This invention relates to the construction of vapor generators and the like and, more particularly, to the construction of an improved buckstay arrangement for vapor generators and the like.

In the construction of vapor generating units, the gas chamber of such units is generally enclosed by vertically oriented fluid-cooled tubes which form walls. Buckstays, in the form of beams, rafters, or other strut-like shapes, generally encompass the generator engaging all four walls, and are arranged to take or withstand lateral forces imposed on the wall by wind, internal pressure, and other such forces.

In modern vapor generators, a wall construction for the combustion chamber and gas flow passages is conventionally used in which the buckstays are disposed outside of the generator wall insulation. In this way, the buckstays are exposed to ambient temperature conditions. At one time, such buckstay construction utilized a tension tie which was located behind the buckstays and was welded to the tubes. At each corner, a corner bracket was welded to the corner of the tube wall and also to the two tension ties which meet at the respective corner. Linkages, oftentimes in the form of various bars and pins, connected with the corner bracket and the ends of the two adjacent buckstays. This construction, utilizing welded tension ties and corner brackets, is not only expensive but generally requires very close tolerances, particularly in the linkages, which results in difficulties during field erection.

A recent improvement over the earlier design has been the use of a plurality of suspended tension rods behind the buckstays which are connected to the ends of the two adjacent buckstays. This design, although an improvement over the early construction, is still unduly expensive and complex.

Therefore, it is an object of this invention to provide an improved wall and buckstay arrangement which is simpler and less expensive to erect.

Another object is to provide an improved wall and buckstay arrangement which requires a minimum of shop assembly and parts.

A feature of this invention resides in the use of a single tension cable independently suspended behind a buckstay. Each tension cable is connected to the ends of the two buckstays at approximately right angles to the respective tension cable. Since all the tension rods behind the buckstays lie in a common plane, a cross-over means, preferably in the form of a turnbuckle, is utilized. The buckstays are suspended from the walls of the vapor generator so as to permit separate parallel movement of the wall and the buckstay. The tension rods are located within the means for suspending the buckstays which suspension means includes a means for retaining the tension rods against the wall of the vapor generator.

The invention may be better understood from the following detailed description considered in conjunction with the accompanying drawings in which:

FIGURE 1 is a perspective view partially broken away of a corner of a vapor generating unit incorporating the novel buckstay arrangement in accordance with this invention.

FIGURE 2 is a side elevation in cross section of a vapor generating unit with the outside covering removed incorporating a buckstay arrangement in accordance with this invention.

FIGURE 3 is a top sectional view of a steam generator utilizing the invention and having the internal tubes removed.

FIGURE 4 is a cross-sectional view along line 4-4 of FIGURE 3 showing the details of a clip arrangement utilized in accordance with this invention with the insulation and outside covering removed.

FIGURE 5 is a cross-sectional view along line 5-5 of FIGURE 4.

FIGURE 6 is a partial top sectional view of a corner of a steam generator utilizing the invention and showing the position of the invention and the steam generator when heated from operation.

FIGURE 7 is a partial top sectional view similar to FIGURE 6 but showing the position of the invention and the steam generator when cold.

