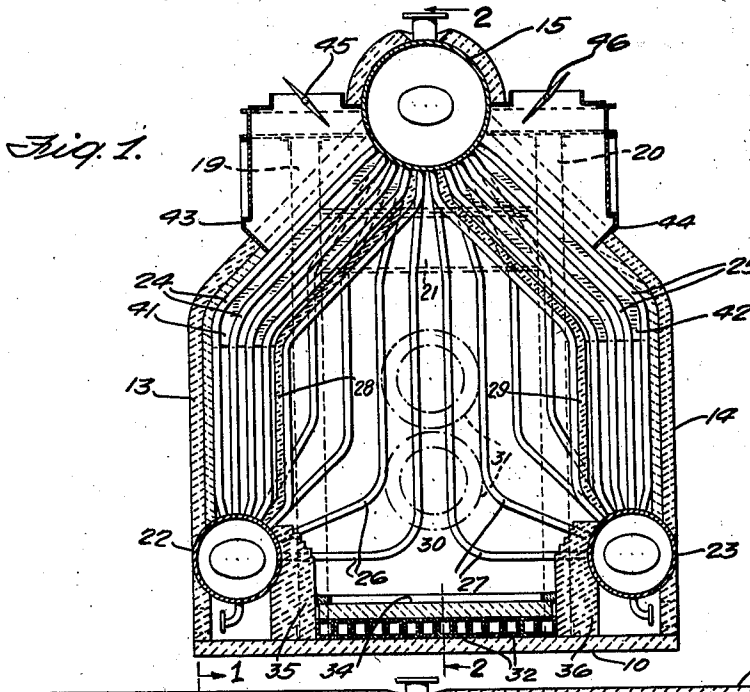
Feb. 22, 1944. W. F. KEENAN, JR 2,342,148

VAPOR GENERATOR

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Fig. 1.



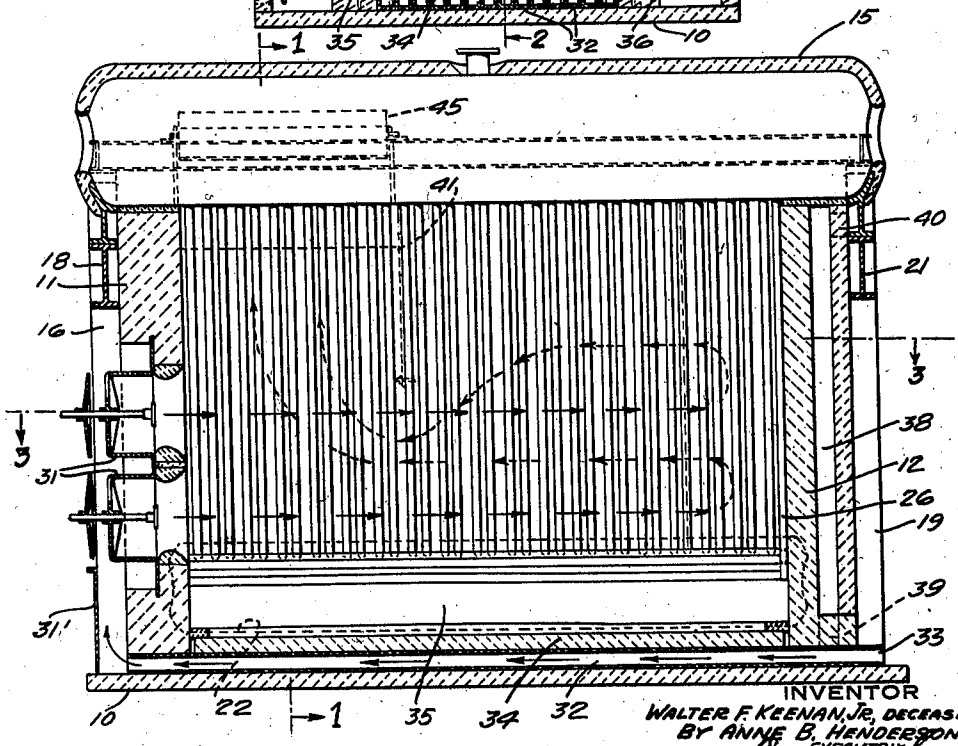


Fig. 2.

