May 13, 1958 J. J. BANKER 2,834,325

VAPOR GENERATING AND SUPERHEATING UNIT

Filed July 16, 1953 3 Sheets-Sheet 1

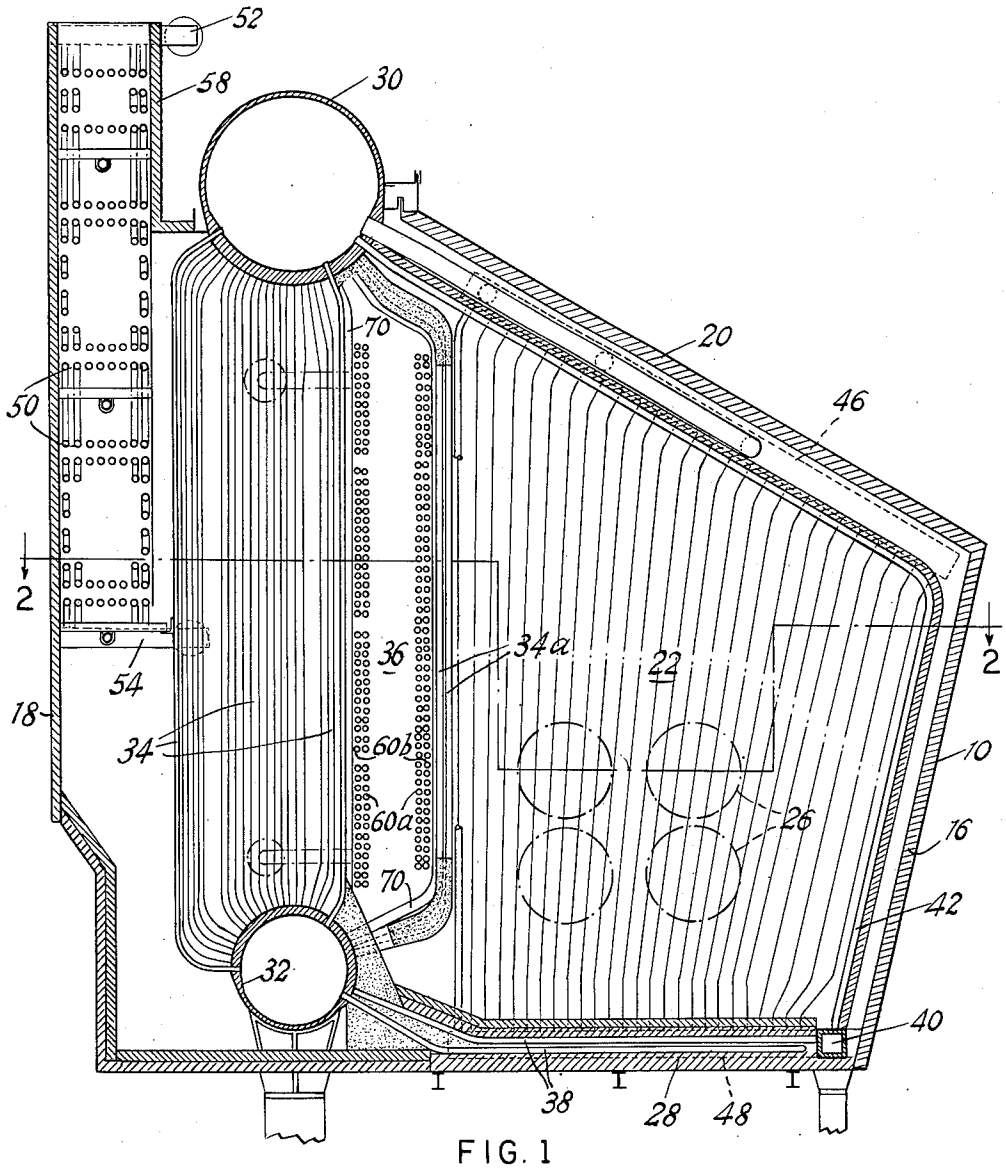


FIG. 1

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VAPOR GENERATING AND SUPERHEATING UNIT

