April 19, 1938. L. M. BEALL 2,114,960

FURNACE

Filed July 23, 1934 2 Sheets-Sheet 1

Fig. 1.

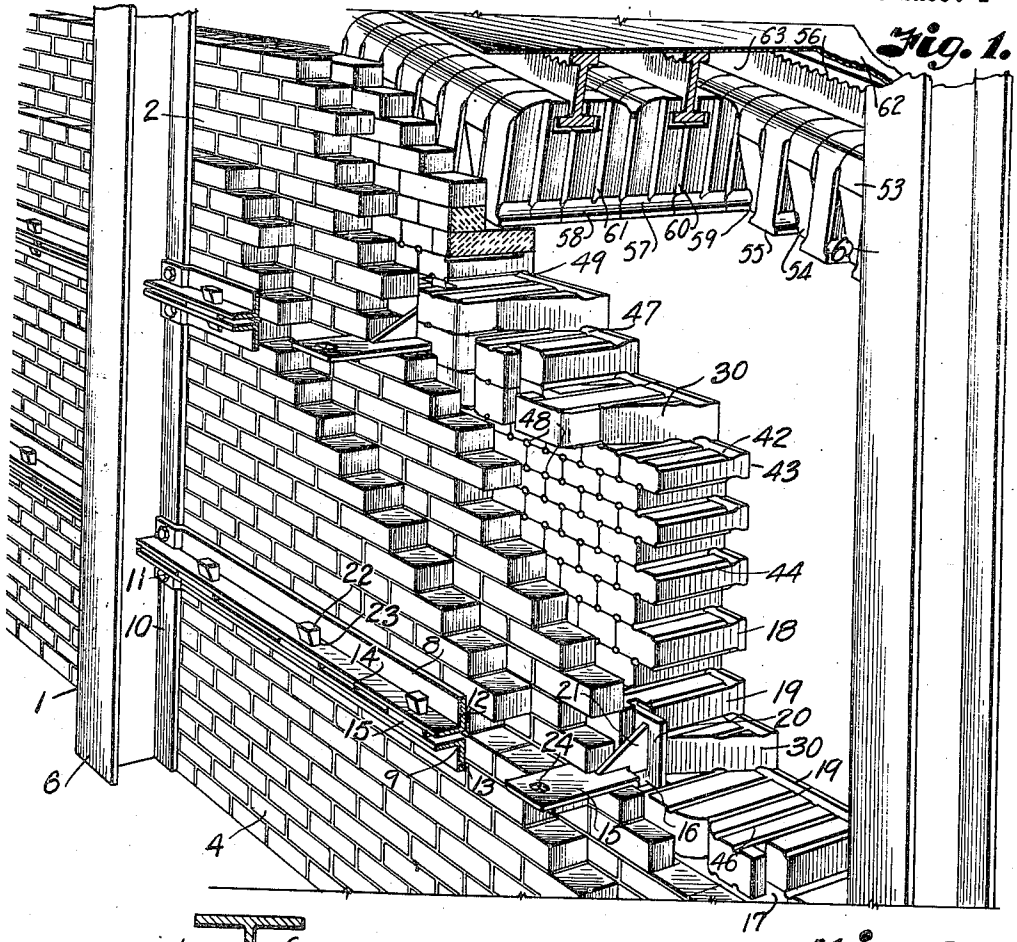
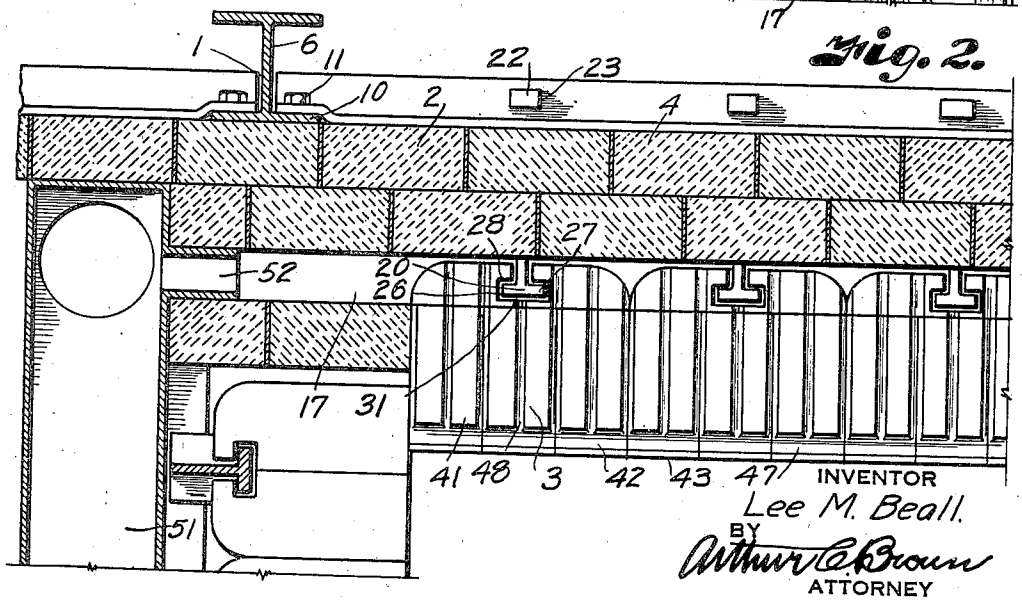