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Filed May 18, 1940 2 Sheets-Sheet 2

Fig. 3.

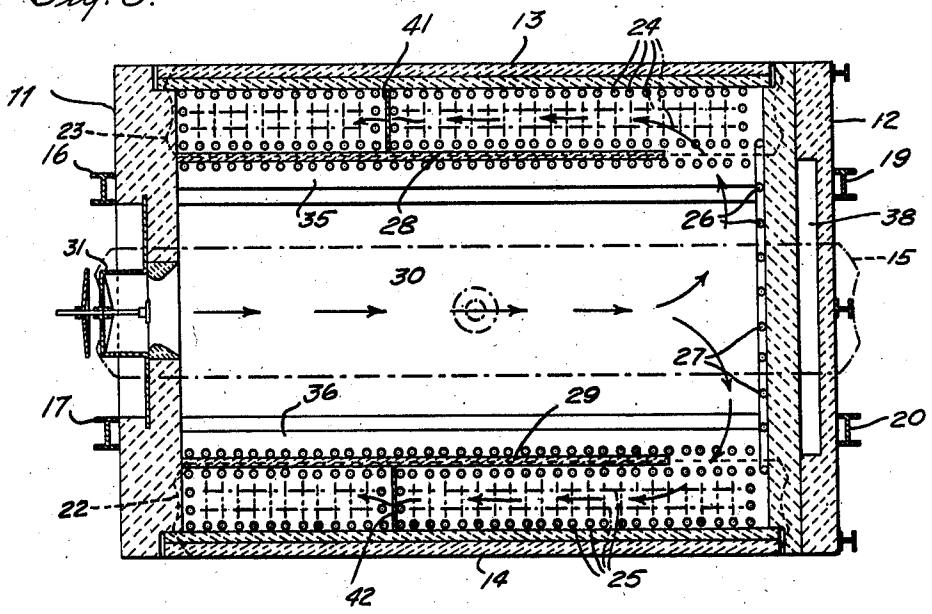
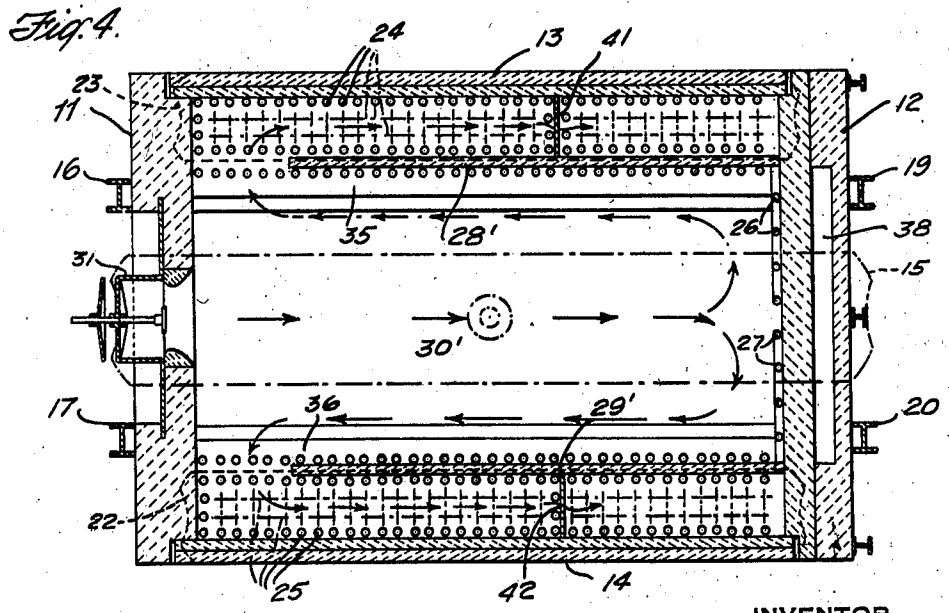


Fig. 4.