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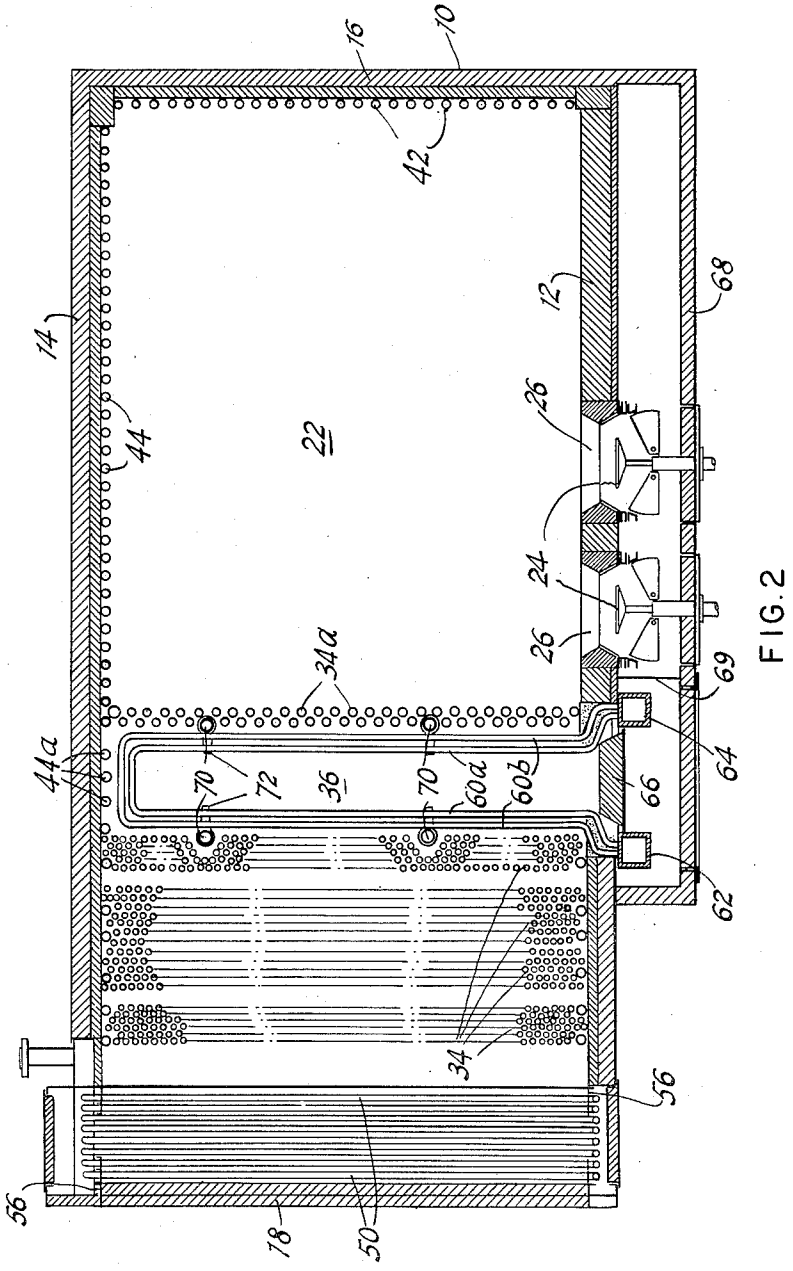


FIG. 2

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VAPOR GENERATING AND SUPERHEATING UNIT

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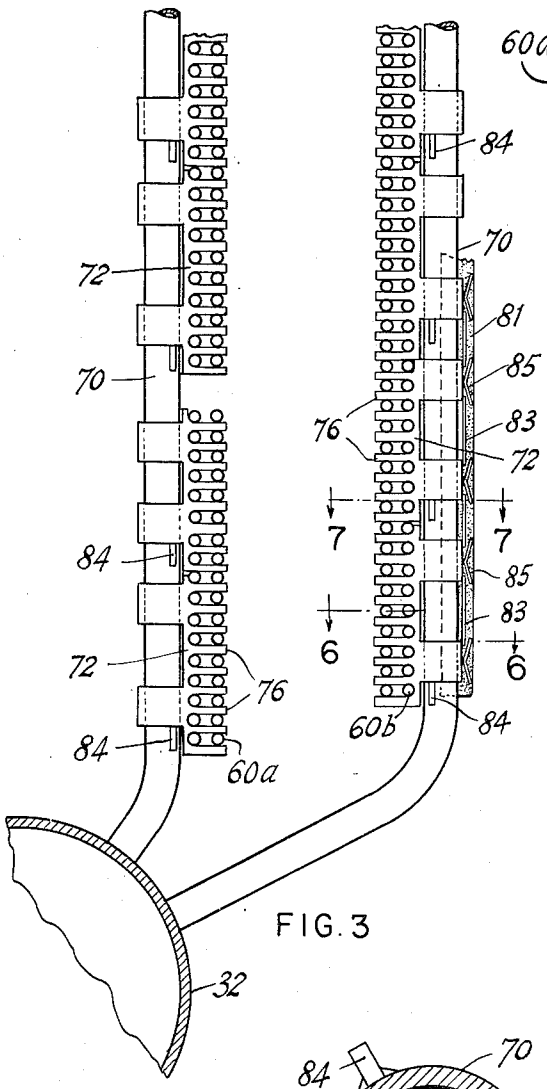


