

Oct. 25, 1966

R. P. SULLIVAN

3,280,800

VAPOR GENERATOR HAVING BOILER BANK SUPPORTED BY DOWNCOMERS

Filed July 28, 1965

3 Sheets-Sheet 1

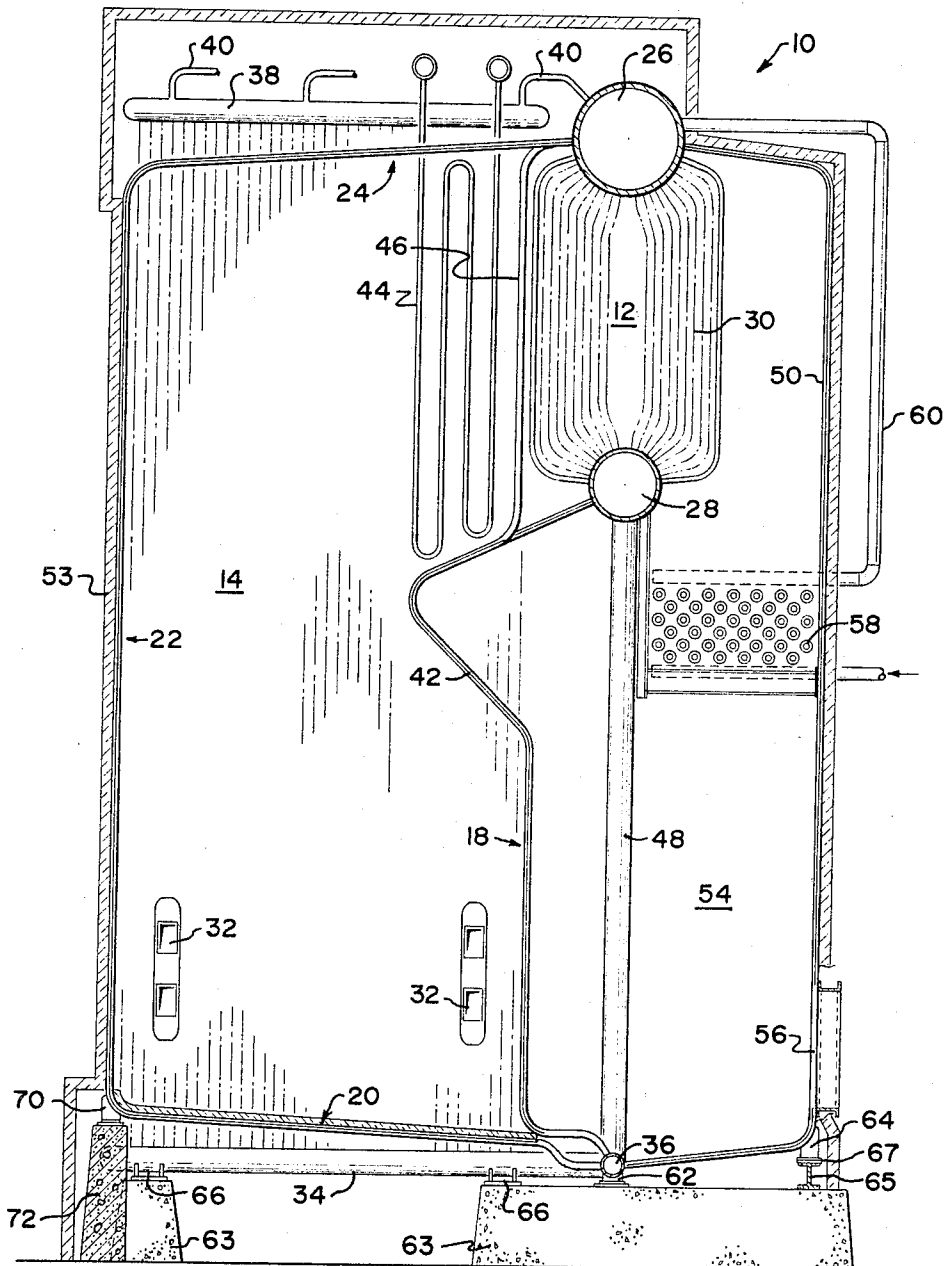


FIG. 1

INVENTOR.
ROBERT P. SULLIVAN
BY *John F. Carney*
ATTORNEY

Oct. 25, 1966

R. P. SULLIVAN

3,280,800

VAPOR GENERATOR HAVING BOILER BANK SUPPORTED BY DOWNCOMERS

Filed July 28, 1965

3 Sheets-Sheet 2

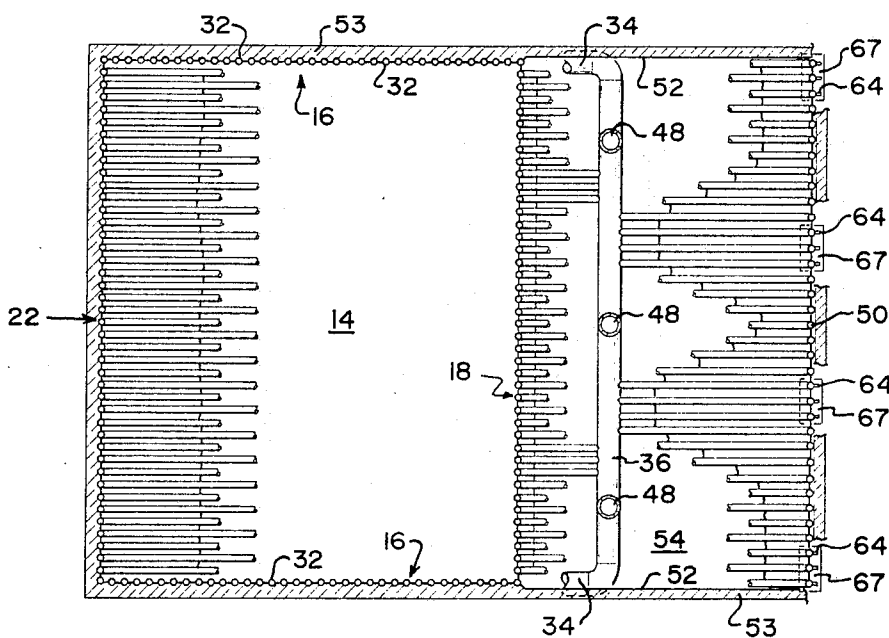


FIG. 2

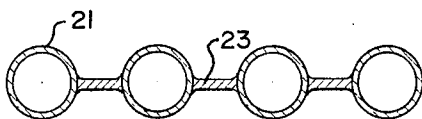


FIG. 4

INVENTOR.
ROBERT P. SULLIVAN
BY *John F. Carney*
ATTORNEY

Oct. 25, 1966

R. P. SULLIVAN

3,280,800

VAPOR GENERATOR HAVING BOILER BANK SUPPORTED BY DOWNCOMERS

Filed July 28, 1965

3 Sheets-Sheet 3

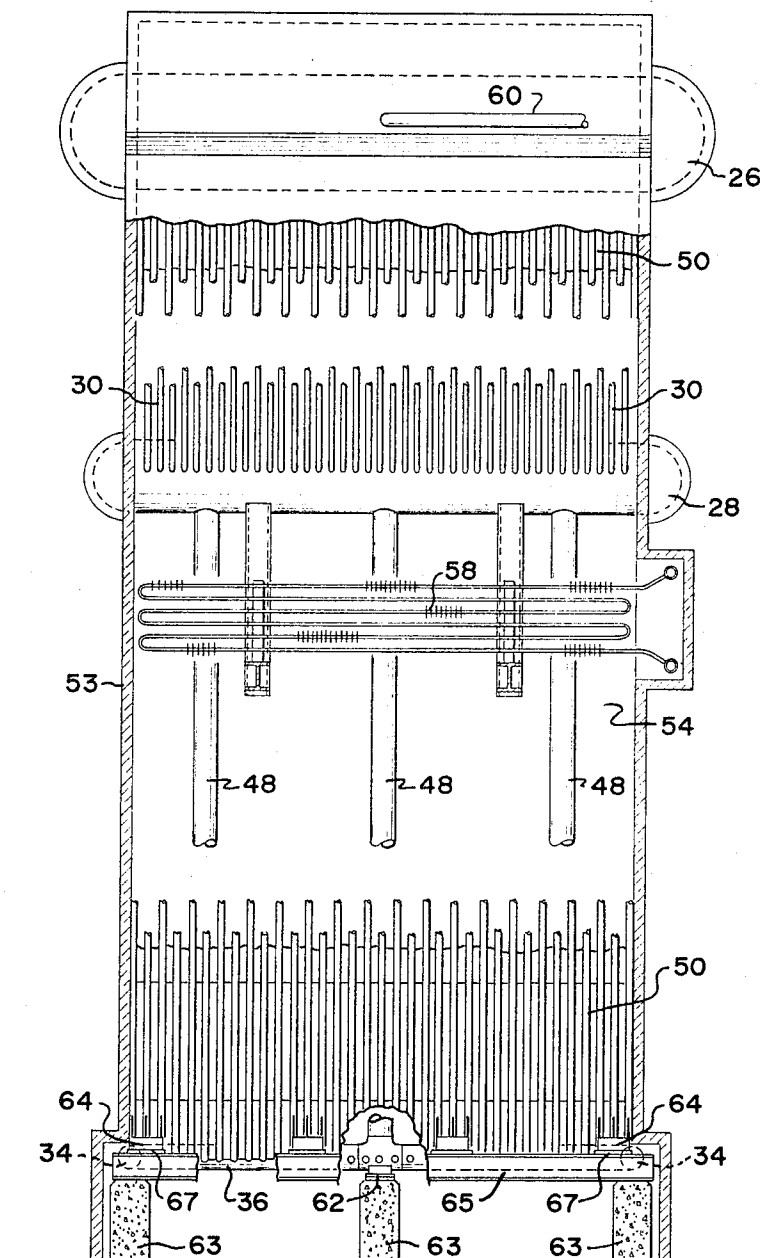


FIG. 3

INVENTOR.

ROBERT P. SULLIVAN

BY

John F. Carney
ATTORNEY

1

3,280,800

VAPOR GENERATOR HAVING BOILER BANK SUPPORTED BY DOWNCOMERS

Robert P. Sullivan, Chattanooga, Tenn., assignor to Combustion Engineering, Inc., Windsor, Conn., a corporation of Delaware