Fig. 2.



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Fig. 3.

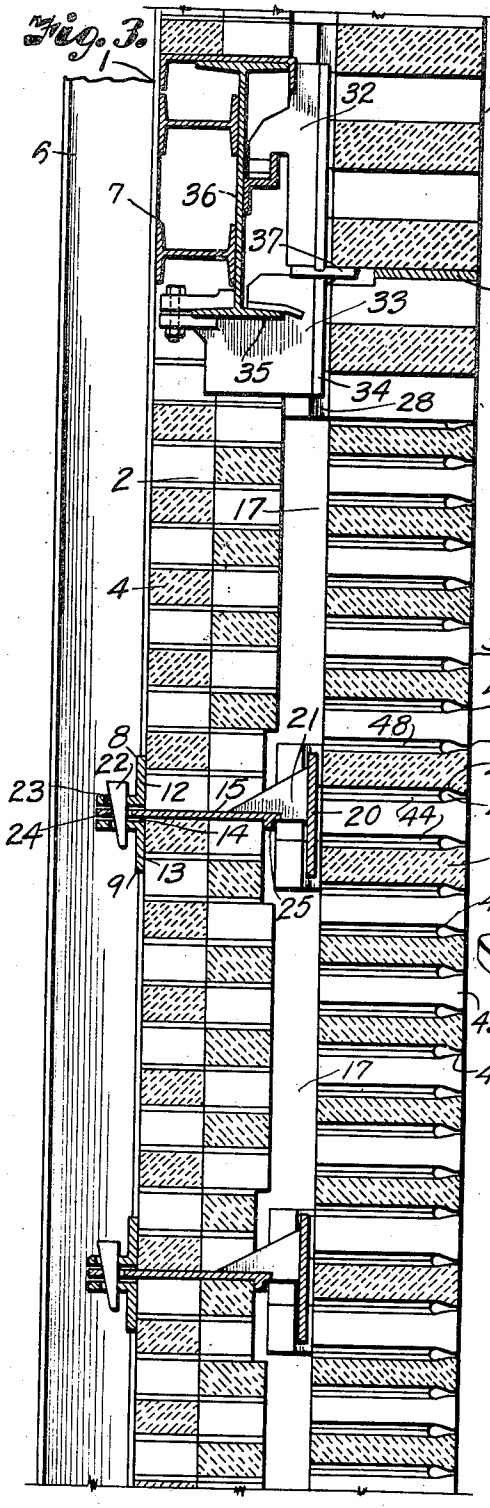


Fig. 4.