FIG. 3

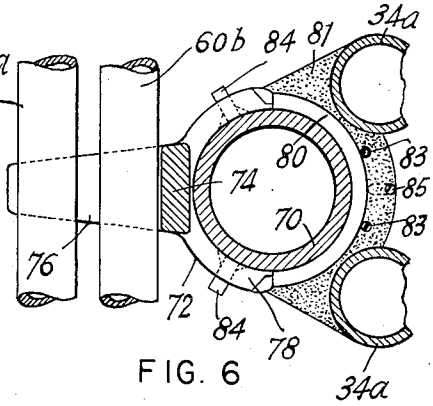


FIG. 6

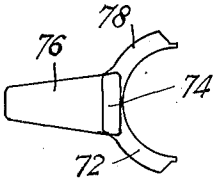


FIG. 5

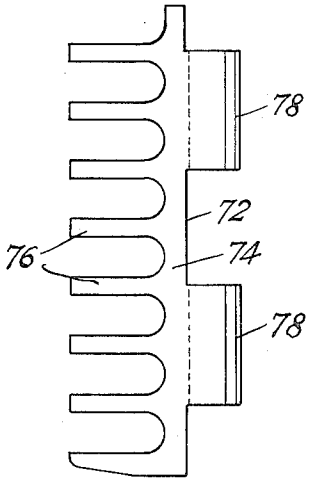


FIG. 4

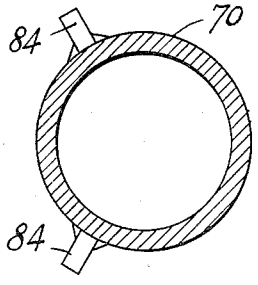


FIG. 7

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2,834,325

VAPOR GENERATING AND SUPERHEATING UNIT

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Application July 16, 1953, Serial No. 368,326

4 Claims. (Cl. 122—478)

The present invention relates to the construction and operation of vapor generating and superheating units, and more particularly, to marine type water tube steam boilers of the two-drum type in which the steam superheating tube surface is located within or alongside an upright bank of steam generating tubes connecting the vertically spaced horizontally arranged drums.

In steam boilers of the character described the steam superheating tubes are usually horizontally arranged U-shaped tubes with the tube ends connected to vertical headers and the leg and loop portions of the tubes supported from one or more large diameter tubes arranged between the tube legs through special support castings carried by those tubes. Under the designed operating conditions for steam boilers of this type, the superheater tubes and supporting elements are contacted by the high temperature heating gases immediately on leaving the furnace and when those gases contain corrosive constituents, these parts will be subjected to severe operating conditions. Accessibility to these parts for inspection and repair is ordinarily difficult in view of the congested condition of the space occupied by the superheater, and it is usually necessary in replacing a defective part to remove adjoining non-defective parts which would otherwise not require replacement at that time. The prior superheater tube arrangement and support, and location of the connected headers, usually require that in the replacement of a tube, the tube ends be cut away from the headers and the tube withdrawn through the end of the boiler in which the looped ends of the superheater tubes are located. This requires a considerable tube withdrawal space to be available at that end of the boiler. Where the superheater headers are located at the end of the boiler opposite to the tube withdrawal space, additional space is usually required for an enclosure for the headers and associated parts.

The main object of my invention is the provision of a vapor generating and superheating unit of the character described with an improved construction and arrangement of the vapor superheating tubes and associated parts, whereby the space requirements and initial cost of the unit are reduced and the superheater tubes and associated parts have greatly increased accessibility for quicker and easier inspection and repair.

