Dec. 13, 1938. W. S. BUELL 2,140,279

HEAT EXCHANGE APPARATUS

Filed April 23, 1931 2 Sheets-Sheet 1

Fig. 1.

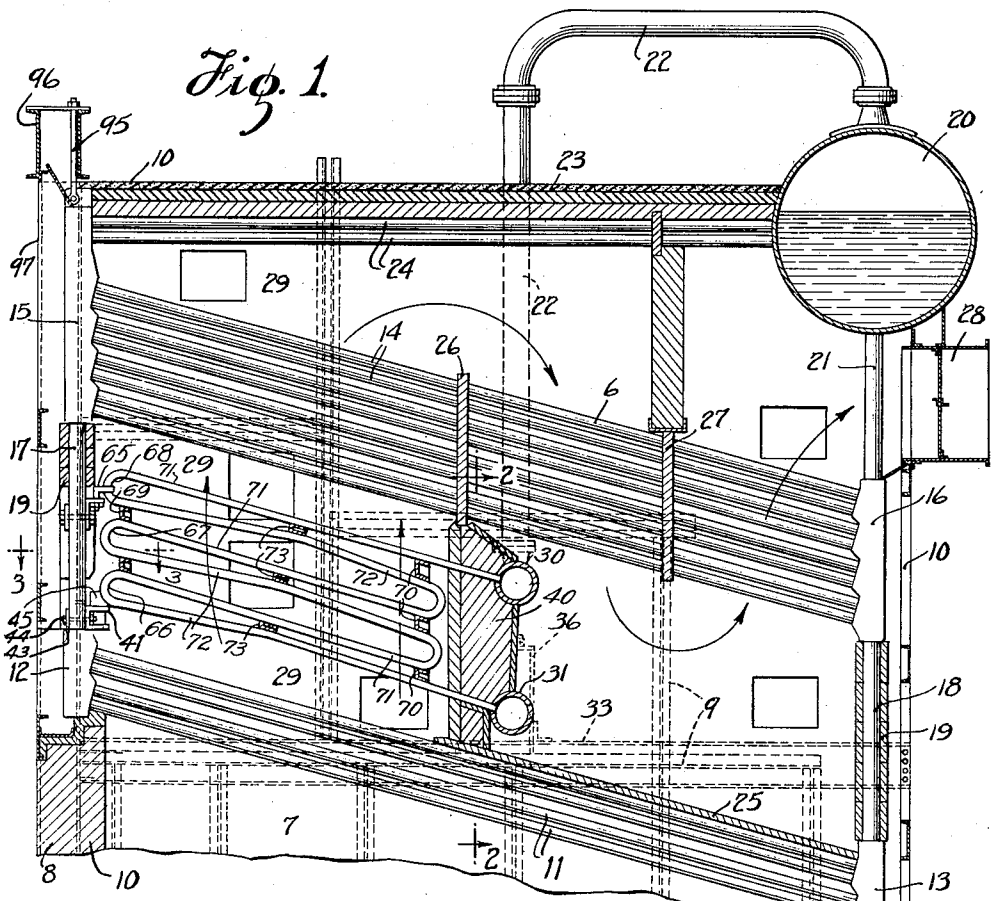
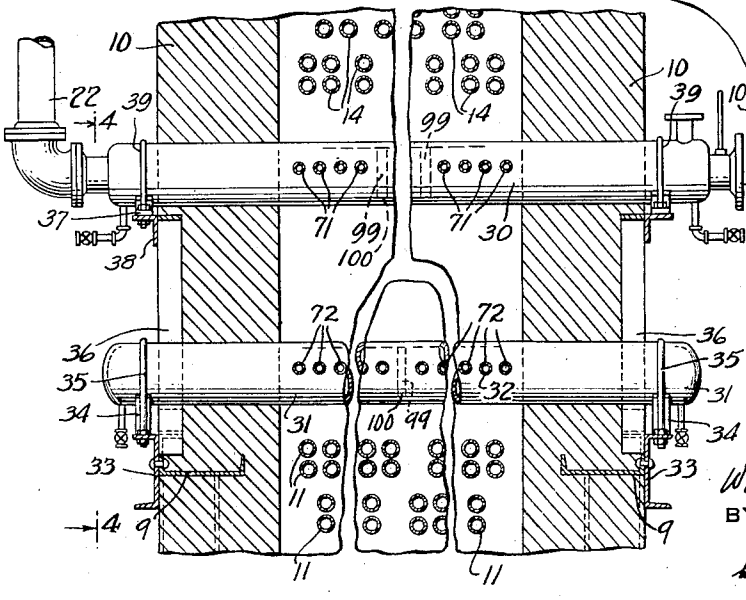