Filed July 28, 1965, Ser. No. 475,444

12 Claims. (Cl. 122—510)

The present invention relates to the construction of vapor generators. More particularly, the invention relates to the construction of a vapor generator that is completely bottom supported and wherein the weight of the boiler bank is supported by one or more fluid supply tubes of the circulation system.

Heretofore, it has been the practice, in order to eliminate the need for expensive external structural supporting steel required for top supporting a vapor generator, to bottom support the various pressure parts of the unit at approximately the same elevation with a predominant portion of the weight of the drums and tubes that form the boiler bank being supported by upright tubes that form a portion of the fluid supply system. By so supporting the boiler bank the limitations imposed by the difference in thermal expansion of the walls forming the furnace chamber and the boiler bank during normal operation of the unit is minimized. Such an arrangement is limited, however, to vapor generator units having a relatively low height-to-width ratio especially when the units are erected in an unenclosed area that is exposed to the effects of wind and other atmospheric elements that will subject the unit to horizontal loading thus tending to cause it to topple. Another undesirable feature of such a construction is the difference in thermal expansion undergone by the various pressure parts forming the furnace chamber and boiler bank-supporting fluid supply tubes during startup of the unit when the furnace chamber pressure parts are subjected to a considerably greater amount of heat than are the fluid supply tubes. This unbalance in heating of the component elements creates differential expansion between certain elements and with it the tendency to overstress the members that form the connections between the boiler bank and the furnace.

