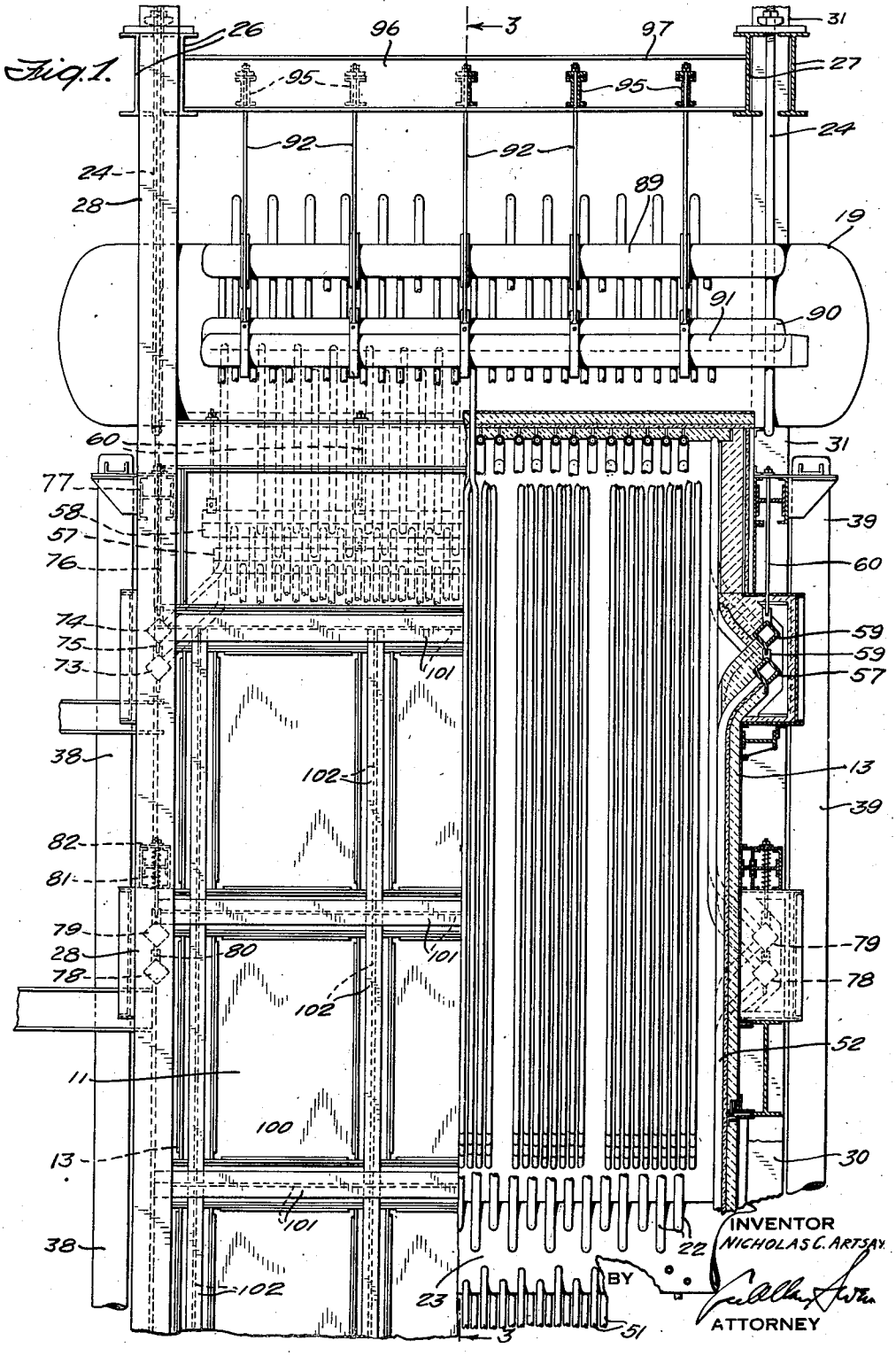
Aug. 11, 1942. N. C. ARTSAY 2,292,354

VAPOR GENERATOR

Filed June 7, 1939 6 Sheets-Sheet 1

Fig. 1.



