Oct. 13, 1953 I. L. LANGVAND 2,655,238

FLUID HEATER CASING

Filed Nov. 13, 1946 4 Sheets-Sheet 1

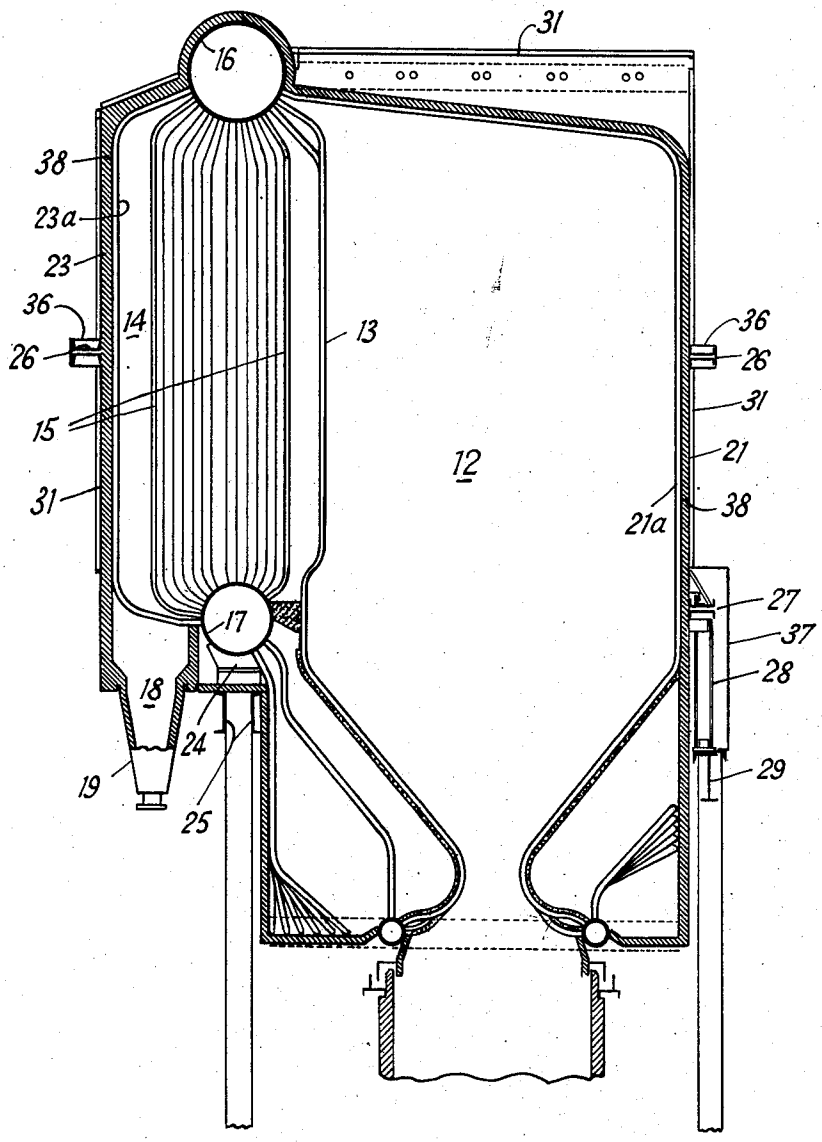


Fig. 1

