

Description

Title of the Invention

METHOD FOR CONSTRUCTING REFRACTORY TILES FOR PROTECTING
BOILER WATER PIPES

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Field of the Invention

[0001]

The present invention relates to a method for constructing refractory tiles for protecting boiler water pipes.

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Background of the Invention

[0002]

A plurality of boiler water pipes are installed on a furnace wall of a combustion furnace in facilities such as a waste incineration plant that includes a boiler and generates power while incinerating waste and a power plant that burns fuel such as coal, that is, combustion plants equipped with boilers. Generally, the plurality of boiler water pipes are erected in the vertical direction, and are spaced apart from each other at equal intervals in the horizontal direction, that is, are evenly disposed. Two boiler water pipes adjacent to each other in the horizontal direction are connected to each other with a plate-shaped fin without any gap, and a water pipe panel is formed by the boiler water pipes and the fins.

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[0003]

In order to protect these boiler water pipes from excessive heat, a refractory tile may be installed on the surface of the boiler water pipe on the furnace side (the upper surface) in the water pipe panel (hereinafter, "installing a refractory tile on the upper surface of the boiler water pipe"). At this time, for example, there is a technique in which hooks are uniformly installed on the fins of a water pipe panel, and the refractory tile is mechanically supported by the hooks (see Patent Document 1). According to this technique, a refractory joint material such as mortar serving as an adhesive is applied to the back surface of a rectangular refractory tile, the hook is hooked on a depression (hereinafter, referred to as a "recess") provided near the center of the back surface of the refractory tile, and the refractory tile is pressed toward the water pipe panel, whereby the refractory tile is fixed on two adjacent boiler water pipes on both sides of the hook. By sequentially repeating this, the plurality of refractory tiles are installed on the upper surfaces of the plurality of boiler water pipes in a state where clearances for thermal expansion are opened.

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[0004]

In a case where a large number of refractory tiles are installed, for example, there is a technique in which nine refractory tiles arranged in a rectangular alignment form one tile set, a refractory joint material is applied to gaps between adjacent refractory tiles in one tile set, and a refractory expansion allowance filler such as Fiber Cast is embedded in a gap between a tile set and an adjacent tile set (see Patent Document 2).

Citation List Patent Literature

10 [0005]

Patent Document 1: JP 3176108 U

Patent Document 2: JP 3122422 B

Summary of the Invention

15 Issue to be solved by the Invention

[0006]

Since each of the plurality of refractory tiles is sequentially installed by being hooked on a corresponding hook among the plurality of hooks installed evenly in advance in the water pipe panel, it is expected that the refractory tiles are aligned without deviation as designed.

However, a positional relationship between the refractory tile and the hook may slightly deviate from a predetermined position due to the influence of the refractory joint material applied into the recess on the back surface of the refractory tile.

25 At this time, since the misalignment of each refractory tile is a small amount, the worker may not notice the misalignment, and the installation work of the refractory tile may be continued. As a result, small misalignment of each refractory tile is accumulated, resulting in large misalignments or distortion when the overall structure is viewed after installation of a large number of refractory tiles, and there is a possibility that construction has to be performed again.

[0007]

The present invention has been made in view of the above problems, and an object of the present invention is to provide an installation method for installing a plurality of refractory tiles for protecting boiler water pipes at predetermined positions with simple and accurate alignment.

Solution to the Issue

[0008]

The present invention provides a method for constructing refractory tiles for protecting boiler water pipes, in which a plurality of rectangular refractory tiles are aligned and fixed to a water pipe panel including a plurality of boiler water pipes uniformly arranged in a horizontal direction, a plurality of fins connecting two boiler water pipes adjacent in the horizontal direction, and a plurality of hooks provided on the plurality of fins.

The plurality of hooks are fixed to the plurality of fins in a regular arrangement corresponding to the positions of recesses formed on the back surfaces of the refractory tiles to be aligned. By applying refractory joint material to the back surface of each refractory tile and hooking and fixing hooks corresponding in number to the recesses provided in one refractory tile to the recesses, the plurality of refractory tiles are aligned at predetermined intervals from each other, and one refractory tile is fixed to the upper surfaces of two or more boiler water pipes.

[0009]

Furthermore, the present invention characteristically includes at least the following steps. That is, the method includes:

a first step of selecting one of the plurality of refractory tiles as a reference tile, and without applying refractory joint material to its back surface, hooking it onto a number of reference hooks among the plurality of hooks, the number corresponding to the number of recesses formed on the back surface of the reference tile;

a second step, performed after the first step, of applying refractory joint material to the back surface of one refractory tile different from the reference tile among the plurality of refractory tiles, hooking the refractory tile coated with the refractory joint material onto a number of hooks among the plurality of hooks—including a hook adjacent to one of the reference hooks and corresponding in number to the recesses formed on the back surface of the different tile—and pressing and fixing the coated refractory tile toward the water pipe panel while aligning it with the reference tile;

a third step, performed after the second step, of performing either one of the following two branching steps: a first branching step including: removing the reference tile from the reference hooks, applying refractory joint material to its back surface, hooking the reference tile onto the reference hooks, and then pressing and fixing the reference tile toward the water pipe panel while aligning it with the refractory tile fixed in the second step; or a second branching step including: applying refractory joint material to a back surface of one refractory tile different from all refractory tiles fixed in all preceding steps up to this step among the plurality of refractory tiles, hooking the coated refractory tile onto a number of hooks on which no refractory tile has yet been hooked among the plurality of hooks—including a hook

Advantageous Effects of the Invention

According to the construction method of the present invention, first, in the first step, the refractory joint material is not applied to the back surface of the refractory tile serving as the reference tile, and the reference tile is hooked on a number of reference hooks corresponding to the number of recesses formed on the back surface. Since the refractory joint material is not painted, the reference tile is merely hooked on the reference hook. Therefore, since the reference hook enters the deepest portion of the recess on the back surface and directly contacts the reference tile, the up-down and horizontal positions of the reference tile are arranged at designed positions.

In the third step, the further refractory tile fixed in position as designed in the second step can be used as a new reference for alignment. Accordingly, the refractory tile immediately adjacent to the other refractory tile may similarly be accurately aligned and fixed in position as designed based on the new reference refractory tile.

In the fourth step, the third step is repeated a predetermined number of times, so that the plurality of rectangular refractory tiles can be aligned and fixed as designed while the new reference refractory tile is sequentially changed.

[0011]

- 5 Therefore, according to the present invention, it is possible to provide a construction method for installing a plurality of refractory tiles for protecting boiler water pipes at predetermined positions in a simple and accurate alignment.

Brief Description of Drawings

10 [0012]

FIG. 1 is a schematic front view showing a water pipe panel and a refractory tile to which a construction method according to an embodiment is applied.

- FIG. 2 shows the refractory tile shown in FIG. 1, where FIG. 2A is a front view as viewed from the front surface, FIG. 2B is a rear view as viewed from the back surface, and FIG. 2C is a top view as viewed from arrow A of FIG. 2A.

FIG. 3 shows a first fitting-type refractory tile, where FIG. 3A is a front view as viewed from the front surface, FIG. 3B is a rear view as viewed from the back surface, FIG. 3C is a top view, FIG. 3D is a bottom view, and FIG. 3E is a cross-sectional view taken along line B-B of FIG. 3A.

- 20 FIG. 4 shows a second fitting-type refractory tile, where FIG. 4A is a front view as viewed from the front surface, FIG. 4B is a rear view as viewed from the back surface, FIG. 4C is a top view, FIG. 4D is a bottom view, and FIG. 4E is a cross-sectional view taken along line C-C of FIG. 4A.

- FIG. 5 shows a third fitting-type refractory tile, where FIG. 5A is a front view as viewed from the front surface, FIG. 5B is a rear view as viewed from the back surface, FIG. 5C is a top view, FIG. 5D is a bottom view, and FIG. 5E is a cross-sectional view taken along line D-D of (A).

FIG. 6 is a schematic front view showing an example of a water pipe panel on which a fitting-type refractory tile is constructed.

- 30 FIG. 7 is a schematic front view of a water pipe panel after refractory tile construction, showing an example of a tile set different from the tile set in FIG. 6.

