June 6, 1933. O. NYGAARD 1,912,913

WATER WALL

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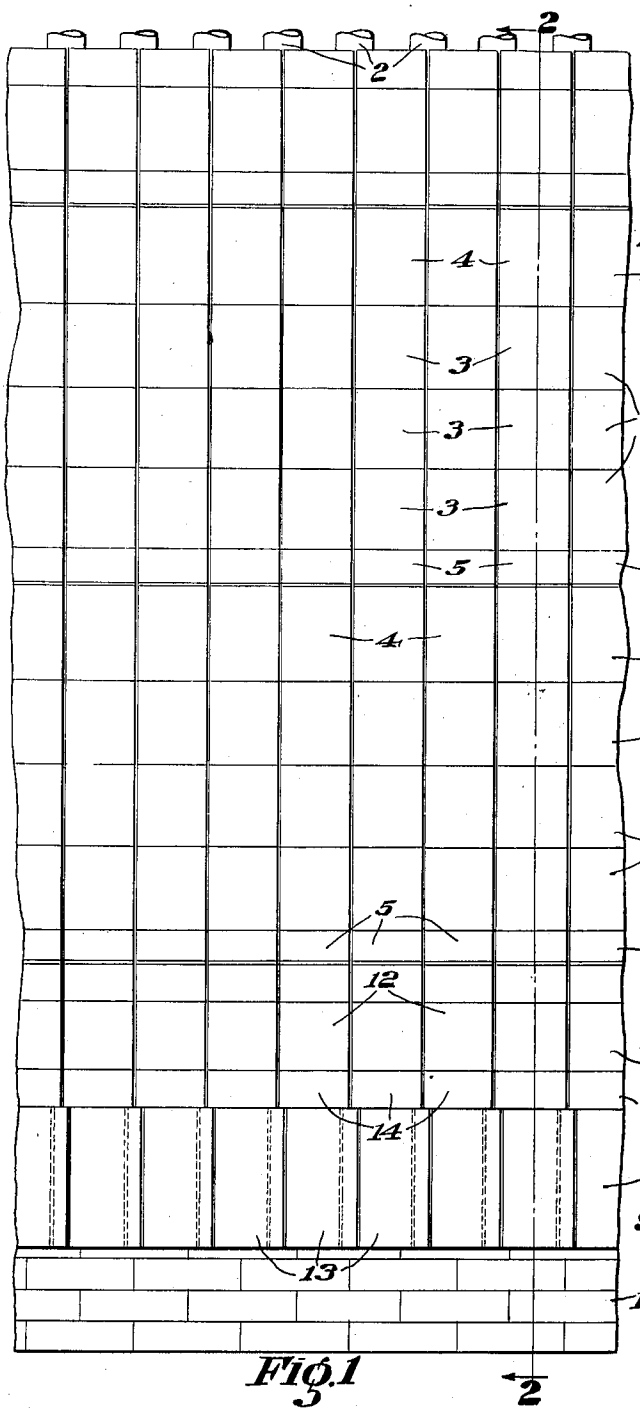


