Dec. 6, 1966 R. H. EVANS 3,289,645

VAPOUR GENERATOR NOSE ARCH SUPPORTS

Filed Aug. 10, 1964 5 Sheets-Sheet 1

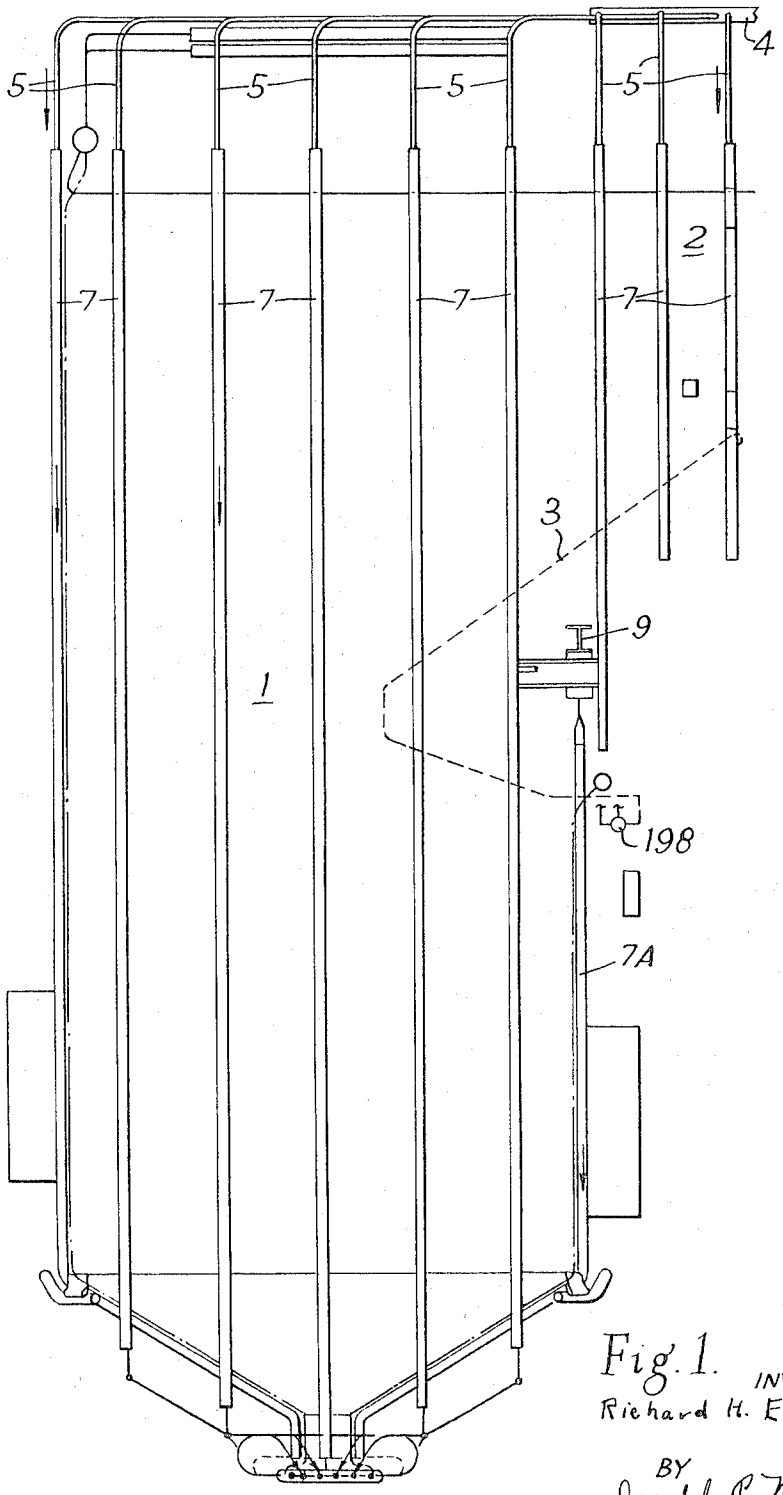


Fig. 1.