Fig. 2.



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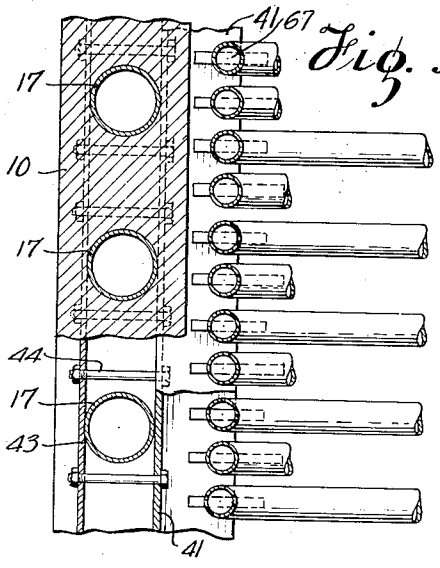


Fig. 3.

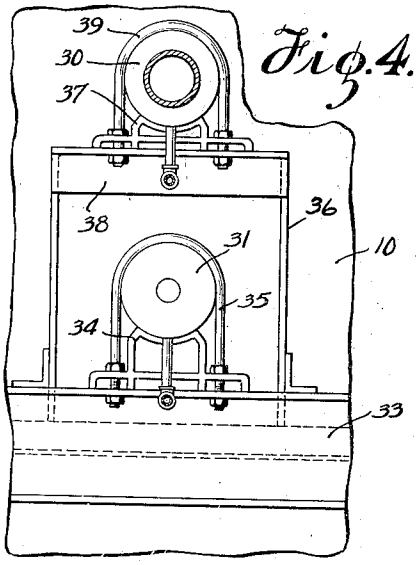


Fig. 4.

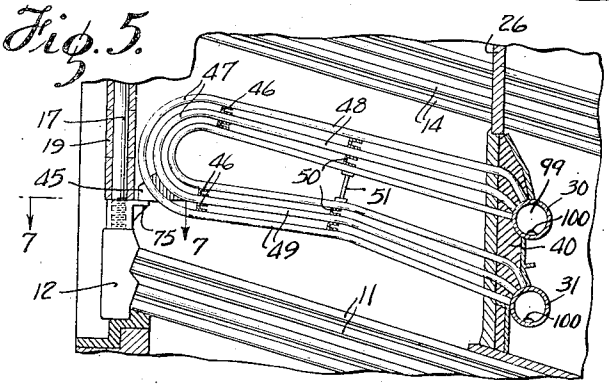


Fig. 5.

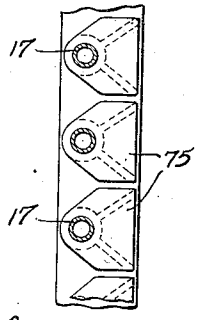


Fig. 7

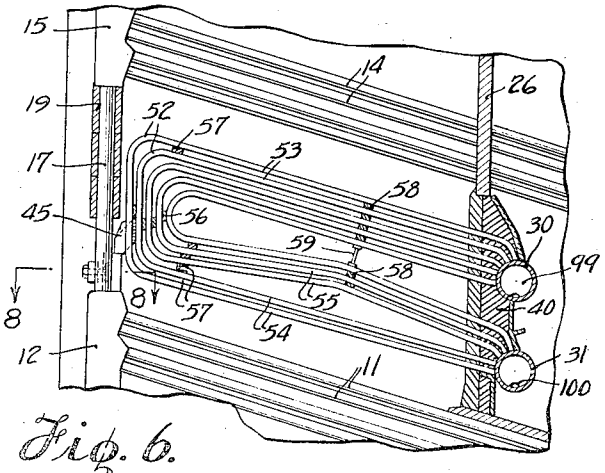


Fig. 6.