FIG. 1

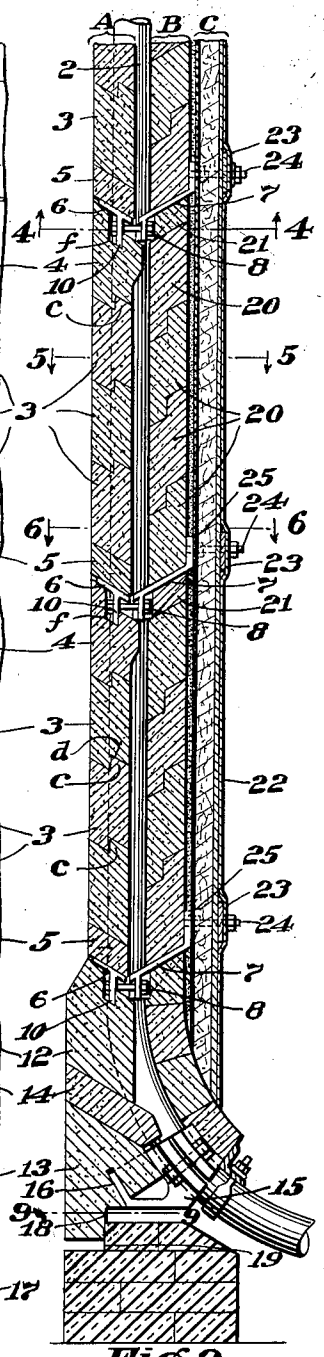


FIG. 2

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Fig. 3

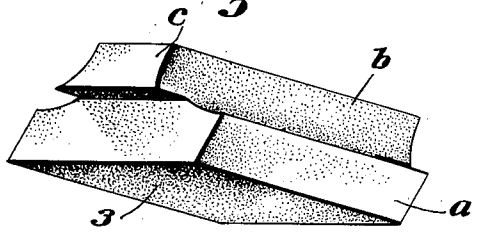


Fig. 4

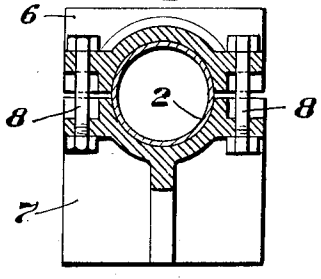


Fig. 5

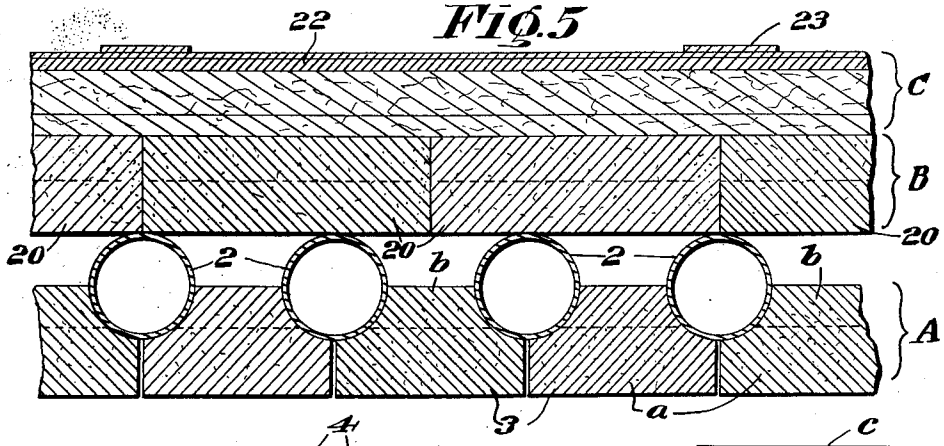


Fig. 6

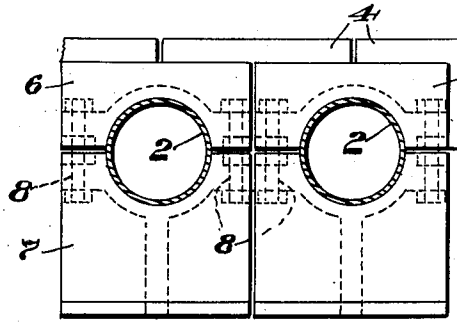


Fig. 8

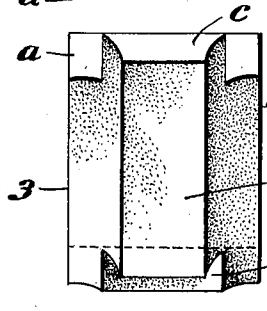


Fig. 9

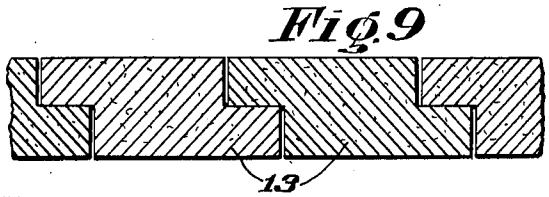
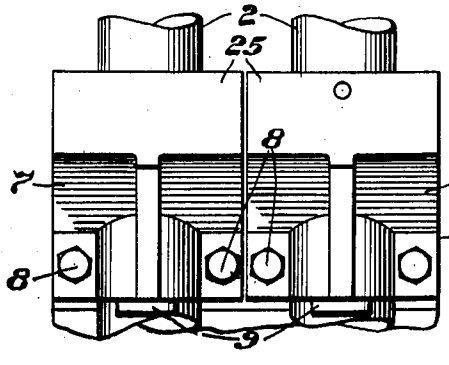


Fig. 7



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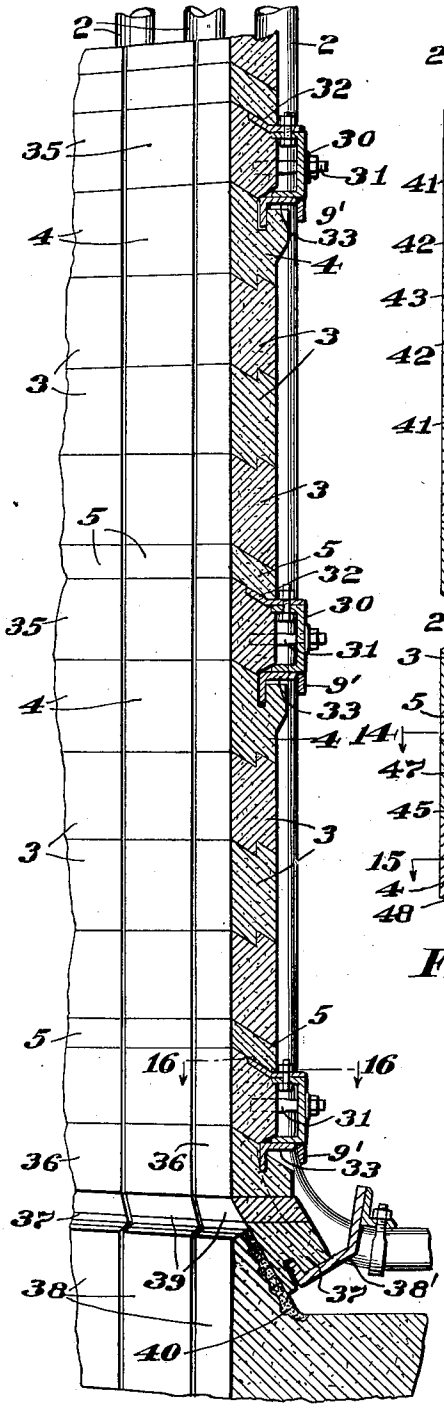