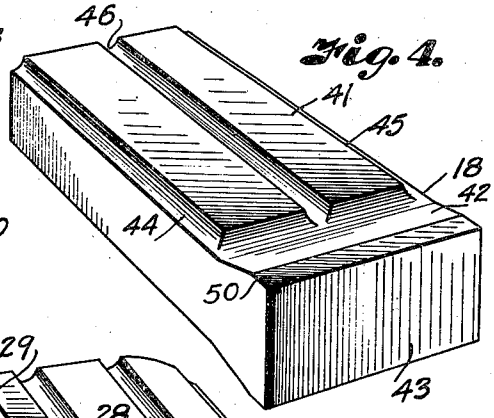


Fig. 5.

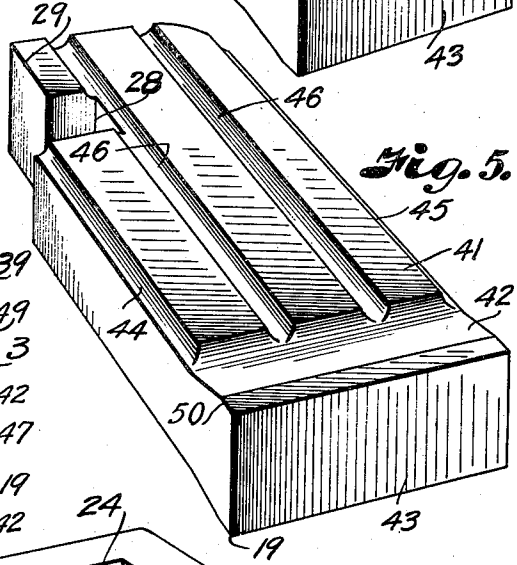
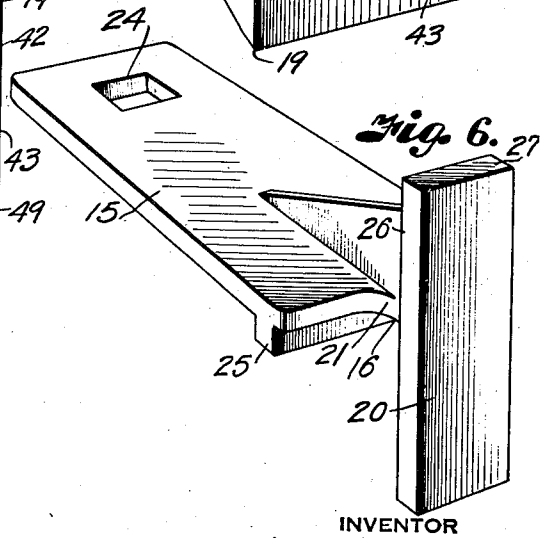


Fig. 6.



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UNITED STATES PATENT OFFICE

2,114,960

FURNACE

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Application July 23, 1934, Serial No. 736,551

11 Claims. (Cl. 110—75)

This invention relates to furnaces and more particularly to a furnace wall and arch construction and has for its principal object to provide a wall and arch of this character which is resistant to the destructive elements of the furnace such as expansion and contraction under wide variation in temperatures, erosion produced by melting slag running down the inner walls and arch of the furnace and spalling effects caused by the slag over-heating the wall surfaces.

Other important objects of the invention are to provide for movement of air over the inner walls and arch of the fire box, to retain the temperature of the slag collecting thereon below its melting point, to provide an improved refractory lining having sliding anchored support relatively to the exterior portions of a furnace wall, and to provide for cooling the refractory elements comprising the lining portions of the wall and arch.

In accomplishing these and other objects of the invention, as hereinafter pointed out, I have provided improved details of structure, the preferred form of which is illustrated in the accompanying drawings, wherein:

Fig. 1 is a perspective view of a portion of a furnace wall and arch sections of a fire box under construction to better illustrate the elements comprising the respective sections.