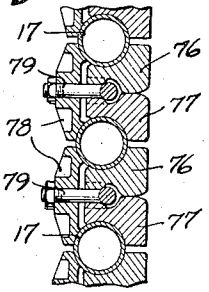


Fig. 8

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2,140,279

HEAT EXCHANGE APPARATUS

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Application April 23, 1931, Serial No. 532,198

5 Claims. (Cl. 122—478)

The object of my invention is to provide novel means for supporting heat exchange apparatus such as a steam superheater, in certain types of steam generators, for example, the type having vertically disposed banks or groups of tubes inclined somewhat from the horizontal between which is disposed a superheater, generally called an "interdeck" superheater.

The nature of my invention will become apparent from the following description considered in connection with the accompanying drawings, wherein I have illustrated preferred forms of my invention in connection with one type of known steam generator. It will, of course, be obvious that many changes may be made in the forms disclosed without departing from the spirit of the invention, and that my improved manner of supporting superheaters may be applied to other types of steam generators.

In the drawings:

Fig. 1 is a vertical sectional view of an inter deck type of water tube boiler embodying the present invention;

Fig. 2 is a broken sectional view taken substantially on line 2—2 of Fig. 1;

Fig. 3 is a partial sectional view taken on line 3—3 of Fig. 1;

Fig. 4 is an elevational view taken on line 4—4 of Fig. 2;

Fig. 5 is a partial vertical sectional view showing another form of superheater;

Fig. 6 is a view similar to Fig. 5, showing another form of superheater;

Fig. 7 is a sectional view taken on line 7—7 of Fig. 5; and

Fig. 8 is a sectional view on line 8—8 of Fig. 6.

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

Referring, in general, to the disclosure of Fig. 1, a superheater of the interdeck type is shown applied to a typical water-tube boiler, the front end of which superheater, that is to say, the end opposite the header end, is supported on the water leg of the boiler adjacent to it. To this water leg of the boiler, supporting brackets are bolted or otherwise secured. One suitable form of supporting bracket comprises a member of suitable form and preferably of a length such that it will contact with two or more nipples. These members are secured to the nipples by any desired means such as bars and bolts.

Referring more particularly to Fig. 1, reference character 10 designates the setting of a steam generator. The setting includes the usual steel-work comprising vertical and horizontal angle and channel bars 9 and the brick-work 8, and the usual heat insulation, closures and the like. The setting encloses a furnace chamber 7 in the lower portion thereof and the boiler generally indicated at 6 in the upper part thereof.

As shown in Fig. 1, the boiler comprises the usual steam and water drum 20. Connected to the bottom of the steam and water drum is a row of nipples 21. Connected laterally to the steam and water drum are horizontal circulating tubes 24. Connected to the circulating tubes 24 and the nipples 21 are upper lateral opposite rows of vertical headers 15 and 16, respectively. A row of tubular nipples 18 is connected to the row of headers 16 at the bottom. A row of tubular nipples 17 is connected to the row of headers 15 at the bottom. The nipples are surrounded by refractory blocks 19. The various tubular elements are suitably expanded into the headers. Each of the vertical headers is connected to one nipple. At the bottom of each nipple a lower header is connected thereto. There are opposite rows of lower headers 12 and 13. The headers of the row 12 are connected to the respective nipples 17. The headers of the row 13 are connected to the respective nipples 18. It will be seen that the header 15 is higher than the header 16 and that the header 12 is higher than the header 13. Nipples 21, headers 16, nipples 18 and headers 13 comprise a conduit for the passage of water downwardly from the drum 20 and hence may be termed downcomers, while headers 15, nipples 17 and headers 12 comprise a conduit for the passage of steam and water upwardly toward the drum 20, and hence may be termed upcomers.