Aug. 11, 1942. N. C. ARTSAY 2,292,354

VAPOR GENERATOR

Filed June 7, 1939 6 Sheets-Sheet 2

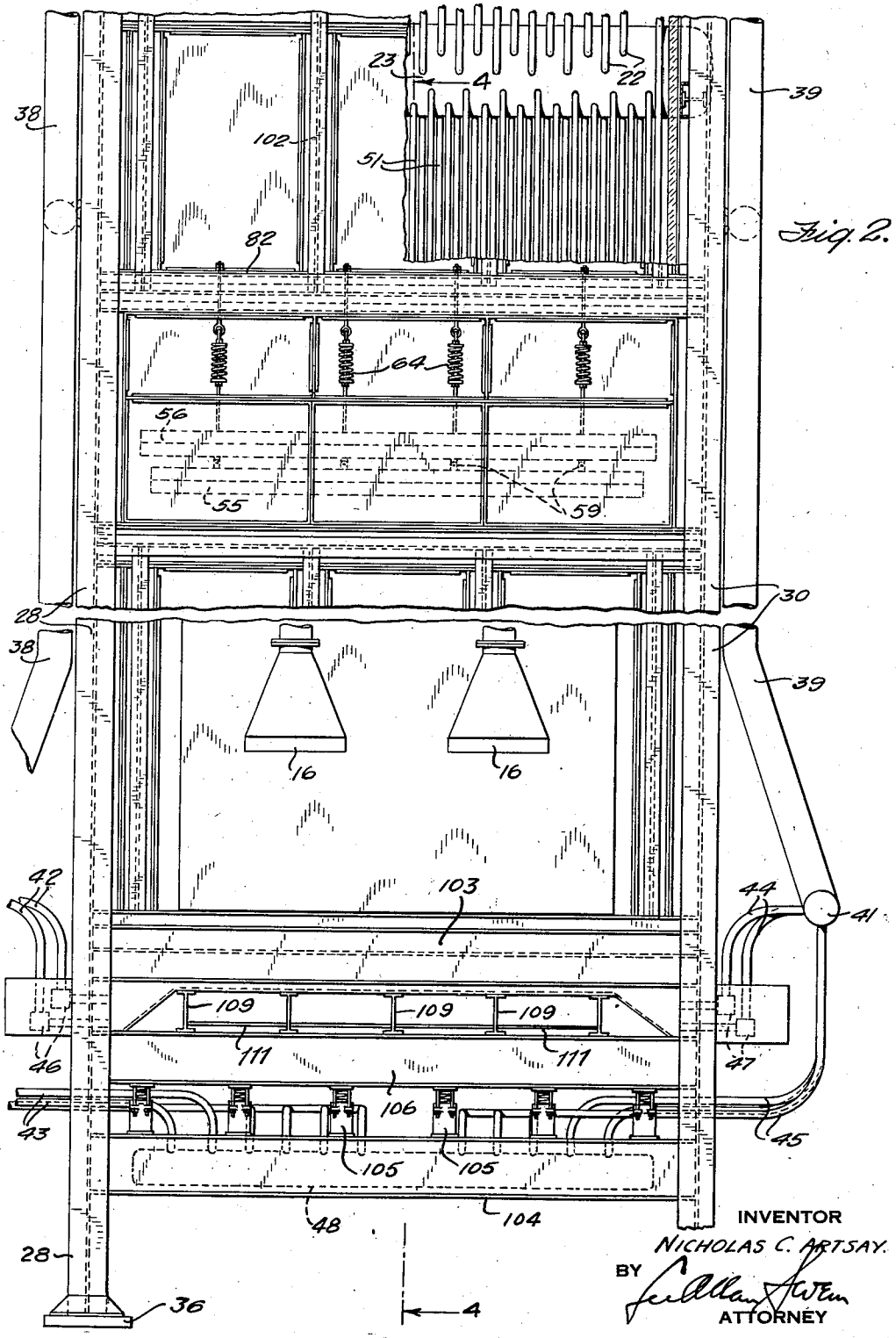


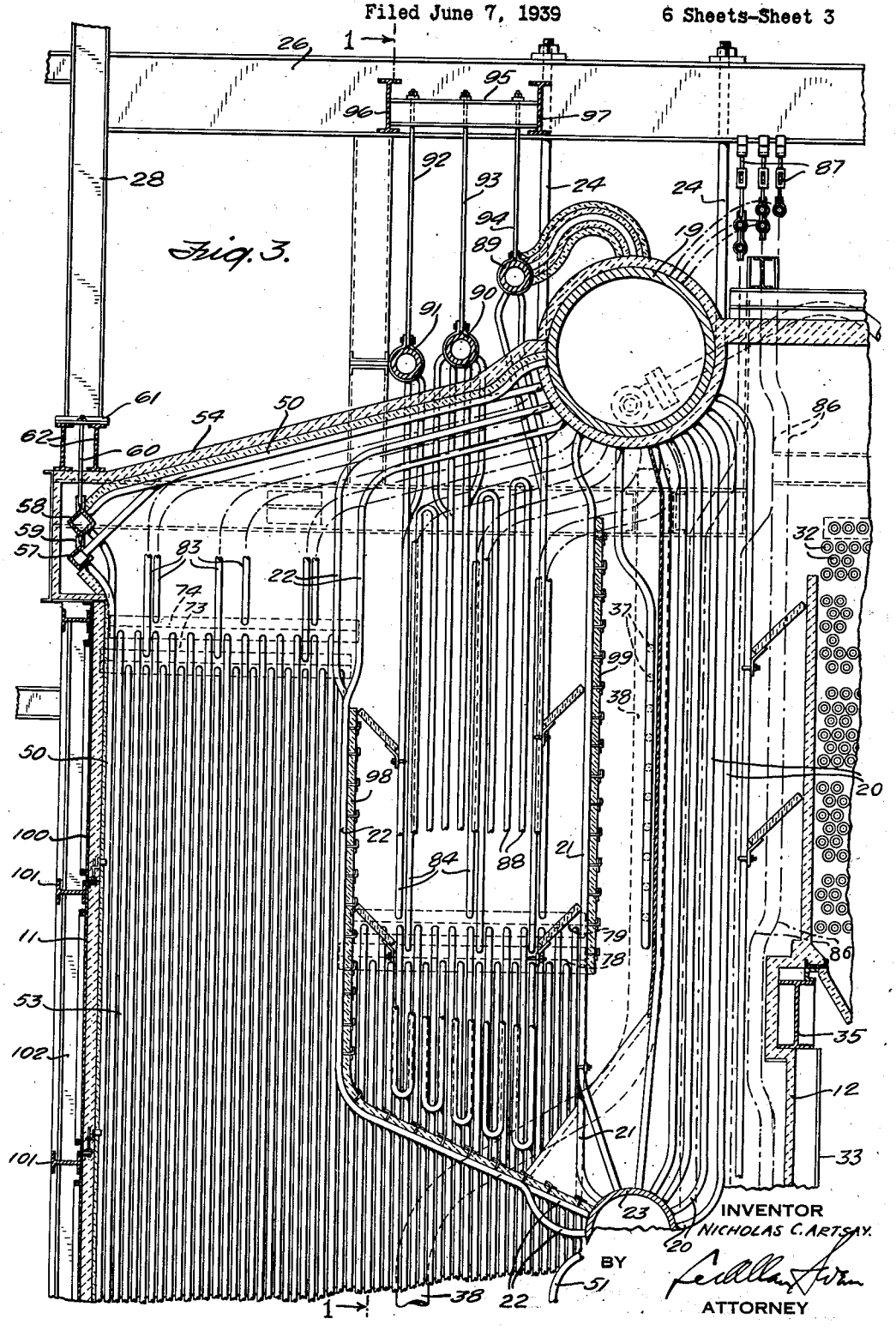
Fig. 2.