FIG. 10

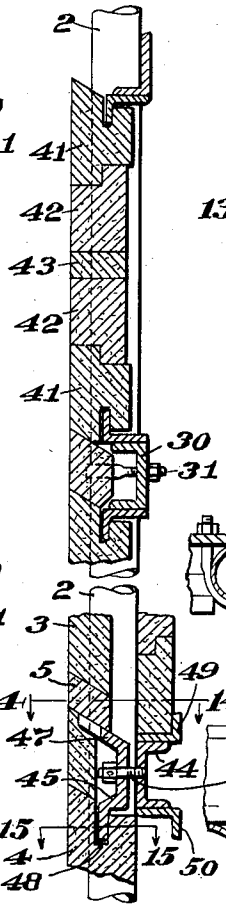


FIG. 11

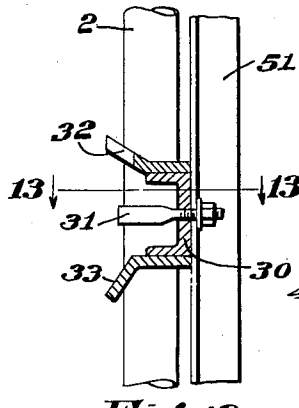


FIG. 12

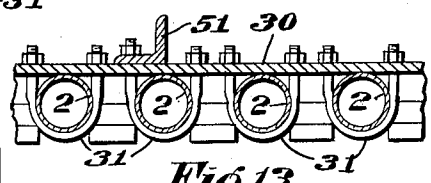


FIG. 13

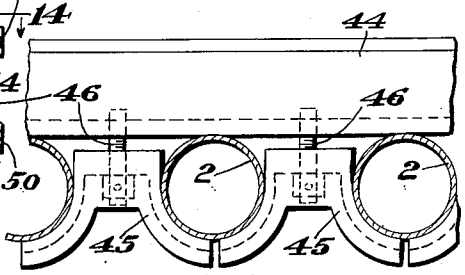


FIG. 14



FIG. 15

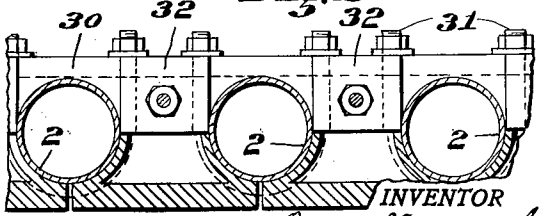


FIG. 16

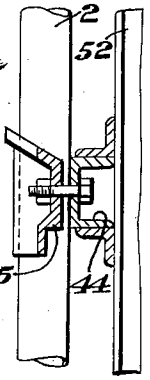


FIG. 17

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Patented June 6, 1933 1,912,913

UNITED STATES PATENT OFFICE

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WATER WALL

Application filed December 18, 1928. Serial No. 326,736.

This invention relates to furnace walls of the water cooled type.

It is now becoming a common practice to associate tubes with the refractory walls of furnaces, particularly in boiler installations, and to circulate water or steam through the tubes and thus to cool the wall sufficiently to prevent it from softening or fusing under the action of the heat. Such walls are ordinarily referred to as water cooled walls even though the fluid medium circulating through the tubes may be steam.

The present invention has for its chief object to reduce the expense of manufacture of walls of this type and to facilitate the making of repairs, while at the same time providing a wall construction which will give long and efficient service.

In walls of this character it has usually been found preferable to make the face portion of the wall of bricks of some highly refractory non-metallic material. Silicon carbide bricks are especially desirable for this purpose. These highly refractory materials, however, are quite expensive, and it is one of the objects of this invention, therefore, to devise a wall construction in which these high priced refractories will be used in an economical manner. The invention is especially concerned with the construction of the bricks and the means for holding the bricks and tubes in their cooperative relationship to each other.

The nature of the invention will be readily understood from the following description when read in connection with the accompanying drawings, and the novel features will be particularly pointed out in the appended claims.

In the drawings,

Figure 1 is a front elevation of a portion of a furnace wall constructed in accordance with this invention;

Fig. 2 is a vertical sectional view substantially on the line 2—2, Fig. 1;

Fig. 3 is a perspective view of one of the bricks used in the wall shown in Figs. 1 and 2;

Figs. 4, 5 and 6 are sectional views on the lines 4—4, 5—5 and 6—6, respectively, Fig. 2, the illustration of the bricks, however, being omitted from Figs. 4 and 5;

Fig. 7 is a front elevation of the clamp construction shown in Fig. 6;

Fig. 8 is a rear elevation of the brick shown in Fig. 3;

Fig. 9 is a sectional view on the line 9—9, Fig. 2;

Fig. 10 is an angular view, partly in section, of a modified construction of furnace wall;

Fig. 11 is a vertical sectional view of another modification;

Fig. 12 is a side view showing a bracket construction which can be used in holding the bricks in cooperative relationship to the tubes;

Fig. 13 is a sectional view on the line 13—13, Fig. 12;

Figs. 14 and 15 are sectional views on the lines 14—14 and 15—15, respectively, Fig. 11, the bricks, however, being omitted;

Fig. 16 is a similar sectional view on the line 16—16, Fig. 10; and

Fig. 17 is a side view showing another form of bracket construction.