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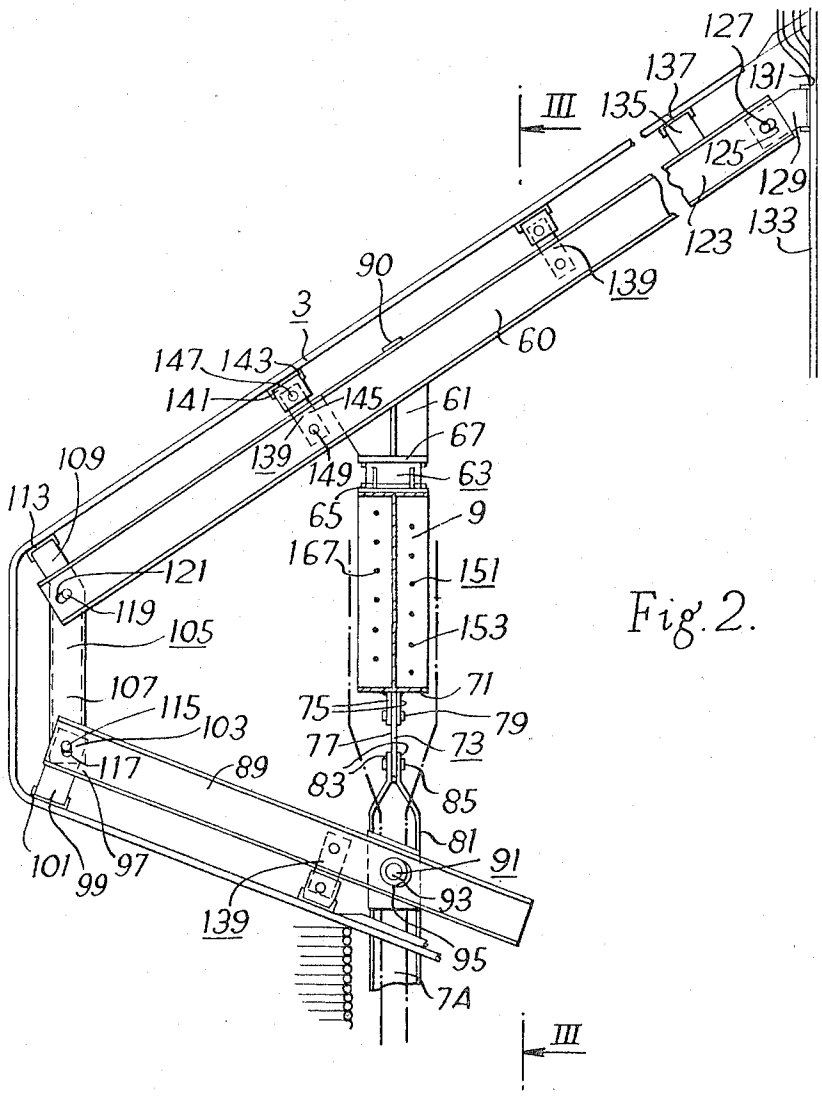


Fig. 2.