FIG. 8 is a schematic front view of a water pipe panel after refractory tile construction, showing an example of a tile set different from the tile set in FIGS. 6 and 7.

- 35 FIG. 9 shows a first half-split type refractory tile similar to the first fitting-type refractory tile, in which FIG. 9A is a front view as viewed from the front surface, FIG. 9B is a rear view as viewed from the back surface, FIG. 9C is a bottom view,

FIG. 9D is a top view, and FIG. 9E is a cross-sectional view taken along line E-E of FIG. 9 A.

FIG. 10 shows a first half-split type refractory tile similar to the second fitting-type refractory tile, where FIG. 10A is a front view as viewed from the front surface, FIG. 10B is a rear view as viewed from the back surface, FIG. 10C is a bottom view, FIG. 10D is a top view, and FIG. 10E is a cross-sectional view taken along line F-F of FIG. 10A.

FIG. 11 shows a first half-split type refractory tile similar to the third fitting-type refractory tile, in which FIG. 11A is a front view as viewed from the front surface, FIG. 11B is a rear view as viewed from the back surface, FIG. 11C is a bottom view, FIG. 11D is a top view, and FIG. 11E is a cross-sectional view taken along line G-G of FIG. 11A.

FIG. 12 is a schematic front view showing an example of a water pipe panel on which first and second half-split type refractory tiles are constructed.

FIG. 13 is a perspective view showing a block-type refractory tile.

FIG. 14 is a perspective view showing a modification of the block-type refractory tile.

FIG. 15 is a schematic front view showing an example of a water pipe panel on which a large refractory tile is constructed.

FIG. 16 is a schematic front view showing an example of a water pipe panel on which another type of large refractory tile is constructed.

FIG. 17 is a schematic front view showing an example of a water pipe panel after refractory tile construction, used to describe the construction method according to the embodiment.

Description of Embodiments of the Invention

[0013]

Hereinafter, a method for constructing refractory tiles for protecting boiler water pipes according to an embodiment of the present invention will be described with reference to FIGS. 1 to 17. In the drawings, for convenience of explanation, an orthogonal coordinate system including an X axis, a Y axis, and a Z axis is used as appropriate. Here, the Z axis is arranged vertically, and the X axis and the Y axis are arranged horizontally. The Z-axis indicates the up-down direction, i.e., the longitudinal direction, in which the refractory tiles are aligned. The arrow direction of the Z axis indicates a direction toward the upper side in the up-down direction. The X-axis indicates a left-right direction, i.e., a lateral direction, in which the plurality of refractory tiles are aligned. The Y-axis indicates the direction perpendicular to the water pipe panel, i.e., the thickness direction of the refractory tile.

The arrow direction of the Y axis indicates a direction from the boiler water pipe toward the refractory tile installed on the upper surface of the boiler water pipe.

Note that, here, as an example, the longitudinal direction will be described as the vertical direction, but it may be inclined with respect to the vertical direction as long as it is along the up-down direction. For example, there is a case where the furnace wall is inclined from the vertical direction at a part of the combustion furnace, and in this case, the following description may be understood assuming that an orthogonal coordinate system is arranged in which the Z axis and the Y axis are inclined while the X axis maintains the horizontal direction.

The embodiment is merely an example, and there is no intention to exclude various modifications and applications of technologies that are not explicitly described. Except for the configuration essential to the present invention, each configuration of the embodiment can be selected or modified in various ways as necessary.

[0014]

First, the basic matters of the method (hereinafter, referred to as a “construction method”) for constructing refractory tiles for protecting boiler water pipes (hereinafter, referred to as “refractory tile”) of the embodiment will be briefly described with reference to FIG. 1, and thereafter, examples of various refractory tiles used in the construction method will be described with reference to FIGS. 2 to 16. Finally, a construction method will be described in detail with reference to FIG. 17.

[0015]

[1. Basic matters]

FIG. 1 is a schematic front view of a plurality of rectangular refractory tiles aligned on the upper surfaces of a plurality of boiler water pipes 1 viewed from inside a combustion furnace of a combustion plant including a boiler.

In FIG. 1, as an example, the refractory tile 2 described in detail later in [2. Types of refractory tiles] is disposed, but instead of the refractory tile 2, another type of refractory tile also described in detail in [2. Types of refractory tiles] may be used. However, when other types of refractory tiles are used, the number of recesses 6 included in one refractory tile may be plural, or the positions of the recesses 6 may be different from those of other types of refractory tiles, so that the hooks 5 need to be appropriately arranged corresponding to the number and positions of the recesses 6 of the refractory tile.

The water pipe panel 4 includes a plurality of boiler water pipes 1, each erected in the Z-axis direction and arranged at equal intervals in the X-axis direction, and a plate-like fin 3 connecting two adjacent boiler water pipes 1 in the X-axis direction, that is, in the lateral direction without a gap. In other words, the water

pipe panel 4 has a rectangular plate shape, and has a structure in which each of the plurality of fins 3 fills the space between the plurality of aligned boiler water pipes 1.

Since the furnace wall of the combustion furnace generally has a rectangular tubular shape, a plurality of plate-shaped water pipe panels 4 are welded to form the rectangular tubular shape, but here, for convenience of description, the water pipe panel 4 on one surface of the rectangular tubular shape will be used for description.

In the fin 3, a plurality of hooks 5 are regularly installed by welding at positions corresponding to the positions of the recesses formed on the back surfaces of the plurality of refractory tiles to be aligned.

[0016]

As long as the rectangular refractory tile has a structure in which it is installed to cover the upper surfaces of two or more boiler water pipes 1, is supported by hooks 5 at recesses 6 formed on its back surface, and can be disposed with a gap of a predetermined width between two adjacent refractory tiles, any structure may be used, not limited to the various examples of refractory tiles described below. In a state where the refractory tile is fixed to the water pipe panel 4, a surface facing the inside of the furnace is referred to as a “front surface” of the refractory tile, and an opposite side thereof, that is, a surface facing the boiler water pipe 1, is referred to as a “back surface”.

The refractory tile is desirably made of SiC as a main component. In this case, the predetermined width is desirably, for example, about 4 mm to about 8 mm, more specifically, about 6 mm.

[0017]

In FIG. 1, the refractory tile 2 includes one recess 6 near the center of the back surface. However, as in other types of refractory tiles described below, the refractory tile only needs to include at least one recess 6, and may include one or more recesses 6, such as two or three recesses, in the lateral direction. The recess 6 is shaped such that the upper end of the refractory tile is held horizontally when the refractory tile is hooked on the L-shaped hook 5.

Further, in FIG. 1, the plurality of hooks 5 are installed on every other fin 3 in the lateral direction, and are regularly installed at equal intervals in the longitudinal direction of the fin 3. However, the hooks 5 may be arranged regularly as appropriate, depending on the type of refractory tile, that is, the number and position of the recesses 6 included in one refractory tile.

[0018]

Furthermore, in FIG. 1, as indicated by the two-dot chain line, a plurality of tile sets, each composed of a predetermined number of refractory tiles, are arranged in order to facilitate the assignment of work areas to multiple workers during installation

and to implement countermeasures against thermal expansion of the refractory tiles due to heat inside the furnace when the combustion furnace is in operation.

Specifically, as an example, a tile set 7A including a total of nine refractory tiles 2, three in the longitudinal direction and three in the lateral direction, and a tile set 7B

5 having the same configuration as the tile set 7A and arranged beside the tile set 7A are shown.

The arrangement of the plurality of refractory tiles in one tile set is not limited to one in which three refractory tiles are arranged in the longitudinal direction and three refractory tiles are arranged in the lateral direction (hereinafter, the tile set in
10 this arrangement is referred to as a “first tile set”) as in the tile sets 7A and 7B, and may be one in which two refractory tiles are arranged in the longitudinal direction and two refractory tiles are arranged in the lateral direction (hereinafter, the tile set in this arrangement is referred to as a “second tile set”) or one in which three or more refractory tiles are arranged in the longitudinal direction and two refractory tiles are
15 arranged in the lateral direction (hereinafter, the tile set in this arrangement is referred to as a “third tile set”).