Referring first to Figs. 1 and 2, the wall construction there shown includes a series of tubes 2 through which steam, water or any other suitable fluid medium can be circulated. In a boiler installation feed water usually is circulated through these tubes or they may be connected directly into the circulating system of the boiler. The wall consists of three sections, a front section A composed of bricks and lying chiefly in front of the tubes, an intermediate section B also composed of bricks and lying behind the tubes, and a rear section C composed chiefly of heat insulating material. While the materials used in these sections neccessarily will vary somewhat with the requirements of individual installations, the front section A usually is made of highly refractory bricks, silicon carbide being the preferred material, while the intermediate section B can be made of less refractory material, fire clay bricks usually being satisfactory.

It will be seen from an inspection of Figs. 1 and 2 that in the illustrative embodiment

of the invention the bricks in the front section A are arranged in vertical rows. Also, that each row is divided into sections, each section including a series of bricks 3 which are duplicates of each other, another brick 4 at the upper end of said series, and a key brick 5 at the lower end of said series. Each series constitutes what may be termed a "wall unit" which is independent of the other units. Each of these units or series of bricks is supported on one member 6 of a bracket which is carried by one of the tubes. As best shown in Figs. 2, 4, 6 and 7, each bracket comprises two members 6 and 7 clamped rigidly on the tubes by bolts 8—8, both of these bracket members having brick supporting surfaces which are inclined toward the tubes. In order to avoid any possibility of the brackets slipping on the tubes, small lugs 9, Fig. 7, may be welded to the tubes, the lower edges of the brackets being rested on these lugs.

The details of construction of the bricks 3 are best shown in Figs. 2, 3, 5 and 8 from which it will be seen that each of these bricks has a main body portion *a* which lies chiefly in front of the tubes 2, and that a reduced extension *b* projects rearwardly from the body part *a* and is provided with curved surfaces at its opposite edges to fit between and against two adjacent tubes 2. Both the upper and lower faces of the brick are inclined at an acute angle to the front face, the planes of the upper and lower faces being approximately parallel, and at one end of the brick the extension *b* is provided with a portion *c* which projects for a substantial distance beyond the plane of the brick at that end. At its other end the brick has a notch *d*, Fig. 8, of suitable shape and dimensions to receive the projections *c* of the next vertically adjacent brick. It will be clear from an inspection of Fig. 2 that the projection *c* of one of the bricks 3 fits into the notch *d* of the next vertically adjacent brick and lies behind the main body portion of said adjacent brick. This construction interlocks the bricks with each other. The uppermost brick 4 of each series of bricks is similarly interlocked with the brick 3 immediately below it and is provided in its upper edge with a groove or notch *f* to receive a flange 10 which projects downwardly from the lower side of the bracket member 6. The lowermost brick 5 in each series is not interlocked with the brick above it but is provided with upper and lower faces inclined rearwardly at substantially the same angle as the upper and lower faces of the bricks 3 and 4. This angle agrees with the upper surface of the bracket member 6 Consequently, while the bricks in this construction are not interlocked with the tubes, all of the bricks in each series tend to gravitate toward the tubes and are held by gravity in contact with the tubes, due to the construction of the brackets and the shapes of the bricks. At the same time all of the bricks, except the key brick 5, are interlocked with each other so that they can only be removed from the wall by a relative movement of the bricks parallel to the front face of the wall and to the tubes. Normally the key brick 5 locks the other bricks of the series against such movement. This brick can, however, be readily slipped out of the wall at the fire side thereof, and it then permits the bricks 3 and 4 to drop far enough to release the uppermost brick 4 from the flange 10. These bricks 3 and 4 can then be lifted out of the wall.

This is a great convenience in making repairs since it permits the replacement of any broken or worn out brick while working at the fire side of the wall, and such replacement requires the removal of a very few bricks only immediately above or below the brick to be replaced. The intermediate and rear sections of the wall remain entirely undisturbed. In placing the bricks in the wall either initially or in making repairs, the bricks 3 and 4 of any individual series are placed against the tubes and then lifted and held in an elevated position with the flange 10 entered in the slot *f* of the uppermost brick 4, while the key brick 5 is slipped into place between the lower brick 3 and the bracket member 6 which supports that particular series.

The main body, or at least a very substantial part of the front face of the wall, is made in the manner above described. Usually the tubes 2 are connected to a header at one end of the water cooled section of the wall, and in order to make provision for the expansion and contraction of this part of the wall a supplemental wall section is provided at the region where the tubes curve outwardly through the wall. This supplemental wall may be used at either the top or bottom, depending upon the nature of the construction, but is shown in Figs. 1 and 2 at the bottom of the water cooled section. The supplemental wall comprises wall units each consisting of a short series of bricks alined with the rows of bricks above referred to, each such series, as shown, consisting of an upper brick 12, a lower brick 13, and an intermediate or key brick 14. Each upper brick 12 is interlocked with and held to the tubes by the flange 10 of a bracket member 6 in the same manner that the bricks 4 are supported. Each of the lower bricks 13 is supported by a bracket member 15, which is clamped to the curved portion of one of the tubes, this bracket member having an upwardly inclined lip 16 at its forward edge which enters a correspondingly inclined slot formed in the brick 13. The key brick 14 has inclined

upper and lower surfaces engaging correspondingly inclined faces on the upper and lower sides, respectively, of the bricks 13 and 12 so that it is held by gravity in its operative position in the wall. By drawing this brick out of the wall the upper brick 12 may then drop far enough to be released from the flange 10, and the brick 13 also may be removed from the bracket 15.