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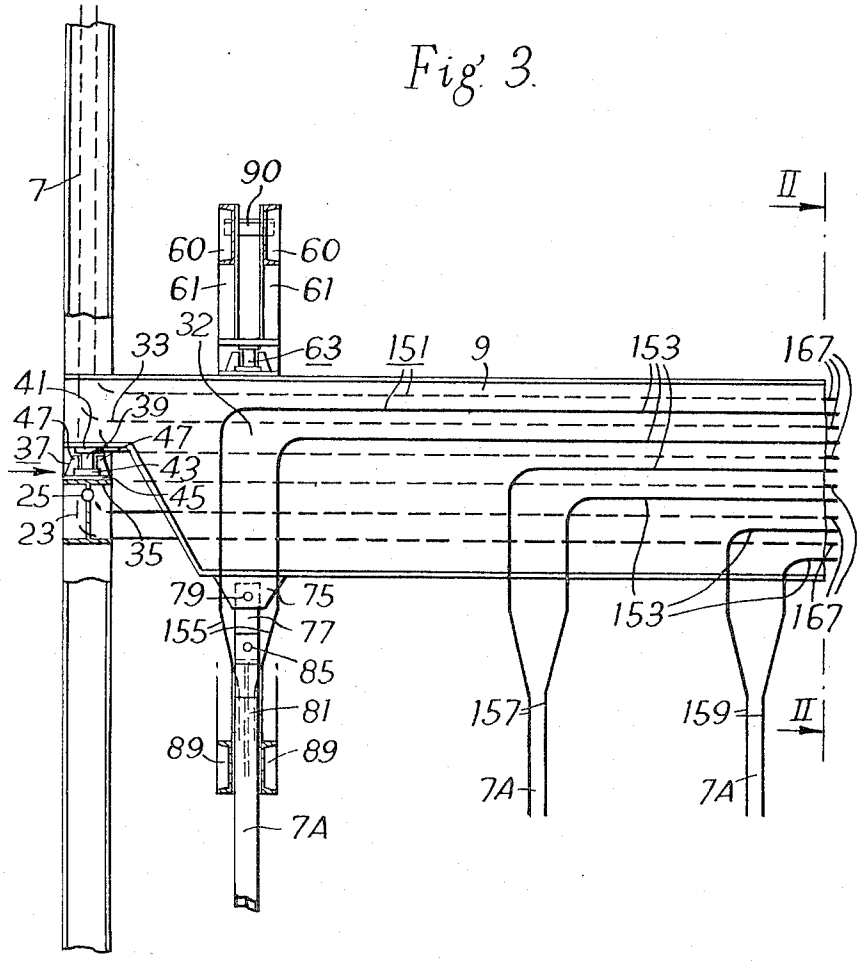
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VAPOUR GENERATOR NOSE ARCH SUPPORTS

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Fig. 3.



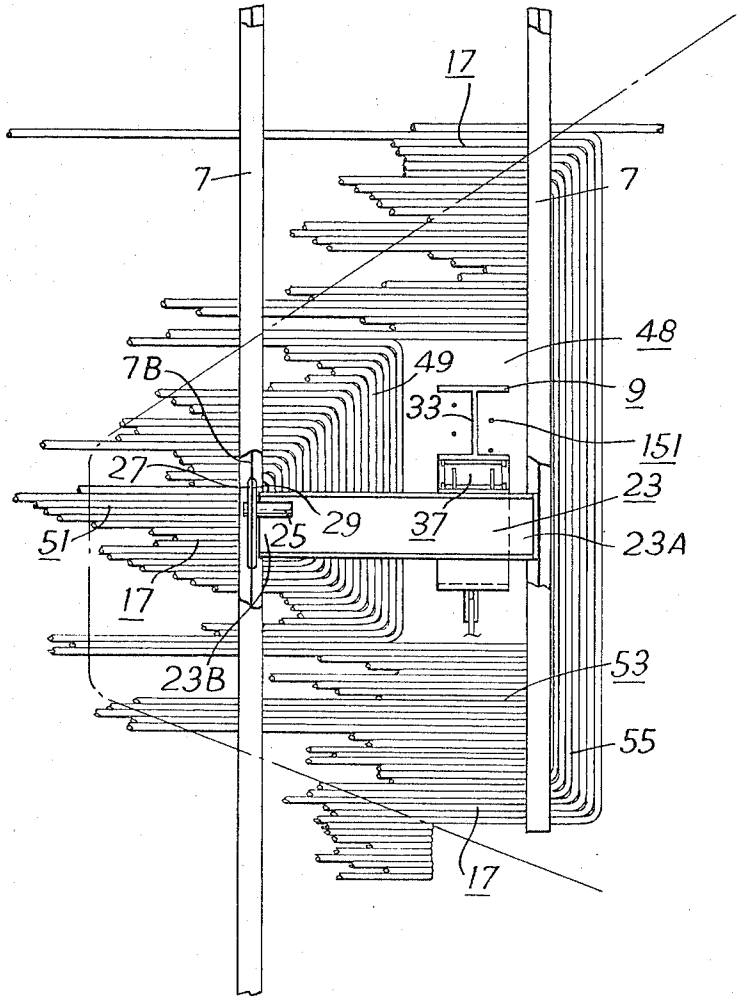
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Fig. 4.