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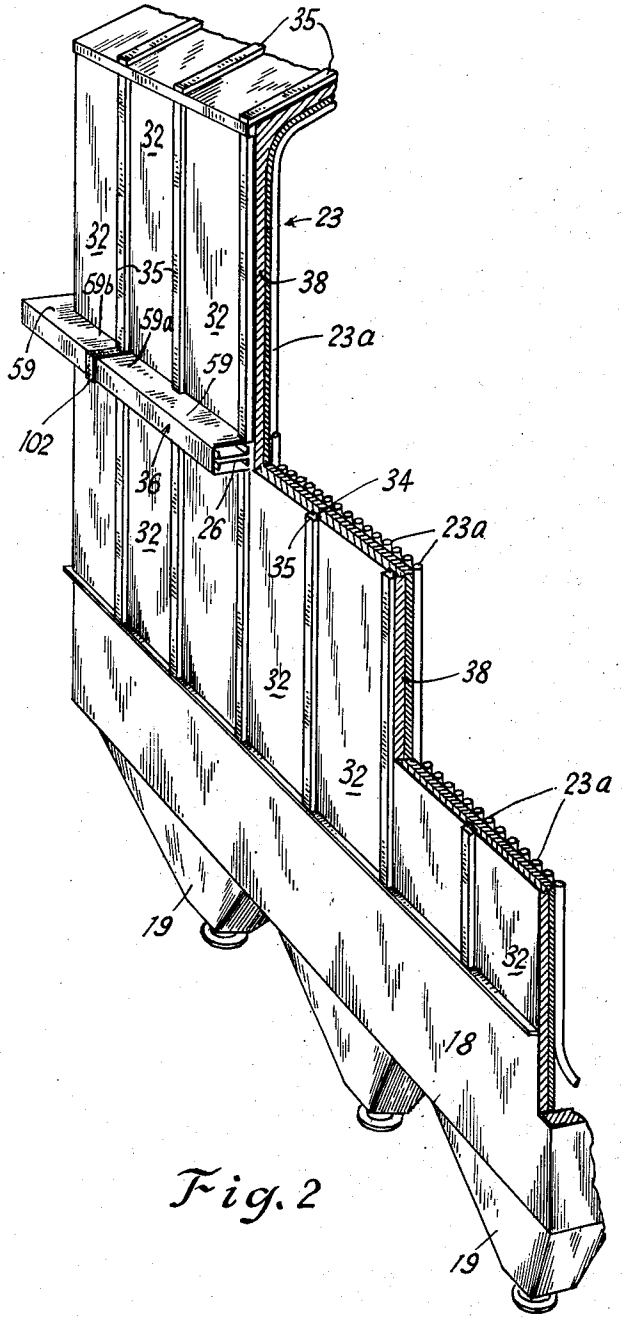


Fig. 2

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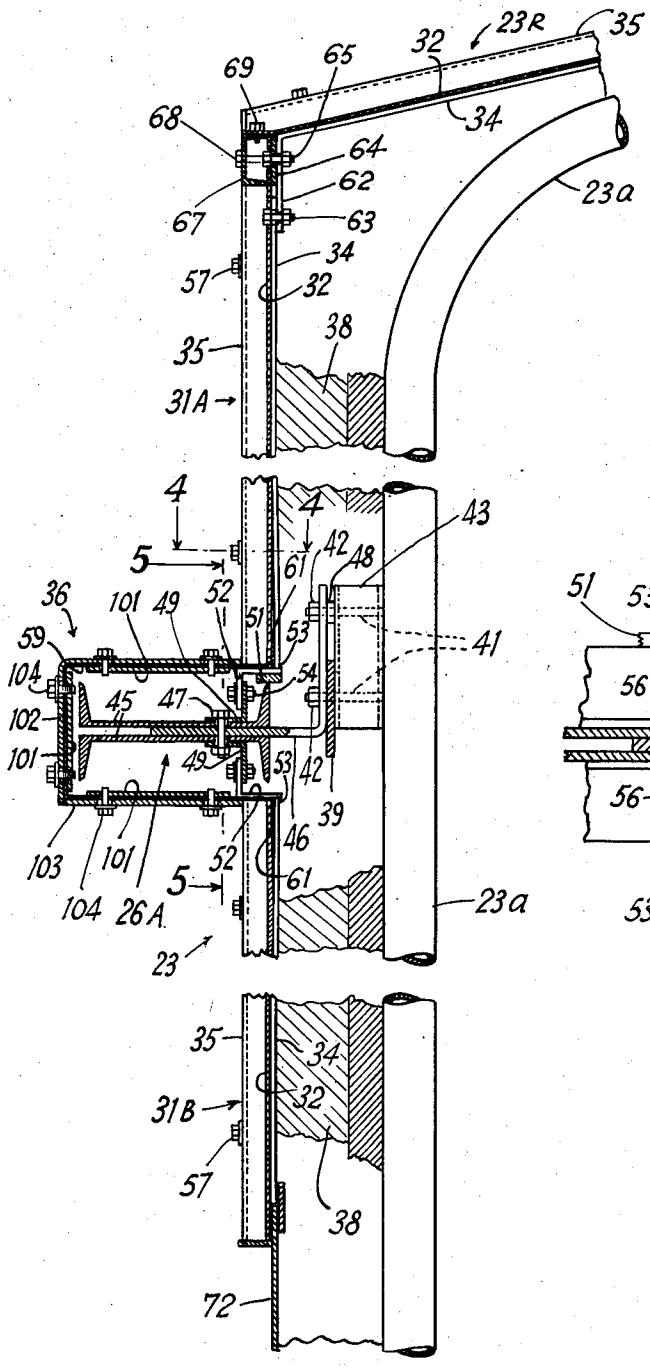