In accordance with the present invention, the various vapor generator pressure parts are bottom supported at approximately the same elevation, with a predominant portion of the weight of the boiler bank drums and tubes being carried by a support arrangement which includes upright tubular columns connecting to and extending downwardly from the lower drum and supplying fluid from the drum to the furnace wall tubes. This support arrangement also includes a welded rear pass wall spaced from the furnace rear wall and being bottom supported at its base at a point spaced rearwardly from the supports of the tubular columns to thereby form a three-point support for the boiler bank that reduces the height-to-width ratio of the unit and thereby enables it to better withstand horizontal forces imposed by high velocity winds or the like when the unit is not enclosed within a protective building structure. The welded rear pass wall also serves, in conjunction with the furnace rear wall and extensions of the furnace side walls, to form a rear gas pass enclosing these tubular columns such that they are caused to be heated to a temperature comparable to that of the remaining vapor generator pressure parts thus reducing differential thermal expansion between these pressure parts.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming part of the specification. For a better understanding of the invention, its operating ad-

2

vantages and specific objects reference should be had to the accompanying drawings and descriptive matter in which a preferred embodiment of the invention is illustrated and described.

FIGURE 1 is a diagrammatic sectional elevation of a vapor generating unit embodying the invention;

FIGURE 2 is a horizontal cross section taken along line 2—2 of FIGURE 1;

FIGURE 3 is a fragmentary rear elevation of the invention shown in FIGURE 1; and

FIGURE 4 is a typical section taken through a wall of the unit shown in FIGURE 1.

Referring now to the drawings there is shown in FIGURE 1 a vapor generator 10 comprising a boiler bank 12 deriving heat from a fuel fired, water cooled furnace 14. The vapor generator setting is of substantially rectangular cross section and comprises the vertically extending furnace chamber 14 defined by fluid cooled tubular walls including spaced side wall 16, furnace rear wall 18 and panels of parallel, continuous, substantially C-shaped tubes forming the furnace floor 20, front wall 22 and roof 24. In the preferred form of the invention these walls are constructed of a plurality of parallel tubes 21 that are welded together in side-by-side relation with the spaces between the tubes being filled with weld material 23, as shown in FIGURE 4, that serves, together with the tubes, to form the pressure containment structure of the unit. An insulation material 53 which may take the form of Magnesite or the like covers the exterior walls. The rear portion of the setting includes boiler bank 12 laterally adjoining and communicating with the upper portion of the furnace chamber 14 and defined by upper drum 26, lower drum 28 and interconnecting boiler bank tubes 30. The drums 26 and 28 are horizontally disposed across the width of the setting with their axes in substantial vertical alignment. The furnace walls, 16, 18 and 20, are provided with appropriate openings here shown as openings 32 located in the corners of the walls to accommodate fluid fuel burners capable of burning pulverized coal, oil or gas. Air for combustion is delivered in a suitable known manner by means of duct work (not shown) surrounding the burners. The furnace 14 may also be adapted for stoker firing by merely removing the tubes forming the floor 22 and installing a travelling grate or other suitable grate means.

The vapor generator pressure parts also include upper and lower header arrangements for connecting the furnace tubes in fluid circulation. This header arrangement includes at the bottom, lower side wall headers 34 and lower rear wall header 36 that are rectangularly disposed with their longitudinal axes lying in a horizontal plane and forming a substantially U-shaped member opening to the front of the unit. The arrangement at the top of the unit comprises spaced, horizontal, upper side wall headers 38 that are provided with vapor relief tubes 40 connecting the headers to the upper drum 26. Vertical tubes forming the furnace side walls 16 extend between, and connect, the lower and upper side wall headers 34 and 38. The C-shaped tubes forming the furnace front wall 20, floor 22 and roof 24 connect at their lower ends to the rear wall header 36 and at their upper ends to the upper drum 26. The furnace rear wall 18 is formed by parallel tubes connected at their lower ends to the rear wall header 36 and at their upper ends to the upper drum 26. These tubes are provided with a lateral offset defining a nose baffle 42 over the lower portion of the furnace chamber 14 that serves to protect a superheater 44 interposed in a gas flow path between the furnace 14 and the boiler bank 12 from the radiant effects of the furnace flame. These tubes are arranged in close, welded relation at their lower ends but are disposed in spaced rela-

tion above the nose 42 to form a screen 46 ahead of the boiler bank 12.

