

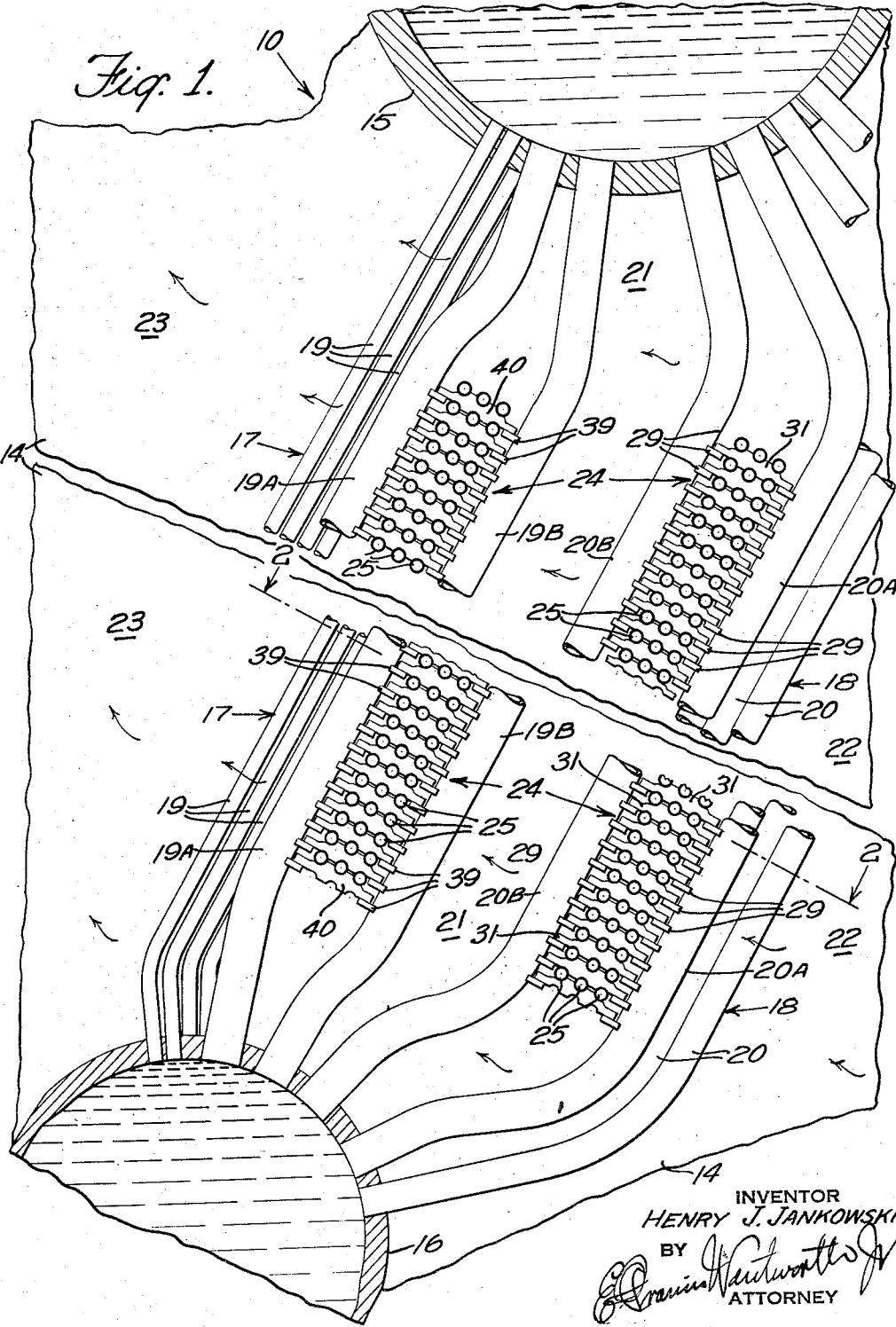
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TUBE SUPPORT MEANS