Fig. 3

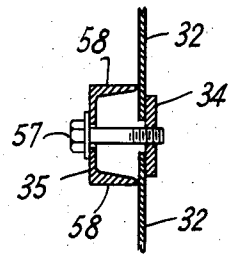


Fig. 4

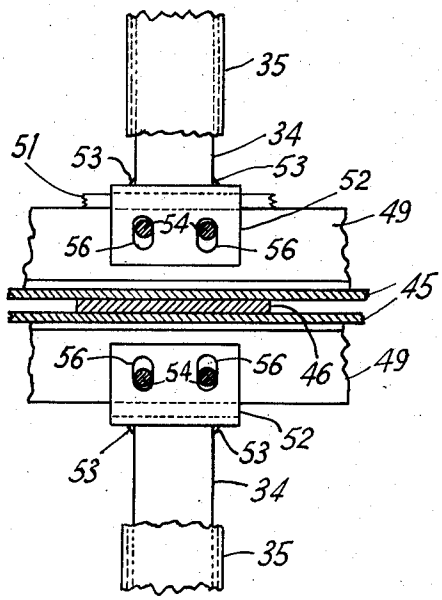


Fig. 5

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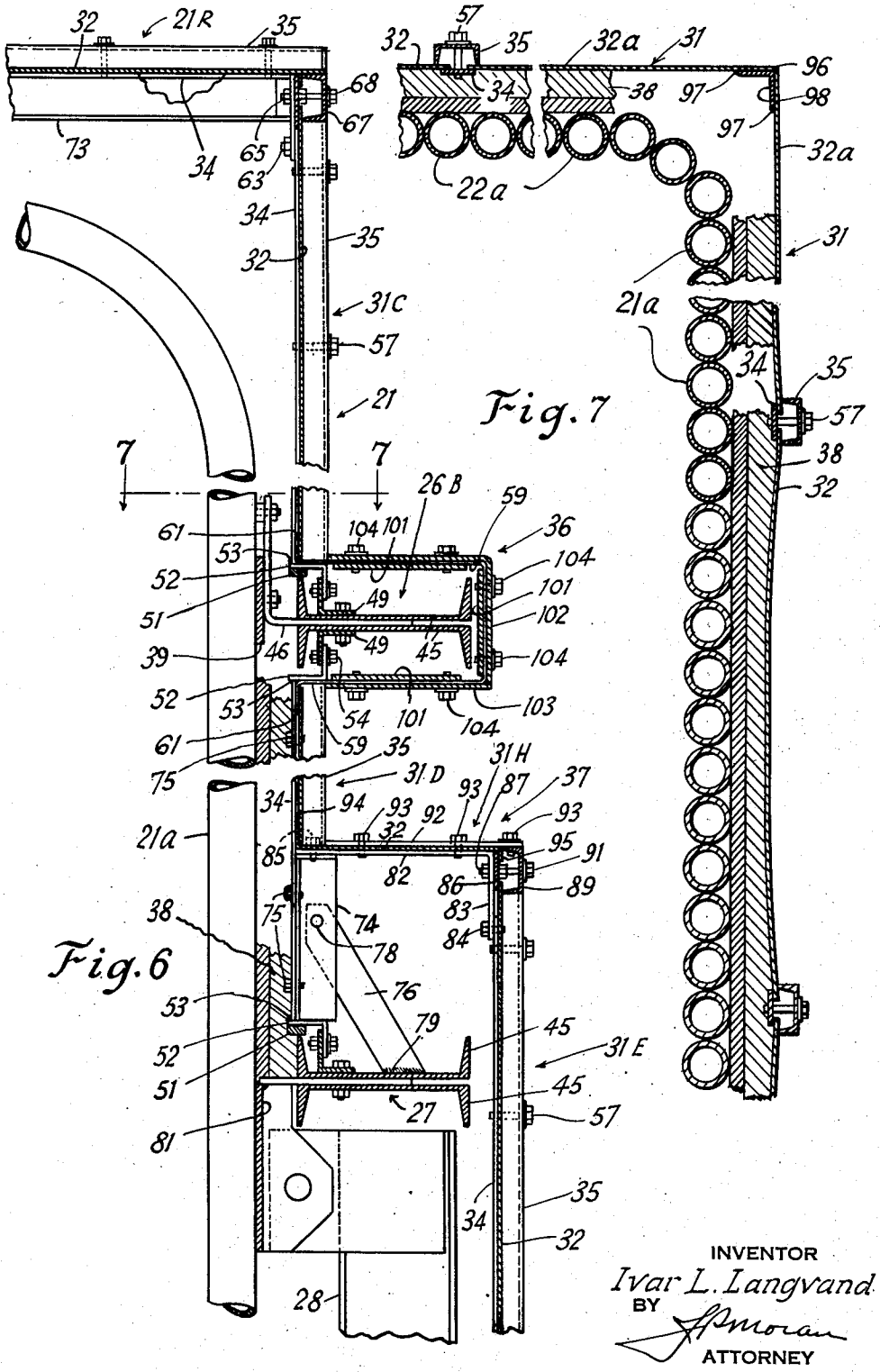