A lower bank of horizontally inclined water tubes 11 connects the lower headers 12 and 13. An upper bank of horizontally inclined water tubes 14 connects the headers 15 and 16. There is an appreciable space between the two banks of water tubes in which is situated a superheater, presently to be described. It will be seen that the nipples 17 and 18, in effect, are spacers between the lower units comprising the tubes 11 and the headers 12 and 13, and the upper units comprising the tubes 14 and the headers 15 and 16. Each connected set of headers 12 and 15 and nipple 17 constitute an upflow water leg. Each group of connected headers 13 and 16 and nipple 18 constitute a downflow water leg.

The weight of the right-hand part of the boiler, as shown in Fig. 1, is supported by a cradle 90 carried on horizontal channels 91 forming part of the steel-work of the setting and in turn supported by vertical channels 92. The cradle 90 directly supports a mud drum 93, which is connected by nipples 94 to the headers 13. The weight at the opposite end or side of the boiler is carried by suspension from eye-bolts 95 suspended from across channels 96 carried by a vertical member 97 of the steel-work. Eye-bolts 95 are secured to headers 15. The weight of the lower headers 12 and associated parts is carried through the nipples 17 from the headers 15. If desired, additional supporting means may be supplied.

The channel 92 may be carried upwardly or some of the steel members 9 may be arranged to secure and support the transverse channel 33. The steam and water drum 20 may be suspended from overhead steel-work.

On top of the upper row of tubes of the lower bank 11 is a baffle 25, which extends from headers 13 to approximately midway of the interior of the boiler setting. From this point a vertical baffle 26 extends upwardly. Vertical baffle 26 and baffle 25 form an up-pass 29 between the baffle 26 and the nipples 17. Extending downwardly from the roof 23 of the boiler setting is a baffle 27, which extends through the upper tube bank 14 and terminates at the top of the interspace between the tube banks. An outlet 28 is provided for the products of combustion. All of the tubes of the lower bank 11 are exposed to radiant heat of the fire in the furnace 7. Products of combustion flow upwardly through the up-pass 29, thence downwardly through the down-pass between baffles 26 and 27, and thence upwardly in a second up-pass between baffle 27 and headers 16, and thence between nipples 21 and out through the outlet 28.

A steam offtake pipe 22 connects the top of the steam and water drum 20 with an upper header 30 of the superheater. Upper header 30 extends through the brick-work of the setting and the ends thereof are outside the setting, as shown in Fig. 2. Header 30 is adjacent baffle 26 and on the side thereof opposite to the up-pass 29. Thus, this header is protected from the intense radiant heat of the fire and the hot gases flowing through the up-pass.

Below inlet header 30 and having the same relative position with respect to baffle 26 and the up-pass is a lower superheater header 31. Lower header 31 likewise passes through the walls of the setting, and its ends are outside the setting as shown in Fig. 2. Connecting headers 30 and 31 are a plurality of rows of vertically disposed multi-loop elements, the leads of which pass through baffle 26 and extend within the up-pass 29, the bend portions thereof being adjacent the nipples 17 but spaced somewhat therefrom in order to allow for expansion. The loops of each superheater element are indicated 66, 67 and 68 respectively. Within upper superheater header 30 are two diaphragms 99 having drainage recesses 100 at the bottom thereof. Diaphragms 99 are so disposed that the number of tube connections to the header between them is equal to the sum of the tube connections laterally thereof. Within header 31 is a centrally disposed diaphragm 99, also having a drainage recess 100 at the bottom thereof. The steam to be superheated passes through the conduit 22 and into the left-hand end of header 30 (as shown in Fig. 2). The steam thence passes through a group of the superheater elements at the inlet side of the nearest diaphragms 99. The steam after passing through this group of superheater elements enters the header 31. Here the steam passes into a second group of superheater elements and returns therethrough to the space in superheater header 30 between the diaphragms 99. Thence the steam passes through a third group into header 31, to the right of the diaphragm in header 31, as shown in Fig. 2, and thence through a fourth group of superheater elements back to header 30, passing out through the right-hand end 104, as shown in Fig. 2, of header 30.