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UNITED STATES PATENT OFFICE

2,342,148

VAPOR GENERATOR

Walter F. Keenan, Jr., deceased, late of Pelham Manor, N. Y., by Anne B. Henderson, executrix, Pelham Manor, N. Y., assignor to Foster Wheeler Corporation, New York, N. Y., a corporation of New York

Application May 18, 1940, Serial No. 335,982
In Canada June 10, 1939

13 Claims. (Cl. 122—328)

The invention relates to vapor generators, and provides a compact and simplified construction which renders the generator especially well adapted for use in industrial steam power plants or the like, although the invention is capable of general application in the heating of liquids and vapors.

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

Fig. 1 is a transverse vertical sectional view of a vapor generator embodying a preferred form of the invention, taken on line 2—2 of Fig. 1;

Fig. 2 is a longitudinal vertical sectional view taken on line 2—2 of Fig. 1;

Fig. 3 is a horizontal sectional view taken on line 3—3 of Fig. 2, and

Fig. 4 is a horizontal sectional view similar to Fig. 3, but illustrating another form of the invention.

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

Referring to the drawings, Figs. 1 to 3 illustrate a three drum, symmetrically arranged vapor generating unit having a refractory setting which includes a rectangualr floor portion 10, vertical front and rear walls 11 and 12 respectively, and side walls 13 and 14, the upper portions of which are inclined inwardly to a centrally disposed upper drum 15, which extends longitudinally of the setting. Drum 15 is supported at its front end by vertical steel columns 16 and 17 and cross beam 18, and at its rear end by similar steel columns 19 and 20 and cross beam 21. Adjacent the lower portions of the side walls are lower drums 22 and 23 which are parallel with the upper drum and connected thereto by symmetrical groups or banks of vapor generating tubes 24 and 25 respectively, which extend substantially parallel with the adjacent side wall and are so arranged that the outermost row of tubes of each group forms a water wall for the inner surface of the adjacent side wall. Extending between the rear end portion of the upper drum and the rear end portions of each of the lower drums are additional tube groups 26 and 27 which form a row of relatively widely spaced water wall tubes for a substantial portion of the rear setting wall. The lower portions of these tubes extend inwardly over the inner surface of the wall from each of the lower drums and continue through bent portions upwardly to the upper drum. In the space between the innermost row of tubes 24 and the row adjacent thereto, is a baffle wall 28 which extends upwardly from the lower drum 22 to the upper drum, and longitudinally of the setting from the front wall to within a comparatively short distance of the rear wall of the setting. A baffle wall 29 is similarly disposed within the bank of tubes 25. These baffle walls provide in part, an interior furnace chamber 30, which is fired by a plurality of fuel burners 31 centrally positioned in the front wall of the setting. Preheated air for combustion is supplied to the burner casing 31' through a plurality of parallel tile, floor cooling conduits 32, which are open to the atmosphere at the rear of the setting at 33, and which, under operating conditions, are protected from the intense heat of the furnace chamber by suitable refractory material 34. Refractory piers 35 and 36 form the lower side walls of the furnace chamber and serve to protect the drums 22 and 23 respectively. The rear wall of the setting is air cooled by a single air duct 38 which extends vertically from the top to the bottom of the wall, and horizontally for the width of the furnace. Circulation of air through the air duct 38 is provided by suitable air inlets and outlets 39 and 40 respectively.

In operation, products of combustion produced by the burners flow longitudinally through the furnace chamber from front to rear, and adjacent the rear wall they divide and pass around the rear end of each baffle wall to flow forwardly in two passes over the main groups of tubes 24 and 25 disposed between the baffle walls and the side walls of the setting. As shown in Figs. 1 to 3 of the drawings, transverse baffles 41 and 42 extend downwardly from the upper drum through the tube groups 24 and 25 respectively to a point approximately midway between the upper and lower drums, and serve to deflect the furnace gases downwardly in each tube pass as they move forwardly before they flow upwardly over the remaining portions of the heating surface between the transverse baffles and the front wall, to leave the furnace through uptake flues 43 and 44 adjacent either side of the upper drum at the forward end of the setting. The flow of the spent products of combustion through each outlet flue is controlled by dampers 45 and 46 respectively, which may be operated by any suitable means not shown. The baffles 41 and 42 prevent any tendency of the furnace gases to by-pass a portion of the heating surface before entering the uptakes. Any type of firing means, other than the fuel burners shown, may be employed if desired.