Fig. 2 is a horizontal section through the wall and a portion of the wind box wherefrom the cooling medium such as air is delivered between the refractory elements to regulate the temperature of any slag that may tend to collect on the inner surface of the walls.

Fig. 3 is an enlarged vertical section through the wall taken at a point in front of the furnace arch.

Fig. 4 is a detail perspective view of one of the brick shaped refractory elements.

Fig. 5 is a similar perspective view of one of the refractory header elements for securing the refractory wall portion to the outer supporting wall portion.

Fig. 6 is a detail perspective view of one of the anchor members.

Referring more in detail to the drawings:

1 designates a side wall of the fire box of a conventional type furnace such as is employed in the firing of large boilers as used in commercial power plants and which includes an outer wall portion 2 constructed of common brick and an inner refractory wall portion 3 constructed of refractory elements for resisting heat of combustion in the fire box.

Heretofore, furnace walls of this character were subject to rapid deterioration due to differential expansion between the outer and inner portions of the wall brought about by the different materials of construction and particularly when the refractory wall portion is of the same temperature as the fire box.

To overcome this difficulty, I have provided for free vertical expansion between the outer and inner wall portions as well as a lower temperature of the refractory lining.

Another reason for rapid deterioration of the walls is erosion caused by melted slag running down the surface of the refractory wall portions and wearing away the refractory elements. To overcome this difficulty, I have provided for circulating cooling medium through the refractory wall portions to maintain the temperature thereof below the temperature of any slag that may tend to collect thereon.

By thus cooling the wall, any slag which does collect thereon does not melt, but remains in soft porous condition and serves as a protective coating for the wall rather than as a destructive element.

In carrying out these features of the invention, the outer supporting wall portion is laid up of superimposed courses of ordinary brick 4 which may be bonded at suitable intervals as in conventional masonry construction. The supporting wall portion is reinforced by the structural frame work of the furnace including vertical columns 6 interconnected by box girders 7 which are incorporated into the wall construction. The columns are also interconnected by a series of vertically spaced angle bars 8 and 9 that are located in supporting relation with selected courses of brick.

The angle bars 8 and 9 have their ends connected to the vertical flanges 10 of the columns 6 by fastening devices 11 extending through the vertical legs 12 and 13 of the angle bars as best shown in Fig. 1.

The vertical flanges of the angle bars are preferably inset relatively to the ends thereof so that they lie flatly against the outer face of the wall structure. The horizontal leg portions of the angle bars extend outwardly therefrom and are spaced apart a sufficient distance to form a slot 14 therebetween for securing the plate portions 15 of anchor members 16 by which the inner refractory portion is secured to the outer supporting wall portion. The inner refractory portion of the wall is spaced from the supporting portion of the wall to provide a vertical passageway or

duct 17 therebetween for the circulation of the cooling medium as later described. The refractory wall portion is laid up of courses of refractory elements 18 of substantially brick shape and arranged in the wall in right angular relation to the arrangement of bricks comprising the outer wall portion, with the refractory elements in one course in bonded relation with those of the adjacent courses.

Incorporated in the refractory wall in alignment with the anchor members are courses of refractory header elements 19 for engaging the anchor members to retain the wall portions in vertically spaced relation, but which are slidable relatively thereto to provide for differential expansion of the respective wall portions.

The anchor members are best illustrated in Fig. 6 which shows the plate portions 15 thereof provided with heads 20 extending in vertically spaced relation with the plate portions and which are connected thereto by neck portions 21.

The plate portions of the anchor members are preferably the same thickness as the spacing of the mortar joints between the respective bricks and are of sufficient length to extend from the inner surface of the outer wall portion through the spacing between the angle bars 8 and 9 so that the plate portions can be secured thereto by wedge members 22 extending through openings 23 in the horizontal flanges of the angle bars and through aligning openings 24 in the plate portions. The opposite ends of the plate portions are also preferably provided with depending ribs 25 for engaging over the inner face of the course of bricks on which the plate portions of the anchor members are supported.