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Filed Jan. 23, 1956

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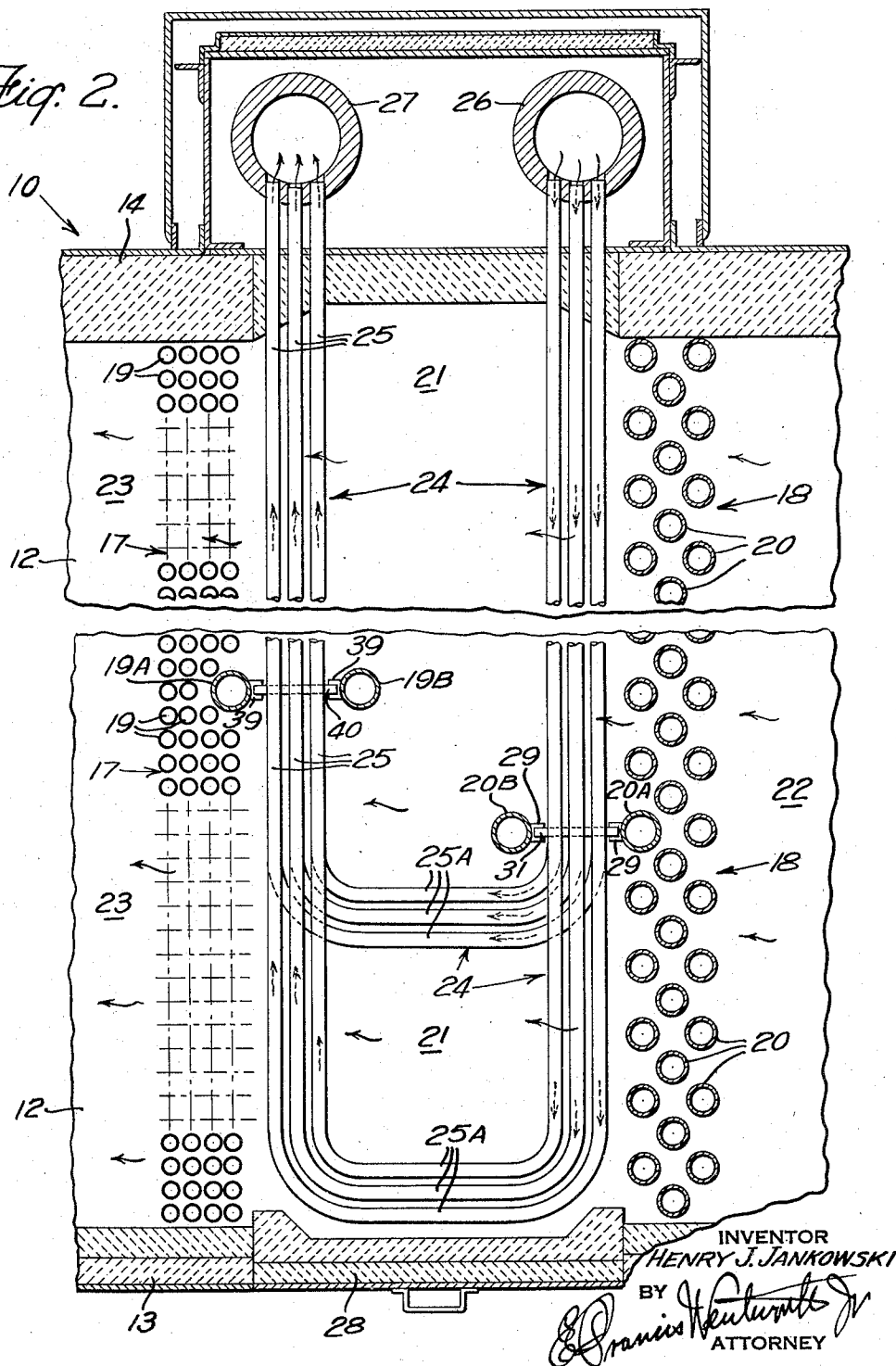
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Fig. 2.