A further and more specific object is the provision of a marine steam boiler of the character described in which the steam superheating tubes and associated headers are relatively arranged and supported, so that the superheater tubes are removable through either end of the boiler without removing the headers.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described a preferred embodiment of the invention.

Of the drawings:

Fig. 1 is a sectional elevation of a two-drum water tube steam boiler constructed in accordance with my invention;

Fig. 2 is a sectional plan view of the construction shown in Fig. 1;

Fig. 3 is an enlarged view of a portion of the superheater shown in Fig. 1;

Fig. 4 is an elevation of one of the superheater tube support brackets;

Fig. 5 is a plan view of the bracket shown in Fig. 4;

Fig. 6 is a horizontal section taken on the line 6—6 of Fig. 3; and

Fig. 7 is a horizontal section taken on the line 7—7 of Fig. 3.

The marine steam generating unit illustrated comprises a casing 10 having a front wall 12, a rear wall 14, side walls 16, 18, and roof 20. The walls 12, 14, 16, and roof 20, defining a furnace chamber 22 at one side of the unit which is fired by a plurality of fluid fuel burners 24 arranged to discharge through burner ports 26 in the front wall 12. The furnace chamber floor 28 is positioned subjacent the lowermost burners.

The fluid heating section of the unit comprises an upper steam and water drum 30 and lower water drum 32, both of which are horizontally arranged with their longitudinal axes in vertical alignment. The entire unit is bottom-supported, as indicated in Fig. 1, the upper drum being supported on the lower drum through a bank of vertically arranged steam generating tubes 34 having their opposite ends bent and radially connected to the corresponding drum. The innermost rows of water tubes 34^a are of larger diameter and bent laterally to define two staggered rows of screen tubes separating the furnace chamber 22 from a space 36 extending the full length of the tube bank. The steam generating surface of the unit also includes floor tubes 38 extending from the drum 32 to a side wall heater 40, tubes 42 extending from the header 40 along wall 16 and roof 20 to the drum 30, and rear wall tubes 44 extending between upper and lower rear wall headers 46 and 48, which in turn are connected to the drums 30 and 32 respectively.

At the outer side of the tube bank 34 is arranged an economizer formed by laterally spaced vertical platens of multi-looped horizontal tubes 50 having their upper ends connected to an inlet header 52 and their lower ends to an outlet header 54. The loop portions of the economizer tubes extend through and are supported by vertical plates 56 adjacent the loop portions thereof. The upper end of the economizer is located in a breeching 58 leading to a stack connection.

In accordance with my invention, the steam superheating section of the unit is defined by rows of horizontally arranged nested U-shaped tubes 60^a, 60^b positioned in the space 36 between the main bank of steam generating tubes 34 and the screen tubes 34^a. In the embodiment shown each superheater row consists of two nested U-shaped tubes with the legs of the inner tube 60^a spaced apart sufficiently, for example, 13¾", to permit a man to walk therebetween for inspection or repairs. In the embodiment shown the looped ends of the outer tubes 60^b are slightly spaced from the rear wall 14 and the adjacent wall portions integrally formed and cooled by wall tubes 44^a. The ends of the tubes 60^a, 60^b are bent laterally and then forwardly for connection to laterally spaced headers 62 and 64, which are vertically arranged at the outer side of the front wall 12. The wall portion between the diverging bent portions of the tubes 60^a and the headers 62 and 64 is closed by one or more heat insulated hinged doors 66, which are used for access to the space 36. The headers 62 and 64, and fuel burners 24 are enclosed by an outer panelled casing 68 which is arranged

parallel with the furnace chamber front wall **12**. The section enclosing the headers may be separated from the portion enclosing the burners by a partition **69**. Combustion air flows downwardly through the casing burner section to the burner ports **26**. As indicated in Fig. 1, the headers **62** and **64** and associated tubes **60a**, **60b** are substantially coextensive with the height of the space **36**.

