication with the gas outlet flow path of a tube bank and with the passage between said banks, the passage between the banks and the gas outlet flow paths having separate gas outlets located to respectively receive gases after said gases have passed through said passage and through said flow paths, and means for separately controlling the flow of gases through said passage and the flow of gases through said gas outlet flow paths.

3. A natural circulation vapor generator comprising a setting having laterally spaced furnaces therein, means for separately firing each furnace, a vapor generating tube group in the space between said furnaces, the tube group comprising a plurality of spaced tubes arranged in laterally adjacent tube banks spaced from one another to provide a passage therebetween, a superheater in the passage, an upper vapor and liquid drum in the setting communicating with the upper ends of the tubes of said group, spaced lower drums in the setting, said drums respectively being in communication with the lower ends of the tubes of said tube banks, baffle means separating the passage from each of said banks, other baffle means associated with each of said banks and positioned in spaced relationship with said first-mentioned baffle, each baffle and other baffle comprising a plurality of tubes of a bank laterally spaced from one another in a row extending longitudinally of said drum, the baffles also comprising elongated, flat, metallic strips having opposite sides and longitudinally extending opposite edges, said strips being secured to adjacent tubes to extend longitudinally thereof with a portion of one side of the strips abutting a tube and with the opposite side of the strips closely adjacent the opposite side of another strip on an adjacent tube in the row, the space between said tubes and the thickness of said strip and said other strip being substantially equal, the strips extending in said spaces substantially at a right-angle to said passage and with a longitudinal edge

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thereof adjacent said passage, means for securing adjacent strips together in a fluid-tight manner along one longitudinal edge thereof, said baffle and other baffle thereby forming a gas outlet flow path through the banks, the furnaces each having a gas opening in communication with the gas outlet flow path of a tube bank and with the passage between said banks, the passage between the banks and the gas outlet flow paths having separate gas outlets located to respectively receive gases after said gases have passed through said passage and through said flow paths, and means for separately controlling the flow of gases through said passage and the flow of gases through said gas outlet flow paths.

4. A natural circulation vapor generator comprising a setting having a generally vertically extending vapor generating tube group therein, said tube group comprising a plurality of spaced tubes arranged in laterally adjacent tube banks spaced from one another to provide a vertically extending substantially centrally located passage therebetween, a superheater in the passage, an upper vapor and liquid drum in the setting above said passage and in substantial vertical alignment therewith, the upper ends of the tubes of said group communicating with the drum, spaced lower drums in the setting on opposite sides of said passage, the drums respectively being in communication with the lower ends of the tubes of said tube banks, a furnace laterally adjacent each of said tube banks, means for firing each furnace, baffle means separating the passage from each of said banks, other baffle means associated with each of said banks and positioned in spaced relationship with said first-mentioned baffle, said baffle and other baffle thereby forming a gas outlet flow path through the banks, the furnaces each having a gas opening in communication with the gas outlet flow path of the tube bank adjacent said furnace and with the passage between said banks, gas outlet means forming a gas outlet for said gas outlet flow paths through the banks, other gas outlet means forming a gas outlet separate from said gas outlet means and providing a gas outlet for said passage, said gas outlet means, and other gas outlet means being located to receive gases after said gases have passed through said passage and gas outlet flow paths, and means for separately controlling the flow of gases through said passage and the flow of gases through said gas outlet flow paths.

5. A natural circulation vapor generator having a setting comprising a cylindrically-shaped fluid-tight casing, an air compressor, conduit means for conducting air under pressure into the casing, a generally vertically extending vapor generating tube group in the central part of said casing, said tube group comprising a plurality of spaced tubes arranged in laterally adjacent tube banks spaced from one another to provide a vertically extending substantially centrally located passage therebetween, a superheater in the passage, an upper vapor and liquid drum disposed in the setting and communicating with the upper ends of the tubes of said group, said drum being so disposed that the longitudinal axis thereof extends in substantially the same vertical plane as the longitudinal axis of the setting, spaced lower drums in the setting located on opposite sides of said passage with the longitudinal axes thereof extending in horizontal planes parallel to the horizontal axes of said upper drum and said setting, said drums respectively being in communication with the lower ends of the tubes of said tube