The superheater elements are arranged parallel to the boiler tubes, that is, the straight portions thereof are somewhat inclined from the horizontal.

The headers 30 and 31 of the superheater are supported adjacent their ends on the setting. Channel bars 33, forming a part of the steel-work of the setting and tightly secured to the other members of the steel-work as by rivets, extend horizontally along each side of the setting somewhat below the header 31 of the superheater. The ends of the header 31 rest on header crutches 34 mounted on the channels 33 and the header and supporting crutches are secured to the channel by means of U-bolts 35. The header 30 is supported at its ends by support frames 36 suitably carried by the setting 10 and secured to the channels 33. The ends of header 30 rest on header crutches 37 mounted on angle bars 38 which are secured to the support frames 36 and U-bolts 39 secure the header to the support frames 36. Refractory material 40 forming part of the baffle 26 protects the headers 30 and 31 and the connections of the elements 32 therewith from the intense heat of the products of combustion flowing through the first pass of the boiler.

The front end of the superheater, that is to say, the end opposite the header end, is supported on the vertical nipples 17 which connect the headers 12 and 15 of the lower and upper banks of tubes 11 and 14 or on the headers 12 or both. To this end, a plurality of supporting brackets 41 are bolted or otherwise secured to the lower ends of the nipples 17 as clearly shown. One suitable form of supporting bracket 41 comprises a channel member preferably of a length such that it will contact with two or more nipples. The channels are secured to the nipples by any desired means such as the bars 43 and bolts 44.

Each of the loops 66 of the superheater elements has a supporting foot 45 welded or otherwise secured thereto so that when the superheater is in position, the feet 45 will bear on the supporting brackets 41. It will be apparent that the dimensions of the supporting feet and brackets should be such as to allow ample expansion of the superheater and the adjacent boiler parts under the influence of the heat of the combustion gases. Spacers 69 and 70 are provided for the front and header ends of the elements to space the loops and the legs of each loop. The upper legs 71 of each loop are substantially straight while the lower legs 72 are arched upwardly or toward the upper legs of each loop as shown, to provide, with the spacers 73, a support for the intermediate portions of the upper legs 71. The upper front end of the superheater is steadied by the steadying clamps 65.

The brackets 41 may rest on headers 12 so that the weight of the superheater acts directly downwardly on headers 12, the bolts 44 merely serving to hold the brackets in place, or brackets 41 may be somewhat above headers 12 and carried entirely by nipples 17. In either event, the load is carried in direct vertical alignment with eye-bolts 95. The brackets are attached to the water leg of the boiler in such a way that the weight of the superheater acts directly downward on this water leg so that the load is carried in either direct or nearly direct vertical alignment with the boiler supports carrying this water leg. The steel-work of the setting rigidly connects the mountings for the superheater head-

ers and the boiler supporting steel work 90 so that there is no distortion due to expansion.

In this manner, so-called interdeck superheaters may be supported in position in the boiler entirely independently of the boiler tubes. The advantages of this type of superheater support are, among others, that the superheater imposes no load on the boiler tubes and causes no interference with boiler repairs. Additionally, the superheater supports are better cooled and thus reduce to a minimum the danger of the supports becoming overheated or burned out and thereby rendered unsafe.

In the form of superheater shown in Fig. 5, the superheater comprises a plurality of rows of vertically disposed, substantially U-shaped, nested elements 47 connecting the headers 30 and 31. The upper leg or branch 48 of each element 47 is substantially straight from the header 30 to the bend in the element, but the lower leg 49 of each element is arched upwardly or toward the leg 48 as shown. The superheater as a unit is supported independently of the boiler tubes in substantially the same manner as the superheater shown in Fig. 1, that is, by means of the supporting feet 45, supporting brackets secured to the front water leg and the spacers 46 adjacent the bend in the elements. In this case, however, the supporting brackets are in the form of castings 75, one of which is threaded onto each of the nipples 17 as shown. This bracket is shown to illustrate a variation only of its form and may be changed as best suits individual requirements.