The form of the invention illustrated in Fig. 4

is similar to the form previously described excepting that the baffle walls 28' and 29' extend forwardly from the rear wall of the setting and form an interior furnace chamber 30' in which there is a reverse flow of gases towards the front wall before the gases enter the main groups of heating tubes 24 and 25 between the side walls and the respective baffle walls, and are finally discharged through uptake flues 43 and 44, which in the present case, are disposed adjacent the rear end of the unit.

The present invention provides an improved vapor generator of relatively simple and symmetrical construction, the component parts of which are capable of being readily standardized to facilitate fabrication and erection. Heat losses by radiation through the walls of the unit are minimized due to the interior arrangement of the combustion chamber which is almost entirely enclosed within banks of heating tubes and other groups of floor and wall cooling elements. Obviously if desired, a portion of the steam generating surface may be omitted, and superheating elements installed in the place thereof to meet final steam temperature requirements.

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

What is claimed is:

1. A vapor generator comprising a setting, an upper drum, two spaced lower drums, a bank of vapor generating tubes extending between the upper drum and each lower drum, a furnace between said tube banks, burner means for firing the furnace positioned at one end thereof to direct a horizontal stream of products of combustion to the opposite end of said furnace where the stream thereafter divides and reverses its direction of flow, and a baffle wall in each tube bank between rows of tubes on the furnace side of the bank and extending between the upper and lower drums of the bank and longitudinally of the bank for a distance short of the entire extent thereof to provide a gas passage from the furnace to the tube bank.

2. A vapor generator comprising a setting, an upper drum, two spaced lower drums, a bank of vapor generating tubes extending between the upper drum and each lower drum, a furnace between said tube banks, burner means for firing the furnace positioned at one end thereof to direct a horizontal stream of products of combustion to the opposite end of said furnace where the stream thereafter divides and reverses its direction of flow, a baffle wall in each tube bank between rows of tubes on the furnace side of the bank and extending between the upper and lower drums of the bank and longitudinally of the bank for a distance short of the entire extent thereof to provide a gas passage from the furnace to the tube bank, and tubes extending between the upper drum and each lower drum and disposed adjacent the wall on said opposite end of the furnace.

3. A vapor generator comprising a setting, an upper drum, two spaced lower drums, a bank of vapor generating tubes extending between the upper drum and each lower drum, a furnace between said tube banks, burner means for firing the furnace positioned at one end thereof to direct a horizontal stream of products of combustion to the opposite end of said furnace where the stream thereafter divides and reverses its direction of flow, a baffle wall in each tube bank between rows of tubes on the furnace side of the bank and extending between the upper and lower drums of the bank and longitudinally of the bank for a distance short of the entire extent thereof to provide a gas passage from the furnace to the tube bank, and air cooling means for cooling the wall on said opposite end of the furnace.

4. A vapor generator comprising a setting, an upper drum, two spaced lower drums, a bank of vapor generating tubes extending between the upper drum and each lower drum, a furnace between said tube banks, burner means for firing the furnace positioned at one end thereof to direct a horizontal stream of products of combustion to the opposite end of said furnace where the stream thereafter divides and reverses its direction of flow, a baffle wall in each tube bank between rows of tubes on the furnace side of the bank and extending between the upper and lower drums of the bank and longitudinally of the bank for a distance short of the entire extent thereof to provide a gas passage from the furnace to the tube bank, and means for passing air in heat exchange relationship with one of the walls of the furnace to preheat the air for said burner.