The neck portions 21 of the anchor members preferably comprise triangular shaped webs extending vertically from the upper surface of the plate portions and are in position to lie between the head joints of the bricks in the course which extends across the top of the plate portions.

The heads 20 of the anchor members are preferably integrally connected with the neck portions to provide lateral flanges 26 and 27 with which the header elements of the refractory wall portions are slidably interengaged.

The refractory header elements include one course having substantially the same width and height as the refractory elements 18 as illustrated in Fig. 4 and are arranged so that the head joints thereof are positioned in bonded relation with the head joints of the refractory elements 18.

The header elements, however, are of greater length than the refractory elements 18 so that the rear ends thereof project within the space 17 as clearly shown in Figs. 2 and 3 and are provided with vertically arranged notches 28 in a side face thereof to engage over one of the respective flange portions 26 and 27 depending upon the position of the refractory relatively thereto. The rear end of the brick is also cut away as at 29 to accommodate the neck portion 21 of the anchor member.

In order to provide a bond of the header elements in the next course, the elements of the next upper course include portions 30 extending in bias relation with the projecting portions thereof so that the end faces of the bias portions overlie the head joints of the next lower course of header elements in the same manner as the bonding of the refractory elements 18 previously described.

In building the wall, a sufficient number of courses of the brick refractory elements 18 are laid so that they extend to the approximate level of the bottom of the heads of the anchor members, a course of the refractory headers 19 being laid along the wall in such a manner that the refractory elements lie in pairs with the notches 28 of the pairs forming substantially T-shaped slots 31 for engaging over the flanges of the anchor members as illustrated in Fig. 2, the anchor members being spaced along the wall so that they are in position to be engaged by each succeeding pair of header elements in the course.

A course of bias refractory elements is then placed in the wall in like manner, after which another course of headers of the type illustrated in Fig. 5 is applied and so on until the top of the heads 20 is reached.

The construction of the wall then progresses with the refractory 18 until the next row of anchors is reached and a second series of header elements is built into the wall. The construction of the wall progresses in like manner above the level of the box girders 7; however, a plurality of the courses of header elements are secured to the girder by means of special anchor members 32 and 33 having flange portions 34 similar to the flange portions of the anchors 16.

The lower anchor member 33 is clamped to the lower flanges 35 of the main I-beam 36 of the box girder and the upper end thereof carries an inwardly extending shelf portion 37 for supporting that portion 38 of the refractory wall extending above the box girder.

The portion 39 of the refractory wall below the shelf 37 is positioned within the hottest portion of the fire box and, therefore, has the major portion of the expansion and contraction incidental to heating and cooling of the furnace and to take care of this expansion and contraction, the courses on the opposite sides of the shelves 37 are interposed with a layer of expansive material 40 to maintain the joint in closed condition during expansion and contraction of the wall.

I have found that by spacing the refractory portions of the wall from the supporting portion and that by circulating a cooling medium such as air through the space, I am enabled to retain the refractory wall in relatively cool condition to minimize the expansion and contraction thereof; however, to supplement this cooling effect of the air moving through the space 17, I provide for circulating air directly through the refractory portion of the wall as now to be described.

In carrying out this feature of the invention, the bed portion 41 of each refractory element 18 as well as each header element 19 below the girder 7 is provided with a transverse groove 42 adjacent the face ends 43 thereof and longitudinal grooves 44, 45, and 46 extending respectively along the longitudinal corners and intermediate portions of the refractory elements as best shown in Figs. 4 and 5.

Thus when the bricks are placed in juxtaposition in the wall, the grooves of one brick cooperate with the corresponding grooves of the adjacent brick to provide longitudinal and transverse channels 47 and 48 wherethrough air is circulated from the space 17 in close proximity to the inner surface of the wall as shown in Fig. 3.