banks, a furnace laterally adjacent each of said tube banks, said chambers being in communication with the air compressor to receive air under pressure therefrom for combustion, means for firing each furnace, baffle means separating the passage from each of said banks, other baffle means associated with each of said banks and positioned in spaced relationship with said first-mentioned baffle, said baffle and other baffle thereby forming a gas outlet flow path through the banks, the furnaces each having a gas opening in communication with the gas outlet flow path of the tube bank adjacent said furnace and with the passage between said banks at one end of said flow path and passage, gas outlet means forming a gas outlet for said gas outlet flow paths through the banks, other gas outlet means forming a gas outlet separate from said gas outlet means and providing a gas outlet for said passage, said gas outlet means and other gas outlet means being located at the end of said flow paths and passage opposite said one end to receive gases after said gases have passed through said passage and gas outlet flow paths, and means for separately controlling the flow of gases through said passage and the flow of gases through said gas outlet flow paths.

6. A vapor generator having a setting comprising a cylindrically-shaped fluid-tight casing, an air compressor, conduit means for conducting air under pressure into the casing, a generally vertically extending vapor generating tube group in the central part of said casing, said tube group comprising a plurality of spaced tubes arranged in laterally adjacent tube banks spaced from one another to provide a vertically extending passage, a superheater in the passage, an upper vapor and liquid drum disposed in the setting and communicating with the upper ends of the tubes of said group, said drum being so disposed that the longitudinal axis thereof extends in substantially the same vertical plane as the longitudinal axis of the setting, spaced lower drums in the setting located on opposite sides of said passage with the longitudinal axes thereof extending in horizontal planes parallel to the horizontal axes of said upper drum and said setting, said drums respectively being in communication with the lower ends of the tubes of said tube banks, a furnace laterally adjacent each of said tube banks, said chambers being in communication with the air compressor to receive air under pressure therefrom for combustion, means for firing each furnace, a wall extending around and spaced from the inner periphery of the casing from a point adjacent said upper drum at one side thereof to a point adjacent the upper drum at the opposite side thereof, said space between the wall and the casing being adapted to receive air under pressure from the interior of the setting, baffle means separating the passage from each of said banks, other baffle means associated with each of said banks and positioned in spaced relationship with said first-mentioned baffle, said baffle and other baffle thereby forming a gas outlet flow path through the banks, the furnaces each having a gas opening in communication with the gas outlet flow path of the tube bank adjacent said furnace and with the passage between said banks at one end of said flow path and passage, gas outlet means forming a gas outlet for said gas outlet flow paths through the banks, other gas outlet means forming a gas outlet separate from said gas outlet means and providing a gas outlet for said passage, said gas outlet means

and other gas outlet means being located at the end of said flow paths and passage opposite said one end to receive gases after said gases have passed through said passage and gas outlet flow paths, and means for separately controlling the flow of gases through said passage and the flow of gases through said gas outlet flow paths.

7. A vapor generator having a setting comprising a cylindrically-shaped fluid-tight casing, an air compressor, conduit means for conducting air under pressure into the casing, a generally vertically extending vapor generating tube group in the central part of said casing, said tube group comprising a plurality of spaced tubes arranged in laterally adjacent tube banks spaced from one another to provide a vertically extending passage, a superheater in the passage, an upper vapor and liquid drum disposed in the setting and communicating with the upper ends of the tubes of said group, said drum being so disposed that the longitudinal axis thereof extends in substantially the same vertical plane as the longitudinal axis of the setting, spaced lower drums in the setting located on opposite sides of said passage with the longitudinal axes thereof extending in horizontal planes parallel to the horizontal axes of said upper drum and said setting, said drums respectively being in communication with the lower ends of the tubes of said tube banks, a furnace laterally adjacent each of said tube banks, said chambers being in communication with the air compressor to receive air under pressure therefrom for combustion, means for firing each furnace, baffle means separating the passage from each of said banks, other baffle means associated with each of said banks and positioned in spaced relationship with said first-mentioned baffle, said baffle and other baffle thereby forming a gas outlet flow path through the banks, the furnaces each having a gas opening in communication with the gas outlet flow path of the tube bank adjacent said furnace and with the passage between said banks at one end of said flow path and passage, gas outlet means forming a gas outlet for said gas outlet flow paths through the banks, other gas outlet means forming a gas outlet separate from said gas outlet means and providing a gas outlet for said passage, said gas outlet means and other gas outlet means being located at the end of said flow paths and passage opposite said one end to receive gases after said gases have passed through said passage and gas outlet flow paths, means for separately controlling the flow of gases through said passage and the flow of gases through said gas outlet flow paths, and a gas turbine associated with said air compressor, said gas turbine and said other gas outlets being in communication so that the gas turbine is actuated by gases of combustion from the vapor generator.