The arrangement of the plurality of refractory tiles in one tile set may be one in which two refractory tiles are arranged in the longitudinal direction and three or more refractory tiles are arranged in the lateral direction (hereinafter, the tile set in
20 this arrangement is referred to as a “fourth tile set”), one arranged in a row only in the longitudinal direction (hereinafter, the tile set in this arrangement is referred to as a “fifth tile set”), or one arranged in a row only in the lateral direction (hereinafter, the tile set in this arrangement is referred to as a “sixth tile set”).

In one water pipe panel, a plurality of tile sets of any one of the first to sixth
25 tile sets may be arranged, or a plurality of types of tile sets may be arranged in a mixed manner according to the furnace wall shape of the combustion furnace.

The plurality of tile sets may be arranged in the longitudinal or lateral direction. In addition, the number of refractory tiles included in the tile set may be appropriately changed depending on the location of the furnace wall. Further, the
30 same type of refractory tile may be used for all tile sets, or different types of refractory tiles may be used for each tile set.

[0019]

A refractory joint material such as mortar or castable is applied to the gaps around each of the plurality of refractory tiles arranged in one tile set, and a refractory
35 expansion allowance filler such as Fiber Cast is embedded in the gap around one tile set.

In FIG. 1, the refractory expansion allowance filler is embedded in the gap between the tile set 7A and the adjacent tile set 7B, and the refractory joint material is

applied to the gaps between the plurality of refractory tiles included in the tile set 7A and the gaps between the plurality of refractory tiles included in the tile set 7B.

[0020]

[2. Types of refractory tiles]

5 Next, a specific configuration example of a type of refractory tile to which the construction method of the present invention can be applied will be described.

[Gull-type refractory tile (non-fitting-type)]

FIGS. 2A to 2C show the refractory tile 2 shown in FIG. 1. That is, only one recess 6 is formed at the center of the back surface of one rectangular refractory tile 2 in the X-axis direction and slightly upward from the center in the Z-axis
10 direction, and the refractory tile 2 covers two boiler water pipes 1.

In the rectangular refractory tile 2, one rectangular side portion 2B covering one boiler water pipe 1 is disposed on each side of a rectangular central portion 2A provided at the center in the X-axis direction when viewed in the XZ plane. That is,
15 one side portion 2B is disposed on the right side of the central portion 2A, and one side portion 2B is disposed on the left side of the central portion 2A. When viewed in the XY plane, the side portion 2B has a shape curved along about a half of the outer periphery of the boiler water pipe 1. The thickness of the curved shape is substantially the same at all portions, and is thinner than the thickness of the central
20 portion 2A. A recess 6 is formed in the central portion 2A.

On the back surface of the refractory tile 2, a plurality of spacers 2C protruding toward the boiler water pipe 1 are formed on each side portion 2B. The spacer 2C has a function of making the thickness of a refractory joint material such as mortar applied to the back surface of the refractory tile 2 uniform to strengthen the
25 adhesive force and make the heat transfer performance uniform. In FIG. 2, three spacers 2C are formed on one side portion 2B, but the number of spacers 2C may be four or more or two or less.

The refractory tile 2 is referred to as a “gull-type” refractory tile because, as viewed in the XY plane, the side portions 2B on both sides of the central portion 2A
30 resemble the “wings of a gull” in flight.

[0021]

[Gull-type refractory tile (fitting-type)]

Like the refractory tile 2, the refractory tiles 8 to 10 shown in FIGS. 3 to 5 are a kind of refractory tile of a “gull-type”. The refractory tiles 8 to 10 are different
35 from the refractory tile 2 only in that they are “fitting-type” refractory tiles, and thus the same components as those of the refractory tile 2 are denoted by the same reference numerals and description thereof is omitted.

The refractory tile 8 is a “first fitting-type refractory tile” including both a fitting protrusion 8D and a fitting recess 8E described later. The refractory tile 9 is a “second fitting-type refractory tile” including only the fitting protrusion 8D described later. The refractory tile 10 is a “third fitting-type refractory tile” including only the fitting recess 8E described later. The refractory tile 9 is identical in shape to the refractory tile 8, except that only the fitting recess 8E is not formed. The refractory tile 10 has the same shape as the refractory tile 8, except that only the fitting protrusion 8D is not formed.

The fitting protrusion 8D and the fitting recess 8E have shapes that can be fitted to each other. Accordingly, the fitting protrusion 8D of the refractory tile 8 can fit into the fitting recess 8E of the refractory tile 10, and the fitting recess 8E of the refractory tile 8 can fit into the fitting protrusion 8D of the refractory tile 9. Similarly, the fitting protrusion 8D of the refractory tile 9 can fit into the fitting recess 8E of the refractory tile 10.

[0022]

In the rectangular refractory tile 8, one rectangular side portion 2B covering one boiler water pipe 1 is disposed on each side of a rectangular central portion 8A provided at the center in the X-axis direction when viewed in the XZ plane. That is, one side portion 2B is disposed on the right side of the central portion 8A, and one side portion 2B is disposed on the left side of the central portion 8A. Only one recess 6 is formed at the center of the central portion 8A in the X-axis direction and slightly above the center in the Z-axis direction.

When viewed in the XZ plane, a fitting protrusion 8D protruding in a rectangular shape upward from the position of the upper end of the side portion 2B and a fitting recess 8E recessed in a rectangular shape above the position of the lower end of the side portion 2B and having a size with which the fitting protrusion 8D can be fitted are formed in the central portion 8A.

[0023]

In the rectangular refractory tile 9, one rectangular side portion 2B covering one boiler water pipe 1 is disposed on each side of a rectangular central portion 9A provided at the center in the X-axis direction when viewed in the XZ plane. That is, one side portion 2B is disposed on the right side of the central portion 9A, and one side portion 2B is disposed on the left side of the central portion 9A. Only one recess 6 is formed at the center of the central portion 9A in the X-axis direction and slightly above the center in the Z-axis direction.

When viewed in the XZ plane, a fitting protrusion 8D protruding in a rectangular shape upward from the position of the upper end of the side portion 2B is formed in the central portion 9A.

[0024]

As shown in FIGS. 5A to 5E, in the refractory tile 10, one rectangular side portion 2B covering one boiler water pipe 1 is disposed on each side of a rectangular central portion 10A provided at the center in the X-axis direction as viewed in the XZ plane. That is, one side portion 2B is disposed on the right side of the central portion 10A, and one side portion 2B is disposed on the left side of the central portion 10A. Only one recess 6 is formed at the center in the X-axis direction of the central portion 10A and slightly above the center in the Z-axis direction.

When viewed in the XZ plane, a fitting recess 8E is formed in the central portion 10A, which is recessed in a rectangular shape upward from the position of the lower end of the side portion 2B and has dimensions that allow fitting with the fitting protrusion 8D.

[0025]

FIG. 6 shows an example of a case where the refractory tiles 2 in FIG. 1 are replaced with the fitting-type refractory tiles 8 to 10, which are installed on the water pipe panel 4. As described above, each of the tile set 7A and the tile set 7B is the first tile set in which three refractory tiles are installed in the longitudinal direction, so that the refractory tile 9, the refractory tile 8, and the refractory tile 10 can be disposed in this order from bottom to top in the Z-axis direction.

Here, the fitting protrusion 8D of the refractory tile 8 is fitted into the fitting recess 8E of the refractory tile 10, and the fitting recess 8E of the refractory tile 8 is fitted into the fitting protrusion 8D of the refractory tile 9.

When construction is performed using the fitting-type refractory tile as shown in FIG. 6, the two vertically adjacent refractory tiles are fitted to each other, so that the refractory tile can be more securely prevented from peeling or falling due to shaking such as an earthquake, as compared with the case of using the non-fitting-type refractory tile 2.

[0026]

As described above, in one tile set, the number of contained refractory tiles may be appropriately changed depending on the location of the furnace wall. FIG. 7 shows an example of a third tile set in which a total of six refractory tiles are arranged, three in the longitudinal direction and two in the lateral direction. Specifically, two columns, each formed by fitting two vertically adjacent refractory tiles in the order of refractory tile 9, refractory tile 8, and refractory tile 10 from bottom to top in the Z-axis direction, are arranged in the X-axis direction to form one tile set. Then, FIG. 7 shows an example in which two tile sets, that is, a tile set 7A' and a tile set 7B' are arranged in the lateral direction.