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Fig. 5.

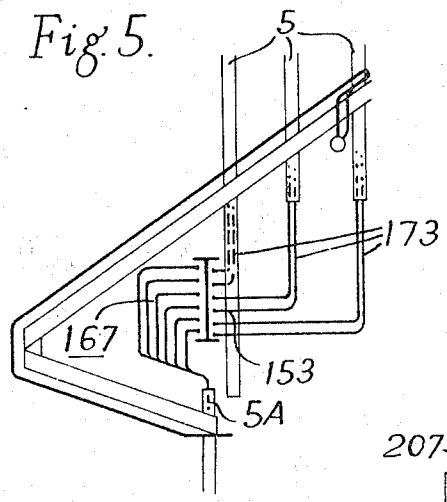


Fig. 6.

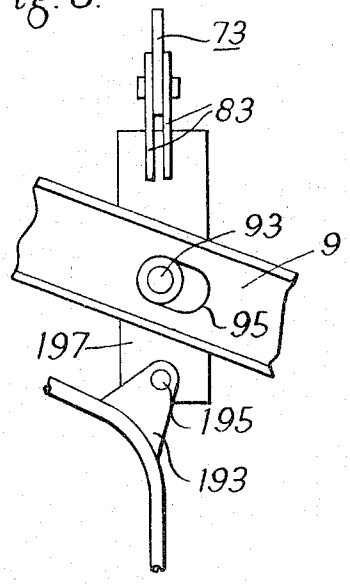
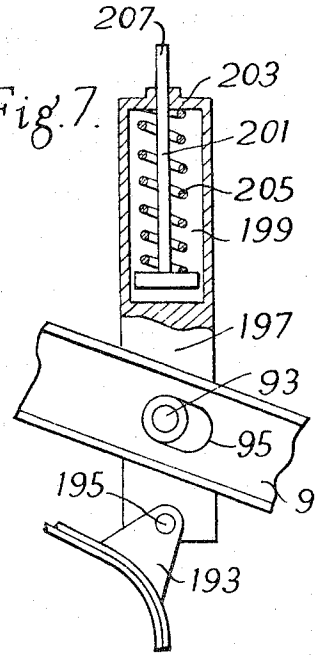


Fig. 7.



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United States Patent Office

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3,289,645

VAPOUR GENERATOR NOSE ARCH SUPPORTS

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Claims priority, application Great Britain, Aug. 9, 1963, 31,515/63
7 Claims. (Cl. 122—510)

This invention relates to tubulous vapour generators and is particularly concerned with a form of forced flow generator having an upright furnace chamber lined by tube lengths supported by vertical suspension means arranged during operation of the vapour generator to be heated so that differential thermal expansion between the tube lengths and the suspension means is largely avoided. When such a vapour generator is formed with a furnace chamber having at an upper region thereof, an inwardly extending arch above which is an entry to a lateral gas pass, the presence of the arch has led to complications. Thus, for example, a vertical suspension means taken through the lateral gas pass must be provided with seals where it passes through the roof and floor of the gas pass.

It is an object of the invention to provide means whereby the need for such seals may be avoided.