8. A vapor generator comprising a setting having a generally vertically extending vapor generating tube group therein, said tube group comprising a plurality of spaced tubes arranged in laterally adjacent tube banks spaced from one another to provide a vertically extending passage therebetween, a superheater in the passage, an upper vapor and liquid drum in the setting above said passage and in substantial vertical alignment therewith, the upper ends of the tubes of said group communicating with the drum, spaced lower drums in the setting on opposite sides of said passage, the drums respectively being in communication with the lower ends of the tubes of said tube banks, a furnace laterally adjacent

each of said tube banks, means for firing each furnace, baffle means separating the passage from each of said banks, other baffle means associated with each of said banks and positioned in spaced relationship with said first-mentioned baffle, each baffle and other baffle comprising a plurality of tubes of a bank laterally spaced from one another in a row extending longitudinally of said drum, the baffles also comprising elongated, flat, metallic strips having opposite sides and longitudinally extending opposite edges, said strips being secured to adjacent tubes to extend longitudinally thereof with a portion of one side of the strips abutting a tube and with the opposite side of the strips closely adjacent the opposite side of another strip on an adjacent tube in the row, the space between said tubes and the thickness of said strip and said other strip being substantially equal, the strips extending in said spaces substantially at a right-angle to said passage and with a longitudinal edge thereof adjacent said passage, means for securing adjacent strips together in a fluid-tight manner along one longitudinal edge thereof, said baffle and other baffle thereby forming a gas outlet flow path through the banks, the furnaces each having a gas opening in communication with the gas outlet flow path of the tube bank adjacent said furnace and with the passage between said banks, gas outlet means forming a gas outlet for said gas outlet flow paths through the banks, other gas outlet means forming a gas outlet separate from said gas outlet means and providing a gas outlet for said passage, said gas outlet means and other gas outlet means being located to receive gases after said gases have passed through said passage and gas outlet flow paths, and means for separately controlling the flow of gases through said passage and the flow of gases through said gas outlet flow paths.

9. A vapor generator comprising a setting having a generally vertically extending vapor generating tube group therein, said tube group comprising a plurality of spaced tubes arranged in laterally adjacent tube banks spaced from one another to provide a vertically extending passage therebetween, a superheater in the passage, an upper vapor and liquid drum in the setting above said passage and in substantial vertical alignment therewith, the upper ends of the tubes of said group communicating with the drum, spaced lower drums in the setting on opposite sides of said passage, the drums respectively being in communication with the lower ends of the tubes of said tube banks, a furnace laterally adjacent each of said tube banks, means for firing each furnace, baffle means separating the passage from each of said banks, other baffle means associated with each of said banks and positioned in spaced relationship with said first-mentioned baffle, each baffle and other baffle comprising a plurality of tubes of a bank laterally spaced from one another in a row extending longitudinally of said drum, the baffles also comprising elongated, flat, metallic strips having opposite sides and longitudinally extending opposite edges, said strips being secured by welding along one of said longitudinal edges to the tube adjacent thereto to extend longitudinally thereof with a portion of one side of the strips abutting a tube and with the opposite side of the strips closely adjacent the opposite side of another strip on an adjacent tube in the row, the space between said tubes and the thickness of said strip and said other strip being substantially equal, the strips extending in