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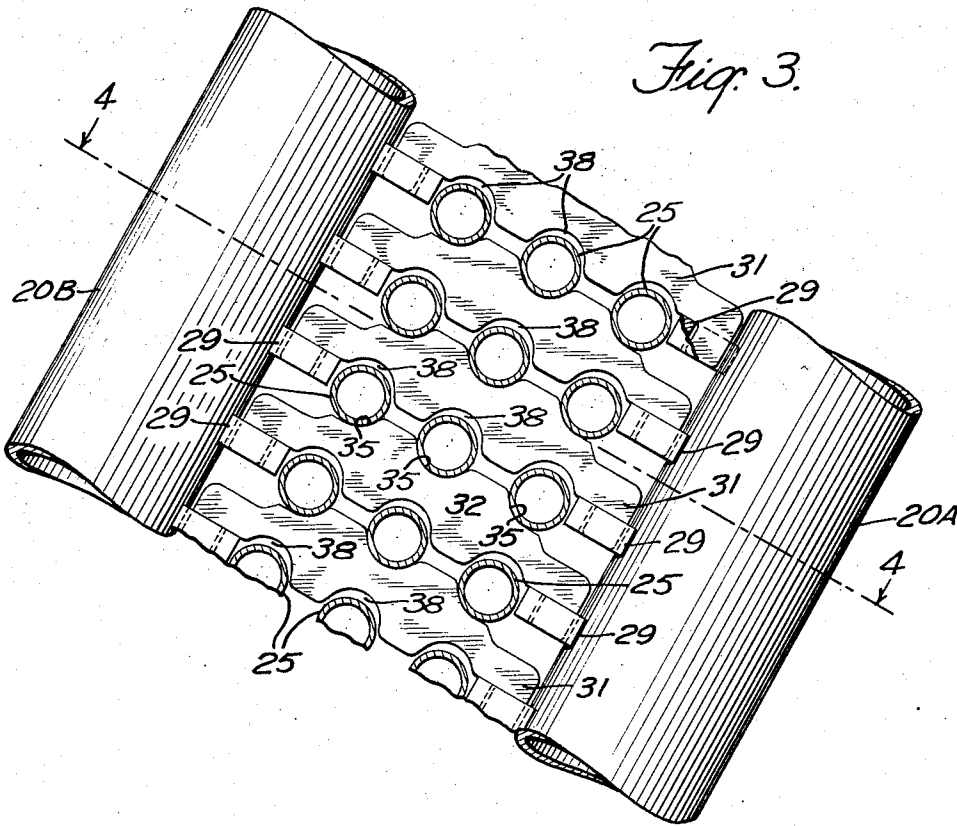
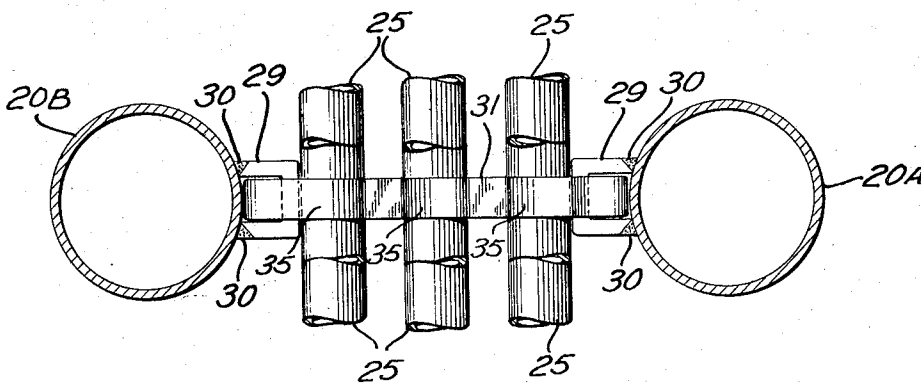
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Fig. 5.