Fig. 7

Fig. 6

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2,655,238

UNITED STATES PATENT OFFICE

2,655,238

FLUID HEATER CASING

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Application November 13, 1946, Serial No. 709,568

4 Claims. (Cl. 189—34)

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The invention herein disclosed relates to a wall casing construction adapted for application to chambered structures of various types, particularly those in which the casing is to be maintained substantially gas-tight under varying temperature conditions. My invention is therefore especially useful in the construction of walls for fuel fired furnaces, and for fluid heaters in general whether supplied with heat from an associated fuel-fired furnace or, for example, from hot gases directed therethrough, such apparatus including boilers, superheaters, economizers, air heaters and the like.

An object of my invention is to provide a wall casing of relatively low material cost, utilizing for example panels of relatively thin plates or sheets, and supporting such plates or sheets in a manner facilitating their removal and reassembly when access is to be had to interior portions of the apparatus.

Another object is to provide a paneled casing construction wherein panels of commercially available flat metal plates or sheets may be utilized directly in the assembly without the need of preliminary machining, shaping, or other fabricating operations.

An additional object is to provide means for maintaining the casing substantially gas-tight at varying operating temperatures while permitting adequate expansive and contractive movement of component parts without distortion.

A further object is to utilize the inherent flexibility of thin metal plates or sheets in maintaining a gas-tight seal at their edges, and by the application of forces adjacent an edge of each such plate producing a resilient flexure to increase plate stiffness.

Other more specific objects include the support of a casing of paneled arrangement on fluid heating tubes; the provision of tube-supported separately expansible casing sections; and the provision of a gas-tight seal between such sections.

The various features of novelty which characterize my 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 my invention.

Of the drawings:

Fig. 1 is a sectional elevational view of a vapor generating unit having fluid cooled walls constructed in accordance with my invention;

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Fig. 2 is a fragmentary isometric view of the unit in Fig. 1, showing features of the exterior casing;

Fig. 3 is a fragmentary enlargement of Fig. 1 showing details of the wall construction adjacent a gas flow passage;

Figs. 4 and 5 are enlarged sections taken along lines 4—4 and 5—5 of Fig. 3;

Fig. 6 is a fragmentary enlargement of Fig. 1 showing details of the wall construction adjacent the combustion chamber; and,

Fig. 7 is an enlarged plan section taken along line 7—7 of Fig. 6 showing wall details adjacent a corner of the setting and along adjoining walls.

As illustrated, the invention is shown in connection with a steam generating unit or boiler of the type disclosed in my copending application Serial No. 653,843, filed March 12, 1946, wherein fuel is burned in a fluid cooled combustion chamber 12 and the resulting hot gases are directed around one end of a partition wall 13 into and through a fluid cooled gas passage 14 in contact with a main bank of boiler tubes 15 having opposite ends connected to upper and lower boiler drums 16 and 17, the cooled gases being discharged through a suitable gas outlet as described in my aforesaid prior application. A soot hopper 18 having a pluralty of discharge spouts 19 is arranged beneath passage 14 as a receptacle for solids separated from the gases during their flow through the passage.

As further disclosed in said application the boiler setting is generally rectangular in horizontal cross section and comprises fluid cooled front, rear and side walls which, in the unit as herein illustrated, include the fluid cooled side wall 21 having tubes 21*a* therein and constituting a boundary wall of the combustion chamber or furnace 12, and the fluid cooled side wall 23 having tubes 23*a* therein and constituting a boundary wall of gas passage 14, the walls 21 and 23 having upper end portions extended toward drum 16 to form the upper enclosing wall or roof.