The supplemental wall is made up of these units each consisting of a series of three bricks 12, 13 and 14, this entire supplemental section being supported by the tubes themselves.

The bricks 13 are located in vertical overlapping relationship to a stationary wall section 17, Figs. 1 and 2, a substantial space being left between the adjacent horizontal surfaces of the stationary wall section 17 and the supplemental wall section so that these surfaces can approach or recede from each other, the vertical surface 18, Fig. 2, of the supplemental wall section sliding on the vertical wall surface 19 of the stationary section and preventing any serious air leakage through the wall, notwithstanding the changes in relationship between the two wall sections. The bricks 13 are also overlapped one upon the other, as shown in Fig. 9, to close the joints between them. This supplemental wall section is usually required at one end only of each water cooled wall section.

The intermediate wall section B may be of any suitable construction. Preferably, however, it is quite similar to the construction of the front section A, although usually made of less refractory material. It is of advantage to make this intermediate section in units, as in the case of the front section, each unit comprising a series of bricks 20, Fig. 2, interlocked with each other and having upper and lower surfaces inclined toward the tubes 2. The lowermost brick in each series rests on a bracket member 7, and a key brick 21 is used in this instance at the upper end of the series. It will be clear from an inspection of Fig. 2 that if the key brick 21 is slipped out of the wall the bricks 20 can then be moved upwardly out of interlocking engagement with each other and removed from the wall, these bricks having parts which interlock with each other vertically in the same manner that the projections *c* interlock with adjacent bricks of the front section A. Obviously, if desired, the bricks of the intermediate section B could be made of the same shape and held to the tubes in the same manner as in the front section A. In both cases, however, the bricks tend to gravitate into contact with the tubes and are held against the tubes by gravity.

The heat insulating section C is made of considerable thickness and may consist, for example, of layers of magnesia backed up and held in place by a sheet metal shell 22, or the shell may be made of plates of non-metallic but rigid material, some of the non-combustible boards on the market being suitable for this purpose. In either event it is preferable to use stay strips 23 of metal at the back of the shell and these strips may be secured in place by bolts 24 projecting through them and threaded into the upstanding flange 25 formed at the end of each bracket member 7.

It will now be appreciated that the wall construction provided by this invention is economical to manufacture and install, the labor of laying up the wall being greatly facilitated by the means provided for supporting the bricks and by the construction of the bricks themselves. Since the bricks used at the fire side of the wall, or in other words, the front section A, need not extend backwardly beyond the center lines of the tubes, an economical use is made of the high priced highly refractory materials, such as silicon carbide. Repairs, also, can be made very easily, as above explained, and the fact that the repairs to the front section of the wall can be made from the fire side of it without disturbing the intermediate or rear sections of the wall is an important practical advantage, particularly since it is the front section of the wall which is subjected to the disintegrating action of the flame and excessive temperatures created in the combustion chamber. This front section or lining, therefore, may have to be renewed several times before it is necessary to renew the intermediate wall section.

Figs. 10 and 16 show a wall similar to that illustrated in Figs. 1 and 2 but in which a different bracket construction is employed. In this arrangement the brackets consist of channel bars 30 arranged horizontally, the flanges being cut out at regular intervals to receive the tubes, as clearly shown in Fig. 16. The tubes are clamped to the channel bars and held in the seats so provided, by U-bolts 31. Bracket members 32 having upwardly inclined brick supporting parts are bolted, riveted or welded to the upper flanges of the channel bars, and additional bracket members 33 are similarly secured to the lower flanges of the channel bars. These bracket members cooperate with the bricks 5 and 4, respectively, in the same manner that the parts 6 and 10 cooperate with these bricks in the construction shown in Figs. 1 and 2. The channel bar, however, is of advantage in holding the tubes rigidly spaced from each other. Lugs 9′ similar to the lugs shown in Fig. 7, may be welded on the tubes to prevent any possibility of the channel bars slipping.

In this construction a special brick 35 is used between the uppermost brick 4 of each

series and the key brick 5 of the next series above, this special brick being held against the tubes by gravity, as are the other bricks.

A supplemental wall section of a slightly different construction is shown in Fig. 10 and is located at the region where the tubes curve outwardly away from the wall. This supplemental wall is divided into units, as in the construction previously described, each unit comprising an upper brick 36 held in place by the flange 33, a lower brick 37 supported by a bracket 38′ rigid with one of the tubes, and an intermediate key brick 39. The stationary wall section includes bricks 38 located in overlapping relationship to the lower bricks 37, and a packing 40 of asbestos or equivalent material is interposed between the overlapping portions of the bricks 37 and 38.

Figs. 11, 14 and 15 show a further modification. In the upper part of Fig. 11 it will be observed that the bricks 41—41 which are held to the tubes by brackets are interlocked with bricks 42—42, the latter bricks being held in interlocking relationship to the bricks 41 by a central key brick 43.