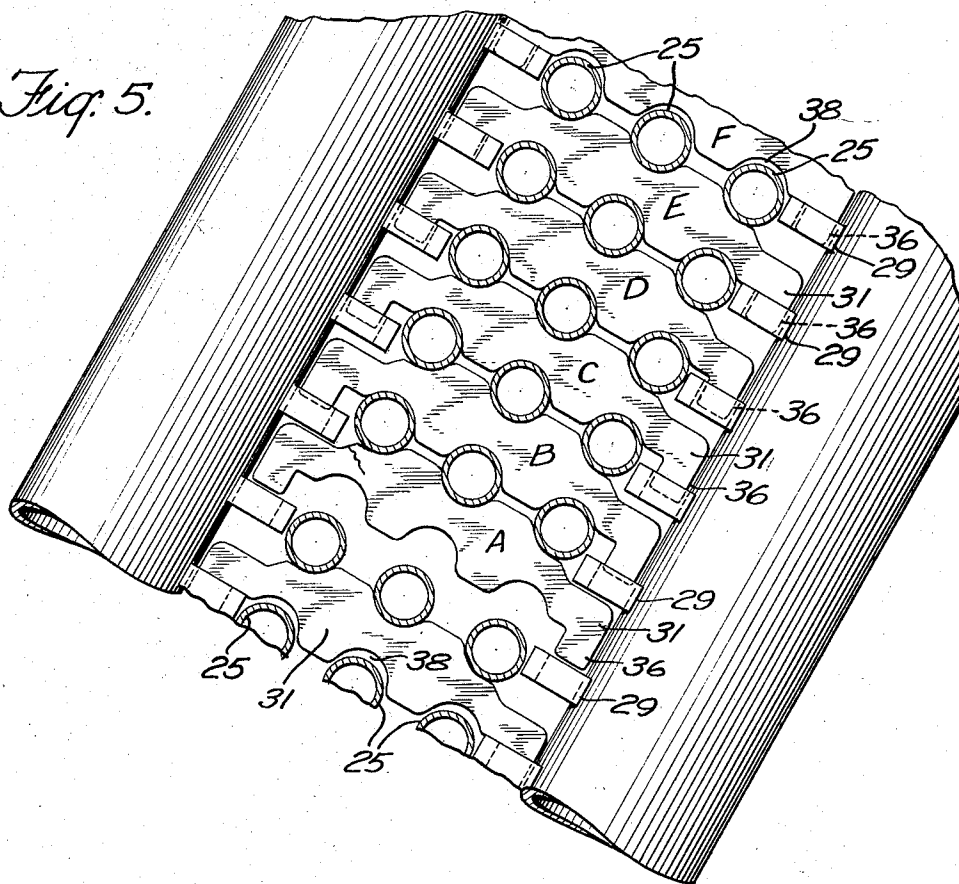
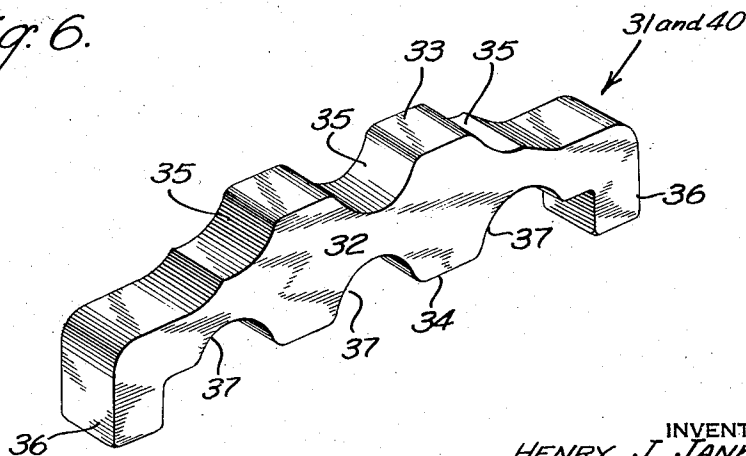


Fig. 6.



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TUBE SUPPORT MEANS

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6 Claims. (Cl. 122—510)

This invention relates to support means and more particularly to means for supporting a plurality of closely spaced tubular members.

The support of a plurality of tubular members comprising a superheater unit of a vapor generating apparatus, as for example, a marine boiler, is presently accomplished by providing relatively large plates or sheets, which plates are provided with a plurality of openings therein adapted to receive therethrough the superheater tubular members to be supported. The plates are mounted on the boiler wall or on the vapor generating tubes of the boiler. In these installations, the removal of a defective plate requires the removal of the superheater tubular members supported by the defective plate in order to disengage the plate from its supporting wall or tubes. The necessity of disconnecting and removing superheater tubular members to accomplish replacement of a defective plate and the reconnection of superheater tubular members results in relatively high boiler maintenance costs and is a time consuming operation.

Accordingly, an object of the present invention is to provide novel support means for supporting a plurality of tubular members wherein removal of a support plate member is accomplished easily and quickly.

The present invention contemplates novel support means for a plurality of closely spaced tubular members and wherein the support means comprises a plurality of plate members and means engaging and supporting each plate member in the space between adjacent rows of tubular members. The plate members are spaced from each other and lie substantially in the same plane. Each plate member is constructed to engage and support tubular members of a row adjacent thereto and to be spaced from the tubular members of a next adjacent row. The space between each plate member and the tubular member of a row adjacent thereto is of a value which is proportionate to the distance of displacement necessary to detach a plate member from the support means.

The invention will be understood from the following description when considered in connection with the accompanying drawings and in which:

Fig. 1 is a fragmentary sectional view, in elevation, of a vapor generator in which U-bend tubular members comprising a superheater are supported within the vapor generator by support means in accordance with the present invention;

Fig. 2 is a view in section taken substantially along line 2—2 of Fig. 1;

Fig. 3 is an enlarged fragmentary view, in elevation, of the support means according to the present invention;

Fig. 4 is a view in section taken along line 4—4 of Fig. 3;

Fig. 5 is a view similar to Fig. 3, showing a plate member according to this invention in position for removal and showing the displacement of other upper adjacent plate members and the tubular members supported thereon; and

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Fig. 6 is a perspective view of one of the plate members according to this invention.