INVENTOR
NICHOLAS C. ARTSAY.
BY
ATTORNEY

Aug. 11, 1942. N. C. ARTSAY 2,292,354

VAPOR GENERATOR

Filed June 7, 1939 6 Sheets-Sheet 3

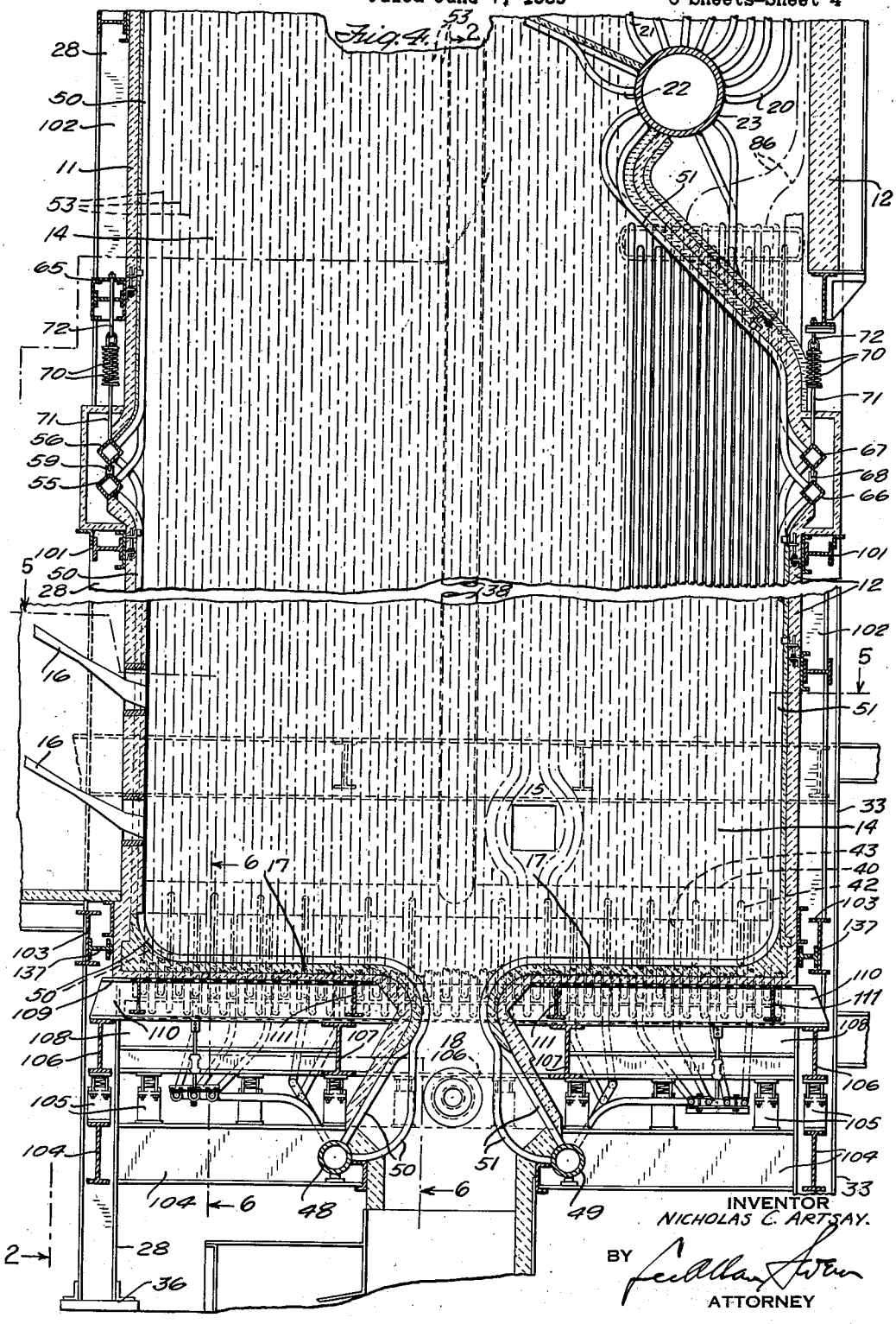


Aug. 11, 1942. N. C. ARTSAY 2,292,354

VAPOR GENERATOR

Filed June 7, 1939 6 Sheets-Sheet 4

Fig. 4.



INVENTOR
NICHOLAS C. ARTSAY.