In FIGS. 6 and 7, the lower end of the tile set is a refractory tile 9, and the upper end is a refractory tile 10. Between the refractory tile 9 and the refractory tile 10, two or more plural refractory tiles 8 may be vertically aligned, and two vertically adjacent refractory tiles may be fitted.

5 As another example, FIG. 8 shows an example of a fourth tile set in which a total of six refractory tiles, two in the longitudinal direction and three in the lateral direction, are arranged. Specifically, one tile set is formed by arranging three rows in the X-axis direction, each row being formed by fitting two vertically adjacent refractory tiles in order of the refractory tile 9 and the refractory tile 10 from bottom
10 to top in the Z-axis direction. Then, FIG. 8 shows an example in which two tile sets are arranged in the lateral direction, that is, a tile set 7A" and a tile set 7B" are arranged.

[0027]

[Gull-type refractory tile (fitting-type and half-split type)]

15 The refractory tiles 11 to 13 shown in FIGS. 9 to 11 are different from the fitting-type refractory tiles 8 to 10 only in that one side portion 2B of the fitting-type refractory tiles 8 to 10 shown in FIGS. 3 to 5 is a half-split type divided along the Z axis near its center. Therefore, the same configurations as those of the refractory tiles 8 to 10 are denoted by the same reference numerals, and description thereof is
20 omitted.

Each of the fitting-type and half-split type refractory tiles 11, 12, and 13 shown in FIGS. 9A, 10A, and 11A has a configuration in which one side portion 2B is disposed on the right side of each of the central portions 8A, 9A, and 10A and one half-split side portion 11F is disposed on the left side of each of the central portions
25 8A, 9A, and 10A as viewed from the surface of the refractory tile, and is referred to as "first half-split type" refractory tiles. On the other hand, a refractory tile having a symmetrical shape with respect to the refractory tile of the first half-split type is referred to as a "second half-split type" refractory tile.

The half-split side portion 11F has a structure in which the side portion 2B is
30 split along the Z axis and the side portion 2B has been reduced in size in the lateral direction, and has a shape curved along about 1/4 of the outer periphery of the boiler water pipe 1 as viewed in the XY plane.

[0028]

35 As the first half-split type refractory tile, there is shown here the refractory tile 11 of FIG. 9 (a first half-split type refractory tile similar to the first fitting-type refractory tile), which differs from the refractory tile 8 of FIG. 3 only by its half-split side portion 11F, the refractory tile 12 of FIG. 10 (a first half-split type refractory tile similar to the second fitting-type refractory tile), which differs from the refractory tile

9 of FIG. 4 only by its half-split side portion 11F, and the refractory tile 13 of FIG. 11 (a first half-split type refractory tile similar to the third fitting-type refractory tile), which differs from the refractory tile 10 of FIG. 5 only by its half-split side portion 11F.

5 As the second half-split type refractory tile, a refractory tile 14 (a second half-split type refractory tile similar to the first fitting-type refractory tile) having a symmetrical shape with respect to the refractory tile 11, a refractory tile 15 (a second half-split type refractory tile similar to the second fitting-type refractory tile) having a symmetrical shape with respect to the refractory tile 12, and a refractory tile 16 (a
10 second half-split type refractory tile similar to the third fitting-type refractory tile) having a symmetrical shape with respect to the refractory tile 13 are shown in FIG. 12, but unlike the first half-split type refractory tile, individual illustration is omitted.
[0029]

As shown in FIG. 9A, the refractory tile 11 of the first half-split type has a
15 structure in which the left side portion 2B of the central portion 8A of the refractory tile 8 of the fitting-type shown in FIG. 3 is replaced with a half-split side portion 11F as viewed from the surface. For this reason, similarly to the fitting-type refractory tile 8, the central portion 8A of the first half-split type refractory tile 11 is provided with a fitting protrusion 8D above the central portion 8A and a fitting recess 8E below
20 the central portion 8A.

As shown in FIG. 10A, the refractory tile 12 of the first half-split type has a structure in which the left side portion 2B of the central portion 9A of the refractory tile 9 of the fitting-type shown in FIG. 4 is replaced with a half-split side portion 11F as viewed from the surface. For this reason, similarly to the fitting-type refractory
25 tile 9, the fitting protrusion 8D is provided above the central portion 9A of the first half-split type refractory tile 12.

As shown in FIG. 11A, the refractory tile 13 of the first half-split type has a structure in which the left side portion 2B of the central portion 10A of the refractory tile 10 of the fitting-type shown in FIG. 5 is replaced with a half-split side portion 11F
30 as viewed from the surface. For this reason, similarly to the fitting-type refractory tile 10, a fitting recess 8E is provided below the central portion 10A of the first half-split type refractory tile 13.
[0030]

On the other hand, although not individually shown, the refractory tile 14 of
35 the second half-split type has a structure in which the right side portion 2B of the central portion 8A of the refractory tile 8 of the fitting-type shown in FIG. 3 is replaced with a half-split side portion 11F as viewed from the surface. For this reason, the central portion 8A of the refractory tile 14 of the second half-split type is

provided with a fitting protrusion 8D above the central portion 8A and a fitting recess 8E below the central portion 8A.

In addition, the refractory tile 15 of the second half-split type has a structure in which the right side portion 2B of the central portion 9A of the refractory tile 9 of the fitting-type shown in FIG. 4 is replaced with a half-split side portion 11F as
 5 viewed from the surface. For this reason, the fitting protrusion 8D is provided above the central portion 9A of the refractory tile 15 of the second half-split type.

Further, the refractory tile 16 of the second half-split type has a structure in which the right side portion 2B of the central portion 10A of the refractory tile 10 of the fitting-type shown in FIG. 5 is replaced with a half-split side portion 11F as
 10 viewed from the surface. For this reason, a fitting recess 8E is provided below the central portion 10A of the second half-split type refractory tile 16.

[0031]

As shown in FIG. 12, the refractory tile of the first half-split type and the
 15 refractory tile of the second half-split type can cover the three boiler water pipes 1 by disposing their respective half-split side portions 11F facing each other.

As described above, the plurality of hooks 5 are previously installed on the fin 3 at positions corresponding to the positions of the recesses formed on the back surfaces of the plurality of refractory tiles to be aligned. Unlike the water pipe panel
 20 4 shown in FIG. 1, when a half-split type refractory tile is used, the hooks 5 are installed on two fins 3 adjacent to each other across one boiler water pipe 1 of the water pipe panel 4', and are regularly installed at equal intervals in the longitudinal direction of the fins 3.

FIG. 12 shows an example in which, from bottom to top in the Z-axis
 25 direction, a first row 18 formed by fitting two vertically adjacent refractory tiles in the order of the refractory tile 12, the refractory tile 11, and the refractory tile 13 as the first half-split type refractory tile, and a second row 19 formed by fitting two vertically adjacent refractory tiles in the order of the refractory tile 15, the refractory tile 14, and the refractory tile 16 as the second half-split type refractory tile adjacent
 30 to the right of the first row 18 are arranged, and the first row 18 and the second row 19 form one tile set 17. The tile set 17 is a third tile set.

In this example, the refractory tiles adjacent to each other in the longitudinal direction are fitted to each other. However, the refractory tile may be a half-split type refractory tile in which the fitting protrusions 8D and fitting recesses 8E of these
 35 refractory tiles are not formed.

[0032]

[Block-type refractory tile]

FIG. 13 shows a configuration example of a block-type refractory tile 20. The refractory tile 20 is different from the gull-type refractory tile 2 of FIG. 2 only in that the surface is formed of a flat surface, and thus the same configurations as those of the refractory tile 2 are denoted by the same reference numerals, and description thereof is omitted.

In the refractory tile 20, the surfaces of the central portion 2A, the right side portion 2B thereof, and the left side portion 2B thereof are at the same position in the Y-axis direction, that is, in the thickness direction. Accordingly, the two U-shaped groove portions 20A covering the two boiler water pipes 1 and the recess 6 for hooking the hook 5 are scraped from the raw material of the refractory tile formed into a quadrangular prism shape and fired, whereby the refractory tile 20 can be formed.

The block-type refractory tile 20 is heavier because the side portions 2B are thicker than the gull-type refractory tile, but it can be used in the furnace wall depending on the design.