Referring to the drawings, and more specifically to Figs. 1 and 2, the support means of the present invention is disclosed as embodied in a vapor generator having a setting 10, which setting comprises a floor 12 (Fig. 2), a roof (not shown), a front wall 13, a rear wall 14, and opposite end walls (not shown). A liquid-vapor or water-steam drum 15 (partly shown) is disposed in the roof of setting 10 and a liquid or water drum 16 (partly shown) is positioned in floor 12 to one side of the vertical axis of liquid-vapor drum 15. Two inclined vapor generating tube banks 17 and 18 extend between liquid-vapor drum 15 and liquid drum 16 and transversely of setting 10. Tube banks 17 and 18 comprise tubes 19 and 20, respectively, which tubes 19 and 20 are connected at adjacent ends to liquid drum 16 and at the opposite adjacent ends to vapor-liquid drum 15. Tube banks 17 and 18 are arranged in lateral spaced relationship to each other to provide a space 21 therebetween.

A furnace chamber 22 (partly shown in Figs. 1 and 2), is provided in setting 10, adjacent tube bank 18. Furnace chamber 22 has burners (not shown) for producing combustion gases therein. Setting 10 is provided with a convection gas passageway 23 (partly shown in Figs. 1 and 2), adjacent tube bank 17, which communicates with furnace chamber 22 to receive combustion gases from the latter. Setting 10 is further provided with a gas outlet opening (not shown) for the discharge of combustion gases from passageway 23.

A superheater 24 is disposed within space 21 and comprises a plurality of closely spaced U-bend tubes 25, best shown in Fig. 2. A superheater inlet header 26 and a superheater outlet header 27 are disposed exteriorly of rear wall 14 of setting 10 and adjacent space 21 (Fig. 2). Each superheater tube 25 is connected at one end to inlet header 26 to receive steam therefrom and, at the opposite end, to outlet header 27 to discharge superheated steam into the latter. Tubes 25 extend substantially horizontally from inlet and outlet headers 26 and 27, respectively, through rear wall 14, and transversely of setting 10, the bight or curved portions 25A of tubes 25 being spaced from front wall 13. Tubes 25 are arranged in a plurality of rows of nested tubes, each row of nested tubes comprising three closely spaced tubes 25, lying in parallel relationship to each other and in the same plane. Each row of nested tubes is spaced one above the other to provide a flow path between the rows of nested tubes 25 for the passageway of combustion gases flowing from furnace chamber 22 to passageway 23.

Several of the adjacent lowermost rows of tubes 25 are shorter in length than the upper rows of tubes 25 so that the bight portions 25A of the lowermost rows of tubes 25 are spaced further away from front wall 13 (Fig. 2). The space between the lowermost rows of tubes 25 and front wall 13 facilitates entry into the space between the legs of the U-bend superheater tubes 25, through an access door 28 which is disposed in wall 13 near floor 12, for a purpose hereinafter to be set forth.

Superheater tubes 25 are supported, adjacent their bight portions 25A, in the novel manner which constitutes the present invention, as hereinafter described.

A first pair of oversized vapor generating tubes 20A and 20B are disposed on opposite sides of the legs of U-bend tubes 25 adjacent tube bank 18. Tube 20A is positioned within and forms a part of tube bank 18, while tube 20B is disposed in the space between the opposite legs of the U-bend tubes 25 and extends parallel to tube 20A, between liquid-vapor drum 15 and liquid drum 16.

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A plurality of U-shaped members 29, best shown in Fig. 4, and hereinafter referred to as staples, are disposed in spaced relationship to each other along the length of tubes 20A and 20B and adjacent superheater tubes 25. Staples 29 are arranged on tubes 20A and 20B so that a staple on each tube 20A and 20B is adjacent each row of superheater tubes 25. Staples 29 are welded at their ends, as indicated at 30 (Fig. 4), to the surface of tubes 20A and 20B and extend in a direction toward tubes 25 and normal to the surface of tubes 20A and 20B.

A plate member 31 is disposed between each row and nested superheater tubes 25 and is supported at opposite ends by a staple 29 on each tube 20A and 20B so as to extend normal to the longitudinal axes of superheater tubes 25. Each plate member 31 is adapted to support an above adjacent row of nested superheater tubes 25, as hereinafter more fully described.