The entire weight of the unit is supported on a frame-like structure disposed below the level of boiler drum 17, substantially in accordance with the disclosure in the copending application of Glen J. Schoessow, Serial No. 654,239, filed March 14, 1946, now Patent No. 2,583,599, patented January 29, 1952, the lower drum 17 being seated at each end in a saddle 24 supported on side frame member 25, and fluid cooled walls of the setting being laterally supported by com-

bination tie-bar and buckstay units 26 and 27 arranged at different elevations; the upper buckstay unit 26 extending completely around the setting and engaging all four walls, and the lower buckstay unit 27 at approximately mud drum level engaging the front, the rear, and one side wall 21 and terminating in ends secured to lower drum 17; the individual buckstay units or assemblies in adjoining walls being connected together at the corners of the setting so as to coordinate expansion and contraction of the respective walls; and the walls of combustion chamber 12 being vertically supported at substantially mud drum level by columns which transmit the weight to the supporting frame structure; for example, as herein illustrated for side wall 21, a column 28, illustrative of a plurality of such columns, being pivotally connected at its upper end to the lower tie-bar and buckstay assembly 27 and at its lower end to a side frame member 29.

The side walls and roof of the setting are enclosed in a metal casing 31 of novel construction comprising a plurality of separate plate members 32 having their adjacent edge portions clamped between inner and outer batten members 34 and 35 in a manner to be more fully described, certain portions of the casing being extended outwardly to form a housing 36 for the upper buckstay unit 26, and a housing 37 for the lower buckstay unit 27 and supporting columns 28. Each of the enclosing walls includes one or more layers of wall insulating material 38 suitably applied to the associated wall or roof tubes inwardly of the metal casing 31.

In side wall 23 adjoining the gas passage 14, the spaced upright wall tubes 23*a* are bonded together throughout the row by means of a continuous tie-bar 39 suitably secured thereto by means such as studs 41 welded to each tube and fitted with nuts 42, the studs 41 extending through channel-section spacer members 43 between which an inner heat refractory layer of the material 38 may be installed. The buckstay unit 26A for wall 23 comprises continuous channel members 45 arranged back-to-back and tied in to tie-bar 39 by a series of angle-form tie-bar clips 46 spaced at intervals throughout the horizontal extent of the wall, each clip 46 having its horizontal leg assembled between the pair of buckstay channels 45 and secured to web portions thereof by bolt 47, its vertical leg being secured to tie-bar 39 and to tubes 23*a* by studs 41, with a pipe spacer 48 interposed between the upper end of each clip 46 and the associated channel spacer 43. Continuous angle bars 49 are secured to the upper and lower sides of buckstay 26A, to provide support for the corresponding upper and lower sections 31A and 31B of casing 31, such bars 49 being secured by the same bolts 47 as for successive tie-bar clips 46.

In the upper casing section 31A, the casing plate members 32 are installed in a row against horizontally spaced batten bars 34 which overlap the edges of each pair of adjacent plates or sheets 32 at their inner sides, each batten bar 34 having its bottom end supported on a clip angle 52 to which the associated bar is welded as at 53, or otherwise suitably secured, and each clip angle 52 being secured to the upper continuous angle bar 49 by bolts 54 which extend through slotted holes 56 in each clip angle to provide a vertically expansible connection. A filler bar 51 is welded to the horizontal leg of each clip angle 52 to close the gap between the clip angles and the flange of upper buckstay channel 45 when channels of the smaller sizes are used, thereby providing positive support for the clip angles while maintaining the desired clearances between bolts 54 and the ends of slotted holes 56. At the outer sides of the row of plates 32 the adjacent edge portions of each pair of plates are clamped against batten bars 34 by outer batten members 35 which are held in clamping position by bolts 57 threaded into the inner batten members 34, as detailed in Fig. 4. Individual casing plates 32 are of widths providing an expansion space between the adjacent upright edges of each pair of plates in the row, additional to the space required for accommodation of the clamping bolts 57.