FIG. 14 shows a configuration example of a refractory tile 21 which is a modification of the block-type refractory tile 20. Unlike the block-type refractory tile 20, the block-type refractory tile 21 does not form two U-shaped groove portions 20A covering the two boiler water pipes 1. Therefore, the refractory tile 21 can be formed by scraping only the recess 6 for hooking the hook 5 from the raw material of the refractory tile formed in a quadrangular prism shape and firing.

Block-type refractory tile 21 has the advantage of being easier to manufacture than block-type refractory tile 20, and can be used in furnace walls depending on the design, as with refractory tile 20.

[0033]

[Large refractory tile]

As previously noted, of the plurality of sets of tiles, one set of tiles may be composed of a plurality of refractory tiles of a particular type, and another set of tiles may be composed of refractory tiles of a different type than the particular type.

FIG. 15 shows a tile set 7B, which is a first tile set in which a total of nine refractory tiles 2, three in the longitudinal direction and three in the lateral direction, are arranged, and a tile set 7A", which is a fifth tile set in which three large refractory tiles 23 are arranged in a row only in the longitudinal direction.

Usually, one surface of a furnace wall of a combustion furnace is formed by joining a plurality of rectangular water pipe panels by welding. A linear trace remains at a welded portion between two adjacent water pipe panels, and this is referred to as a welding line. Since the welding line is uneven, the hook 5 may not be attached to the fin having the welding line.

On the other hand, depending on the size and design of the combustion furnace, when the refractory tile 2 is installed in one water pipe panel in the lateral direction, one boiler water pipe 1 at the end of the water pipe panel may not be covered with the refractory tile 2.

5 FIG. 15 is a diagram showing this state. In FIG. 5, one water pipe panel 4" is disposed on each of the left and right sides. In the water pipe panel 4", similarly to the water pipe panel 4 of FIG. 1, the plurality of hooks 5 are installed on every other fin 3 in the lateral direction, and are regularly installed at equal intervals in the longitudinal direction of the fin 3. However, in FIG. 15, since the left end of the
10 right water pipe panel 4" and the right end of the left water pipe panel 4" are welded to each other, the welding line 26 is formed on the fin 3 on which the hook 5 is to be installed when only the refractory tile 2 is to be installed, and the hook 5 cannot be appropriately attached.

Therefore, a large refractory tile 23 capable of simultaneously covering the
15 boiler water pipes 1 of the two water pipe panels 4" across the welding line 26 is used.
[0034]

The large refractory tile is rectangular, and two or more recesses 6 are formed and can cover three or more boiler water pipes 1.

A large refractory tile 23 shown in FIG. 15 as an example has a structure in
20 which three refractory tiles 2 are integrally formed so as to be connected in the lateral direction. However, in the refractory tile 23, the recess 6 located at the welding line 26 is unnecessary, and thus is not formed. Thus, in FIG. 15, the refractory tile 23 is provided with a total of two recesses 6, a recess 6 hooked on the hook 5 installed on the left water pipe panel 4", and a recess 6 hooked on the hook 5 installed on the right
25 water pipe panel 4".

As the large refractory tile, the large refractory tile 23 having a structure in which three refractory tiles 2 are integrally formed so as to be connected in the lateral direction has been described here, but the present invention is not limited thereto, and the large refractory tile may have a structure in which four or more are integrally
30 formed so as to be connected in the lateral direction. The large refractory tile is not limited to the structure in which the plurality of refractory tiles 2 are connected in the lateral direction. For example, the large refractory tile may have a structure in which the plurality of fitting-type refractory tiles 8 are integrally formed so as to be connected in the lateral direction, or a structure in which the plurality of block-type
35 refractory tiles 20 and 21 are integrally formed so as to be connected in the lateral direction.

Conventionally, a large refractory tile can be installed across the welding line 26 even at a position where the welding line 26 exists, which has been dealt with by

applying the refractory joint material, so that the protection of the boiler water pipe 1 of the water pipe panel 4" can be enhanced.

[0035]

Note that the large refractory tile is not necessarily installed only at a position straddling the welding line 26, and may be installed in one water pipe panel. As described above, the large refractory tile may be rectangular, with two or more recesses 6 formed therein, and may be capable of covering three or more boiler water pipes 1. Therefore, as shown in FIG. 16, the refractory tile 28 may have a structure in which the first half-split type refractory tile and the second half-split type refractory tile that are adjacent to each other in the left-right direction in FIG. 12 are integrally formed in a connected manner.

FIG. 16 shows an example of a fifth tile set in which a large refractory tile 28B having a configuration in which the refractory tile 12 and the refractory tile 15 are connected to each other in FIG. 12, a large refractory tile 28A having a configuration in which the refractory tile 11 and the refractory tile 14 are connected to each other in FIG. 12, and a large refractory tile 28C having a configuration in which the refractory tile 13 and the refractory tile 16 are connected to each other in FIG. 12 are installed in a row in this order from bottom to top in the Z-axis direction.

The two fitting protrusions 8D provided in the large refractory tile 28A are fitted into the two fitting recesses 8E included in the large refractory tile 28C, and the two fitting recesses 8E provided in the large refractory tile 28A are fitted into the two fitting protrusions 8D provided in the large refractory tile 28B.

FIG. 16 shows fitting-type large refractory tiles 28A, 28B, 28C. However, the present invention is not limited thereto, and a single type of non-fitting-type large refractory tile may be used without forming the fitting protrusion 8D and the fitting recess 8E.

[0036]

[3. Construction method]

An example of the rectangular refractory tile to which the construction method of the present invention can be applied has been described above.

A construction method of the present invention using these refractory tiles will now be described.

For convenience of explanation, the following description will proceed with an example in which the refractory tile 2, which is a "gull-type refractory tile" among the plurality of types of refractory tiles described above, that is, "gull-type refractory tile (non-fitting-type)", "gull-type refractory tile (fitting-type)", "gull-type refractory tile (fitting-type and half-split type)", "block-type refractory tile", "large refractory tile", and the like, is constructed.

However, if the hooks 5 are fixed to the fins 3 in a regular arrangement corresponding to the number and positions of the recesses formed on the back surface of the refractory tile to be arranged in line with the water pipe panel, the construction method of the present invention can be applied not only to the “gull-type refractory tile (non-fitting-type)” but also to any refractory tile of the “gull-type refractory tile (fitting-type)”, the “gull-type refractory tile (fitting-type and half-split type)”, the “block-type refractory tile”, and the “large refractory tile”.

[0037]

In FIG. 17, the refractory tile 2 shown in FIG. 1 is numbered 2-1, 2-2, 2-3,..., and 2-18. These numbers are used in the following description to indicate the order in which the refractory tiles 2 are constructed.

In FIG. 17, since the tile set 7A and the tile set 7B are the first tile set, the refractory tiles 2 are arranged in three rows in the lateral direction, that is, in the order of the lowermost row, the middle stage, and the uppermost stage from bottom to top.

In addition, since the tile set 7A and the tile set 7B, which are the first tile sets, are arranged adjacent to each other in the lateral direction, a total of six columns of refractory tiles 2, i.e., three columns in the longitudinal direction in the tile set 7A and three columns in the longitudinal direction in the tile set 7B, are arranged.

Accordingly, a total of $(3 \times (3+3)) = 18$ refractory tiles 2 are installed in the tile set 7A and the tile set 7B.

The six refractory tiles 2 arranged in the lowermost row are numbered 2-1, 2-2, 2-3, 2-4, 2-5, and 2-6 from the left, the six refractory tiles 2 arranged in the middle row were numbered 2-7, 2-8, 2-9, 2-10, 2-11, and 2-12 from the left, and the six refractory tiles 2 arranged in the uppermost row were numbered 2-13, 2-14, 2-15, 2-16, 2-17, and 2-18 from the left.

The hooks 5 are also numbered in accordance with the numbering of the refractory tiles 2. That is, the six hooks 5 arranged in the lowermost row are numbered 5-1, 5-2, 5-3, 5-4, 5-5, and 5-6 from the left, the six hooks 5 arranged in the middle row are numbered 5-7, 5-8, 5-9, 5-10, 5-11, and 5-12 from the left, and the six hooks 5 arranged in the uppermost row are numbered 5-13, 5-14, 5-15, 5-16, 5-17, and 5-18 from the left.