Each plate member 31 comprises, as best shown in Fig. 6, a body portion 32, substantially rectangular in cross-section which includes an upper surface 33 and a lower surface 34. The upper surface 33 is provided with arcuate cut-out portions or recesses 35 corresponding in number to the number of tubes to be supported by the plate member. Each recess 35 is adapted to receive therein, in abutting relationship, a superheater tube 25. In the aforesaid structure, three arcuate recesses 35 are provided in upper surface 33 since there are three tubes in each row of nested superheater tubes 25. Body portion 32 is provided with pendant end portions 36 which are receivable in staples 29, whereby plate member 31 is supported and anchored between tubes 20A and 20B. The lower edge surface of plate member 31 has a plurality of arcuate cut-out portions or recess 37, corresponding in number to the number of tubes 25 in the next lower adjacent row (three in the apparatus illustrated in the drawings). Recesses 37 are dimensioned so as to partially encompass the next lower adjacent row of superheater tubes 25 and to provide spaces 38, best shown in Fig. 3, between plate 31 and the next lower adjacent row of superheater tubes 25 when plate member 31 is held by staples 29 in the normal tube supporting position. Spaces 38 have a dimension which is proportionate to the length of pendant end portions 36 of plate 31, the importance of which will become apparent hereinafter.

The legs of U-bend superheater tubes 25, adjacent vapor generating tube bank 17 (Figs. 1 and 2), are supported in a similar manner as the aforesaid opposite legs of superheater tubes 25, which tube legs are adjacent tube bank 18. Two oversized vapor generating tubes 19A and 19B are disposed, as tubes 20A and 20B, on opposite sides of the legs of U-bend superheater tubes 25, adjacent tube bank 17. A plurality of staples 39, similar to staples 29, are secured to and arranged on tubes 19A and 19B in the same manner as staples 29 of tubes 20A and 20B. A plurality of plate members 40, similar to plate members 31, are supported by staples 39 between the rows of nested superheater tubes to support the tubes of the next above adjacent row.

In the event of failure of one or more of the plate members 31 and/or 40, or when an inspection of the interior of the vapor generator is deemed desirable, access door 28 in front wall 13 is removed. Personnel then enter setting 10 by passing under the upper group of superheater tubes 25, at bight portions 25A. To gain access to the space between the opposite legs of superheater tubes 25, personnel pass over the bight portions 25A of the lowermost group of superheater tubes 25. Once in the space between the opposite legs of superheater tubes 25, plates 31 and 40 may be easily inspected, removed and replaced, if necessary.

Referring now to Fig. 5, removal of a defective plate member, as for example, one of the plate members 31, designated in Fig. 5 as plate member A, is accomplished by moving plate A in a substantially vertical direction until pendant end portions 36 are free of staples 29. In

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order to disengage plate member A from staples 29, as shown in Fig. 5, the above adjacent plate members 31, designated B, C and D, and tubes 25 supported by those plates, must be displaced upwardly a successively lesser distance. Since spacers 38 are provided between each plate member and the next lower adjacent row of tubes 25, only a convenient number of upper plate members 31 and the tubes supported by them, adjacent the defective plate member, need be lifted to effect the removal and replacement of the defective plate member. When plate member A, as shown in Fig. 5, is raised to a position where it can be disengaged from staples 29, plate B and its associated tubes 25 are displaced upwardly approximately $\frac{3}{4}$ of the length of pendant end portions 36 thereof; plate member C and its associated tubes 25 are displaced approximately $\frac{1}{2}$ the length of pendant end portions 36, while plate member D and its associated tubes 25 are moved upwardly approximately $\frac{1}{4}$ the length of pendant end portions 36. A plate member E, immediately above plate member D, is not moved, because the displacement of plate member D and its associated tubes 25 is only sufficient to move tubes 25, supported by plate member D, into spaces 38 which are normally provided between plate member E and the next adjacent lower tubes 25. A plate member F, immediately above plate E, remains in a normal supporting position unaffected by the displacement of the lower plate members A, B, C and D.

It has been found that it is preferable to provide spaces 38 which are of a dimension in the value of approximately $\frac{1}{4}$ the length of pendant end portions 36 of plate members 31 so that a maximum of only four plate members, including the defective plate member, and tubes 25 supported thereon, need be lifted to effect the removal and replacement of a defective plate member. This aforesaid preferred construction permits removal and replacement of a plate member quickly and with relative ease. Obviously, the recesses 37 may be dimensioned to provide smaller or larger spaces 38 whereby a respectively greater or lesser number of plate members and the tubes supported thereon, must be displaced to effect the removal and replacement of a plate member. However, the preferred construction provides a tube support means wherein the displacement of plate members and associated tubes can be easily accomplished while maintaining proper spacing between the rows of superheater tubes for efficient flow of combustion gases therebetween and, at the same time, providing plate members having body portions 32 of sufficient structural strength to support tubes 25 without rapid failure.