Fluid supply to the tubes forming the unit enclosure is provided by vertically upright tubular columns 48 connected between the lower drum 28 and rear wall header 36. The rear end of the unit is closed by a tubular welded wall 50 similar in construction to the furnace walls 16, 18 and 20. The tubes that form the unit rear wall 50 extend between the lower portion of the upper drum 26 and the rear wall header 36. As shown the wall 50 is rearwardly spaced from the furnace rear wall 18 and, together with extensions 52 of insulation casing 53 covering the side walls 16, form a vertically extending rear gas pass 54 between the boiler bank 12 and the bottom of the unit. Openings 56 are provided at the lower end of the rear pass wall 50 to permit exit of the combustion gases. Within the rear gas pass 54 is mounted in known fashion a liquid preheater 58 having a tubular connection 60 with the upper drum 26.

The pressure parts of the boiler bank 12 and its associated furnace 15 are arranged for bottom support at substantially the same elevation to minimize differential thermal expansion between the various pressure parts and thereby eliminate the need for external structural steel for top supporting the pressure parts. The predominant portion of the weight of the boiler bank 12 comprising drums 26 and 28 and tubes 30 is taken by a support arrangement comprising the upright supply tubes 48 which are disposed at spaced positions along the length of the drum 28. A minor portion of the vertical loading of the boiler bank is taken by the rear pass wall 50. By means of this arrangement the tubes 48 function as supply tubes in the fluid circulation system and also as part of the boiler bank support structure. For the purpose of supporting the boiler bank the tubes are provided in sufficient number and are of sufficient diameter and thickness to possess sufficient column strength for carrying the weight of the boiler bank 12. Bottom support of the unit is provided by a plurality of support members mounted atop pedestals 63 and adapted to engage various pressure parts at the base of the unit. These support members include mountings 62 that fixedly engage the rear wall header 36 and mountings 66 that slidably engage the lower side wall headers 34 as shown in the FIGURES 1 and 3. Support for the rear pass wall 50 is provided by a plurality of vertical supports which include gussets 64 that are welded to the tubes forming the wall 50 and that are slidably mounted atop a structural steel member 65 by means of a bearing plate 67 that attaches the gussets.

While the wall 50 is adapted to accommodate a fraction of the vertical loading of the boiler bank an important function is to stay the structure against horizontal forces acting against the walls of the unit that would tend to topple it. Such a support is desirable when the unit is to be erected in an area that is exposed to atmospheric conditions. The rear pass wall 50 also serves to form the rear gas pass 54, the lateral ends of the pass being closed by extensions 52 of the side wall insulation. The gas pass 54 houses the liquid preheater and also surrounds the upright fluid supply tubes 48 such that the latter will be subjected to the heat of the combustion gases flowing through the pass. This is of primary importance during startup of the unit when it is highly desirable to have the tubes 48 heated by an amount comparable to the degree of heating undergone by the tubes in the furnace chamber 14 in order that no undue differential thermal expansion will be undergone between these tubes that would tend to cause excessive amounts of stress within the pressure parts that form the connections between these two sections of the unit.

The operation of the vapor generator is as follows. Air and fuel are fed to the furnace in controlled quantities, and combustion of the fuel generates heating gases that flow upwardly through the furnace chamber, then horizontally through the superheater 44, the boiler bank

12, then vertically downward through the rear gas pass 54 and out of the unit through the rear wall opening 56. At the same time vaporizable liquid is admitted to the pressure parts forming the fluid circulating system of the unit where heat from the combustion gases transforms a portion of the liquid into steam that is delivered to the upper drum 26 from whence it is removed for use in any steam operated application. Liquid separated from the steam in upper drum 26 is caused to flow downwardly through the tubes forming the rearwardmost rows of the boiler bank to the lower drum 28 and thence through the upright fluid supply tubes 48 to the header 36 which supplies liquid to the side wall headers 34. Liquid is also supplied to the rear wall header through the tubes forming the rear pass wall 50 which supplements that supply through the tubes 48.

It will be understood that various changes in the details, materials, and arrangements of parts which have been herein described and illustrated in order to explain the nature of the invention, may be made by those skilled in the art within the principle and scope of the invention as expressed in the appended claims.