5. A vapor generator comprising a setting, an upper drum, two spaced lower drums, a bank of vapor generating tubes extending between the upper drum and each lower drum, a furnace between said tube banks, burner means for firing the furnace positioned at one end thereof to direct a horizontal stream of products of combustion to the opposite end of said furnace where the stream thereafter divides and reverses its direction of flow, a baffle wall in each tube bank between rows of tubes on the furnace side of the bank and extending between the upper and lower drums of the bank and longitudinally of the bank for a distance short of the entire extent thereof to provide a gas passage from the furnace to the tube bank, and means for passing air in heat exchange relationship with the floor of the furnace to preheat the air for said burner.

6. A vapor generator comprising a setting having side and end walls, a single drum disposed in the upper central part of the setting, a lower drum disposed adjacent each side wall and parallel to the upper drum, tube banks connecting the upper drum and each lower drum, the outermost row of tubes of each bank lining the inner surface of the adjacent side wall, the tubes of each bank being bent so that the lower portions extend substantially vertically upwardly from the lower drum and the upper portions extend inwardly in a vertically inclined direction to the upper drum, a furnace between the tube banks defined in part by a baffle wall in each tube bank between the two innermost rows of tubes therein and extending between the upper and lower drums of the bank and longitudinally of the bank for a distance short of the entire extent thereof to provide a gas passage from the furnace to the tube bank, burner means for firing the furnace positioned at one end thereof to direct a horizontal stream of products of combustion to the opposite end of said furnace where the stream thereafter divides and reverses its direction of flow, and tubes extending between the upper drum and each lower drum and disposed adjacent said opposite end wall of the furnace.

7. A vapor generator comprising a setting having side and end walls, a single drum disposed in the upper central part of the setting, a lower

drum disposed adjacent each side wall and parallel to the upper drum, tube banks connecting the upper drum and each lower drum, the outermost row of tubes of each bank lining the inner surface of the adjacent side wall, the tubes of each bank being bent so that the lower portions extend substantially vertically upwardly from the lower drum and the upper portions extend inwardly in a vertically inclined direction to the upper drum, a furnace between the tube banks defined in part by a baffle wall in each tube bank between rows of tubes on the furnace side of the bank and extending between the upper and lower drums of the bank and longitudinally of the bank for a distance short of the entire extent thereof to provide a gas passage from the furnace to the tube bank, burner means for firing the furnace positioned at one end thereof to direct a horizontal stream of products of combustion to the opposite end of said furnace where the stream thereafter divides and reverses its direction of flow, tubes extending between the upper drum and each lower drum and disposed adjacent said opposite end wall of the furnace, and baffle means for directing the flow of gases over the tubes in each bank.

8. A vapor generator comprising a setting having side and end walls, a single drum disposed in the upper central part of the setting, a lower drum disposed adjacent each side wall and parallel to the upper drum, tube banks connecting the upper drum and each lower drum, the outermost row of tubes of each bank lining the inner surface of the adjacent side wall, the tubes of each bank being bent so that the lower portions extend substantially vertically upwardly from the lower drum and the upper portions extend inwardly in a vertically inclined direction to the upper drum, a furnace between the tube banks defined in part by a baffle wall in each tube bank between rows of tubes on the furnace side of the bank and extending between the upper and lower drums of the bank and longitudinally of the bank for a distance short of the entire extent thereof to provide a gas passage from the furnace to the tube bank, burner means for firing the furnace positioned at one end thereof to direct a horizontal stream of products of combustion to the opposite end of said furnace where the stream thereafter divides and reverses its direction of flow, tubes extending between the upper drum and each lower drum and disposed adjacent said opposite end wall of the furnace, baffle means for directing the flow of gases over the tubes in each bank, and means for air cooling said opposite end wall.