Recesses 35 of plate members 31 and 40 serve to prevent lateral movement of superheater tubes 25 which are supported therein with respect to the vapor generating tubes 19 and 20, and lateral movement of the tubes with respect to each other. The maintenance of tube spacing and parallelism of superheater tubes 25 is of particular importance where, as shown in the drawings, the rows of tubes lie in a plane inclined with respect to a horizontal plane.

It is readily apparent that the present invention provides novel support means for a plurality of closely spaced tubular members whereby defective plate members may be quickly and easily removed and replaced without removal of any of the tubular members.

Although one embodiment of the invention has been illustrated and described in detail, it is to be expressly understood that the invention is not limited thereto. Various changes can be made in the arrangement of parts without departing from the spirit and scope of the invention, as the same will now be understood by those skilled in the art.

What is claimed is:

1. Support means for a plurality of spaced rows of superheater tubes having a plurality of superheater tubes in each row, said rows being arranged substantially par-

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allel to each other and substantially normal to a bank of substantially vertically extending vapor generating tubular members, said means comprising a support plate for each row of tubes to support the latter, each of said support plates being disposed with an upper surface thereof in contact with the superheater tubes of the row to be supported to support the same and a lower surface spaced from the superheater tubes of the next lower row, each plate member being provided with pendant end portions of predetermined length, anchor means connected to two of said vapor generating tubular members for engaging said pendant end portions of said support plates to support and restrict movement of each of said support plates except in an upward direction, said support plates being disengageable from the anchor means and removable after upward linear displacement thereof for substantially the length of said pendant end portions, the spacing of the lower surface of each of said support plates from its associated lower row of superheater tubes being proportionate to the length of said pendant end portions to effect the movement of a predetermined number of superheater tubes and their support plates without disengagement thereof from the anchor means when a support plate to be moved is displaced through substantially the length of said pendant end portions to be disengaged from the anchor means supporting the support plate to be removed.

2. Support means for a plurality of closely spaced rows of tubular members having a plurality of closely spaced parallel tubular members in each row, said rows being arranged substantially parallel to each other and one above the other, said means comprising a support plate for each row of tubular members, said support plates being disposed substantially transversely of said longitudinal axes of said tubular members, said support plates having an upper surface and a lower surface, said upper surface being provided with a plurality of arcuate recesses for receiving each of the tubular members of the next upper row thereto to support the same and to maintain the spaced relationship of said tubular members to each other, said lower surface being provided with a plurality of arcuate recesses for partially encompassing each of the tubular members of the next lower row in spaced relationship with each of said tubular members, each of said support plates having two pendant end portions, anchor means for each of said support plates, said anchor means being adapted to receive each of the pendant end portions for a predetermined distance to support the support plates in spaced relationship to each other, said anchor means restricting movement of said support plates except in an upward direction normal to the longitudinal axes of the tubular members, said support plates being disengageable from said anchor means and removable from said tubular members after upward linear displacement thereof for said predetermined distance, the spacing of the support members from each other and the spacing of the arcuate recesses of the lower surface of each of the support plates from the next lower row of tubular members being proportionate to said predetermined distance to effect the upward movement of a predetermined number of tubular members and their support plates when a support plate to be removed is displaced through said predetermined distance.

3. Support means for a plurality of closely spaced rows of tubular members having a plurality of closely spaced parallel tubular members in each row, said rows being arranged substantially horizontally and one above the other, said means comprising a support plate for each row of tubular members, each support plate being disposed below a row of tubular members to be supported and substantially normal to the longitudinal axes of the tubular members, a supporting column disposed on each side of said rows of tubular members and extending substantially normal to said rows, a plurality of anchor

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members disposed in spaced relationship with each other along the length of each of the supporting columns to provide a pair of anchor members for each support plate, each support plate having opposite pendant leg portions of predetermined length adapted to engage each of said pairs of anchor members for a predetermined distance whereby said support plates are supported in spaced relationship to each other and restricted against movement except in an upward direction normal to the longitudinal axes of the tubular members, said support plates each having an upper surface and a lower surface, said upper surface having a plurality of arcuate recesses for receiving each of the tubular members of the upper row adjacent thereto to support the same and maintain the lateral spaced relationship of said tubular members, said lower surface being provided with a plurality of arcuate recesses for partially encompassing each of the tubular members of the next lower row in spaced relationship with each of said tubular members, each of said support plates being disengageable from its associated pair of anchor members and removable from said tubular members after upward linear displacement for said predetermined distance, the spacing of the lower surface of each of the support plates from the next lower row of tubular members and the next lower support plate being proportionate to said predetermined distance to effect the upward movement of a predetermined number of tubular members and support plates when a support plate to be removed is displaced through said predetermined distance.