What is claimed is:

1. A bottom supported vapor generator unit including rectangularly disposed tubular walls forming a setting; a boiler bank including horizontally disposed upper and lower drums and a bank of upwardly extending tubes connecting said drums; said setting including opposed front, rear and side walls forming a furnace chamber laterally adjacent and opening to said tube bank; support means for said boiler bank comprising horizontally extending header means disposed below said lower drum, a plurality of laterally spaced upright tubes disposed along the length of said lower drum and connected at their ends to said lower drum and said header means, means for bottom supporting said header means; a tubular wall closing the rear of said unit comprising generally vertically extending tubes connected at their ends to one of said drums and to said header means; and means spaced rearwardly of said header means for vertically supporting said unit rear closure wall.

2. A bottom supported vapor generator unit including rectangularly disposed tubular walls forming a setting; a boiler bank including horizontally disposed upper and lower drums and a bank of upwardly extending tubes connecting said drums; said setting including opposed front, rear and side walls forming a furnace chamber laterally adjacent and opening to said tube bank; support means for said boiler bank comprising horizontally extending header means disposed below said lower drum, a plurality of laterally spaced upright tubes disposed along the length of said lower drum and connected at their ends to said lower drum and said header means, means for bottom supporting said header means; means forming a gas envelope about said upright tubes including a tubular wall closing the rear of said unit comprising generally vertically extending tubes connected at their ends to one of said drums and to said header means; and means spaced rearwardly of said header means for vertically supporting said unit rear closure wall.

3. A bottom supported vapor generator unit including rectangularly disposed tubular walls forming a setting; a boiler bank including horizontally disposed upper and lower drums and a bank of upwardly extending tubes connecting said drums; said setting including opposed front, rear and side walls forming a furnace chamber laterally adjacent and opening to said tube bank; support means for said boiler bank comprising horizontally extending header means disposed below said lower drum, a plurality of laterally spaced upright tubes disposed along the length of said lower drum and connected at their ends to said lower drum and said header means, means for bottom supporting said header means; means forming a gas envelope about said upright tubes including a tubular wall closing the rear of said unit comprising generally

7. A bottom supported vapor generator unit including rectangularly disposed tubular walls forming a setting; a boiler bank including horizontally disposed, vertically aligned upper and lower drums and a bank of upwardly extending tubes connecting said drums; said setting including opposed front, rear and side walls forming a furnace chamber laterally adjacent and opening to said tube bank; support means for said boiler bank comprising

11. A bottom supported vapor generator unit including regularly disposed tubular walls forming a setting; a boiler bank including horizontally disposed, vertically

aligned upper and lower drums and a bank of upwardly extending tubes connecting said drums; said setting including opposed front, rear and side walls forming a furnace chamber laterally adjacent and opening to said tube bank; support means for said boiler bank comprising horizontally extending head means disposed below and in vertical alignment with said lower drum, a plurality of laterally spaced upright tubes disposed along the length of said lower drum and connected at their ends to said lower drum and said header means, means for bottom supporting said header means; a tubular wall comprising generally vertically extending tubes connected at their ends to said upper drum and to said header means; gas impervious casing means coplanar with said furnace side walls extending from said furnace rear wall to the unit rear closure wall and therewith forming a gas envelope about said upright tubes; and means spaced rearwardly of said header means for vertically supporting said unit rear closure wall.

12. A bottom supported vapor generator unit including rectangularly disposed tubular walls forming a setting; a boiler bank including horizontally disposed, vertically aligned upper and lower drums and a bank of upwardly extending tubes connecting said drums; said setting in-

cluding opposed front, rear and side walls forming a furnace chamber laterally adjacent and opening to said tube bank; support means for said boiler bank comprising horizontally extending header means disposed below and in vertical alignment with said lower drum, a plurality of laterally spaced upright tubes disposed along the length of said lower drum and connected at their ends to said lower drum and said header means, means for bottom supporting said header means; a tubular wall comprising generally vertically extending tubes connected at their ends to said upper drum and to said header means; gas impervious casing means coplanar with said furnace side walls extending from said furnace rear wall to the unit rear closure wall and therewith forming a gas envelope about said upright tubes; means spaced rearwardly of said header means for vertically supporting said unit rear closure wall; and tubular economizer means positioned within said gas envelope.

References Cited by the Examiner

UNITED STATES PATENTS

2,979,041 4/1961 Young ----- 122—510

KENNETH W. SPRAGUE, *Primary Examiner*.