In accordance with the invention the superheater tubes **60a**, **60b** are supported so as to remain in their designed spaced relation during operation and yet can be readily removed when replacement is necessary. For this purpose pairs of large diameter water tubes **70** are arranged at opposite sides of the superheater tubes **60b** with their ends connected to the drums **30** and **32**. As shown in Figs. 3–7, the tubes **70** each support a series of similar tube-supporting brackets **72**, each of which consists of a vertically extending body portion **74**, from one face of which extend horizontally spaced tube supporting fingers **76** and from vertically spaced points on the opposite face of which extend semi-circular sleeves **78**, to which are welded complementary sleeve sections **80** in the field, to hold the support castings on the corresponding tubes **70**. As shown in Figs. 3 and 7, the tubes **70** have angularly spaced lugs **84** welded thereon and projecting radially therefrom, and positioned relative to a corresponding sleeve section **78** so as to support the brackets **72** and yet restrict their rotation with respect to the supporting tube. The tube supporting brackets on each pair of tubes **70** are oppositely arranged so that corresponding U-shaped superheater tubes **60a** and **60b** can be inserted therein between the fingers **76** and then have their ends expanded into corresponding tube openings in the headers **62** and **64**.

The supporting brackets and bracket supporting section of the tubes **70** nearer the furnace chamber are protected by a layer of initially plastic castable refractory **81** on the furnace side of the tubes **70** and collars **80** held in place by the adjacent screen tubes **34a** and straight metal rods **83** extending between and welded to adjacent collars **80** and bent rods **85** on the collars, as shown in Figs. 3 and 6.

When the unit is shut down for inspection or repairs, one or more panels in the wall **68** are removed and the door **66** opened to permit a workman to enter the space **36** and move throughout the length thereof to inspect the superheater tubes and associated supporting elements. Although the tube support brackets **72** are designed to be cooled by the heat absorbing action of the associated supporting tubes **70**, they are frequently exposed to high temperature corrosive conditions and may occasionally require repair or replacement. If for this or any other reason any of the tubes **60a** or **60b** require removal, the tube or tubes to be removed are cut away at their connections to the headers **62** and **64** and their ends sprung together sufficiently to permit the tube to pass between the headers **62** and **64**, and be readily removed through the opening closed by the door **66**. The innermost tubes **60a** may be displaced sufficiently to allow the corresponding outer tube **60b** to be removed. The formation of the tube support castings **72** in relatively short sections reduces the thermal stresses on the castings. A new casting section may be installed without requiring the corresponding tubes to be replaced or disconnected from the headers **62** and **64**. The capacity for limited angular movement of certain support castings on the tube **70** facilitates replacement of the tubes and castings.

The described superheater construction and support permits easier and faster erection of the unit, reduces the floor space requirements for tube removal by permitting the tubes to be removed at the burner end of the unit without requiring additional space for superheater header enclosure, and insures a high degree of accessibility to the entire superheater and its supporting elements, permitting quicker and easier inspection and repair of those parts.

The superheater tube supporting provisions described are also adapted for use where the wall tubes **44a** are omitted and an opening or openings provided in the rear wall **14** for withdrawing the superheater tubes through the rear end of the boiler unit after their ends have been severed from the headers **62** and **64**.

The superheater headers **62** and **64** may be partitioned to provide a steam flow through the tubes in one or more passes, as is well known.

While in accordance with the provisions of the statutes I have illustrated and described herein the best form of the invention now known to me, those skilled in the art will understand that changes may be made in the form of the apparatus disclosed without departing from the spirit of the invention covered by the claims, and that certain features of the invention may sometimes be used to advantage without a corresponding use of other features.

What is claimed is:

1. A vapor generating and superheating unit comprising an upper horizontally extending vapor and liquid drum, a lower horizontally extending liquid drum, a bank of vapor generating tubes connecting said drums, walls defining a furnace chamber arranged along one side of said tube bank, fuel burning means for said furnace chamber, a heating gas outlet at the opposite side of said tube bank, a vertically extending bank of U-shaped vapor superheating tubes horizontally arranged in the space alongside said tube bank and having the legs of the tubes laterally spaced a distance apart to form a manway therebetween, a pair of vertically extending headers at one end of said unit externally of said walls and one header laterally spaced from the other a distance slightly greater than the spacing of said tube legs, said superheating tubes having their opposite ends connected to said headers, a manway door in the wall between said headers permitting access by a man to said manway, a pair of laterally spaced heavy tube wall vapor generating tubes at opposite sides of the vapor superheating tube bank, and superheater support means on each of said last named tubes including a series of superheater tube-supporting fingers of sufficient size to permit lateral and longitudinal sliding movement of the superheater tubes supported thereon.