In a forced flow tubulous vapour generator having an upright furnace chamber lined by tube lengths supported by vertical suspension means arranged during operation of the vapour generator to be heated so that differential thermal expansion between the tube lengths and the suspension means is largely avoided, according to the present invention the furnace chamber is formed at an upper region thereof with an inwardly extending hollow arch above which is an entry to a lateral gas pass and the furnace chamber wall below the arch is suspended from a beam disposed within the arch and arranged during operation of the vapour generator to be heated so that differential thermal expansion between the beam and the said wall is largely avoided.

By way of example, embodiments of the invention will now be described with reference to the accompanying drawings, in which:

FIGURE 1 is a sectional side view of a vapour generator;

FIGURE 2 is a side view partially in section of a nose arch arrangement in the generator for a furnace having horizontal wall tubes;

FIGURE 3 is a section taken along the line III—III in FIGURE 2 and showing one end of the arrangement: The line II—II in FIGURE 3 indicates the viewpoint of FIGURE 2;

FIGURE 4 is an end view of the arrangement of FIGURE 2 seen from the left of FIGURE 3;

FIGURE 5 illustrates diagrammatically flow paths of heating fluid for the arrangement;

FIGURE 6 shows a detail of a modification of the arrangement of FIGURES 1–5 incorporated in a furnace chamber having vertically extending wall tubes; and

FIGURE 7 shows a detail of a modification of the arrangement of FIGURE 6, in which the vertically extending wall tubes are interconnected to form a membrane wall.

Referring first to FIGURE 1, a vapour generator includes an upright furnace chamber 1 lined with horizontal wall tubes (not shown), a lateral gas pass 2 and an inwardly extending hollow nose arch 3 formed in the chamber 1 below the entry to the pass 2.

A header 4 located at the upper end of the pass 2 is fed with fluid from an economiser (not shown) which may be disposed between superheater and reheater tube banks

and the lateral gas pass or/and in a downpass following the lateral gas pass.

The header 4 serves sets of downcomers 5 extending downwardly from the header 4. The downcomers 5 of one set are disposed in heat exchange relationship with respective vertical upright rolled steel support members or support means 7 of I-shaped cross-section extending over the length of the furnace and supporting the furnace side walls. The downcomers 5 of the other set are disposed in heat exchange relationship with other of the vertical members 7 extending downwardly from the top of the gas pass to positions between the upper and lower limbs of the nose arch 3, and supporting the side walls of the gas pass.

A beam 9 to be hereinafter described in more detail is located within the nose arch 3 and is heated by tubes which extend downwardly from the beam in heat exchange relationship with vertical suspension members 7A which are of similar construction to the members 7 and provide a support for the rear wall of the furnace chamber 1.

Referring now also to FIGURES 2 to 4, each side wall of the furnace in the vicinity of the arch 3 is lined by a multiplicity of nested tubes the horizontal lengths 17 of which are united by return bends constituted by upright tube portions.

A transom 23 is located at each end of the arch 3 between the upper and lower extents thereof. The transom is of I-shaped cross-section and extends between two of the members 7. One end 23A of transom 23 is secured to the adjacent member 7 whilst the other end 23B of the transom is secured to an end portion of a trunnion-like device 25 which at its other end portion extends in sliding engagement through apertures formed in the web 7B of the adjacent member 7 and two plates 27 and 29 secured to either side of the web. The device thereby permits relative movement of the transom 23 laterally of the member 7.

Supported on the transoms 23 and extending through the arch 3 is the beam 9 of I-shaped cross-section. The beam 9 is disposed on the transoms 23 with its centre point nearer to the transom adjacent a first end (not shown) of the beam than to the transom adjacent the second end 32 of the beam. The beam 9 has at each end a portion 33 where the depth of the beam measured from its upper flange is reduced.