The lower part of Fig. 11 and Figs. 14 and 15 show a different bracket construction which includes a channel bar 44 extending horizontally across the backs of the tubes and brackets 45 at the fronts of the tubes, each bracket being secured to the channel bar by a bolt 46. The brackets are curved to fit between and against two adjacent tubes so that this construction clamps the tubes securely to the channel bar and holds the tubes in spaced relationship. Each bracket also has an inclined upper flange 47 to support the bricks at the face of the wall and a lower flange 48 to hold the brick 4 in position. Angle bars 49 and 50 are welded, riveted, or otherwise secured to the flanges of the channel bar 44 to support the bricks of the intermediate section of the wall.

Fig. 12 shows a bracket construction similar to that illustrated in Figs. 10 and 16, but in which the channel bars 30 are secured to upright angle bars 51. These angle bars may be used to take part of the weight of the bricks, if desired, and serve, also, to hold the channel bars spaced properly in the event that the U-bolts 31 stretch or expand sufficiently to become loosened.

Fig. 17 shows an upright angle bar 51 used in the same relationship to the bracket construction shown in Figs. 11, 14 and 15.

While I have herein shown and described preferred embodiments of my invention, it will be understood that the invention may be embodied in a variety of forms without departing from the spirit or scope thereof.

Having thus described my invention, what I desire to claim as new is:

1. In a furnace wall, the combination of a series of upwardly extending tubes, refractory bricks located in protective relationship to said tubes at the fire side thereof, additional bricks at the opposite side of said tubes, and brackets on the tubes for supporting all of said bricks, said bricks at the fire side of the wall resting one on another and having surfaces inclined toward the tubes to cause the bricks to gravitate toward the tubes.

2. In a furnace wall, the combination of a series of upwardly extending tubes, refractory bricks located in protective relationship to said tubes at one side thereof, additional bricks at the opposite side of said tubes, and brackets on the tubes for supporting all of said bricks, said bracket having brick supporting surfaces inclined toward the tubes and the bricks resting one on another and having similarly inclined surfaces, whereby the bricks at both sides of the tubes tend to gravitate toward the tubes.

3. In a furnace wall, the combination of a series of upwardly extending tubes, bricks of highly refractory material associated with said tubes at the fire side of the tubes and in protective relationship to them, bracket members rigid with said tubes for supporting said bricks in their operative positions, additional bricks of less refractory material located at the rearward side of the tubes, and bracket members rigid with the tubes for supporting the latter bricks, each of said bracket members having brick supporting surfaces inclined toward the tubes whereby the bricks will tend to gravitate toward the tubes.

4. In a furnace wall, the combination of a series of upwardly extending tubes, refractory bricks located in protective relationship to said tubes at one side thereof, additional bricks at the opposite side of said tubes, brackets on the tubes for supporting all of said bricks, a shell at the rear side of said wall, and fastening devices connecting said shell to said brackets and serving to hold the shell in spaced relationship to said tubes.

5. In a furnace wall, the combination of a series of upwardly extending tubes, refractory bricks closely associated with said tubes, brackets on said tubes supporting said bricks, another wall section at the rear of said bricks, and a shell secured to said brackets and backing up said rear section.

6. In a furnace wall, the combination of a series of upwardly extending tubes, refractory bricks closely associated with said tubes, brackets on said tubes supporting said bricks, and a shell at the rearward side of said wall, said shell being anchored to said brackets.

7. In a furnace wall, the combination of a series of upwardly extending tubes, refractory bricks closely associated with said tubes, brackets on said tubes supporting said bricks, a shell located at the rear of the brick

section of the wall but spaced therefrom, means for anchoring said shell to said brackets, and refractory heat insulating material held between said shell and said brick wall section.

8. In a furnace wall, the combination of a series of upwardly extending tubes, refractory bricks closely associated with the tubes, said bricks being arranged in rows extending parallel to the tubes and each row including a series of bricks resting one on another, brackets on the tubes supporting the several series of bricks, and other brackets on the tubes engaging the uppermost bricks of said series and holding them against movement away from the tubes, the intermediate bricks of the series being held in their operative positions by their engagement with each other.

9. In a furnace wall, the combination of a series of upwardly extending tubes, refractory bricks closely associated with the tubes, said bricks being arranged in rows extending parallel to the tubes, brackets on the tubes supporting the several series of bricks, and other brackets on the tubes engaging the uppermost bricks of said series and holding them to the tubes, the intermediate bricks of said series resting one on another and having upper and lower surfaces inclined toward the tubes whereby they are held in their operative positions by gravity.

10. In a furnace wall, the combination of a series of upwardly extending parallel tubes, bricks arranged in rows parallel to said tubes and closely associated with them, the bricks in each row resting one on another and having inclined faces serving to cause the bricks to gravitate toward the tubes, and brackets supported solely by said tubes and each serving to support a series of bricks in one of said rows, each series of bricks including a key brick adapted to be removed from the wall but normally cooperating with said brackets to lock the other bricks of the series in the wall, said other bricks of each series being removable from the will when the key brick has been removed.

11. In a furnace wall, the combination of a series of upwardly extending parallel tubes, bricks arranged in rows parallel to said tubes and closely associated with them, the bricks in each row resting one on another and having inclined faces serving to cause the bricks to gravitate toward the tubes, and brackets supported solely by said tubes and each serving to support a series of bricks in one of said rows, the bricks of each series being interlocked with each other, and a key brick in each series for holding the other bricks in their interlocked relationship, said key brick being mounted for removal from the wall and when so removed permitting the other bricks to be unlocked from each other and removed.