2. A vapor generating and superheating unit comprising an upper horizontally extending vapor and liquid drum, a lower horizontally extending liquid drum, a bank of vapor generating tubes connecting said drums, walls defining a furnace chamber arranged along one side of said tube bank, fuel burning means for said furnace chamber, a heating gas outlet at the opposite side of said tube bank, a plurality of rows of vertically extending vapor generating screen tubes having their ends connected to said drums and their intervening portions spaced laterally a substantial distance in advance of said tube bank, a vertically extending bank of U-shaped vapor superheating tubes horizontally arranged in the space between said tube bank and screen tubes and having the legs of the tubes laterally spaced a distance apart to form a manway therebetween, the legs of each superheater tube being arranged in the same horizontal plane, a pair of vertically extending headers at one end of said unit externally of said walls and one header laterally spaced from the other a distance slightly greater than the spacing of said tube legs, said superheating tubes having their opposite ends connected to said headers, a manway door in the wall between said headers permitting access by a man to said manway, a pair of laterally spaced heavy tube wall vapor generating tubes at opposite sides of the vapor superheating tube bank, and superheater support means on each of said last named tubes including a series of superheater tube-supporting fingers of sufficient size to permit lateral and longitudinal sliding movement of the superheater tubes supported thereon.

3. A vapor generating and superheating unit comprising an upper horizontally extending vapor and liquid drum, a lower horizontally extending liquid drum, a bank of vapor generating tubes connecting said drums, walls defining a

furnace chamber arranged along one side of said tube bank, fuel burning means for said furnace chamber, a heating gas outlet at the opposite side of said tube bank, a plurality of rows of vertically extending vapor generating screen tubes having their ends connected to said drums and their intervening portions spaced laterally a substantial distance in advance of said tube bank, a vertically extending bank of U-shaped vapor superheating tubes horizontally arranged in the space between said tube bank and screen tubes and having the legs of the tubes laterally spaced a distance apart to form a manway therebetween, a pair of vertically extending headers at one end of said unit externally of said walls and one header laterally spaced from the other a distance slightly greater than the spacing of said tube legs, said superheating tubes having their opposite ends connected to said headers, a manway door in the wall between said headers permitting access by a man to said manway, a pair of laterally spaced heavy tube wall vapor generating tubes at opposite sides of the vapor superheating tube bank, and a bracket on each of said last named tubes having a vertical series of superheater tube-supporting fingers of sufficient size to permit lateral and longitudinal sliding movement of the superheater tubes supported thereon, the fingers on opposite brackets being oppositely arranged.

4. A vapor generating and superheating unit comprising an upper horizontally extending vapor and liquid drum, a lower horizontally extending liquid drum, a bank of vapor generating tubes connecting said drums, walls defining a furnace chamber arranged along one side of said tube bank, fuel burning means for said furnace chamber, a heating gas outlet at the opposite side of said tube bank, a plurality of rows of vertically extending vapor generating screen tubes having their ends

connected to said drums and their intervening portions spaced laterally a substantial distance in advance of said tube bank, a vertically extending bank of nested U-shaped vapor superheating tubes horizontally arranged in the space between said tube bank and screen tubes and having the legs of the tubes laterally spaced a distance apart to form a manway therebetween, the legs of the superheater tubes of each nest being arranged in the same horizontal plane, a pair of vertically extending headers at one end of said unit externally of said walls and one header laterally spaced from the other a distance slightly greater than the spacing of said tube legs, said superheating tubes having their opposite ends connected to said headers, a manway door in the wall between said headers permitting access by a man to said manway, a pair of laterally spaced heavy tube wall vapor generating tubes at opposite sides of the vapor superheating tube bank, a bracket on each of said last named tubes having a vertical series of superheater tube-supporting fingers of sufficient size to permit lateral and longitudinal sliding movement of the superheater tubes supported thereon, the fingers on opposite brackets being oppositely arranged, means for restricting vertical and angular movements of said brackets on said bracket-supporting tubes.

References Cited in the file of this patent

UNITED STATES PATENTS

1,475,924	Nelis	Nov. 27, 1923
2,310,801	Mayo et al.	Feb. 9, 1943
2,332,534	Rooney	Oct. 26, 1943
2,420,647	Boland	May 20, 1947

FOREIGN PATENTS

771,052	France	July 16, 1934