These portions 33 of the beam 9 are carried on upper flanges 35 of the transoms 23 by means of rocker devices 37 located between the upper flange 35 of each transom 23 and the lower face of each beam portion 33. These devices permit a relative movement of the beam 9 laterally of the wall tubes 17.

Each rocker device 37 comprises a short upright bar 39 having arcuate ends rotatable in complementary sockets respectively formed in a plate 41 secured to the beam portion 33 and a plate 43 mounted on a further plate 45 secured to the transom flange 35. Guide plates 47 are provided on either side of the bar 39 to limit its maximum movement in the direction of the longitudinal axis of the beam 9 and prevent rocking in a direction normal to that axis.

In order to provide a cavity 48 to house the beam 9, upright portions 49 of an inner group 51 of the nested tubes are disposed adjacent the beam 9 at the inner side thereof, whilst the tubes of an outer group 53 pass above and below the beam and have upright portions 55 extending in several layers as a narrow band adjacent to the outer side of beam 9.

The arch 3 and the floor of the lateral gas pass are lined with tubes extending around the arch and longitudinally of the gas pass. These tubes are connected to

girders **60** which are supported by two pairs of adjacent laterally spaced floor members **61** extending transversely of the beam and supported thereon by means of rocker device **63** which permits a degree of relative movement between the beam and the floor member longitudinally of the beam.

The rocker devices **63** are of the same nature as the devices **37** hereinbefore described and include plates **65, 67** carried on the upper flange of the beam **9** and on the lower flange of the floor members **61**.

Vertical suspension members **7A** for the rear wall similar to the members **7** already described of the furnace are hung from the lower flange **71** of the beam **9** by pivotal means **73** permitting swinging of the suspension members **7A** in the direction of the longitudinal axis of the beam **9**. Each pivotal means **73** includes vertical adjacent plates **75** welded to and extending perpendicularly of the lower beam flange **71**, and a link **77** pivotally coupled at its upper end to these plates by a pin **79** to swing in a vertical plane, and coupled at its lower end to an upper portion **81** of the member **7A**. The upper portion **81** provides spaced end parts **83** to which the link **73** is pivotally coupled at its lower end by a pivot **85**.

The tubes of the arch **3** are supported by two pairs of adjacent laterally spaced arch support members **60, 89** extending transversely of the beam **9**. The members **60** above the arch are secured together at their upper flanges by a cross-link **90** and at their lower flanges are mounted on respective members **61**.

The support members **89** below the arch are supported at their outer ends by the rear wall suspension means **7A** through a linking device **91** permitting between the member **7A** and the arch tubes a degree of relative movement longitudinally of the member **89**. The linking device **91** comprises a pin **93** extending perpendicularly of the member **7A** and housed in a slot **95** formed in and extending longitudinally of the arch support member **89**.

The inner ends **97** of the members **89** lie adjacent the upper end of blocks **99** secured at lower ends to a cross channel **101** secured to the lower tubes of the nose arch. Also adjacent the ends **97** is the lower end **103** of a bar **105** having a lower portion **107** extending vertically and an upper portion **109** extending perpendicularly to the upper tubes of the nose arch **3** and secured at its uppermost part to a cross channel **113** welded to the tubes.

The ends **97** of the members **89**, the block **99** and the bar **105** are coupled together by a pin **115** carried on the end **103** and housed in vertically extending slots **117** formed in the ends **97** and the block **99** so as to permit a vertical movement of the bar **105** relative to the member **89** and block **99**.

That part of the bar **105** between the portions **107** and **109** carries a pin **119** housed in a slot **121** formed in and extending longitudinally of each arch support member **60** so as to permit longitudinal movement of the members **60** relative to the bar **105**.

At its uppermost end **123**, ecah member **60** carries a slot **125** extending longitudinally of the member **60** and housing a pin **127** carried by a block **129** secured to a cross channel **131** mounted on upright tubes **133**. The end **123** is rigidly secured to the upper ends of the upper arch tubes by a block **135** secured at its lower end to the member **60** and at its upper end to a cross channel **137** carried on the upper arch tubes.