BY

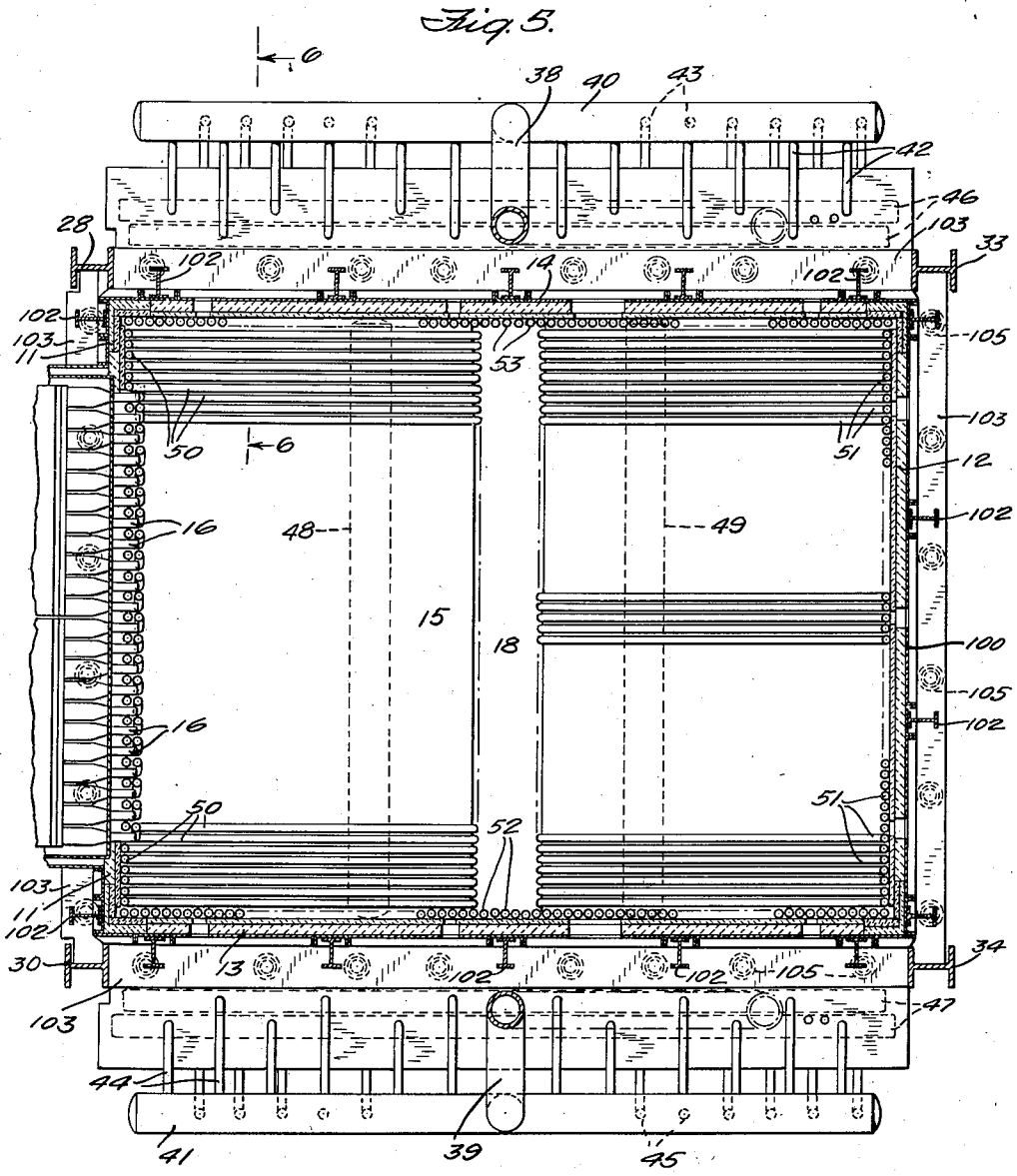
ATTORNEY

Aug. 11, 1942. N. C. ARTSAY 2,292,354

VAPOR GENERATOR

Filed June 7, 1939 6 Sheets-Sheet 5

Fig. 5.

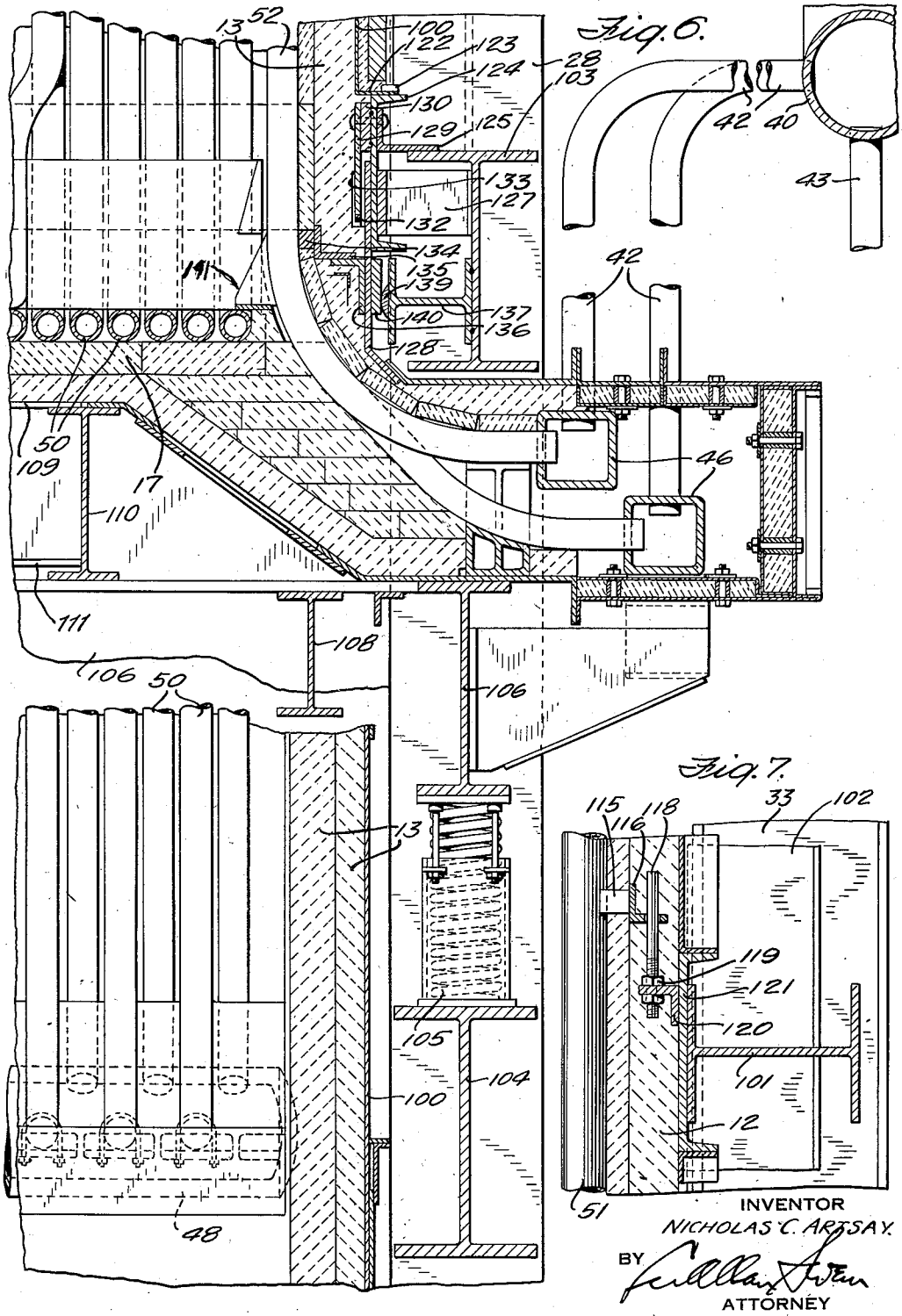


INVENTOR
NICHOLAS C. ARTSAY.
BY
ATTORNEY

Aug. 11, 1942. N. C. ARTSAY 2,292,354

VAPOR GENERATOR

Filed June 7, 1939 6 Sheets-Sheet 6



INVENTOR
NICHOLAS C. ARTSAY.
BY
ATTORNEY

Patented Aug. 11, 1942 2,292,354

UNITED STATES PATENT OFFICE

2,292,354

VAPOR GENERATOR

Nicholas C. Artsay, Valhalla, N. Y., assignor to Foster Wheeler Corporation, New York, N. Y., a corporation of New York

Application June 7, 1939, Serial No. 277,811

16 Claims. (Cl. 122—235)

This invention relates to vapor generators and more particularly pertains to relatively large steam generators having furnaces of the "basket bottom" type, the refractory walls of which are of relatively great height and are lined with vertically disposed water wall tubes, while the furnace floor or bottom is lined with similar, horizontally disposed tubes.

The invention provides novel supporting means for steam generators of this type, which permits expansion and contraction of portions of the heating surface and vertical movement of the furnace floor as a unit, as well as permitting the longitudinal expansion of the horizontal tubes on the furnace floor under varying thermal conditions, but which prevents at the same time, any undesirable relative movement between the wall and floor tubes, or between these tubes and the refractory structure of the furnace walls and the furnace bottom. A slag tight furnace construction is thus assured, and the possibility of distortion and damage to the steam generating unit, resulting from ash or slag working into open spaces between the tubes and the refractory furnace walls or floor is entirely eliminated, so that regardless of temperature changes, the normal relative positions of the component parts of the heating surface on the furnace walls and floor as well as the refractory portions of the furnace wall and floor structure will remain constant.

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 side elevational view with parts in section of the upper portion of a steam generator embodying the invention, the section being taken on line 1—1 of Fig. 3;

Fig. 2 is a similar view of the lower portion of the steam generator shown in Fig. 1, the section being taken on line 2—2 of Fig. 4;

Fig. 3 is a vertical sectional view of the upper portion of the steam generator, taken on line 3—3 of Fig. 1;

Fig. 4 is a vertical sectional view of the lower portion of the steam generator, taken on line 4—4 of Fig. 2;

Fig. 5 is a horizontal sectional view of the lower portion of the steam generator furnace, taken on line 5—5 of Fig. 4;

Fig. 6 is a vertical sectional view, on an enlarged scale, of portions of the furnace bottom and walls, taken on lines 6—6 of Figs. 4 and 5, and

Fig. 7 is a sectional view on an enlarged scale, illustrating a detail of an upper wall portion of the furnace.

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

Referring to the drawings, the steam generator illustrated is substantially in the form of a rectangular parallelopiped, with a setting having vertical, refractory front and rear walls 11 and 12, and similar side walls 13 and 14. A combustion chamber or furnace 15, in the lower part of the setting, is fired by a plurality of burners 16 which extend through the front wall 11. A "basket type," continuous slagging furnace bottom is provided by a horizontal refractory floor 17 in which there is a centrally disposed slag discharge opening 18 that extends across the furnace floor at right angles to the walls 13 and 14. The furnace bottom and the supports therefor will be described fully hereinafter.

An upper steam drum 19 is connected by groups or banks of steam generating tubes 20, 21 and 22, to a lower drum 23. The upper drum, the lower drum, and the connecting tube groups, are suspended from the steel framework for the setting, through hanger straps or bolts 24, one adjacent each end of the upper drum, which are attached to horizontal steel beams 26 and 27, these beams being supported at their ends by steel columns some of which also serve to frame and support the front setting wall. Beam 26 is supported at its front end by a column 28 and at its rear end by a similar column, not shown, while beam 27 is supported at its front end by a column 30 and at its rear end by a column 31. Column 31 and the corresponding column not shown, are spaced a substantial distance to the rear of the rear setting wall and form part of the supporting structure for auxiliary heat recovery devices, such as an economizer 32 partially shown in Fig. 3. As indicated, the columns extend upwardly above the setting, and form part of the supporting structure for the building or housing which encloses the steam generator. The rear setting wall 12 is framed and supported by stub columns 33 and 34, which extend upwardly adjacent the rear corner portions of the setting only as far as horizontal beam 35, which supports in part, the economizer 32. These stub columns together with the main columns previously described, rest on concrete foundations 36, and carry the entire weight of the steam generating unit.

As shown, the inner surface of each of the four walls of the furnace 15 and the setting is entirely

lined by groups of closely spaced vertical water wall tubes. Certain of these tube groups extend horizontally over the surface of the furnace floor 17. Circulating water from the upper drum 19 is supplied to these wall and floor tubes by a circulatory system including downcomer tubes 37 which extend from the bottom of the drum along the greater part of its length, through the side walls of the setting and connect with large vertical manifold headers 38 and 39 that extend downwardly outside the side walls of the setting respectively, to horizontal distributing headers 40 and 41 respectively, from which the circulating water is fed to the lower ends of the various tube groups lining the four setting walls and the furnace floor through a plurality of external connections 42, 43, 44 and 45, pairs of intermediate headers 46, 47, and single headers 48 and 49. For example, the headers 48 and 49 respectively, supply tubes 50 and 51 which line respectively the front and rear walls 11 and 12, adjacent portions of the furnace floor and the throat of the slag discharge opening 18, while the headers 46 and 47 respectively supply water wall tubes 52 and 53 which line the side walls 13 and 14 respectively. At the top of the setting, the tubes 50 extend inwardly in a horizontally inclined direction to the drum 19, directly beneath the roof 54 of the setting. As shown in Figs. 3 and 4, the tubes 50 are divided into three sections, i. e., a lower wall and floor section, an intermediate or upper wall section, and a roof section. The upper ends of the tubes in the lower section and the lower ends of the tubes in the intermediate section are alternately connected to headers 55 and 56 which extend horizontally across front wall 11, while the upper ends of the tubes in the intermediate section and the lower ends of the tubes in the roof section are connected to horizontal headers 57 and 58. The headers of each of the header pairs 55, 56 and 57, 58 are held together rigidly by suitable tie plates 59. The headers 57 and 58 are suspended rigidly by a plurality of rigid hangers 60 secured at their upper ends to a plate 61 which rests upon steel cross beams 62 which are framed into the vertical supporting columns 28 and 30. The headers 55 and 56 on the other hand are suspended resiliently by a plurality of resilient supports from steel members 65 which are part of the wall supporting structure. Each resilient support comprises a coil spring 70 which is secured to link 71, the lower end of which is attached to header 56, and a link 72, the upper end of which is attached to a member 65. Link 71 is connected to, or bears upon, the upper end of spring 70, while link 72 is connected to the lower end of the spring. With this arrangement, downward movement of the headers will compress the spring.

The water wall tubes 51 consist of a lower wall and floor section, the tubes of which are alternately connected at their upper ends to headers 66 and 67, and an upper inclined section, the tubes of which are connected at their upper ends to the lower portion of the drum 23. The headers 66 and 67 are similar to the headers 55 and 56, being held together rigidly by tie plates 68, and flexibly suspended by resilient supports from the fixed steel framework of the rear setting wall. Since the tubes 50 and 51 are rigidly supported at their upper ends, these tubes will normally expand downwardly under furnace operating conditions, and such expansion will be absorbed by the resilient header supports described.