The air, therefore carries away heat accumulating in the wall so that the inner surface of the wall is maintained below the melting point of any slag which tends to collect thereon.

I also provide for emitting jets of cooling me-

dium from the channels 47 through slots 49 formed between the respective courses of refractory elements. These slots are formed by offsetting the faces of the bed portions of the elements on opposite sides of the transverse grooves 42 so that when the elements are placed in superimposed courses the portions 50 are spaced apart to provide the slots 49 therebetween and which are in communication with the respective channels.

Thus, the cooling medium is caused to move in direct contact with the slag to retain it in soft porous condition so that the air passes readily therethrough and prevents it from melting and running down the wall to cause the erosion above pointed out.

While the cooling medium may be provided from any source, I preferably circulate the cooling medium from the wind box 51 of the furnace which is connected with the wall space 17 by means of a connecting flue 52 as shown in Fig. 2.

In a furnace constructed as described, air is circulated from the wind box 51 through the space 17 for distribution to all of the channels 48 for flow to the longitudinal channels 47 to maintain the refractory portion of the wall in relatively cool condition or below the temperature at which the elements tend to crack and produce spalling.

Also by circulating the air in close proximity with the inner face of the wall and by discharging jets of air in sheet like formation through the slots 49 and into the furnace, any slag which tends to collect thereon is maintained below its melting point so that if it does adhere to the wall, it is of soft porous nature and acts as a protective coating on the wall.

A similar method may be used in cooling and protecting the arch section 53 of the fire box, as illustrated in Fig. 1, wherein refractory elements 54 and 55, similar to the header elements employed in the wall construction, are suspended in juxtaposed relation from I-beam supports 56. The refractories are positioned on the supports so that courses of the bias elements 54 alternate with the straight elements 55 to provide a bonded construction.

The grooves 57 in the side faces of the refractory elements 54 and 55 also cooperate to form channels 58 extending across the width of the arch and having slots 59 wherethrough air is passed from the channels into the fire box in direct contact with slag tending to collect on the under surface of the arch, the air being supplied to the channels through the lateral channels 60 formed by the longitudinal grooves 61 of the refractories. The tops of the supports 56 carry a sheet metal covering 62 to provide an air space 63 above the refractories for preventing loss of furnace heat through the arch, this heat being absorbed by the air and returned to the fire box through the respective flow channels. The space 63 may be connected through suitable ports (not shown) with the vertical spaces 17 in the side walls, or it may connect directly with the wind box 51 through ducts similar to the flues 52, previously described.

It may be desirable in most arch installations to have the slots 59, or at least most of them, closed by a high temperature cement to retain the air for circulation through the channels in close proximity to the inner surface of the arch for maintaining the cooling effect without passing the air directly in contact with the slag.

From the foregoing, it is apparent that I have provided a wall having maximum strength and which is resistant to the destructive elements incidental to furnaces of the type illustrated and wherein differential expansion and contraction of the respective materials is adequately compensated for to prevent disintegration of the wall structure.

While I have specifically related my invention to furnace wall and arch construction, it is obvious that the construction may be used in any type of still, retort, blast or like furnaces, wherein it is desirous to prevent the formation of melted slag or to compensate for expansion and contraction between inner and outer portions of a wall.

What I claim and desire to secure by Letters Patent is:

1. A furnace wall including an outer wall portion, an inner wall portion comprising juxtaposed refractory elements having interconnecting longitudinal and transverse grooves cooperating to provide transverse and lateral flow channels, anchor members carried in said outer wall portion, header elements interposed between selected refractory elements and having bias portions positioned in bonded relation with said refractory elements and provided with notched portions for sliding engagement with said anchor members to retain the wall portions in spaced relation and provide a duct therebetween communicating with said flow channels, and means for delivering a cooling medium to said duct for flow through said channels.