[0038]

Now, the description of the construction method will be started. In the water pipe panel 4 of FIG. 17, a plurality of hooks 5 are regularly fixed by welding or the like in every other fin 3 in the lateral direction. The description starts from a state in which no refractory tile 2 is disposed.

(1) First Step

The worker is in charge of construction of the refractory tile 2 in the tile set 7A and the tile set 7B.

In the first step, one refractory tile of the plurality of refractory tiles is used as a reference tile, and the refractory joint material is not applied to its back surface, and the reference tile is hooked on reference hooks among the plurality of hooks, the number of reference hooks corresponding to the number of recesses formed on the back surface of the reference tile.

Therefore, the worker first selects a reference tile from the refractory tiles 2 to be constructed. In view of ease of operation, it is desirable to install the refractory tile 2 to be located at the lower and lateral ends of the tile set.

Here, the worker first selects the refractory tile 2-1 to be positioned at the left end of the lowermost step of the tile set 7A as the reference tile. The refractory tile 2-1 will be described as a reference tile, but the refractory tile 2 at any position may be selected as the reference tile according to the judgment of the worker.

[0039]

Since the refractory tile 2-1 includes only one recess 6, the reference hook corresponding to the number of recesses 6 is only hook 5-1. If a plurality of recesses 6 are provided as in a "large refractory tile", a number of hooks 5 in the lateral direction corresponding to that number serve as reference hooks. Therefore, the number of reference hooks may not only be singular but also plural.

[0040]

The worker hooks the recess 6 on the back surface of the refractory tile 2-1 selected as the reference tile on the hook 5-1 as the reference hook without applying a refractory joint material such as mortar to the back surface. Since the refractory tile 2-1 is merely hooked on the hook 5-1 without applying the refractory joint material to the back surface of the refractory tile 2-1, the tip of the hook 5-1, which is an L-shaped hook, can naturally penetrate as far as possible into the recess 6. That is, it can reach the uppermost part of the recess 6 as much as possible.

Then, the upper end of the refractory tile 2-1 is aligned horizontally. The position of the upper end aligned in this manner and the position of the side end at this time are reference positions in the row and the column in which the reference tile is arranged. Here, the position of the upper end of the refractory tile 2-1 is a position designed with respect to the upper end of each of the plurality of refractory tiles 2 arranged in the lowermost row. Further, the positions of the side ends of the refractory tiles 2-1 are designed with respect to the respective side ends of the plurality of refractory tiles 2 arranged in the vertical columns of the refractory tiles 2-1.

[0041]

(2) Second step

In the second step, after the first step, the refractory joint material is applied to the back surface of one refractory tile different from the reference tile among the plurality of refractory tiles, the refractory tile applied with the refractory joint material is hooked on the number of hooks corresponding to the number of recesses including the hook next to the reference hook among the plurality of hooks, and then the refractory tile applied with the refractory joint material is pressed toward the water pipe panel and fixed while being aligned with the reference tile.

Therefore, the worker first selects the refractory tile 2 to be fixed by applying the refractory joint material among the refractory tiles 2 adjacent to the refractory tile 2-1 as the reference tile in the vertical and horizontal directions. Here, since the reference tile is a refractory tile 2-1, the candidate refractory tile 2 to be fixed is either a refractory tile 2-7 that is to be located one level above the refractory tile 2-1 or a refractory tile 2-2 that is to be located one level to the right of the refractory tile 2-1.

When the worker selects the refractory tile 2-2 as the refractory tile 2 to be fixed, the worker applies a refractory joint material such as mortar as an adhesive to the back surface of the refractory tile 2-2, and hooks the single recess 6 provided on the refractory tile 2-2 on the hook 5-2 which is “a number of hooks including the hook next to the reference hook 5-1, corresponding to the number of recesses”. Here, since the refractory tile 2 includes only one recess 6, the number of hooks 5 corresponding to the number of recesses 6 is also one. However, if the refractory tile includes a plurality of recesses 6, the number of hooks 5 corresponding to the number of recesses 6 is also a plurality as described above.

Since the refractory joint material has entered the recess 6 of the refractory tile 2-2, the refractory tile 2-2 is fixed to the water pipe panel 4 by pressing it toward the panel while aligning the upper end of the refractory tile 2-2 with the upper end of the reference refractory tile 2-1 and vertically vibrating the refractory tile 2-2 in the length direction of the boiler water pipe 1 so that the thickness of the refractory joint material is uniformized to a predetermined thickness of about 10 to about 20 mm.

The lateral dimension of the recess 6 of the refractory tile 2 is then substantially identical to the lateral dimension of the tip of the L-shaped hook 5, so that the position of the lateral end of the fixed refractory tile 2-2 naturally coincides with the designed position.

Since the position of the upper end and the position of the side end of the refractory tile 2-2 thus fixed correspond to the designed position, the refractory tile 2-2 can be treated as a new reference tile for aligning the refractory tile 2 to be installed in the subsequent step in the designed position.

As described above, since the spacer 2C is disposed on the back surface of the refractory tile 2, the refractory joint material can have a predetermined thickness only by pressing the refractory tile 2-2 toward the water pipe panel.

[0042]

5 When the worker selects refractory tile 2-7 as the refractory tile 2 to be fixed, the worker applies a refractory joint material such as mortar to the back surface of refractory tile 2-7, and hooks the single recess 6 provided on the refractory tile 2-7 onto the hook 5-7, which is “a number of hooks including the hook next to the reference hook 5-1, corresponding to the number of recesses”. If the refractory tile
10 includes a plurality of recesses 6, the number of hooks 5 corresponding to the number of recesses 6 is also plural as described above.

Since the refractory joint material enters the recess 6 of the refractory tile 2-7, the position of the side end of the refractory tile 2-7 is aligned to coincide with the position of the side end of the reference refractory tile 2-1.

15 However, even if only the side ends are aligned, it is difficult to position the upper ends of the refractory tiles disposed in the vertical rows of the reference tiles at the designed positions. Therefore, two refractory tiles adjacent to each other in the vertical and horizontal directions are designed so as to be spaced apart from each other by a predetermined width.

20 That is, when aligning the side end of refractory tile 2-7 to coincide with the side end of the reference tile, refractory tile 2-1, the worker simultaneously measures whether the interval between the upper end of refractory tile 2-1 and the lower end of refractory tile 2-7 is the predetermined width, and while vertically vibrating refractory tile 2-7 in the length direction of boiler water pipe 1, presses refractory tile 2-7 toward
25 water pipe panel 4 to fix it.

The positions of the upper and lower ends as well as the positions of the lateral ends of the refractory tile 2-7 thus fixed correspond to the designed position, so that the refractory tile 2-7 can be treated as a new reference tile for aligning the refractory tile 2 to be installed in the subsequent steps in the designed position.

30 All the refractory tiles 2 fixed in the subsequent steps are fixed at designed positions, and thus can be handled as new reference tiles.

[0043]

(3) Third step

35 In the third step, after the second step, one of the first branching step and the second branching step described below is performed. The first branching step is performed only once throughout the entire process.

(3-1) First branching step

In the first branching step, the reference tile is removed from the reference hook, the refractory joint material is applied to the back surface of the reference tile, the reference tile is hooked on the reference hook, and then the reference tile is pressed and fixed toward the water pipe panel while being aligned with the refractory tile fixed in the second step.

Therefore, the worker first removes the refractory tile 2-1, which is a reference tile, from the hook 5-1, which is a reference hook. Since the refractory tile 2-1 is simply hooked on the hook 5-1 without applying the refractory joint material which is an adhesive, it can be easily removed.

Then, after the refractory joint material is applied to the back surface of the refractory tile 2-1, the recess 6 of the refractory tile 2-1 is hooked again on the hook 5-1, and then the refractory tile 2-2 or the refractory tile 2-7 fixed at the already designed position is treated as a new reference tile, and the refractory tile 2-1 is pressed and fixed toward the water pipe panel 4 while being aligned with the refractory tile 2-2 or the refractory tile 2-7.

Specifically, the refractory tile 2-1 is fixed to the water pipe panel 4 as follows.