The central portions of the upper and lower arch tubes are secured to adjacent portions of the members **60, 89** by pivotal devices **139** each of which comprises a block **141** mounted in a cross channel **143** secured to the nose arch tubes and a link **145** coupled to the block by a pivot **147** and to the arch support member by a pivot **149**.

It will be appreciated that the coupling between the upper nose arch tubes and the member **60** provided by the linkages at the end and central portions of the member permits longitudinal movement of the member relative to the bar **135** and the upper nose arch tubes. Similarly the coupling between the lower nose arch tubes and the member **89** permits longitudinal movement of the member **89** relative to the bar **99** and the lower nose arch tubes. Finally, the linkages at the uppermost ends of the member **89** allow a vertical movement of the bar **105** relative to the members **89** and the lower nose arch tubes. Thus in operation of the furnace chamber, differential expansion between the nose arch tubes and the nose arch support members can be accommodated by the linkages above described.

The beam **9** is heated by a plurality of tube lengths **151** located adjacent the web of the beam and arranged to convey fluid from the economiser to the furnace wall tubes.

The tube lengths **153** at one side of the beam **9** extend downwardly from the economiser to said first end of the beam **9**, along the major part of the beam length, and downwards in pairs of tube lengths **155, 157** and **159**, each pair providing heating means for both sides of the appropriate rear wall suspension means **7A**. After traversing these suspension means, the tube lengths are led to headers at the bottom of the furnace chamber from which the fluid flows through the wall tubes.

The tube lengths **167** at the other side of the beam **9** extend downwardly from the economiser to the second end **32** of the beam **9**, along the major part of the beam length, and downwards in pairs of tube lengths (not shown), each pair providing heating means for both sides of adjacent rear wall suspension means (not shown). After traversing these suspension means, the tube lengths are led to headers at the bottom of the furnace chamber from which the fluid flows through the wall tubes.

All the groups of tube lengths located on either side of the beam and associated with the heating of the beam are fed with fluid from tubes taken around the upright portions of wall tubes at the outer side of the beam.

Referring to FIGURE 5, the tube lengths **153** on one side of the beam **9** are fed by tubes **173** from downcomers located at said first end of the beam and discharge through tubes **155, 157** and **159** at said second end of the beam. The tube lengths **167** on the other side of the beam are fed by further downcomers **5** located at said second end of the beam and discharge into pairs of tube lengths **5A**.

In the present invention the upright support members for the vapour generator walls are heated by downcomers located adjacent the members. The general arrangement of the wall tubes and the vertical suspension members may, for example, be of the form disclosed in U.S. Patent No. 3,173,405. Alternatively, the vapour generator may have upright walls lined with horizontally extending wall tubes in which vertically adjacent tube lengths are united to form a gas tight wall, the wall is supported by upright support means formed along their lengths with separate compartments and the wall tubes and the compartments provide flow paths in which the compartments connect tube lengths located at different levels, the tube lengths being connected between compartments of pairs of support means and being sufficiently short to limit to safe values thermal stresses due to temperature differences between adjacent tube lengths. Suitably, the support means are in the form of upright headers longitudinally sectionalised to provide in each header separate compartments and groups of vertically adjacent tube lengths are connected to pairs of headers at compartments which serve to connect groups of tube lengths at different levels.

The invention is also applicable to furnace chambers lined with vertically extending wall tubes. Two such applications are shown in FIGURES 6 and 7 in which members or parts of members adapted to perform identical or similar functions to corresponding members or parts of members in the arrangement of FIGURES 2–5 are given the same reference numerals as those corresponding members or parts.