The side wall tubes 53 extend upwardly over the inner surface of the wall 14 in three parallel, adjacent groups, each group terminating in separate pairs of headers which are positioned at different levels in the wall. The tubes of the group adjacent the front wall 11 are alternately connected at their upper ends to headers 73 and 74, which are held in fixed relationship to each other by tie plates 75, and are rigidly suspended by hangers 76 from steel wall members 77. The tubes of the intermediate group are alternately connected at their upper ends to headers 78 and 79 which are maintained in fixed relationship to each other by tie plates 80 (Fig. 1), and are resiliently suspended by spring supports 81, similar to the spring supports previously described, from wall members 82. Groups of tubes 83 and 84 respectively connect the headers 73, 74, and 78, 79 with the drum 19. The tubes 53 of the third group are adjacent the rear wall, and the upper ends of these tubes are connected to a floating header 85 which is positioned at a level slightly below that of the lower drum 23. From this header external riser tubes 86 extend upwardly to the upper portion of the drum 19, and are suspended near their upper ends by a plurality of flexible hangers 87 which are secured to the beam 26.

It will be understood that, although not fully illustrated, the arrangement of the water wall tubes 52, which line the inner surface of the wall 13, is similar to that of the tubes 53, except that the riser tubes, not shown, which correspond to the riser tubes 86, are suspended by hangers secured to beam 27 instead of beam 26. A convection type superheater 88, having inlet, intermediate and outlet headers 89, 90 and 91 respectively, is suspended within the upper portion of the setting between vertical baffles 98 and 99 by a plurality of hanger rods 92, 93 and 94, from horizontal steel supporting members 95, which are supported by steel beams 96 and 97 that are framed into the main cross beams 26 and 27.

The refractory portion of the four setting walls is enclosed in a steel casing 100, which includes a steel framework of horizontal tie members 101 and vertical steel buckstays 102. The lower ends of the buckstays rest on horizontal beams 103, which are rigidly joined at their opposite ends to the main supporting columns 28, 30, 33 and 34, and thus form a fixed rectangular supporting frame surrounding the furnace adjacent the bottom thereof. The arrangement is such that although the casing rests on a stationary foundation, the inner refractory portions of the four walls are permitted to move vertically inside the casing for the reason that the steel supporting structure for the furnace bottom includes means for a compensating vertical movement of the furnace floor in response to expansion and contraction of the water wall tubes, and the refractory lining of the furnace walls.

Referring particularly to Figs. 4 and 6, a fixed rectangular supporting frame consisting of four horizontal beams 104 are rigidly secured at their opposite ends to the supporting columns 28, 30, 33 and 34 at a sufficient distance above the lower ends of the supporting columns to allow for the proper disposal of slag discharged from the furnace. On the top of each of the beams 104 are a plurality of spaced resilient supporting members 105 upon which rest four horizontal beams 106, which also extend for the full length and width of the setting between the four vertical supporting columns, but they are not secured

to the columns and hence are free to move vertically. The beams 106 thus form a "floating" frame which is stiffened at an intermediate portion by cross beams 107 which extend parallel to the longitudinal axis of the slag discharge slot on both sides thereof. Additional stiffening members 108 extend at right angles to the cross beams and between the latter and the ends of the frame. The arrangement of the beams 106 and the stiffening members 107 and 108 is such that any pressure exerted on the frame from above is evenly distributed and transmitted to the resilient supporting members 105 below, which rest upon the stationary beams 104. The supporting members 105 comprise a coil spring, the lower end of which is disposed in a cylindrical casing, and a plate on the top of the spring the movement of which away from the casing is limited by a plurality of bolts to thereby limit the expansion of the coil spring. The spring may be compressed until the plate rests upon the top of the casing.

The refractory portion of the furnace floor rests directly on steel plates 109 supported by a plurality of parallel, relatively closely spaced steel beams 110 which extend at right angles to the slag discharge slot. The inner ends of the beams 110 rest on the cross beams 107, while their outer ends are supported by the beam 106. Each group of members 110 is reinforced and stiffened by a plurality of transverse beams 111. This rigid grid-like furnace bottom structure transmits pressure evenly from the walls and floor above to the "floating" frame below.

As shown particularly in Fig. 7, means are provided to maintain the individual water wall tubes of the several groups previously described, in vertical alignment with the walls of the setting. As shown, such means includes a lug 115 welded to each tube which is suitably connected by studs, not shown, to the opposed face of a horizontally disposed angle bracket 116, which may be of any desired length, preferably of sufficient length to span a plurality of tubes. These angle brackets are each provided with apertures 117 which receive upright guide pins 118 that are attached at their lower ends to angle members 120 fixed to a portion of the stationary steel casing which includes a horizontal fixed steel channel 121 and one of the supporting steel tie members 101. The arrangement is such, that the pins will prevent any tendency of the tubes to move away from the walls, but will permit vertical movement of the tubes with respect to the walls. It will be understood that the wall refractory material will be so disposed with respect to the lugs 115 and the brackets 116 as not to interfere with the normal downward expansion of the tubes. Moreover, although the pins and members 120 will remain stationary, the adjacent refractory material will be arranged to allow for the free downward expansion of that portion of the furnace wall.

Fig. 6 illustrates the construction employed at the foot of each of the walls adjacent the floor of the furnace chamber, whereby any relative movement between the tubes and the refractory portions of the four walls is absorbed and equalized, as well as the means for preventing outward expansion or "spreading" of the walls at this point. The tubes 52 and 53 which line the side walls 13 and 14 respectively, have lugs or abutment members 141 which exert pressure, directly or indirectly, on the floor tubes 50 upon downward expansion of the tubes 52 and 53. Upon contraction of the wall tubes, the floor tubes will exert pressure on the wall tubes 52 and 53 through the members 141, acting under the influence of the resilient supports for the floor, whereby relative movement of the wall and floor tubes will be prevented. The lower edge of the casing 100 has an outwardly extending flanged portion 122 which is secured by studs 123 to the upper flange of a channel member 124. This channel member extends horizontally for the width of the setting and has secured to its upper portion an angle 125 which is also fixed to the top flange of one of the fixed beams 103. The channel member 124 thus becomes a fixed extension of the stationary casing, and is supported by brackets 127 which are disposed between the beam 103 and the lower portion of the channel. Adjacent the bottom of the setting and the floor of the furnace chamber, the refractory walls are enclosed in a supplementary steel casing 128, the upper edge of which overlaps but is not secured to, the inner portion of the channel. An expansion joint is thus formed between the stationary casing and the supplementary casing which permits an independent downward movement of the furnace bottom in response to downward expansion of the tubes and the walls. Obviously, the coefficient of expansion of steel water wall tubes is greater than that of refractory material. Any uneven expansion therefore between the tubes and portions of the refractory which might otherwise result in open spaces in the wall and leakage of air through the expansion joint is provided for by a sealing plate 129 which, together with a filler piece 130, is firmly secured to the upper portion of the inner wall of channel 124 and to the angle bracket 125. To further insure a leak-proof construction, asbestos packing material 132 is placed between the lower edge of the sealing plate 129 and the supplementary casing, and is held securely in place by a retaining piece 133. Lugs or tie back members 124 on the tubes secure the lower ends of the straight sections of the tubes to the supplementary casing by means of fixed angle brackets 135 and 136. Also the downward expansion of the refractory walls is transmitted to, and is absorbed by, the supplementary casing, the downward movement of which, together with the corresponding movement of the bottom structure of the furnace is transmitted directly and evenly by the "floating" beams 106 and their supporting framework to the "cushion" supporting members 105, which are distributed under all four walls of the setting, and are supported on a solid foundation provided by the beams 104.