Each batten member 35 is suitably in the form of a channel having its flanges 58 symmetrically positioned with respect to the width of the corresponding inner batten bar 34 and contacting adjacent plate members 32 at locations beyond the side edges of bar 34. As an example of suitable relative dimensions, for casing plates or sheets of No. 10 gauge thickness, the inner batten member 34 may be a bar 2¼ inches wide, and the outer batten member 35 a 3-inch, 5-pound, standard channel. As a result of the relative sizes and positioning of the corresponding batten bars and channels, the force exerted by a channel 35, for example, is concentrated against an edge portion of a sheet 32 at a location offset from the location at which the opposing force exerted by bar 34 is applied. A force couple is thereby created adjacent one edge of the sheet which, in conjunction with suitable support of the sheet along its opposite edge, causes the given sheet 32 to be sprung inwardly, that is, toward the side of batten bars 34, as indicated in Fig. 7, and as a result of the flexure, the sheet becomes slightly curved throughout its width so that its rigidity is considerably increased. Thus, a relatively thin gauge panel 32, when assembled as described, is made the equivalent of a much thicker gauge panel insofar as stiffness is concerned. The resilient flexure of the sheet also results in tighter engagement of the sheet with wall insulation 38, while the increased stiffness substantially obviates vibration and drumming in addition to providing an appearance of ruggedness commensurate with the size of structure involved.

The upper end of each side wall batten bar 34 overlaps the downwardly extending flanged end 62 of a similar batten bar 34 associated with the roof casing section 23R, each side wall bar 34 being secured to the corresponding roof bar 34 by a bolt 63 for which the bolt hole in bar 34 is slotted to permit relative vertical expansion. A continuous collector bar 64 is secured to roof bars 34 by bolts 65 and serves to maintain both the roof bars 34 and side wall bars 34 in predetermined spaced relation adjacent their junctures. The upper edges of side wall casing plates 32 are clamped against collector bar 64 by a continuous collector channel 67 which is held in clamping position by bolts 68 threaded into the bar 64. The roof bars 34 have their ends adjacent drum 16 held in substantially fixed relation to said drum by suitable known means, not shown, and thus provide restraint against lateral movement of the side wall casing structure which is connected thereto. The roof casing plate members 32 are clamped between the roof batten members 34 and 35 which are symmetrically positioned and bear the same dimensional relationship to each other as the corresponding members 34 and

35 in side wall 23, the casing members 32 in the first or outer row being secured by bolts 69 to collector channel 67.

For the lower casing section 31B the clip angles 52 are connected to the lower side of buckstay 26A in the manner described for the attachment of clip angles 52 to the upper side except with respect to the vertical clearances provided between bolts 54 and the ends of slotted clip angle holes 56, as indicated in Fig. 5, where, in the case of the upper assembly the greater clearance is provided adjacent the lower end of each bolt hole and in the case of the lower assembly is provided adjacent the upper end of each bolt hole. In the lower casing section 31B, the batten bars 34 are connected at their upper ends to clip angles 52 by welds 53, while at their lower ends are welded or otherwise connected to the relatively stationary external metal plate 72 of soot hopper 18 and thus maintained in substantially fixed position.

The gas-tight housing 36 connecting the upper and lower sections 31A and 31B, respectively, comprises a transversely continuous wrapper plate 59 in the form of a trough or channel enclosing the upper, lower, and outer sides of buckstay unit 26A, the wrapper plate having an integral flange 61 along each of its upper and lower edges in contact with panel plates 32 in the respective adjoining casing sections 31A and 31B. The housing flanges 61 are assembled inwardly of casing plates 32 in both sections and thus between the casing plates 32 and batten bars 34 where they are held in sealing contact with plates 32 by the clamping action of batten channels 35. The wrapper plate 59 is suitably formed of relatively thin gauge metal preferably of a thickness less than the thickness of the main casing plates, for example, of No. 16 gauge as compared with a No. 10 gauge thickness of casing plates 32, thereby providing a degree of flexibility enabling the housing to perform its function as an expansible breather connection between adjacent casing sections without disrupting the integrity of the seal. Although the assembly of flanges 61 between plates 32 and batten bars 34 in each of sections 31A and 31B results in a slight separation between the plates and bars, for a limited distance above and below the edges of flanges 61, the channel members 35 still bear against the outer surfaces of plates 32 throughout their heights and any disadvantageous impairment of the seal is thereby avoided.

When it is necessary to form the housing or wrapper plate 59 in two or more sections because of the length of buckstay involved, the adjacent edges of each pair of housing plate sections, such as 59*a* and 59*b*, are overlapped interiorly by straight bars 101 at the upper, lower and outer sides, and exteriorly by an angle bar 102 at the upper and outer sides and by a straight bar 103 at the under side, each inner bar 101 being permanently secured to one of the adjacent sections to facilitate assembly, and the interior and exterior sets of bars being held in clamping position by bolts 104 as indicated.