12. In a furnace wall, the combination of a series of upwardly extending parallel tubes, bricks arranged in rows parallel to said tubes and closely associated with them, the bricks in each row resting one on another and having inclined faces serving to cause the bricks to gravitate toward the tubes, and brackets supported solely by said tubes and each serving to support a series of bricks in one of said rows, the inclined faces of said bricks in engagement with each other having abrupt shoulders which interrupt said faces and fit against each other, whereby each brick is locked in position by an adjacent brick but may be unlocked by a movement parallel to the face of the wall, and a key brick in each series locking the other bricks against said unlocking movement but itself mounted for removal from the wall at the fire side thereof.

13. In a furnace wall, the combination of a series of upwardly extending parallel tubes, refractory bricks closely associated with said tubes in protective relationship thereto and arranged in rows extending parallel to the tubes, each row including a series of bricks resting one on another, a bracket supporting each series of bricks, each bracket being mounted on one of said tubes, additional brackets engaging the uppermost bricks of said series and holding them against movement transversely away from the tubes, the bricks of each series being held in their positions in the wall by their engagement with each other and with said brackets, and a key brick in each series normally cooperating with the brackets to lock the other bricks of the series in the wall but being itself mounted for removal from the wall and when so removed permitting the other bricks to be removed.

14. In a furnace wall, the combination of a series of upwardly extending parallel tubes, refractory bricks closely associated with said tubes in protective relationship thereto and arranged in rows extending parallel to the tubes, each row including a series of bricks resting one on another, a bracket supporting each series of bricks, each bracket being mounted on one of said tubes, another bracket engaging the uppermost brick of each series and holding it in position, the endmost bricks of each series being held in their operative positions by the brackets, and each of the other bricks of each series being locked in position by an adjacent brick of the same series but being constructed to be unlocked from each other by a movement parallel to the face of the wall, and a key brick in each series normally holding the other bricks of the series against said unlocking movement but itself mounted

for removal from the wall at the fire side thereof.

15. In a furnace wall, the combination of a series of upwardly extending parallel tubes, refractory bricks closely associated with said tubes in protective relationship thereto and arranged in rows extending parallel to the tubes, each row including a series of bricks resting one on another, a bracket supporting each series of bricks, each bracket being mounted on one of said tubes, another bracket engaging the uppermost brick of each series and holding it in position, the brackets on which the several series of bricks rest having upper rearwardly inclined surfaces to support the bricks and the bricks having similarly inclined surfaces whereby the bricks of the series tend to gravitate toward the tubes.

16. In a furnace wall, the combination of a series of upwardly extending parallel tubes, refractory bricks closely associated with said tubes in protective relationship thereto and arranged in rows extending parallel to the tubes, each row including a series of bricks resting one on another, a bracket supporting each series of bricks, each bracket being mounted on one of said tubes, another bracket engaging the uppermost brick of each series and holding it in position, the lower bracket supporting each series of bricks having an upper rearwardly inclined surface and the bricks being provided with similarly inclined surfaces whereby they tend to gravitate toward the tubes, and each of said upper bracket having an interlocking engagement with the uppermost brick in the series from which the brick can be released only by a relative movement of the bracket and brick longitudinally of the tubes.

17. A brick for furnace wall construction comprising a body of refractory non-metallic material having a reduced rearwardly extending portion provided with curved faces near the opposite edges thereof to fit against two adjacent tubes, and a front face portion lying in front of said curved faces, the upper and lower end faces of said brick being inclined rearwardly in approximately parallel planes, and said rearward extention having a part at one end thereof projecting vertically for a substantial distance beyond the inclined plane at its end of the brick.

18. In a furnace wall, the combination of spaced tubes for carrying a fluid medium, said tubes being curved outwardly from the furnace at the lower part of said wall, upper and lower sets of brick supporting brackets on the tubes at said curved portion, a plurality of courses of bricks located between said brackets in protective relationship to the tubes, one of said courses consisting of key bricks for locking other courses of bricks to said brackets in such a manner that the removal of said key bricks releases one of the other courses of bricks from the brackets, the bricks in the lowermost course having downwardly projecting faces, and a stationary wall below said curved portion of the tubes, said downwardly projecting faces of the bricks being in slidable engagement with approximately upright surfaces of said stationary wall for effecting a gas seal while permitting expansion and contraction of the wall.

19. In a furnace wall the combination of a series of upwardly extending tubes, refractory bricks located in protective relationship to said tubes at the fire side thereof, means for holding said bricks in their operative positions including brackets spaced longitudinally of the tubes, said brackets having upwardly inclined surfaces on which the bricks rest and on which said bricks tend to gravitate toward the tubes and means rigid with the tubes for holding the brackets in spaced relationship.

20. In a furnace wall the combination of a series of upwardly extending tubes, refractory bricks located in protective relationship to said tubes at the fire side thereof, means for holding said bricks in their operative positions including brackets spaced longitudinally of the tubes, said brackets having upwardly inclined surfaces on which the bricks rest and on which said bricks tend to gravitate toward the tubes and members welded to the tubes for maintaining the brackets in spaced relationship.