2. A furnace wall including an outer wall portion, an inner wall portion comprising juxtaposed refractory elements having interconnecting longitudinal and transverse grooves cooperating to provide transverse and lateral flow channels, anchor members carried in said outer wall portion, header elements interposed between selected refractory elements and having similar flow channels and provided with notched portions for sliding engagement with said anchor members to retain the wall portions in spaced relation and provide a duct therebetween communicating with said flow channels, and means for delivering a cooling medium to said duct for flow through said channels.

3. A furnace wall including inner and outer wall portions comprising juxtaposed bricks, flanged anchor members carried by one of said wall portions, a row of header elements interposed between selected bricks in the other of said walls and having bias portions arranged in bias relation with said bricks and provided with hook-shaped portions slidably engaging the flanged anchor members to retain said wall portions in spaced relation, and a second row of header members positioned in bonded relation with the bias portions of said first row and having similar hook-shaped portions engaging said anchor members.

4. A furnace wall including an outer supporting wall portion, anchor members having plate portions extending through said wall and having flanged head portions, and an inner refractory wall including refractory elements having notched portions engaging said flanges on said head portions of the anchor members to space said wall portions to form an air duct therebetween, said inner wall portion having air flow channels in communication with said air duct.

5. A furnace wall including an outer wall portion, an inner wall portion comprising juxtaposed refractory elements, anchor members carried in said outer wall portion, and header elements in-

terposed between selected refractory elements and having bias portions positioned in bonded relation with said refractory elements and provided with notched portions for sliding engagement with said anchor members to retain the wall portions in spaced relation.

6. A refractory element including a refractory body having a hooked shaped anchoring portion, and a bias portion having transverse and longitudinal grooves to form flow channels when the refractory element is juxtaposed in bonded relation with similar elements in a wall structure, said bias portion having a bed face provided with offsets on opposite sides of the transverse groove so that when the refractory elements are juxtaposed with similar elements slotted outlets are provided for the flow channels formed by said transverse grooves.

7. A refractory element including a brick like body having a bed portion provided with offset faces separated by a transverse groove and having a longitudinal groove in the highest of said offset faces and connected with the transverse groove to form flow channels and a slotted outlet from the flow channels when the refractory element is juxtaposed with similar elements in a wall structure.

8. A refractory element including a brick like body having a bed portion provided with offset faces separated by a transverse groove and having a longitudinal groove in the highest of said offset faces connecting the transverse groove to form flow channels and a slotted outlet from the flow channels when the refractory element is juxtaposed with similar elements in a wall structure, and a hook-shaped anchor engaging portion on said body.

9. A furnace wall including inner and outer wall portions comprising juxtaposed bricks, flanged anchor members carried by one of said wall portions, and header elements interposed between selected bricks in the other of said wall portions and having biased portions arranged in bias relation with said bricks and provided with hook-shaped ends slidably engaging the flanged anchor members to retain said wall portions in spaced relation, said header elements having flow channels in communication with the space formed between said wall portions.

10. A furnace wall including an outer wall portion, anchor members carried by said outer wall portion and having flanged heads, an inner wall portion including courses of juxtaposed refractory elements, the refractory elements in one course having bed faces provided with channels cooperating with bed faces of the refractory elements in the next adjacent course to form horizontal passageways for air between the bed faces of the respective courses and having notched ends for slidably engaging said flanged heads of the anchors to retain said wall portions in spaced relation to form a chamber in communication with said passageways between the respective courses whereby air is circulated from the chamber through said passageways.

11. A furnace wall including an outer wall portion formed of juxtaposed brick, anchor members having plate portions engaged between selected bricks and having flanged head portions, an inner wall portion including courses of juxtaposed refractory elements, the refractory elements in one course having bed faces provided with channels cooperating with bed faces of the refractory elements in the next adjacent course to form horizontal passageways for air between the bed faces of the respective courses and having notched ends for slidably engaging said flanged head portions to retain said wall portions in spaced relation to form a chamber in communication with said passageways between the respective courses whereby air is circulated from the chamber through said passageways.

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