Thus, the operation and structural details of all but the lower parts of the nose arch arrangements shown in FIGURES 6 and 7 are as is hereinbefore described with reference to FIGURES 2–5. However referring firstly to FIGURE 6, in the lower part of the arrangement shown there, the lowermost portions of the lower nose arch tubes extend vertically downwards to form the rear wall of the furnace and are provided with a plate **193** coupled by a pivot **195** to the lower end of a block **197** carrying in its central portion the pin **93** and at its upper end the plates **83** and **85** of the pivotal coupling **73**. Thus the tapered portions **81** in FIGURES 1–5 are replaced by the block **197**, the member **7A** is dispensed with and the lower tubes of the nose arch are bent to form the vertical wall below the pin **93** instead of extending past the pin in a direction parallel to the member **89** to the header **198** in FIGURE 1.

FIGURE 7 shows a modification of the arrangement of FIGURE 6 applicable to membrane walls having vertical tube lengths. In the arrangement of FIGURE 7, the upper part of the block **197** shown in FIGURE 6 is extended and formed with a chamber **199** housing a piston **201** downwardly biased from an inwardly extending upper flange **203** of the chamber by a compression spring **205**. The upper portion **207** of the piston stem is designed to provide the vertical link **77** for the pivotal coupling **73** to the lower flange of the beam **31**.

In the vapour generators described above the necessity of taking the suspension means for the rear wall through the lateral pass is avoided by the use of the beam in the hollow arch. Since the beam is heated, differential thermal expansion between the beam and the rear wall is largely avoided and such differential expansion as may occur is accommodated by the rockers supporting the beam. Small movements due to differential thermal expansion between the beam and the floor members is also accommodated by the rockers on which those members rest. Differential thermal expansion between the wall tube lengths and the suspension means is also largely avoided thanks to the heating of the suspension means.

Whilst the suspension means have been described as rolled steel sections heated by tubes connecting the economiser to the wall tubes, the suspension means may be of other suitable form and heated in any suitable manner.

What is claimed is:

1. A vapor generator comprising:

tubulous wall structure defining an upright furnace chamber,

said wall structure having a side thereof extending inwardly of said furnace chamber at an upper region thereof to define a hollow arch which is impervious to gas flow,

a lateral gas passageway above said arch and communicating with said furnace chamber,

a beam disposed outside said furnace chamber and within said hollow arch, said beam spanning said side of said wall structure and supporting a portion thereof below the arch,

and means including lengths of fluid-conducting tubes extending within said hollow arch along the length of said beam in heat transfer relationship therewith for heating said beam during operation of the vapor generator to minimize differential thermal expansion between said wall structure and said beam.

2. A vapor generator according to claim **1** including supporting means at opposite ends of the arch for supporting said beam, and fluid-conducting tubular means for heating said supporting means to minimize differential thermal expansion between said supporting means and portions of the tubulous wall structure adjacent thereto.

3. A vapor generator according to claim **2** including a plurality of spaced upright members structurally associated with said tubulous wall structure, and wherein said supporting means includes at each end of said beam a transom extending in horizontal direction between two of said upright members, there being a connection between said transom and at least one of said upright members which permits relative lateral movement therebetween incident to thermal expansion or contraction of said tubulous wall structure.

4. A vapor generator according to claim **2** wherein the supporting means further includes a pivoting device adapted to accommodate at least some of the differential expansion between the beam and the tubulous wall structure.

5. A vapor generator according to claim **1**, and an economizer in operative association therewith, and wherein the lengths of fluid-conducting tubes for heating said beam are connected between said economizer and the tubulous wall structure.

6. A vapor generator according to claim **5** including upright tube-supporting means suspended from said beam, and wherein the tube lengths extend horizontally along the beam for a major portion of its length and downwardly as heating means for said upright tube-supporting means.

7. A vapor generator according to claim **1** including floor members which extend transversely of the beam and support tubulous wall structure portions of said arch and the lateral gas passageway, said floor members being carried by said beam, and rocker members between said beam and said floor members permitting relative movement between the beam and the floor members in the direction of the length of the beam.

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