[0044]

When the refractory tile 2-2 located immediately to the right of the refractory tile 2-1 is fixed, the refractory tile 2-1 is pressed toward the water pipe panel 4 and fixed while the refractory tile 2-1 is vertically vibrated in the length direction of the boiler water pipe 1 while the upper end of the refractory tile 2-1 is aligned with the upper end of the new reference refractory tile 2-2. The position of the upper end and the position of the lateral end of the refractory tile 2-1 thus fixed correspond to the designed position.

The refractory tile 2-1 was originally a reference tile, but by being fixed to the water pipe panel 4 by the first branching step, it can be treated as a new reference tile for aligning the refractory tile 2 to be installed in the subsequent step in the designed position.

[0045]

When refractory tile 2-7 positioned one level above refractory tile 2-1 is fixed, while aligning the side end of refractory tile 2-1 to coincide with the side end of the new reference tile, refractory tile 2-7, the worker simultaneously measures whether the interval between the lower end of refractory tile 2-7 and the upper end of refractory tile 2-1 is the predetermined width, and while vertically vibrating refractory tile 2-1 in the length direction of boiler water pipe 1, presses refractory tile 2-1 toward water pipe panel 4 to fix it. The position of the upper end and the position of the lateral end of the refractory tile 2-1 thus fixed correspond to the designed position.

The refractory tile 2-1 was originally a reference tile, but by being fixed to the water pipe panel 4 by the first branching step, it can be treated as a new reference tile for aligning the refractory tile 2 to be installed in the subsequent step in the designed position.

5 [0046]

(3-2) Second branching step

In the second branching step, refractory joint material is applied to the back surface of one refractory tile different from the refractory tiles fixed in all preceding steps of this present step among the plurality of refractory tiles, and the refractory tile
10 coated with the refractory joint material is hooked onto a number of hooks, among the plurality of hooks, corresponding to the number of recesses, the hooks including a hook adjacent to the hook onto which the refractory tile fixed in the immediately preceding step or the step two steps prior to this step was hooked and are hooks onto which no refractory tile has yet been hooked and then, the refractory tile coated with
15 the refractory joint material is pressed and fixed to the water pipe panel while being aligned with the refractory tile fixed in the immediately preceding step or the step two steps prior to this step.

Therefore, the worker first selects one refractory tile 2 different from the refractory tile 2 fixed in all the preceding steps of this step. As will be described
20 later, since the third step is repeatedly performed in the fourth step performed after the third step, when the second branching step of the third step is performed for the first time, the first branching step of the third step may already be performed.

Accordingly, when the second branching step is performed for the first time, there may be two types of “the refractory tile 2 fixed in all the preceding steps of the present step”: (A) the refractory tile 2-2 fixed in the second step; or (B) the refractory
25 tile 2-2 fixed in the second step and the refractory tile 2-1 fixed in the first branching step. However, in the case of (A), the refractory tile 2-1 is not fixed but remains hooked on the hook 5-1.

In this step, i.e., the second branching step, the “different one refractory tile”
30 is hooked on the “hooks not yet hooked on any refractory tile”, so that the refractory tile 2-1 and the refractory tile 2-2 are excluded from the target of the “different one refractory tile 2” in view of (A) and (B).

However, since “the refractory tile is aligned with the refractory tile fixed in the step immediately before the present step or in the step two steps before the present
35 step”, when the second branching step is performed for the first time, the “different one refractory tile” is, in the case of (A), either the refractory tile 2-3 located immediately to the right of the refractory tile 2-2 or the refractory tile 2-8 located immediately above the refractory tile 2-2. Further, in the case of (B), the above-

mentioned "one different refractory tile" when the second branching step is performed for the first time is any one of the two refractory tiles in the case of (A), that is, the refractory tile 2-3 and the refractory tile 2-8, and the refractory tile 2-7 positioned one above the fixed refractory tile 2-1.

5 In the construction method of the present invention, since the positions of the upper end and lower end as well as the positions of the side ends of the "fixed refractory tile" coincide with the designed positions, all the "fixed refractory tiles" can be handled as the new reference tiles described above. Therefore, not only the refractory tile fixed in the "step immediately before the present step" but also the
10 refractory tile fixed in the "step two steps before the present step" can be handled as a new reference tile.

[0047]

 In the case of (A) and (B), when the worker selects the refractory tile 2-3 as the "one different refractory tile", the worker applies a refractory joint material such
15 as mortar as an adhesive on the back surface of the refractory tile 2-3, and hooks the single recess 6 provided on the refractory tile 2-3 on the hook 5-3 which is "a number of hooks corresponding to the number of recesses, including a hook adjacent to a hook on which a fixed refractory tile was hooked, and being hooks on which no refractory tile has yet been hooked".

20 Then, the fixed refractory tile 2-2 is handled as a new reference tile, and the refractory tile 2-3 is pressed toward the water pipe panel 4 and fixed while the refractory tile 2-3 is vertically vibrated in the length direction of the boiler water pipe 1 while the position of the upper end of the refractory tile 2-3 is aligned with the position of the upper end of the refractory tile 2-2.

25 Since the position of the upper end and the position of the side end of the refractory tile 2-3 thus fixed correspond to the designed position, the refractory tile 2-3 can be treated as a new reference tile for aligning the refractory tile 2 to be installed in the subsequent step in the designed position.

[0048]

30 In the case of (A) and (B), when the worker selects the refractory tile 2-8 as the "one different refractory tile" the worker applies a refractory joint material such as mortar as an adhesive on the back surface of the refractory tile 2-8, and hooks the single recess 6 provided on the refractory tile 2-8 on the hook 5-8 which is "a number of hooks corresponding to the number of recesses, including a hook adjacent to a hook
35 on which a fixed refractory tile was hooked, and being hooks on which no refractory tile has yet been hooked".

 When the fixed refractory tile 2-2 is handled as a new reference tile and the position of the side end of the refractory tile 2-8 is aligned to coincide with the

position of the side end of the refractory tile 2-2, the worker simultaneously measures whether the interval between the position of the upper end of the refractory tile 2-2 and the position of the lower end of the refractory tile 2-8 is the predetermined width, and while vertically vibrating the refractory tile 2-8 in the up-down direction of the boiler water pipe 1, presses the refractory tile 2-8 toward the water pipe panel 4 to fix it.

The positions of the upper and lower ends as well as the positions of the lateral ends of the refractory tile 2-8 thus fixed correspond to the designed position, so that the refractory tile 2-8 can be treated as a new reference tile for aligning the refractory tile 2 to be installed in a subsequent step in the designed position.

[0049]

In the case of (B), when the worker selects the refractory tile 2-7 as the “one different refractory tile”, the worker applies a refractory joint material such as mortar as an adhesive to the back surface of the refractory tile 2-7, and hooks the single recess 6 provided on the refractory tile 2-7 on the hook 5-7 which is “a number of hooks corresponding to the number of recesses, including a hook adjacent to a hook on which a fixed refractory tile was hooked, and being hooks on which no refractory tile has yet been hooked”.

Then, the refractory tile 2-1, although it was a reference tile even before being fixed, is treated as a new reference tile. When aligning the side end of refractory tile 2-7 to coincide with the side end of refractory tile 2-1, the worker simultaneously measures whether the interval between the upper end of refractory tile 2-1 and the lower end of refractory tile 2-7 is the predetermined width, and while vertically vibrating refractory tile 2-7 in the length direction of boiler water pipe 1, presses refractory tile 2-7 toward water pipe panel 4 to fix it.

The positions of the upper and lower ends as well as the positions of the lateral ends of the refractory tile 2-7 thus fixed correspond to the designed position, so that the refractory tile 2-7 can be treated as a new reference tile for aligning the refractory tile 2 to be installed in a subsequent step in the designed position.

[0050]

(4) Fourth step

In the fourth step, after the third step is performed for the first time, the third step is repeatedly performed a predetermined number of times.

Here, the predetermined number of times can be arbitrarily determined by the worker. That is, the construction method of the present invention may be performed a plurality of times in one tile set. However, in general, from the viewpoint of improving the construction speed, the predetermined number of times is desirably the number of times until all the refractory tiles included in at least one tile set are

constructed. In other words, it is desirable to implement the construction method of the present invention in units of one or more tile sets.