9. A vapor generator comprising a setting having side and end walls, a single drum disposed in the upper central part of the setting, a lower drum disposed adjacent each side wall and parallel to the upper drum, tube banks connecting the upper drum and each lower drum, the outermost row of tubes of each bank lining the inner surface of the adjacent side wall, the tubes of each bank being bent so that the lower portions extend substantially vertically upwardly from the lower drum and the upper portions extend inwardly in a vertically inclined direction to the upper drum, a furnace between the tube banks defined in part by a baffle wall in each tube bank between rows of tubes on the furnace side of the bank and extending between the upper and lower drums of the bank and longitudinally of the bank for a distance short of the entire extent thereof to provide a gas passage from the furnace to the tube bank, burner means for firing the furnace positioned at one end thereof to direct a horizontal stream of products of combustion to the opposite end of said furnace where the stream thereafter divides and reverses its direction of flow, tubes extending between the upper drum and each lower drum and disposed adjacent said opposite end wall of the furnace, baffle means for directing the flow of gases over the tubes in each bank, means for air cooling said opposite end wall, and means for passing air in heat exchange relationship with the floor of the furnace to preheat the air for the burner.

10. A vapor generator comprising a setting, an upper drum, two spaced lower drums, a bank of vapor generating tubes extending between the upper drum and each lower drum, a furnace between said tube banks, burner means for firing the furnace positioned at one end thereof to direct a horizontal stream of products of combustion to the opposite end of said furnace where the stream thereafter divides and reverses its direction of flow, and a baffle wall in each tube bank between rows of tubes on the furnace side of the bank and extending between the upper and lower drums of the bank from said opposite end of the furnace and longitudinally of the bank to a point short of the end of the furnace in which said burner is positioned to provide a gas passage from the furnace to the tube bank.

11. A vapor generator comprising a setting, an upper drum, two spaced lower drums, a bank of vapor generating tubes extending between the upper drum and each lower drum, a furnace between said tube banks, burner means for firing the furnace positioned at one end thereof to direct a horizontal stream of products of combustion to the opposite end of said furnace where the stream thereafter divides and reverses its direction of flow, a baffle wall in each tube bank between rows of tubes on the furnace side of the bank and extending between the upper and lower drums of the bank from said opposite end of the furnace and longitudinally of the bank to a point short of the end of the furnace in which said burner is positioned to provide a gas passage from the furnace to the tube bank, and tubes extending between the upper drum and each lower drum and disposed adjacent the wall on said opposite end of the furnace.

12. A vapor generator comprising a setting having side and end walls, a single drum disposed in the upper central part of the setting, a lower drum disposed adjacent each side wall and parallel to the upper drum, tube banks connecting the upper drum and each lower drum, the outermost row of tubes of each bank lining the inner surface of the adjacent side wall, the tubes of each bank being bent so that the lower portions extend substantially vertically upwardly from the lower drum and the upper portions extend inwardly in a vertically inclined direction to the upper drum, a furnace between the tube banks defined in part by a baffle wall in each tube bank between rows of tubes on the furnace side of the bank and extending from one end wall and between the upper and lower drums of the bank and longitudinally of the bank for a distance short of the opposite end of the furnace to provide a gas passage from the furnace to the tube bank, burner means for firing the furnace positioned in said opposite end comprising a burner to direct a horizontal stream of products of combustion which flows successively in the furnace from said burner to the other end of said furnace reversing its direction there-

after to flow over the tubes of each bank in parallel streams, and tubes extending between the upper drum and each lower drum and disposed adjacent said opposite end wall of the furnace.

13. A vapor generator comprising a setting, an upper drum, two spaced lower drums, a bank of vapor generating tubes extending between the upper drum and each lower drum, a furnace between said tube banks, a baffle wall in each tube bank between rows of tubes on the furnace side of the bank and extending between the upper and lower drums of the bank and longitudinally of the bank from one end thereof for a distance short of the opposite end to provide a gas passage from the furnace to the tube bank, and burner means for firing the furnace positioned adjacent said one end of the bank to direct a horizontal stream of products of combustion to said opposite end of the bank where the stream thereafter divides and passes through the gas passages into the tube banks, said stream flowing through the banks in a direction opposite to that in which it flows through the furnace.

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Executrix of the Estate of Walter F. Keenan, Jr., Deceased.