Spreading of the walls adjacent the furnace floor is prevented by horizontal beams or abutment members 137 which are secured to the beams 103 by welding. A bearing surface between the beams 137 and the supplementary casing is provided by a convex portion on the inner side of the beams which is in contact with a rubbing plate 140. With this arrangement, any expansion of the horizontal portions of the tubes 50 and 51 will be inward and this will be absorbed adequately by the bends in these tubes between the walls 11 and 12 and the headers 48 and 49 which are supported by the tubes to which they are connected. Hence there will be no damaging gaps or slag pockets formed between the floor tubes and the furnace floor.

From the foregoing, it will be perceived that the invention provides supporting means for the

component parts of steam generators of the type described, whereby the normal relative positions of the heating surface on the furnace walls and floor, and that of the refractory portions of the wall and floor will remain constant regardless of temperature changes, thus insuring a slag tight construction throughout and preventing the possibility of distortion or damage to the unit resulting from ash or slag working into open spaces between the tubes and any portion of the refractory furnace lining.

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

What is claimed is:

1. A vapor generator having a furnace defined in part by walls and a floor, the floor having an opening intermediate opposite ends and extending from side to side thereof, fluid conducting tubes on the inner surfaces of the walls and floor, means for resiliently suspending the walls from supporting means, movable means for supporting the floor independently of the wall suspending means, a fixed support for the floor, resilient means between the fixed and movable supports for the floor, and a casing for the generator having a stationary section and a section movable with the floor, and an expansion joint between the stationary and movable sections of the casing.

2. A vapor generator comprising an upper and lower drum, a bank of vapor generating tubes connecting said drums, a furnace defined in part by walls and a floor, the floor having an opening intermediate opposite ends and extending from side to side thereof, fluid conducting tubes on the inner surfaces of the walls and the floor, means for suspending the upper drum, the tube bank and the lower drum from supporting means, means for resiliently suspending the walls and the wall tubes from said supporting means, means for resiliently supporting the floor and floor tubes independently of the first mentioned supporting means, a casing for the generator having a stationary section and a section movable with the floor, an expansion joint between the stationary and movable sections of the casing, and means for preventing outward movement of oppositely disposed walls of the furnace upon expansion of the fluid conducting tubes.

3. A vapor generator comprising a vapor generating section and a furnace therefor, the furnace having walls and a substantially horizontal floor provided with an opening intermediate opposite ends, fluid cooling tubes for the walls and the floor of the furnace, means for supporting the vapor generating section and the furnace walls to permit downward expansion of the furnace wall tubes, means for independently supporting the furnace floor so as to permit vertical movement of the floor upon expansion and contraction of the furnace wall tubes and to prevent relative movement of the floor with respect to the wall tubes, a fixed frame surrounding the furnace walls, and means associated with said fixed frame to prevent lateral outward movement of the furnace walls with respect to the floor.

4. A vapor generator comprising a vapor generating section and a furnace therefor, the furnace having walls and a substantially horizontal floor provided with an opening intermediate opposite ends, fluid cooling tubes for the walls and the floor of the furnace, means for suspending the furnace walls to permit downward expansion of the furnace wall tubes, means for supporting the furnace floor independently of the furnace wall suspending means so as to permit vertical movement of the floor upon expansion and contraction of the furnace wall tubes and to prevent relative movement of the floor with respect to the wall tubes, a fixed frame surrounding the furnace walls, and means associated with said fixed frame to prevent lateral outward movement of the furnace walls with respect to the floor.

5. A vapor generator comprising a vapor generating section and a furnace therefor, the furnace having walls and a substantially horizontal floor provided with an opening intermediate opposite ends, fluid cooling tubes for the walls and the floor of the furnace, means for suspending the furnace walls to permit downward expansion of the furnace wall tubes, a stationary support for the floor, resilient means between the support and the floor to permit vertical movement of the floor upon expansion and contraction of the furnace wall tubes and to prevent relative movement of the floor with respect to the wall tubes, a fixed frame surrounding the furnace walls, and means associated with said fixed frame to prevent lateral outward movement of the furnace walls with respect to the floor.

6. A vapor generator comprising a vapor generating section and a furnace therefor, the furnace having walls and a substantially horizontal floor provided with an opening intermediate opposite ends, fluid cooling tubes for the walls and the floor of the furnace, means for suspending the furnace walls to permit downward expansion of the furnace wall tubes, means for securing the wall tubes to the furnace walls, a stationary support for the floor, resilient means between the support and the floor to permit vertical movement of the floor upon expansion and contraction of the furnace wall tubes and to prevent relative movement of the floor with respect to the wall tubes, a fixed frame surrounding the furnace walls, and means associated with said fixed frame to prevent lateral outward movement of the furnace walls with respect to the floor.

7. A vapor generator comprising a vapor generating section and a furnace therefor, the furnace having walls and a substantially horizontal floor provided with an opening intermediate opposite ends, fluid cooling tubes for the walls and the floor of the furnace, means for supporting the vapor generating section and the furnace walls to permit downward expansion of the furnace wall tubes, means for independently supporting the furnace floor so as to permit vertical movement of the floor upon expansion and contraction of the furnace wall tubes and to prevent relative movement of the floor with respect to the wall tubes, means to prevent lateral outward movement of the furnace walls with respect to the floor, a casing for the generator having a stationary section and a section movable with the floor, and an expansion joint between the stationary and movable sections of the casing.