Although the vapor generator illustrated in FIGURE 2 is of relatively low capacity, the invention is useful on generators of many sizes and also for apparatus such as superheaters, economizers, and air heat exchangers where support of the components of the unit is required. The outside of the vapor generator includes four main enclosure walls 11 which are vertically oriented. The four main enclosure walls 11 include two separate pairs of oppositely disposed vertical walls extending between one another and joined together. The vapor generator is provided with a fluid-cooled combustion chamber 12 fired by burners 14. The burners 14 can burn any suitable fuel. The chamber 12 is enclosed in part by a front wall 16 in which the burners 14 are located and a roof 18, a floor 20, and a partition 22. The front wall 16, the roof 18, the floor 26, and the partition 22 are all formed with tubes 24 having fins 26 welded between them. However, by omitting the fins 26 in the upper section 28 of the partition 22, the hot gases of combustion flow out of the chamber 12. A superheater passageway 30 is formed between the partition 22 and a first wall 32. The hot gases leaving the chamber 12 ow into the superheater passageway 30. A lower section 34 of the first wall 32 also fabricated from the tubes 24 has the fins 26 removed to permit flow of the gases into an upward passageway 36 as shown by the directional arrows. The upward passageway 36 is formed between the first wall 32 and a second wall 38. An upper section 40 of the second wall 38 of tubes 24 has the fins 26 removed to permit flow of the gases into a downward passageway 42. The downward passageway 42 of the second wall 38 of tubes 24 has the fins 26 removed to permit flow of the gases into the downward passageway 42. The downward passageway 42 is formed between the second wall 38 and a rear wall 44 of tubes 24. An opening 46 located at a lower section of the rear wall 44 permits the hot gases to flow to a stack (not shown). Located within the upward passageway 36 and downward passageway 42 are tubes 24 but without fins 26. Within the superheater passageway 30, a superheater bank 46 is located. On the opposite side of the partition 22, a reheater bank 48 is located. At the top of the vapor generator, the vapor-liquid mixture is collected in a steam drum 50 and the liquid is returned through the tubes 24 to a water drum 52 at the base of the generator. The tubes 24 within the side walls 54, extend from lower side wall headers 56, which are connected to the water drum 52 to upper side wall headers 58, which in turn are connected to the steam drum 50. The four main enclosure walls 11, previously referred to, include the front wall 16, the side walls 54, and the rear wall 44. Surrounding the main enclosure walls 11 are buckstays 61. The buckstays 61 are located at two levels, namely a lower buckstay.
arrangement 63 and an upper buckstay arrangement 69. The upper buckstay arrangement 69 and the lower buckstay arrangement 63 are similar except that in the lower arrangement 63, a truss 65 is utilized along the front wall 16 due to the need for a wind box 67.

In the upper plane there is located along the front wall 16 a front I-beam 60. Side I-beams 62, 64 are located along the two side walls 54. A rear I-beam 66 is located along the rear wall 44. At both ends of all the buckstays 68 the tubular connector 68 which is preferably secured to the buckstays 61 by welding. The ends of the buckstays 61 extend just slightly beyond the two walls adjoining the wall against which respective buckstay 61 is located. The tubular connectors 68 are located horizontally with their longitudinal axis perpendicular to the plane of the wall against which their respective buckstay 61 is located. The buckstays 61 are placed with the webs 70 of the I-beams in a horizontal position and with their outside flanges 72 and inside flanges 73 vertically oriented.

As best seen in FIGURES 4 and 5, there are welded to the inside flanges 73 buckstay L-shaped clips 74. The sections 75 of the clips 74 welded to the inside flanges 73 are parallel to one another while the sections 76 perpendicular to the welded sections are also parallel to one another but pointing in opposite directions and away from one another. Pairs of fin L-shaped clips 77 are welded to the fins 26. The sections 78 of the clips 77 welded to the fins are at approximately the same distance from each other with the fin clip 77 directly above the other fin clip 77 and with perpendicularly extending sections 79 being parallel in a common plane and directed toward each other. Each pair of buckstay clips 74 is spaced to have the extending sections 76 of the angles 74 behind the extending sections 78 of the fin clips 77 and the buckstay clips 74 extend a much larger distance along the buckstays 61 to permit horizontal expansion of the I-beams 61. In this way the I-beams 61 are secured to the walls but are still able to move horizontally in relationship to the wall behind it. The clips 77 are spaced so that their webs 11 to provide adequate support for the buckstays 61.

Located behind the buckstays 61 are tension rods 81. Suspended behind the front I-beam 60 is a front tension rod 80. Suspended behind the first side I-beam 62 is a first side tension rod 82 while a second side tension rod 84 is independently suspended behind the second side I-beam 64. A rear cable 86 is located behind the rear I-beam 66. The side tension rods 82, 84, which form one pair of tension rods, extend from the tubular members 68 attached to both ends of the front I-beam 60 and the rear I-beam 68. The front and rear tension rods 80-86, which form another pair of tension rods, extend from the tubular members 68 attached to both ends of the front I-beam 60 and the rear I-beam 66. At each corner, a turnbuckle 90 is located which has an opening 92 therein sufficiently large to permit the tension rod 81 crossing it to fit through it. The use of the turnbuckles 90 is necessitated because the tension rods 81 are located in a common plane. By locating two turnbuckles 90 in each of the two side tension rods 82, 84 the front and rear tension rods 80, 86 can pass through them. However, the turnbuckles 90 could be located in the front and rear tension rods 80, 86 or in any combination providing there is a turnbuckle 90 at each corner where two tension rods 81 cross. Both ends of the tension rods 81 are threaded and nuts 91 draw the tension rods 81 into tension between two I-beams 61.

Between the I-beam clips 74 and adjacent the inside flange 72 an angle or other strengthening member 92 is welded in place. Besides strengthening the clips 74 the angle 92, as best seen in FIGURE 4, serves to maintain the tension rods 81 in sliding contact with the fin-tube enclosure walls 11 so that the tension rods 81 are heated by the walls 11. As best seen in FIGURE 6, the tension rods 81 bow outwardly at the ends when the steam generator is cold due to the presence of angles 92 adjacent each corner. As also shown in FIGURE 6, the tension rods 81 straighten as the walls 11 expand from heating. The tension rods 81 also expand as they absorb heat from the walls. Short lengths of bar stock 93 are welded to the angles 92 to support the tension rods 81. However, the tension rods 81 are not secured to the walls 11 and are otherwise independently suspended.

As is shown in FIGURE 1, sheet insulation 94 is fitted against the walls 11 and around the clips 77 and the tension rods 81. On the outside of the I-beams, a covering sheet metal is used to enclose the unit. At every corner a removable shield 96 is used to complete the enclosure.

Although the invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and scope of the invention is hereinafter claimed.

What is claimed is:

1. A vapor generator or the like comprising:
   a first pair of oppositely disposed vertical walls;
   a second pair of oppositely disposed vertical walls extending between said first pair of walls and joined thereto to define a chamber for hot gases;
   buckstays extending transversely adjacent each of said walls, each of said buckstays having end portions which extend beyond the ends of the corresponding wall;
   means supporting said buckstays in a spaced relationship to said walls, said supporting means including means to permit differential transverse thermal expansion between said walls and said buckstays;
   a first pair of tension rods having a circular cross section and extending adjacent said first pair of walls and connected to the corresponding end portions of the buckstays adjacent said second pair of walls, and a second pair of tension rods extending adjacent said second pair of walls and connected to the corresponding end portions of the buckstays adjacent said first pair of walls, said first pair of tension rods and said second pair of tension rods lying in a common plane; and turnbuckles means on said tension rods to permit crossing of said tension rods in said common plane adjacent the junction of said first and second vertical walls.

2. A furnace for a steam generator or the like as set forth in claim 1 wherein said means for supporting said buckstays includes two pairs of interlocking L-shaped clips.

3. A vapor generator or the like comprising:
   a first pair of oppositely disposed vertical walls;
   a second pair of oppositely disposed vertical walls extending between said first pair of walls and joined thereto to define a chamber for hot gases;
   a first pair of I-beams extending transversely adjacent each of said first pair of walls, each of said first pair of I-beams having end portions which extend beyond the ends of the corresponding wall;
   a second pair of I-beams extending transversely adjacent each of said second pair of I-beams having end portions which extend beyond the ends of the corresponding wall, said first pair and said second pair of I-beams having main webs lying substantially in a common horizontal plane; and
   a first set of four tubular connectors, each of said first set secured to a separate end of each I-beam of said first pair of I-beams; and a second set of four tubular connectors, each of said second set secured to a separate end of each I-beam of said second pair of I-beams, each tubular connector of both said first set and said second set having a longitudinal axis which lies substantially
in a horizontal plane and is substantially perpendicular to the corresponding wall of the I-beam to which the tubular connector is secured;
a first pair of tension rods having a circular cross section and extending adjacent said first pair of walls and through said second set of tubular connectors, the end portions of said first pair of tension rods extending through said second set of tubular connectors and being threaded;
a first set of nuts in meshing relationship with the threaded end portions of said first pair of tension rods to draw said first pair of tension rods in tension;
a second pair of tension rods having a circular cross section and extending adjacent said second pair of walls and through said second set of tubular connectors, the end portions of said second pair of tension rods extending through said first set of tubular connectors and being threaded, said first pair of tension rods and said second pair of tension rods lying in a common plane; and turnbuckle means on said tension rods to permit crossing of said tension rods in said common plane adjacent the junction of said first and second vertical walls;
means including two pairs of interlocking L-shaped clips to support said I-beams in a spaced relationship to said walls and to permit differential transverse thermal expansion between said walls and said buckstays;
means including outside pair of L-shaped clips secured to said first and second pairs of I-beams and inside pairs of L-shaped clips secured to said first and second pairs of vertical walls, said outside and inside pairs of L-shaped clips being interlocked to support said I-beams in a spaced relationship to said walls and to permit differential transverse thermal expansion between said walls and said buckstays; and
means secured to said outside pairs of L-shaped clips to retain said first and second pairs of tension rods against the first and second pairs of vertical walls.

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