In the opposite side wall 21, the tubes 21*a* are installed in tube-to-tube relation which reduces the thickness of wall insulation 38 required and thus enables the tie-bar 39 to be mounted directly on wall tubes, as shown, instead of being spaced therefrom, as in wall 23; otherwise, the tie-bar and buckstay assembly 26B is essentially a duplication of the corresponding assembly 26A described for side wall 23. The upper casing section 31C for side wall 21 is also, in all essential respects, a duplication of the corresponding upper casing section 31A for side wall 23, including the juncture with roof section 21R which at an intermediate position includes an I-beam stiffener member 73 as a substitute for one of the roof batten bars 34. Roof plates 32 are clamped against the upper flange of member 73, by a batten channel 35, in the same manner and with the same effect as against each batten bar 34.

The lower section of casing 31 for side wall 21 comprises an intermediate section 31D between buckstay housings 36 and 37, and a bottom section 31E forming part of the lower housing 37. The intermediate casing section 31D is supported on clip angles 52 bolted to the upper side of buckstay 27, each batten bar 34 for this section 31D having a welded connection 53 with a clip angle 52 attached to the upper buckstay 26B and extending downwardly within housing 37 to a similar welded connection 53 with its bottom-supporting clip angle 52 which is bolted to buckstay 27. Each such batten bar 34 is secured to a stiffener angle bar 74 by bolts 75, and each bar 74 braced from the lower buckstay unit 27 by a diagonally positioned bar 76 secured by bolt 78 to stiffener bar 74 and to the buckstay web by weld 79. The tie-bar 81 associated with the lower buckstay assembly 27 is mounted directly on wall tubes 21*a*, and wall weight transmitted therefrom through pivoted columns 28 to the foundation structure as hereinbefore mentioned.

The buckstay housing 36, which forms an expansible gas-tight connection between casing sections 31C and 31D, is a duplicate of the corresponding housing 36 in side wall 23 as previously described; in wall 21, the housing wrapper plate 59 having its upper and lower flanges 61 similarly assembled in overlapping relation to the adjacent ends of casing plate members 32 and the flanges clamped between such plate ends and batten bars 34 in the respective casing sections to form a seal.

The lowermost casing section 31E includes inner and outer batten members 34 and 35 of the same form and arrangement as described for other casing sections. The lower ends of batten bars 34 in section 31E are maintained stationary by welds, or other suitable form of attachment, to a part of the foundation structure such as side member 29. A horizontal casing section 31H connecting the upright casing sections 31D and 31E includes bars 82 having outer end flanges 83 which are connected by bolts 84 to the upper ends of batten bars 34 associated with the bottom casing section 31E, the inner ends of bars 82 being individually secured as by bolts 85 to the corresponding stiffener bars 74 and thus form a rigid assembly with the batten bars 34 of the intermediate casing section 31D. A collector bar 86 is secured by bolts 87 to the flanges 83 of bars 82 and serves as an inner transverse batten member against which the upper ends of casing plates 32 are clamped by a collector channel 89 held in clamping position by bolts 91. Horizontally disposed casing plates 32 are supported on bars 82 with adjacent edges of each pair of plates laid over an inner batten bar 82 so as to be overlapped thereby, and each two such edges clamped in position by an outer batten bar 92 secured by bolts 93 to bar 82 and collector channel 89. The horizontal casing plates 32 are formed along their inner edges with an upstanding flange 94 which is clamped between the casing plate members 32 and batten bars 34

of intermediate section 31D, and along their outer edges with a depending flange 95 which is clamped between collector bar 86 and collector channel 89 at the juncture with section 31E.

Fig. 7 shows a plan section of the casing arrangement adjacent a corner of the setting where casing 31 is spaced from the rows of side wall tubes 21a and rear wall tubes 22a to allow for the required thickness of wall insulation 38. End plates 32a in both walls are joined by a weld 96 along their meeting edges, and further are welded at 97 to the legs of stiffener angle bar 98, thereby providing a corner seal and affording rigidity to the casing at the juncture of two walls.

Walls constructed in accordance with the described invention thus include a number of desirable features such as the provision of a gas-tight enclosure or casing while allowing freedom of movement of associated wall elements due to thermal expansion and contraction including, for example, heat transfer tubes by which the casing is supported; provision being also made for relative expansion and contraction of casing plate members in adjacent panels, and for movement of one casing section relative to another. The panel construction of casing is also advantageous from an economical standpoint in that commercially available plain metal plates or sheets may be utilized directly in the assembly without preliminary fabrication as usually required. In the present construction, such operations as forming, machining and welding are limited mainly to the fabrication of panel wall elements by which the casing plate members are supported and held in operative position, thereby making it possible to construct the casing at reduced cost without sacrificing quality of construction as determined by its continued gas-tightness and pleasing appearance in service.

It is to be understood that in the present specification, the term "plate members" as applied to elements of the casing, and particularly as used in the claims, is intended to cover members that are commercially known as "plates" and "sheets."

While in accordance with the provisions of the statutes I have illustrated and described herein the best form of my 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 my claims, and that certain features of my invention may sometimes be used to advantage without a corresponding use of other features.

I claim:

1. A casing comprising separate relatively flexible planar plate members arranged in a row and each having substantially parallel opposite free edge portions arranged transversely of the row, a framework against which said plate members are assembled comprising parallel bar-like batten members of rigid rectilinear formation engaging the inner side of said plate members and each overlapping the adjacent free edge portions of a pair of said plate members, substantially throughout the extent of said portions transversely of the row, batten members of rigid rectilinear channel-like cross section each having flanges extending substantially normal to said plate members and terminating in edges engaging the outer side of said plate members solely at locations symmetrical with and oppositely displaced longitudinally of said row from the total area engaged by one of said inner side batten members, and means holding said inner and said outer side batten members in clamping engagment with said plate members with sufficient force to effect resilient flexure thereof toward the inner side of said casing and thereby increase plate member stiffness.

2. In a wall having heat insulating material installed adjacent the outer surface of said wall, a paneled casing disposed outwardly adjacent said heat insulating material, said casing comprising separate panels of substantially planar flexible metal plates spaced in a row and providing free edge portions arranged transversely of the row, a rigid casing supporting structure comprising a row of spaced batten bars disposed in a plane adjacent the inner side of said plates and each over-lapping the adjacent free edge portions of a pair of said plates substantially throughout the extent of said portions transversely of the row, outer batten members disposed in a plane adjacent the outer side of said plates and each overlapping adjacent free edge portions of a pair of said plates in common with one of said bars, said outer batten members each providing a pair of transversely spaced ribs laterally adjoining an intermediate recessed major width portion of each member, said ribs of each outer batten member terminating in edges bearing against adjacent free edge portions at the outer side of a pair of said plates at locations oppositely displaced longitudinally of said row from the width of a batten bar overlapping the same edge portions at the inner side, and means separately connecting each outer batten member to the corresponding inner batten member for exerting a clamping force of sufficient magnitude inwardly against each of said outer batten members to cause adjacent plates to be flexed inwardly into resilient contact with said wall insulation, said clamping force being applied through said rib edges against the outer side of said plates in opposed offset relation to the reactive forces applied by each of said batten bars against the inner side of said plates.

3. In a wall having heat insulating material installed adjacent the outer side thereof, a paneled casing disposed outwardly adjacent said heat insulating material and comprising sheet metal plates of substantially planar formation spaced apart in a row and terminating in said row in free marginal edge portions arranged transversely of the row, rigidly formed rectilinear inner and outer batten members confined respectively to the inner and outer sides of said plates and disposed respectively in rows adjacent said opposite sides and each of said members overlapping and engaging adjacent spaced free edge portions of a pair of said plates, substantially throughout the extent of said marginal edge portions transversely of the row, said outer batten members each bearing against said plates at the outer side solely at locations oppositely displaced longitudinally of said row beyond the locations of engagement by said batten members at the inner side, and means for effecting inward flexure of said plates into resilient contact with said wall insulation comprising tension members extending between adjacent spaced free edge portions of successive plates and separably and adjustably connecting said inner and outer batten members in clamping relationship to said plates.

4. In a heating gas chamber enclosure, a paneled casing comprising substantially flat resilient plate members of rectangular form arranged in a row and each terminating in parallel free edge portions extending transversely of the

row, a stationary support for said casing comprising elongate rectilinear support members arranged in pairs parallel to said edge portions, with the members of each pair disposed along opposite sides of said plate members and each overlapping and engaging adjacent edge portions of a pair of said plate members at a different one of said sides, one member of each pair being of rigid channel-like formation and providing spaced flange portions extending substantially normal to adjacent plate members at the outer side thereof, the other member of each pair being of rigid bar-like formation and overlapping adjacent plate members at the inner side thereof throughout a width less than the distance between said flange portions at said outer side, and means for maintaining each pair of said support members in engagement with a pair of said plate members with sufficient force to effect flexure of said plate members toward the chamber side of said casing.

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