8. A vapor generator comprising a vapor generating section and a furnace therefor, the furnace having walls and a substantially horizontal floor provided with an opening intermediate opposite ends, fluid cooling tubes for the walls and

the floor of the furnace, means for supporting the vapor generating section and the furnace walls to permit downward expansion of the furnace wall tubes, means for independently supporting the furnace floor so as to permit vertical movement of the floor upon expansion and contraction of the furnace wall tubes and to prevent relative movement of the floor with respect to the wall tubes, means to prevent lateral outward movement of the furnace walls with respect to the floor, a casing for the generator having a stationary section and a section movable with the floor, and an expansion joint between the stationary and movable sections of the casing, and means for preventing passage of fluid through the expansion joint.

9. A vapor generator comprising a vapor generating section and a furnace therefor, the furnace having walls and a substantially horizontal floor provided with an opening intermediate opposite ends, fluid cooling tubes for the walls and the floor of the furnace, the tubes of opposite walls of the furnace extending continuously over the floor thereof, means for supporting the vapor generating section and the furnace walls to permit downward expansion of the furnace wall tubes, means for independently supporting the furnace floor so as to permit vertical movement of the floor upon expansion and contraction of the furnace wall tubes and to prevent relative movement of the floor with respect to the wall tubes, and means to prevent lateral outward movement of the furnace walls with respect to the floor.

10. A vapor generator comprising a vapor generating section and a furnace therefor, the furnace having walls and a substantially horizontal floor provided with an opening intermediate opposite ends, fluid cooling tubes for the walls and the floor of the furnace, the tubes of a pair of opposite walls of the furnace extending continuously over the floor thereof to said opening, the tubes of other walls of the furnace extending downwardly below the floor tubes, means for supporting the vapor generating section and the furnace walls to permit downward expansion of the furnace wall tubes, means for independently supporting the furnace floor so as to permit vertical movement of the floor upon expansion and contraction of the furnace wall tubes and to prevent relative movement of the floor with respect to the wall tubes, means causing the downward expansion of the tubes of the other walls to exert a pressure upon tubes on the floor, and means to prevent lateral outward movement of the furnace walls with respect to the floor.

11. A vapor generator comprising a vapor generating section and a furnace therefor, the furnace having walls and a substantially horizontal floor provided with an opening intermediate opposite ends, fluid cooling tubes for the walls and the floor of the furnace, means for supporting the vapor generating section and the furnace walls to permit downward expansion of the furnace wall tubes, means for independently and resiliently supporting the furnace floor, the arrangement of the wall and floor tubes being such that downward expansion of the wall tubes will cause downward movement of the floor and contraction of the wall tubes will result in upward movement of the floor whereby relative movement of the walls and floor is prevented, a fixed frame surrounding the furnace walls, and abutment means associated with said fixed frame to prevent lateral outward movement of the furnace walls with respect to the floor.

12. A vapor generator comprising a vapor generating section and a furnace therefor, the furnace having walls and a substantially horizontal floor provided with an opening intermediate opposite ends, fluid cooling tubes for the walls and the floor of the furnace, means for supporting the vapor generating section and the furnace walls to permit downward expansion of the furnace wall tubes, means for independently and resiliently supporting the furnace floor, the arrangement of the wall and floor tubes being such that downward expansion of the wall tubes will cause downward movement of the floor and contraction of the wall tubes will result in upward movement of the floor whereby relative movement of the walls and floor is prevented, a casing for the generator having a stationary section and a section movable with the floor, and an expansion joint between the stationary and movable sections of the casing.

13. A vapor generator comprising a vapor generating section and a furnace therefor, the furnace having walls and a substantially horizontal floor provided with an opening intermediate opposite ends, fluid cooling tubes for the walls and the floor of the furnace, means for supporting the vapor generating section and the furnace walls to permit downward expansion of the furnace wall tubes, means for independently and resiliently supporting the furnace floor, the arrangement of the wall and floor tubes being such that downward expansion of the wall tubes will cause downward movement of the floor and contraction of the wall tubes will result in upward movement of the floor whereby relative movement of the walls and floor is prevented, a casing for the generator having a stationary section and a section movable with the floor, an expansion joint between the stationary and movable sections of the casing, and means engaging the movable section of the casing to prevent lateral outward movement of the furnace walls with respect to the floor.

14. A vapor generator comprising a vapor generating section and a furnace therefor, the furnace having walls and a substantially horizontal floor provided with an opening intermediate opposite ends, fluid cooling tubes for the walls and the floor of the furnace, means for supporting the vapor generating section and the furnace walls to permit downward expansion of the furnace wall tubes, means for independently supporting the furnace floor so as to permit vertical movement of the floor upon expansion and contraction of the furnace wall tubes and to prevent relative movement of the floor with respect to the wall tubes, a fixed frame surrounding the furnace walls adjacent the floor thereof, and abutment means associated with said fixed frame to prevent lateral outward movement of the furnace walls with respect to the floor.

15. A vapor generator having a furnace defined in part by walls and a floor, the floor having an opening intermediate opposite ends and extending from side to side thereof, fluid conducting tubes on the inner surfaces of the walls and floor, means for supporting the furnace walls to permit downward expansion of the furnace wall tubes, movable means for supporting the floor independently of the wall suspending means, a fixed support for the floor, resilient means between the fixed and movable supports for the floor, a casing for the generator having a stationary sec-

tion and a section movable with the floor, and an expansion joint between the stationary and movable sections of the casing.

16. A vapor generator having a furnace defined in part by walls and a floor, the floor having an opening intermediate opposite ends and extending from side to side thereof, fluid conducting tubes on the inner surfaces of the walls and floor, means for supporting the furnace walls to permit downward expansion of the furnace wall tubes, movable means for supporting the floor independently of the wall suspending means, a fixed support for the floor, resilient means between the fixed and movable supports for the floor, a casing for the generator having a stationary section and a section movable with the floor, an expansion joint between the stationary and movable sections of the casing, and means for preventing the outward movement of oppositely disposed walls of the furnace upon expansion and contraction of the fluid conducting tubes.

NICHOLAS C. ARTSAY.