4. Support means for a plurality of closely spaced rows of tubular members having a plurality of closely spaced parallel tubular members in each row, said rows being arranged substantially horizontally and one above the other, said means comprising a plurality of closely spaced support members, each of said support members being disposed below a row of tubular members and substantially normal to the longitudinal axes of the tubular members, a supporting column disposed on each side of said rows of tubular members and extending substantially vertical and normal to the rows of tubular members, a plurality of U-shaped anchor members disposed in spaced relationship with each other along the length of each of said supporting columns to provide a pair of anchor members for each support plate, said U-shaped anchor members being connected at the ends thereof to the supporting columns to define with the latter an enclosed space, said support plates each having opposite pendant end portions of a predetermined length receivable within said enclosed spaces of each of said pair of U-shaped anchor members whereby said support plates are supported and restricted against movement except in an upward direction normal to the longitudinal axes of the tubular members, said support plates each having a plurality of arcuate recesses for receiving each of the tubular members of the next upper row to support the same and maintain the lateral spaced relationship of said tubular members to each other, said lower surface being provided with a plurality of arcuate recesses, each lower recess being adapted to partially encompass a tubular member of the next lower row in spaced relationship with said tubular member, each of said support plates being disengageable from its associated pair of U-shaped anchor members and removable from the tubular members after upward linear displacement for a distance substantially equal to the length of said pendant end portions, the spacing of the lower surface of each plate member from the next lower adjacent row of tubular members and next lower plate member being proportionate to the length of said pendant end portions to effect the upward movement of a predetermined number of tubular members and support plates when a support plate to be removed is displaced substantially the length of its pendant end portions.

5. Support means for a plurality of closely spaced rows

of tubular members having at least one tubular member in each row, said rows being arranged substantially parallel to each other and one above the other, said means comprising a support member for each row of tubular members to support the same, each of said support members having a first surface in contact with the tubular member of the row to be supported to support the same, and a second surface spaced from the tubular member of the next lower row adjacent thereto, each support member having at opposite ends thereof pendant leg portions, engaging means for receiving each of the leg portions of the support members for a predetermined distance to support each of the support members, said engaging means restricting movement of each support member with respect to said tubular members except in an upward direction normal to the longitudinal axes of the tubular members, each of said support members being disengageable from the engaging means and removable from the tubular members after upward displacement of the leg portions of the support member for said predetermined distance, the spacing of the second surface of each of said support members from the next lower adjacent tubular members being proportionate to said predetermined distance to effect the movement of a predetermined number of tubular members and support members when one of said support members to be disengaged from the engaging means is upwardly displaced through said predetermined distance.

6. Support means for a plurality of closely spaced rows of tubular members having at least one tubular member in each row, said rows being arranged substantially parallel to each other and one above the other, said means comprising a support member for each row of tubular members to support the latter, said support members each having an arcuate recess in an upper surface to receive the tubular member of a row therein to be supported and a lower surface, the support member being disposed so that the tubular member of the upper adja-

cent row is resting within the arcuate recess of the upper surface of the support member, said lower surface of each support member having an arcuate recess adapted to partially encompass the tubular member of the next lower adjacent row in spaced relationship with said tubular member, each of said support members having at opposite ends thereof pendant leg portions and means for receiving the pendant leg portions of each of said support members for a predetermined distance to support the support members in spaced relationship to each other, said last mentioned means restricting movement of each of said support members except in an upwardly direction, said leg portions of each of the support members being disengageable from said last mentioned means after upward linear displacement of the support member for said predetermined distance, the spacing of the support members from each other and the spacing of the arcuate recess in the lower surfaces of the support members from their associated lower tubular member being proportionate to said predetermined distance to effect the movement of a predetermined number of tubular members and their support members when a support member to be removed is displaced upwardly through said predetermined distance.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 2,884,911

May 5, 1959

Henry J. Jankowski

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 2, line 49, for "passageway" read -- passage --; column 5, line 24, for "moved" read -- removed --.

Signed and sealed this 29th day of December 1959.

(SEAL)

Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents