April 26, 1932. J. S. BENNETT 1,856,036

WATER WALL AND AIR COOLED REFRACTORY CONSTRUCTION

Filed Oct. 22, 1928 3 Sheets-Sheet 1

Fig. 10

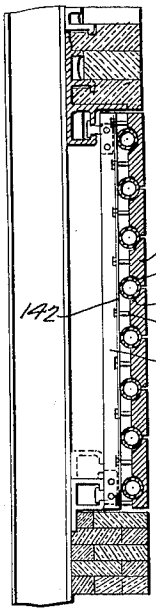

Fig. 1

Inventor:—
Joseph S. Bennett.
by his Attorneys.
Howson & Howson

April 26, 1932. J. S. BENNETT 1,856,036

WATER WALL AND AIR COOLED REFRACTORY CONSTRUCTION

Filed Oct. 22, 1928 3 Sheets-Sheet 2

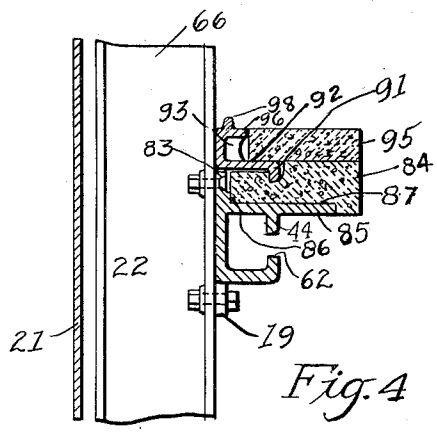

Fig. 4

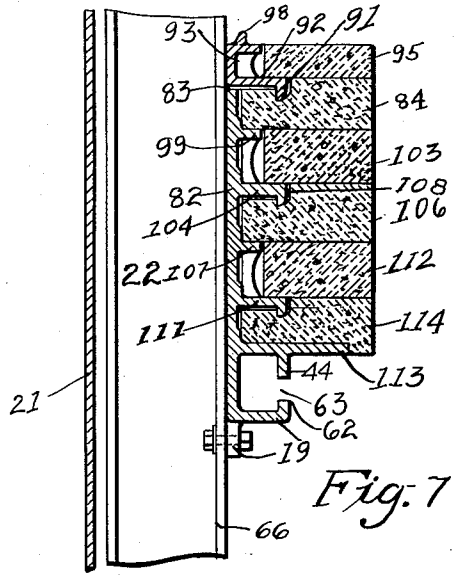

Fig. 7

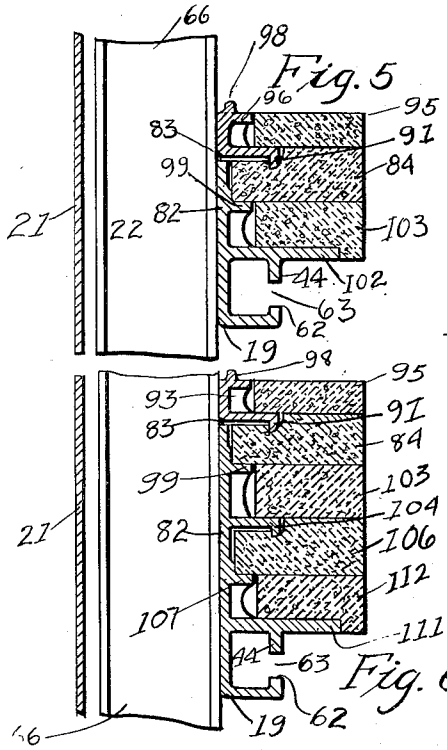

Fig. 5

Fig. 6

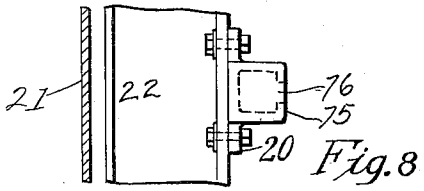

Fig. 8

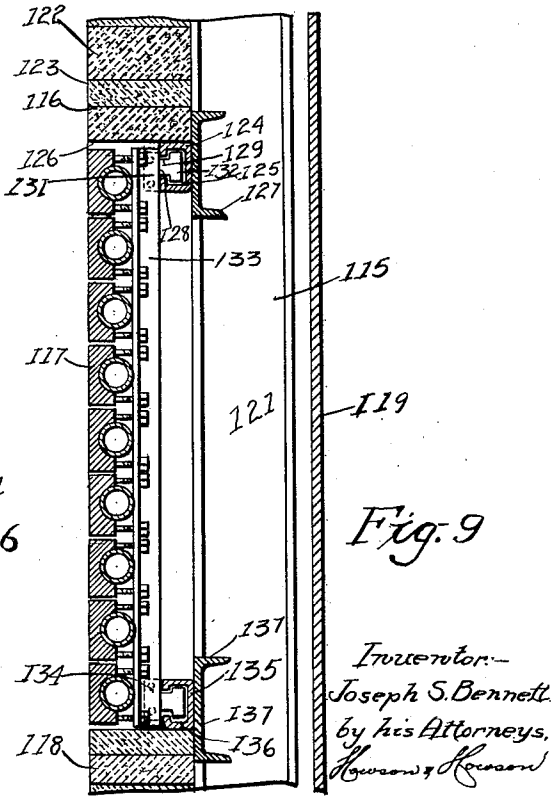

Fig. 9

Inventor:-
Joseph S. Bennett
by his Attorneys,
Howson & Howson

April 26, 1932. J. S. BENNETT 1,856,036

WATER WALL AND AIR COOLED REFRACTORY CONSTRUCTION

Filed Oct. 22, 1928 3 Sheets-Sheet 3

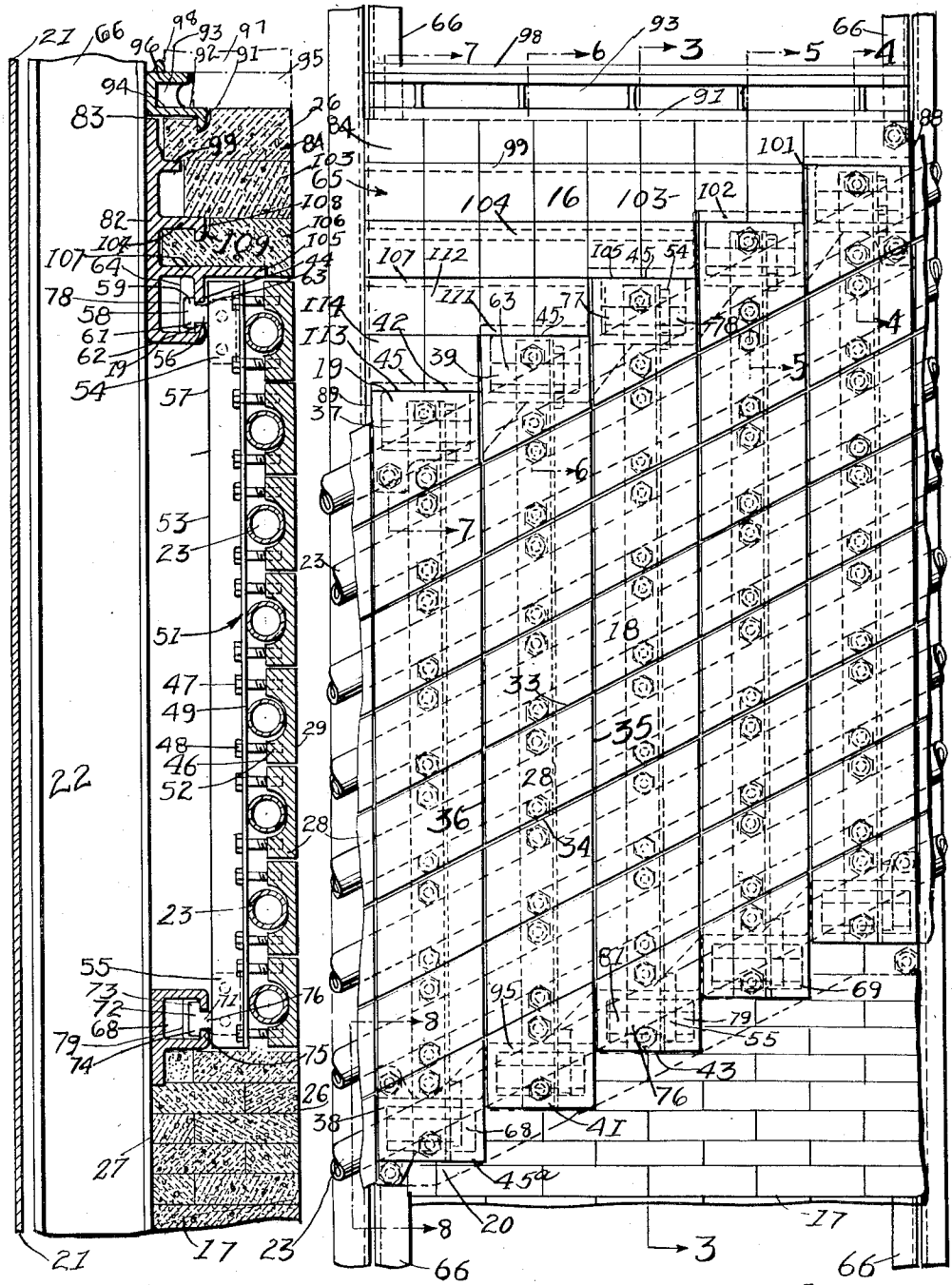

Fig. 3

Fig. 2

Inventor:-
Joseph S. Bennett
by his Attorneys
Howson & Howson

Patented Apr. 26, 1932 1,856,036

UNITED STATES PATENT OFFICE

JOSEPH S. BENNETT, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO AMERICAN ENGINEERING COMPANY, OF PHILADELPHIA, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA

WATER WALL AND AIR COOLED REFRACTORY CONSTRUCTION

Application filed October 22, 1928. Serial No. 314,098.

My invention relates to wall constructions, having particular relation to furnace walls.

In its broad aspect, one object of my invention is to provide a simple and efficient furnace wall, wherein water and air-cooled means are provided for the purpose of maintaining the walls at a safe working temperature and for reducing to a minimum radiation losses therethrough.

A more specific object of my invention is to provide a furnace wall with a protective panel structure, which extends up to a line just above the level of the fuel bed, and also with a secondary wall which is spaced therefrom, so that an air passage may be provided extending over the panel structure.

Another object of my invention is to provide a furnace wall comprising an open supporting frame, a brickwork portion, a panel portion, and means whereby the brickwork portion may be removably carried by the open supporting frame, said means also constituting a support for the panel, maintaining the same in desired alignment with the brickwork portion, while permitting lengthwise expansion thereof.

Still another object of my invention is to provide a bracket construction, wherein a plurality of supporting and locking flanges are provided for the brickwork portion of the wall and movable supporting means afforded an adjacent fluid-cooled panel structure.

With these and other objects and applications in mind, my invention further consists in the details of construction and arrangement, hereinafter described and claimed and illustrated in the accompanying drawings, wherein

Fig. 1 is a vertical, longitudinal sectional view of a furnace embodying my invention;

Fig. 2 is an enlarged detail, side elevational view of a furnace wall;

Fig. 3 is a transverse sectional view taken on the line 3—3 of Fig. 2;

Figs. 4, 5, 6 and 7 are transverse sectional views taken respectively on the lines 4—4, 5—5, 6—6 and 7—7 of Fig. 2;

Fig. 8 is a similar view taken on the line 8—8 of Fig. 2;

Fig. 9 is a transverse sectional view, similar to Fig. 3, of a modification; and

Fig. 10 is a view similar to Fig. 9 of another modification.

Referring to the drawing, an inclined multiple-retort automatic stoker 1 of the underfeed type extends rearwardly from the furnace opening 2 in a front wall 3 to a main supporting beam 4. A rear end 5 of the stoker 1 is spaced from an adjacent rear wall 6 of the furnace to provide an ash pocket 7.

The stoker 1 may comprise a plurality of series of inclined tuyères 8 and a corresponding plurality of series of retorts 9 alternating therewith, only one series of each being shown. A sufficient number of series of tuyères 8 and retorts 9 is provided to extend across the width of the furnace between side walls 11, 11, of which only one, however, has been shown. A fuel bed may be built up on the grate surface afforded by the inclined stoker 1, as shown in dot-and-dash lines in Fig. 1, and slowly moved rearwardly by means of a series of pushers 12 which are actuated by mechanism 13 forming no part of the present invention. The retorts 9, in which the pushers 12 are contained, may receive fuel from a hopper 14 positioned on the outside of the furnace.

In accordance with my invention, each of the side walls 11, 11 may comprise broadly an open supporting frame 15; means for closing an inner side of the open frame 15 comprising an upper inner wall portion 16 of removable brickwork, a lower inner wall portion 17, an intermediate inner wall portion 18 elongated to form a panel, an upper bracket member 19 for supporting the upper wall portion 16 and the panel 18, and a lower bracket member 20 for also supporting the panel 18; and means for closing an outer side of the open frame comprising an outer wall portion 21, whereby an air passage 22 may be formed through the open frame 15.

The panel portion 18 is of relatively small width compared to its length and is so positioned as to extend from a line immediately adjacent to the bottom of the retorts 9 to a

second line just above the upper level of the fuel bed. The inclination of the panel is approximately equal to that of the stoker 1 or the tuyère line thereof and the length is such that it extends from the front wall 3 to the rear wall 6. The panel 18 is thus positioned in that portion of the furnace wall which is directly subjected to wear and deterioration due to the movement of the fuel bed, as well as the intense heat thereof.

As set forth in my co-pending application, Serial No. 219,706 filed September 15, 1927, and assigned to the American Engineering Company, the elongated panel portion 18 comprises a plurality of inclined pipes 23 which extend from an upper front header 24 to a lower rear header 25. These pipes are positioned in spaced relation and in a common vertical plane between inner and outer sides 26 and 27, respectively, of the inner wall portions 16, 17. Protection is afforded the pipes 23 against the direct heat of the furnace, as well as contact with the fuel bed, by means of a plurality of blocks 28 of cast iron or refractory material.

The protective blocks 28, which provide an inner fuel-abutting surface 29, are positioned in side-by-side, as well as superposed relation, forming a plurality of vertical rows 31 and a plurality of horizontal rows 32, respectively. Upper and lower sides 33 and 34 of the blocks 28 are inclined at an angle corresponding to that of the stoker 1, while front and rear sides 35 and 36 are positioned vertically. Blocks 37 and 38, which form the upper and lower edge rows 39 and 41, respectively, are slightly modified in that an upper side 42 of the blocks 37 and a lower side 43 of the blocks 41 are formed horizontally, rather than at an inclination, as in the case of the sides 33 and 34. The panel structure 18 is thus provided with upper and lower step-like edges which fit complementary step-like edge portions 45 and 45*a* provided by the upper and lower bracket members 19 and 20, respectively, as will presently appear in greater detail.

An inner side 46 of each of the protective blocks is so recessed as to partially embrace the circumference of an adjacent cooling pipe 23, and it may be releasably secured in this position by means of a pair of bolts 47 and 48 which extend from a flange 49 of a vertically-extending angle member 51 to threaded borings 52 formed in the inner side 46 of the protective block. The flange 49 of the vertical angle member 51 is thus clamped against the adjacent parallel side portion of the pipes 23, so that the vertical member 51, the pipes 23 and the protective blocks constituting the vertical row immediately in front of the member 51, are rigidly secured together, as shown in Fig. 2. Thus, the blocks of each of the vertical rows 31 are rigidly secured together by means of clamping members, there being one member 51 for each vertical row.

Each of the angle members 51 is provided with a transversely-extending flange 53 carrying spaced locking and supporting lugs 54 and 55 at the upper and lower ends thereof, respectively. The upper locking lug 54 comprises a relatively narrow body portion 56, which projects from an edge 57 of the flange 53, and an enlarged head portion 58 having transversely-extending portions 59 and 61 forming locking shoulders. The body portion 56 extends through and is supported by a lower edge 62 of an elongated opening 63 in a box-like portion 64 of the upper bracket member 19. The bracket member 19 comprises a plurality of sections 65, each section extending between and supported by adjacent vertical buckstays 66, 66 constituting at least a portion of the open frame 15.

As shown in Fig. 2, each of the sections 65 of the upper bracket member 19 may be provided with five box-like portions or housings which are positioned in operative relation to the upper locking lugs 54 of the clamping members 51. Since the body portion 56 of the locking lug 54 rests on the lower edge 62 of the slot 63, the upper portion of the panel 18 is carried thereby. The panel 18 is also maintained in alignment with the upper, inner wall portion 16 by means of the transversely-extending shoulder portions 59 and 61 of the locking lugs 54.

The lower bracket member 20 is provided with a plurality of box-like portions or housings 68, similar in all respects to those of the upper bracket member 19 and is formed of a plurality of sections 69 which are bolted or otherwise secured to the adjacent vertical I-beam 66, 66 of the open frame 15. Each of the lower locking heads 55, associated with the lower end portion of the flanges 53 of the clamping members 51, comprises a supporting body portion 71 and an enlarged head portion 72 having transverse shoulders 73 and 74. The body portion 71 rests upon a lower edge 75 of an elongated opening 76 in the lower box-like portions 68 of the bracket section 69, while the shoulders 73 and 74 co-operate with the adjacent wall portions thereof to prevent an inward movement of the panel 18 and the consequent disalignment thereof with the lower wall portion 17. The box-like portions 68 constituting the lower bracket section 69 are disposed in step-like relation, in accordance with the positioning of the lower locking lugs 55. The lower edge of the bracket section 69 is also formed to fit an upper steplike edge of the lower wall portion 17.

Inasmuch as the panel 18 is supported at its lower edge on the lower bracket 20, the adjacent lower brickwall portion 17 is not required to carry the weight of the wall portions 16 and 18 above the same. Hence, the

wall portion 17 may be repaired independently of the panel portion 18 and, vice versa. It is noted that the openings 63 and 76 in the box-like portions 64 and 68 of the upper and lower bracket members 19 and 20, respectively, are somewhat elongated with respect to the width thereof, thereby permitting a sliding movement of the locking lugs 54 and 55 upon the occurrence of lengthwise expansion in the panel structure 18.

As illustrated in Fig. 2, the end walls 3 and 6 may be subjected to only one-half the total expansion of the panel 18 by rigidly securing the central clamping member 51 to the upper and lower brackets 19 and 20 and associated frame 15. Such rigid connection may be obtained by inserting blocks 77 and 78 in the opening 63 on opposite sides of the upper lug 54 and by similarly inserting a pair of blocks 79 and 81 in the lower opening 76 on opposite sides of the locking lug 55. Should the panel structure 18 be rigidly secured to the frame 15 at one end rather than in the center, then the full expansion of the panel 18 must be provided for at the other end thereof and this leads to undesirable structural complications.

Referring further to the upper bracket 19, each of the triangularly-shaped sections 65 thereof comprises a main vertical plate 82 which is provided with the longitudinally-spaced box-like portions 64 along the lower inclined edge 44 thereof. The upper box-like portion, as viewed in Fig. 2, is spaced slightly from an upper horizontal edge 83 the thickness of a brick 84, Fig. 4, and it is provided with an inwardly-projecting flange portion 85 overhanging the adjacent upper edge of the panel 18. The flange 85 and an upper side portion 86 of the box-like portion together form a continuous bearing surface 87 for the brick 84.

The brick 84, which constitutes one of a horizontal row extending between side edges 88 and 89 of the bracket section 65, may be prevented from moving inwardly by means of a locking shoulder 91. The shoulder 91 extends downwardly from an outer edge of a lower flange 92 of a horizontal supporting beam 93, a base portion 94 of which is mounted on the upper edge 83 of the section 65 and is bolted at its ends on adjacent vertical I-beams 66, 66 of the open frame 15. The lower flange 92 also serves to support an inner end of a row of bricks 95, outer ends of which are mounted on the next lower row of bricks 84. An upper inwardly-extending flange 96 is positioned in alignment with the upper side of the brick 95 so as to provide a supporting surface for the next higher row of bricks 97, while a lug 98 limits the outward movement of the bricks 96. The construction of the part of the wall portion 16 above the upper edge 83 of the bracket section 65 may be the same as that set forth in the patent to Bigelow No. 1,670,490, dated May 22, 1928, which is characterized by the ease with which any one portion of the brick wall may be removed independently of adjacent portions.

Referring again to the bracket section 65, which constitutes one of the important features of my invention, a horizontal flange 99 extends from a side wall 101 of the upper box-like portion to the side edge 89 and serves to support the locked, outer end portions of the bricks 84 constituting the upper horizontal row.

The next lower box-like portion is similarly provided with an overhanging projecting flange 102, Fig. 5, forming a bearing surface for a brick 103 constituting one of a horizontal series extending from the side edge 101 to the side edge 89. The brick 103 is of such dimensions as to abut at its outer edge against the horizontal flange 99. Should it be necessary to remove the brick 84 of any one horizontal series, then the next lower brick 103 is first removed. The remaining bricks in the series are supported by a flange 104 which projects rearwardly from the wall 82 slightly beyond the upper horizontal flange 99.

The next lower or third box-like portion from the right, as viewed in Fig. 2, is similarly provided with a plate portion 105, Fig. 3, providing a supporting surface for a brick 106, constituting one of a horizontal series. The remaining bricks in this series may be supported by means of a rearwardly projecting horizontal flange 107. Each of the bricks 106 is provided with a recess 108 adapted to receive a depending hook-like portion 109 of the next higher horizontal flange 104, so that the inward movement of these bricks may be prevented without having first to remove the next higher or the next lower brick.

As shown in Fig. 6, the fourth box-like portion is provided with a supporting plate 111 for a brick 112 constituting one of a horizontal series, and the end box-like portion is similarly provided with an overhanging plate 113 adapted to support a brick 114. The next adjacent bracket section is similarly constructed, whereby the portion of the wall 16 immediately above the same may be carried directly by the open frame 15.

In accordance with my invention, the furnace wall is completed by the secondary or outer wall portion 21 which closes the outer side of the frame 15 and is bolted or otherwise secured to the vertical I-beam 66, 66 thereof. The air passage 22 which is thus formed may be extended over the inner, upper, intermediate and lower wall portions 16, 18 and 17, respectively, whereby these portions of the wall may be subjected to the cooling effect of air currents. A fan (not shown) may be associated with the air passage 22 in the side walls 11, 11 for the purpose of creat-

ing the air currents, the air leaving the passages 22 being subsequently returned to the furnace, so that a minimum amount of heat energy is lost through radiation.

Assuming that the upper and lower headers 24 and 25 are connected in the circulating system of a boiler (not shown), fluid passes through the pipes 23 of the panel structure 18, causing the protective blocks to be maintained at a safe working temperature. The exposed blocks, as well as the remaining inner portions of the furnace wall, may be also cooled by the air currents passing through the air passage 22. Should it be necessary to repair one of the refractory blocks in the panel 18, this may be readily done without disturbing adjacent blocks. The same is true for the protective blocks carried by the upper supporting bracket 19, since it is necessary to remove only one or possibly two bricks in order to replace a damaged brick. When the panel structure 18 is heated so as to cause unequal expansion between itself and the open frame 15, the slidable mounting afforded by the upper and lower locking heads 54 and 55, and the box-like portions 64 and 68 permit the necessary relative movement without damage to the associated parts.

Referring to Fig. 9, which illustrates an alternative embodiment of my invention, the furnace wall therein shown comprises an open supporting frame 115; upper, intermediate and lower wall portions 116, 117 and 118, respectively, for closing an inner side of the open frame 115; and an outer secondary wall portion 119 for closing an outer side of the open frame 115, whereby an air passage 121 may be formed through the open frame 115. The upper inner wall portion 116 comprises a plurality of removably-positioned blocks 122 and a plurality of supporting members 123 secured to the frame 115.

A bracket member 124 is provided with a plurality of box-like portions 125 disposed in step-like relation, as in the case of the box-like portions of the bracket member 19. A lower edge 126 of the upper wall portion 116 is also of step-like form, fitting the upper edge of the bracket 124, whereby the latter may support, at least partially, the upper wall portion 116. The bracket member 124 is secured to adjacent pairs of vertical I-beams forming the open frame 115 and also to a channel section 127, there being one channel section carried by each pair of I-beams. Each of the box-like portions 125 is provided with an opening 128 for a body portion 129 of a locking lug 131, a head portion 132 of which is positioned within the housing 125. The locking lug 131 extends forwardly from a flange 133, corresponding to the flange 53 of the vertical clamping member 51 shown in Fig. 3. In this way, the upper part of the panel wall portion 117 is prevented from moving out of alignment with the upper wall portion 116 and also, at least partially, supported.

The lower edge portion of the panel 117 is similarly maintained in alignment with the lower wall portion 118 and also supported independently thereof, by means of locking and supporting lugs 134 which extend into box-like portions 135 of a lower bracket member 136. The bracket 136 is mounted on the spaced vertical I-beams comprising the open frame 115 and also on a channel section 137, all as in the case of the upper bracket 124 and associated channel section 127. The construction is otherwise as described in connection with the preceding figures.

Fig. 10 is similar to Fig. 9 but shows another modification of my invention, wherein pairs of adjacent corners of successive protective blocks 138 are provided with recesses 139 and 141, whereby an adjacent cooling pipe 142 may be partially covered. Such construction permits the use of a single clamping bolt 143 between each block 138 and its vertical clamping member 144.

While I have shown my invention as applied to the side wall of a furnace, it is equally adaptable to the front and rear walls thereof without departing from the spirit and scope of my invention. I desire, therefore, that only such limitations shall be imposed thereon, as are indicated in the appended claims or as are demanded by the prior art.

I claim:

1. In a furnace, the combination with a panel structure comprising a plurality of cooling pipes, a plurality of protective blocks, and a plurality of clamping members for attaching the blocks to the pipes, of supporting means, and means extending from said clamping members for slidable supporting said panel structure on said supporting means.

2. In a furnace wall, the combination with a bracket member adapted to support one portion of the wall, a second wall portion, and means carried by said second wall portion in interlocking engagement with said bracket member, whereby said second wall portion may be suspended from the bracket in substantial alignment with said first-mentioned wall portion while permitting the independent expansion and contraction of the former.

3. A bracket member provided with a box-like portion, and an overhanging plate extension above said box-like portion and adapted to provide a support for a brick, said box-like portion being provided with a slot and a member having a lug constructed to enter and be retained in said slot to interlock the member to the bracket.

4. A furnace wall comprising a supporting bracket provided with a plurality of vertically spaced inwardly-extending flanges

adapted to support a plurality of courses of brick in superimposed relation, a bearing member supported by one of said flanges, and a relatively movable wall portion to which said member is secured.

5. A furnace wall comprising a bracket provided with a plurality of vertically spaced horizontal supporting ribs, certain of said ribs being provided with downwardly-extending hook-like portions, said bracket also having below the ribs a plurality of box-like portions each of which has an upper wall projected beyond the forward faces of said boxes and said forward faces being slotted for insertion of a wall-supporting member.

6. A furnace wall comprising a brick portion, a fluid-cooled panel, and a bracket supporting said panel, said bracket having a side wall portion and a plurality of inwardly-extending flange portions adapted to support said brick portion of the furnace wall, one of said flanges overlying said panel.

7. A wall construction comprising a brick portion, a fluid-cooled panel, a supporting bracket for said panel said bracket having a side wall portion and a plurality of flange portions adapted to support said brick portion of the furnace wall, one of said flanges overlying said panel, said bracket having a plurality of recesses, and means extending into said recesses from said panel, whereby the latter may be interlocked with said bracket at a plurality of longitudinally spaced points.

8. In an underfeed furnace, the combination with a system of inclined tuyères and retorts constituting a support for the fuel-bed and underfeed mechanism associated therewith, of a side wall structure comprising a supporting frame, brackets secured to said frame and constituting a support for a refractory wall lining, a tubular fluid-cooled panel suspended from said brackets and including refractory facing elements forming with said lining a continuous wall surface, said panel being inclined in accordance with the inclination of said fuel-supporting structure and constituting an abutment for said fuel-bed, and means for suspending said panel to permit expansion and contraction thereof independently of the adjacent portions of the wall structure.

9. In an underfeed furnace, the combination with a system of inclined tuyères and retorts constituting a support for the fuel-bed and underfeed mechanism associated therewith, of a side wall structure comprising a supporting framework, brackets secured to said framework, a refractory lining supported on said brackets, an inclined tubular fluid-cooled panel forming with said lining a continuous wall surface and embracing the area of said wall abutted by the fuel-bed, and means for suspending said panel from the brackets, said suspending means permitting expansion and contraction of the panel independently of the adjoining portions of the wall structure.

10. In an underfeed furnace, the combination with an inclined system of tuyères and retorts constituting a support for the fuel-bed and underfeed mechanism associated therewith, of a side wall structure comprising a supporting framework, brackets secured to said framework, a refractory lining supported on said brackets, a tubular fluid-cooled panel forming with said lining a continuous wall surface and being inclined in accordance with the inclination of the tuyères and retorts to embrace the area of said wall abutted by the fuel-bed, means for suspending said panel from the brackets, said suspension means comprising slotted openings in said brackets, and elements projecting from said panel and confined in said slots, said elements being movable longitudinally in the slots to compensate for expansion and contraction of said panel.

11. In a furnace, a wall comprising an open frame, a plurality of brackets secured to said frame and forming a support for an upper wall section, said brackets having depending portions forming an inclined series, and a liquid-cooled inclined panel suspended from said depending bracket portions and forming with said upper wall section a substantially continuous effective wall surface.

12. In a furnace, a wall comprising an open frame, a bracket secured to said frame and comprising an inclined series of transversely projecting flanges and underlying depending portions, an upper wall section supported on said flanges and a liquid-cooled panel having substantially the same inclination as said series of flanges and suspended from said depending bracket portions, said panel forming with said upper wall section a substantially continuous wall surface.

13. In a furnace, a wall comprising an open frame, a bracket secured to said frame and having a plurality of transversely projecting substantially horizontal flanges arranged in an inclined series, said bracket also having depending portions underlying said flanges, a panel suspended from said depending portions and including a plurality of tubes and facing elements secured to said tubes and forming the effective surface of said panel, the upper series of said facing elements having substantially horizontal upper edges lying closely adjacent to said bracket flanges, whereby the said facing elements form with said upper wall section a substantially continuous effective wall surface.

14. In a furnace, a wall comprising an open frame, a bracket secured to said frame and having a plurality of projecting substantially horizontal flanges forming a series of steps supporting an upper wall section and depending portions underlying said flanges,

a panel comprising a vertical bank of inclined tubes and facing blocks therefor suspended from the said depending bracket portions, the upper series of said facing blocks respectively adjoining said bracket flanges and being formed with corresponding substantially horizontal upper edges adjoining the stepped lower edge of said upper wall section, whereby said panel forms with the upper wall section a substantially continuous effective wall surface.

15. In a furnace, a wall comprising an open frame, a pair of brackets secured to said frame in vertically-spaced relation, the upper of said brackets having projecting flanges arranged in stepped relation and forming a support for an upper wall section and having also underlying each of said flanges a depending portion, a lower wall section abutting the lower side of said lower bracket and an inclined panel inserted between said upper and lower wall sections and supported in the said depending portions of said upper bracket and in the lower bracket, said panel comprising a series of inclined tubes arranged in a vertical bank and facing elements for said tubes forming the effective surface of said panel, the upper series of said facing elements being formed with upper edges conforming with and adjoining the stepped lower edge of said upper wall section and the lower series of said facing elements adjoining the upper edge of said lower wall section, whereby said panel forms with said wall sections a substantially continuous effective wall surface.

16. In a furnace, a wall comprising an open frame, a bracket secured to said frame and constituting a support for an upper wall section, said bracket having slotted depending portions and a liquid-cooled panel adjoining the lower edge of said upper wall section, and having portions projecting into the slots of said depending bracket portions whereby said panel is flexibly suspended from said brackets to permit expansion and contraction of the panel independently of the upper wall section.

17. In a furnace, a wall comprising an open frame, a bracket carried by said frame and forming a support for an upper wall section, said bracket having depending slotted portions, a panel comprising a plurality of tubes, facing elements for said tubes and clamping bars engaging the backs of said tubes and securing the facing elements in position, lugs on said clamping bars projecting into the slots of said depending bracket portions and supporting the panel, said facing elements at the upper edge of the panel adjoining the upper wall section and forming therewith a substantially continuous effective wall surface.

18. In a furnace wall, the combination with structural wall supporting members, of means provided on said members adapted to form a bearing for one portion of the wall, a second wall portion, and means carried by said second wall portion for engaging said first-mentioned means whereby said second wall portion may be suspended therefrom in substantial alignment with said first-mentioned wall portion while permitting independent expansion and contraction of said second portion.

JOSEPH S. BENNETT.