21. In a furnace wall the combination of a series of upwardly extending spaced tubes, channel bars spaced lengthwise of said tubes and extending transversely to the tubes and serving to maintain the tubes in spaced relationship to each other, the flanges of said bars being recessed to receive the tubes, means for holding said tubes to said bars with the tubes located in said recesses, blocks protecting said tubes, and means for supporting said blocks in their tube protecting positions including brackets secured to both the upper and lower flanges of said bars, said brackets having flanges to engage said blocks.

22. In a furnace wall, the combination of a series of upwardly extending parallel tubes, refractory bricks closely associated with said tubes in protective relationship thereto and arranged in rows extending parallel to the tubes, each row including a series of bricks resting one on another, a bracket supporting each series of bricks, each bracket being mounted on one of said tubes, another bracket engaging the uppermost brick of each series and holding it in position, the endmost bricks of each series being held in their operative positions by the brackets, and certain of the other bricks of

each series being locked in position by an adjacent brick of the same series but being constructed to be unlocked from each other by a movement parallel to the face of the wall.

23. In a furnace wall, the combination of spaced upwardly extending tubes for carrying a fluid medium, blocks closely associated with said tubes and protecting the tubes at the fire side of the main body of the wall, said tubes being curved outwardly away from the wall at the region along the lower part of said wall, a supplemental wall section associated with the tubes at said region, said supplemental section including a plurality of courses of blocks located in protective relationship to the tubes, upper and lower sets of supporting members carried by the tubes for holding certain of said courses of blocks in their operative positions, and key blocks located between the latter courses to lock them in cooperative relationship to their respective supporting members, said key blocks being removable from the wall at the fire side thereof.

24. In a furnace wall, the combination of spaced upwardly extending tubes for carrying a fluid medium, blocks closely associated with said tubes and protecting the tubes at the fire side of the main body of the wall, said tubes being curved outwardly away from the wall at the region along the lower part of said wall, a supplemental wall section associated with the tubes at said region, said supplemental section including a plurality of courses of blocks located in protective relationship to the tubes, upper and lower sets of brackets spaced from each other and secured to said tubes for holding upper and lower courses of blocks in said supplemental wall section in their operative positions, and key blocks cooperating with the latter courses to lock them against removal, said key blocks being removable from the wall at the fire side thereof to release the blocks in said courses, the connection between the blocks so released and said brackets being such that they may be disengaged from the brackets by movement in a direction generally parallel to the tubes after the key blocks have been removed.

25. In a furnace wall, the combination of spaced upwardly extending tubes for carrying a fluid medium, blocks closely associated with said tubes and protecting the tubes at the fire side of the main body of the wall, said tubes being curved outwardly away from the wall at the region along the lower part of said wall, a supplemental wall section associated with the tubes at said region, said supplemental section including a plurality of courses of blocks located in protective relationship to the tubes, upper and lower sets of brackets spaced from each other and secured to said tubes for holding upper and lower courses of blocks in said supplemental wall section in their operative positions, the upper brackets having downwardly extending flanges to lock the upper course of blocks in position, and the lower brackets having upwardly extending flanges to lock the lower course of blocks in their operative positions, and a course of key blocks between said upper and lower courses for holding the latter courses in locking relationship to their respective flanges, said key blocks being removable from the wall at the fire side thereof.

26. In a furnace wall, the combination of spaced upwardly extending tubes for carrying a fluid medium, said tubes being curved outwardly away from the furnace at the lower part of said wall, a lower set of block supporting brackets on said tubes at said lower part of the wall, an upper set of block supporting brackets on said tubes above said lower set, a plurality of courses of blocks located between said brackets at the fire sides of the tubes and in protective relationship to said tubes, one of said courses consisting of key blocks for locking the other courses of blocks to said brackets in such a manner that the removal of said key blocks releases one of the other courses of blocks from its respective set of brackets.

27. In a furnace wall, the combination of spaced tubes for carrying a fluid medium, said tubes being curved outwardly from the furnace at the lower part of the wall, brick supporting brackets on the tubes at said curved position, additional brackets on said tubes but spaced from said first mentioned brackets, and a plurality of horizontal courses of bricks supported by said brackets in protective relationship to the tubes, one of said courses consisting of key bricks removable from the wall at the fire side thereof but serving to lock the bricks of other courses to the brackets, whereby the removal of the key bricks releases said other bricks and permits their removal from the wall at the fire side thereof.

28. In a furnace wall, the combination of a series of upwardly extending spaced tubes, bars spaced lengthwise of said tubes but extending transversely to them for maintaining the tubes in spaced relationship to each other, means for securing said tubes to said bars, brackets secured to said bars, and blocks protecting said tubes and held in their operative positions relatively to the tubes by said brackets, said brackets having flanges to engage said blocks.

29. In a furnace wall, the combination of a series of upwardly extending spaced tubes, channel bars spaced lengthwise of said tubes and extending transversely to the tubes and serving to mantain the tubes in spaced relationship to each other, the flanges of said bars being recessed to receive the tubes,

means for holding said tubes to said bars with the bars located in said recesses, blocks located in protective relationship to said tubes, and brackets secured rigidly to the flanges of said bars, said brackets having flanges to hold the blocks in their operative positions.

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