Intermediate their ends, the legs 48 and 49 are spaced apart by means of spacers 50. A spacer 51, in substantial alignment with the spacers 50 serves to space the legs of the innermost elements of the superheater and further supports the upper legs 48 of the elements. The spacers are held in place by suitable means, preferably by lugs welded to the tubular elements. If desired, a plate or equivalent type of spacer may be used at this and other points. In this manner, the legs of the elements are prevented from sagging intermediate their ends. The arches therein prevent sagging of the lower legs 49 and, together with the spacers, prevent sagging of the upper legs 48.

In the form of superheater shown in Fig. 6, sagging of the legs of the elements is prevented and an intermediate support therefor is provided by utilizing the principle of the triangular truss in the superheater structure. The superheater comprises a plurality of rows of vertically disposed, substantially U-shaped, nested elements 52 connecting the headers 30 and 31, and the front end of the superheater is supported from the water legs substantially as in the forms shown in Figs. 1 and 5. As shown in Fig. 6, the upper leg 53 of each of the superheater elements is substantially straight. The lower leg 54 of the two outermost elements of each vertical row is also straight, while the lower legs 55 of the three inner elements are arched upwardly or toward the upper legs 53. Spacers 56 and 57 suitably space the elements at their U-bends and adjacent thereto, while spacers 58 space the upper and lower legs of the elements intermediate their ends and the spacer 59 spaces the legs of the innermost elements and supports the upper legs of the elements. It will be clear that the lower legs 54 of the outermost elements are subjected to tensile stress by the thrust of the arched legs 55 and serve as resistants to such thrust. The tension thus produced in the lower legs of these elements tends to prevent them from sagging. If desired, a support may be provided at this point which is suspended from the arched elements immediately above to prevent sagging if the tension is not sufficient to do so. The upper legs 53, being supported intermediate their ends by the spacer 59, are also prevented from sagging. As shown in Fig. 6, the lower legs of the two outermost elements in each vertical row are used as tension members, but it will be understood that the lower leg of the outermost element alone or the lower legs of more than two elements may be used if desired. The structure shown in Fig. 6 is particularly advantageous with relatively long superheaters.

As shown in Fig. 8, the supports in which the supporting feet 45 rest comprise a plurality of cast-iron blocks 76 and 77 which engage the nipples 17 and are retained in place by bridge members 78 and bolts 79. This bracket is also shown to illustrate one variant form and obviously the form may be changed to suit individual requirements.

Since changes may be made in the forms of the invention herein disclosed without departing from the principles of the invention, it will be understood the invention is not to be limited excepting by the scope of the appended claims.

What I claim is:

1. Heat exchange apparatus comprising a plurality of superposed tubular elements, and means for supporting one of said elements at its end portions, at least one of the elements being arched in an upward direction in an intermediate portion thereof to provide a support for the intermediate portions of the elements disposed above said one element.

2. Heat exchange apparatus comprising a plurality of superposed return bend tubular elements, means for supporting the lowermost element at its end portions, said lowermost element being arched upwardly in its intermediate portion, and means interposed between said arched portion and the element disposed immediately thereabove for supporting the intermediate portion of said last mentioned element.

3. Heat exchange apparatus comprising a plurality of superposed return bend tubular elements, and means for supporting the lowermost element at its end portions, said lowermost element and certain other elements disposed thereabove being arched upwardly in their intermediate portions respectively to provide supporting means for elements disposed above said arched elements.

4. Heat exchange apparatus comprising a plurality of nested U-bend tubular elements, and means for supporting the lower leg of the outermost element at its end portions, the lower legs of the elements being arched upwardly to provide supports for the upper legs of the elements to prevent sagging of the elements.

5. Heat exchange apparatus comprising a plurality of nested U-bend tubular elements, and means for supporting the lower leg of the outermost element at its end portions, the lower legs of the elements being arranged and supported in such manner as to form a triangular truss to support the upper legs of the elements and prevent sagging of the elements of the apparatus.

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