said spaces substantially at a right-angle to said passage and with a longitudinal edge thereof adjacent said passage, a weld securing adjacent strips together in a fluid-tight manner along one longitudinal edge thereof, said baffle and other baffle thereby forming a gas outlet flow path through the banks, the furnaces each having a gas opening in communication with the gas outlet flow path of the tube bank adjacent said furnace and with the passage between said banks, gas outlet means forming a gas outlet for said gas outlet flow paths through the banks, other gas outlet means forming a gas outlet separate from said gas outlet means and providing a gas outlet for said passage, said gas outlet means and other gas outlet means being located to receive gases after said gases have passed through said passage and gas outlet flow paths, and means for separately controlling the flow of gases through said passage and the flow of gases through said gas outlet flow paths.

10. A vapor generator having a setting comprising a cylindrically shaped fluid-tight casing, an air compressor, conduit means for conducting air under pressure into the casing, a generally vertically extending vapor generating tube group in the central part of said casing, said tube group comprising a plurality of spaced tubes arranged in laterally adjacent tube banks spaced from one another to provide a vertically extending passage, a superheater in the passage, an upper vapor and liquid drum disposed in the setting and communicating with the upper ends of the tubes of said group, said drum being so disposed that the longitudinal axis thereof extends in substantially the same vertical plane as the longitudinal axis of the setting, spaced lower drums in the setting located on opposite sides of said passage with the longitudinal axes thereof extending in horizontal planes parallel to the horizontal axes of said upper drum and said setting, said drums respectively being in communication with the lower ends of the tubes of said tube banks, a furnace laterally adjacent each of said tube banks, said chambers being in communication with the air compressor to receive air under pressure therefrom for combustion, means for firing each furnace, baffle means separating the passage from each of said banks, other baffle means associated with each of said banks and positioned in spaced relationship with said first-mentioned baffle, each baffle and other baffle comprising a plurality of tubes of a bank laterally spaced from one another in a row extending longitudinally of said drum, the baffles also comprising elongated, flat, metallic strips having opposite sides and longitudinally extending opposite edges, said strips being secured to adjacent tubes to extend longitudinally thereof with a portion of one side of the strips abutting a tube and with the opposite side of the strips closely adjacent the opposite side of another strip on an adjacent tube in the row, the space between said tubes and the thickness of said strip and said other strip being substantially equal, the strips extending in said spaces substantially at a right angle to said passage and with a longitudinal edge thereof adjacent said passage, means for securing adjacent strips together in a fluid-tight manner along one longitudinal edge thereof, said baffle and other baffle thereby forming a gas outlet flow path through the banks, the furnaces each having a gas opening in communication with the gas outlet flow path of the tube bank adjacent said furnace and with the pas-

sage between said banks at one end of said flow path and passage, gas outlet means forming a gas outlet for said gas outlet flow paths through the banks, other gas outlet means forming a gas outlet separate from said gas outlet means and providing a gas outlet for said passage, said gas outlet means and other gas outlet means being located at the end of said flow paths and passage opposite said one end to receive gases after said gases have passed through said passage and gas outlet flow paths, means for separately controlling the flow of gases through said passage and the flow of gases through said gas outlet flow paths, and a gas turbine associated with said air compressor, said gas turbine and said other gas outlets being in communication so that the gas turbine is actuated by gases of combustion from the vapor generator.

11. A vapor generator having a setting comprising a cylindrically shaped fluid-tight casing, an air compressor, conduit means for conducting air under pressure into the casing, a generally vertically extending vapor generating tube group in the central part of said casing, said tube group comprising a plurality of spaced tubes arranged in laterally adjacent tube banks spaced from one another to provide a vertically extending passage, a superheater in the passage, an upper vapor and liquid drum disposed in the setting and communicating with the upper ends of the tubes of said group, said drum being so disposed that the longitudinal axis thereof extends in substantially the same vertical plane as the longitudinal axis of the setting, spaced lower drums in the setting located on opposite sides of said passage with the longitudinal axes thereof extending in horizontal planes parallel to the horizontal axes of said upper drum and said setting, said drums respectively being in communication with the lower ends of the tubes of said tube banks, a furnace laterally adjacent each of said tube banks, said chambers being in communication with the air compressor to receive air under pressure therefrom for combustion, means for firing each furnace, a wall extending around and spaced from the inner periphery of the casing from a point adjacent said upper drum at one side thereof to a point adjacent the upper drum at the opposite side thereof, said space between the wall and the casing being adapted to receive air under pressure from the interior of the setting, baffle means separating the passage from each of said banks, other baffle means associated with each of said banks and positioned in spaced relationship with said first-mentioned baffle, said baffle and other baffle thereby forming a gas outlet flow path through the banks, the furnaces each having a gas opening in communication with the gas outlet flow path of the tube bank adjacent said furnace and with the passage between said banks at one end of said flow path and passage, gas outlet means forming a gas outlet for said gas outlet flow paths through the banks, other gas outlet means forming a gas outlet separate from said gas outlet means and providing a gas outlet for said passage, said gas outlet means and other gas outlet means being located at the end of said flow paths and passage opposite said one end to receive gases after said gases have passed through said passage and gas outlet flow paths, means for separately controlling the flow of gases through said passage and the flow of gases through said gas outlet flow paths, and a gas turbine associated with said air compressor, said gas turbine and said other gas outlets being in communica-

tion so that the gas turbine is actuated by gases of combustion from the vapor generator.

12. A vapor generator having a setting comprising a cylindrically shaped fluid-tight casing, an air compressor, conduit means for conducting air under pressure into the casing, a generally vertically extending vapor generating tube group in the central part of said casing, said tube group comprising a plurality of spaced tubes arranged in laterally adjacent tube banks spaced from one another to provide a vertically extending passage, a superheater in the passage, an upper vapor and liquid drum disposed in the setting and communicating with the upper ends of the tubes of said group, said drum being so disposed that the longitudinal axis thereof extends in substantially the same vertical plane as the longitudinal axis of the setting, spaced lower drums in the setting located on opposite sides of said passage with the longitudinal axes thereof extending in horizontal planes parallel to the horizontal axes of said upper drum and said setting, said drums respectively being in communication with the lower ends of the tubes of said tube banks, a furnace laterally adjacent each of said tube banks, said chambers being in communication with the air compressor to receive air under pressure therefrom for combustion, means for firing each furnace, a wall extending around and spaced from the inner periphery of the casing from a point adjacent said upper drum at one side thereof to a point adjacent the upper drum at the opposite side thereof, said space between the wall and the casing being adapted to receive air under pressure from the interior of the setting, baffle means separating the passage from each of said banks, other baffle means associated with each of said banks and positioned in spaced relationship with said first-mentioned baffle, each baffle and other baffle comprising a plurality of tubes of a bank laterally spaced from one another in a row extending longitudinally of said drum, the baffles also comprising elongated, flat, metallic strips having opposite sides and longitudinally extending opposite edges, said strips being secured to adjacent tubes to extend longitudinally thereof with a portion of one side of the strips abutting a tube and with the opposite side of the strips closely adjacent the opposite side of another strip on an adjacent tube in the row, the space between said tubes and the thickness of said strip and said other strip being substantially equal, the strips extending in said spaces substantially at a right angle to said passage and with a longitudinal edge thereof adjacent said passage, means for securing adjacent strips together in a fluid-tight manner along one longitudinal edge thereof, said baffle and other baffle thereby forming a gas outlet flow path through the banks, the furnaces each having a gas opening in communication with the gas outlet flow path of the tube bank adjacent said furnace and with the passage between said banks at one end of said flow path and passage, gas outlet means forming a gas outlet for said gas outlet flow paths through the banks, other gas outlet means forming a gas outlet separate from said gas outlet means and providing a gas outlet for said passage, said gas outlet means and other gas outlet means being located at the end of said flow paths and passage opposite said one end to receive gases after said gases have passed through said passage and gas outlet flow paths, means for separately controlling the flow of gases through said passage and the flow of gases through said outlet flow paths,

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and a gas turbine associated with said air compressor, said gas turbine and said other gas outlets being in communication so that the gas turbine is actuated by gases of combustion from the vapor generator.

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