In a case where a worker takes charge of a plurality of adjacent tile sets, when the types of refractory tiles included in the tile sets are the same, each tile set
 5 may be regarded as one tile set, and the predetermined number of times may be the number of times until all the refractory tiles included in the tile set regarded as one are constructed.

Since the predetermined number of times is the number of times the third step is performed once and then the third step is repeatedly performed, the number
 10 obtained by subtracting 1 from the total number of third steps performed is the predetermined number of times.

[0051]

For example, when constructing refractory tiles 2 in units of tile set 7A, and in the case of the above (A), refractory tile 2-2 of tile set 7A fixed in the step
 15 immediately before the first third step is treated as a new reference tile. Then, refractory tile 2-3 is fixed by the second branching step (first time) of the third step; the fixed refractory tile 2-3 is treated as a new reference tile, and refractory tile 2-9 is fixed by the second branching step (second time) of the third step; the fixed refractory tile 2-9 is treated as a new reference tile, and refractory tile 2-8 is fixed by the second
 20 branching step (third time) of the third step. In this manner, refractory tiles 2 can be sequentially constructed. Subsequently, similarly, the refractory tile 2-7 is fixed in the second branching step (fourth time) of the third step, the refractory tile 2-13 is fixed in the second branching step (fifth time) of the third step, the refractory tile 2-14 is fixed in the second branching step (sixth time) of the third step, and the refractory
 25 tile 2-15 is fixed in the second branching step (seventh time) of the third step. Finally, by fixing refractory tile 2-1 in the first branching step of the third step (first time for the first branching step; however, the eighth time for the third step overall), all the refractory tiles 2 included in tile set 7A can be constructed. Therefore, in this case, the predetermined number of times is $(8-1) = 7$ times.

30 [0052]

Further, in FIG. 17, the refractory tiles included in the tile set 7A and the tile set 7B adjacent to each other are the same type of refractory tile 2. Therefore, when the tile set 7A and the tile set 7B are regarded as one tile set and the refractory tile 2 is constructed, and in the case of (B), the first branching step of the third step is already
 35 performed once, so that only the second branching step of the third step is repeatedly performed.

In this case, for example, similarly to the example in the unit of the tile set 7A described above, the refractory tile 2-2 of the tile set 7A fixed in the immediately

preceding step is treated as a new reference tile, the refractory tile 2-3 is fixed by the second branching step (first time) of the third step, the refractory tile 2-4 of the tile set 7B is fixed by the second branching step (second time) of the third step, the refractory tile 2-5 is fixed by the second branching step (third time) of the third step, the refractory tile 2-6 is fixed by the second branching step (fourth time) of the third step, the refractory tile 2-12 is fixed by the second branching step (fifth time) of the third step, the refractory tile 2-11 is fixed by the second branching step (sixth time) of the third step, and the refractory tile 2-10 is fixed by the second branching step (seventh time) of the third step, The refractory tile 2-9 of the tile set 7A is fixed by the second branching step (eighth time) of the third step, and the refractory tile 2 can be sequentially constructed from the row of the lower stage to the row of the upper stage across the two tile sets. Then, by implementing the method of constructing all refractory tiles 2 in a given row of a certain stage and then constructing all refractory tiles 2 in the row above it, and by performing a total of 16 instances of the second branching step of the third step, the refractory tile 2-18 of the tile set 7B can be fixed in the second branching step of the third step (16th time for the second branching step; however, the 17th time for the third step overall). As a result, all the refractory tiles 2 included in the tile set 7A and the tile set 7B can be constructed. In this case, the predetermined number of times is $(17-1)=16$ times.

[0053]

(5) Post-processing

After the refractory tiles included in all the tile sets handled by the worker are fixed, as described above, the worker applies the refractory joint material, such as mortar or castable, to the gaps between the two refractory tiles adjacent in the vertical and horizontal directions included in one tile set. In addition, the worker embeds a refractory expansion allowance filler such as Fiber Cast in the interval between two adjacent tile sets.

In FIG. 17, the refractory joint material is applied between two adjacent refractory tiles 2 in the tile set 7A, and the refractory joint material is applied between two adjacent refractory tiles 2 in the tile set 7B. Then, the refractory expansion allowance filler is embedded between the tile sets 7A and 7B, around the tile sets 7A, and around the tile sets 7B.

As a result, the protective performance of the boiler water pipe 1 can be improved, and cracking and falling off of the refractory tile 2 due to thermal expansion can be prevented to prolong the life of the combustion furnace.

[0054]

As described above, according to the construction method of the present invention, in the second step, the refractory tile is fixed to the water pipe panel after

being aligned using the reference tile simply hooked on the hook in the first step, in the third step, the refractory tile fixed in the second step is handled as a new reference tile and is aligned, the refractory tile in question is fixed to the water pipe panel, and in the fourth step, the third step is repeated a predetermined number of times.

- 5 That is, the plurality of refractory tiles can be installed at predetermined positions by simply and accurately performing the alignment while sequentially replacing the refractory tiles serving as the reference for the alignment.

Reference Signs List

- 10 [0055]
 1 Boiler water pipe
 2, 8, 9, 10, 11, 12, 13,14,15,16, 20,21, 23, 28 Refractory tile
 2A, 8A, 9A, 10A Central portion
 2B Side portion
 15 2C Spacer
 3 Fin
 4, 4', 4" Water pipe panel
 5 Hook
 6 Recess
 20 7A, 7B, 7A', 7B', 7A", 7B", 7A'" Tile set
 8D Fitting protrusion
 8E Fitting recess
 18 First column
 19 Second column
 25 20A U-shaped groove
 26 Welding line

Claims

[Claim 1]

5 A construction method for constructing refractory tiles for protecting boiler water pipes, wherein a plurality of rectangular refractory tiles are aligned and fixed to a water pipe panel comprising: a plurality of boiler water pipes uniformly arranged in a horizontal direction, a plurality of fins connecting two adjacent boiler water pipes in the horizontal direction, and a plurality of hooks provided on the plurality of fins, wherein the plurality of hooks are fixed to the plurality of fins in a regular
10 arrangement corresponding to positions of recesses formed on back surfaces of the aligned refractory tiles, and

a plurality of the refractory tiles are aligned at predetermined intervals from each other by applying a refractory joint material to the back surface of each refractory tile and hooking and fixing the recesses to a number of the hooks
15 corresponding to the number of the recesses, such that one of the refractory tile is fixed to upper surfaces of two or more of the boiler water pipes, the method comprising:

a first step of selecting one of the plurality of refractory tiles as a reference tile and hooking it, without applying refractory joint material to its back surface, onto
20 a number of reference hooks among the plurality of hooks, the number corresponding to the number of recesses formed on the back surface of the reference tile;

a second step, performed after the first step, of: applying refractory joint material to a back surface of one refractory tile different from the reference tile among the plurality of refractory tiles, hooking the refractory tile coated with the refractory
25 joint material onto a number of hooks among the plurality of hooks, the number corresponding to the number of recesses formed on the back surface of one refractory tile different from the reference tile and including a hook adjacent to the reference hooks, and pressing and fixing the coated refractory tile toward the water pipe panel while aligning it with the reference tile;

30 a third step, performed after the second step, of performing one of the following two branching steps: a first branching step comprising: removing the reference tile from the reference hooks, applying refractory joint material to its back surface, hooking the reference tile onto the reference hooks, and pressing and fixing the reference tile toward the water pipe panel while aligning it with the refractory tile
35 fixed in the second step; or a second branching step comprising: applying refractory joint material to a back surface of one refractory tile different from all refractory tiles fixed in all preceding steps up to this step among the plurality of refractory tiles, hooking the coated refractory tile onto a number of hooks on which no refractory tile

has yet been hooked among the plurality of hooks, the number corresponding to the number of recesses formed on the back surface of one refractory tile different from all refractory tiles fixed in all preceding steps up to this step among the plurality of refractory tiles and including a hook adjacent to a hook onto which the refractory tile
5 fixed in the immediately preceding step or the step two steps prior to this step is hooked among the plurality of hooks, and pressing and fixing the coated refractory tile toward the water pipe panel while aligning it with the refractory tile fixed in the immediately preceding step or the step two steps prior to this step; and

10 a fourth step, performed after the third step, of repeating the third step a predetermined number of times.

[Claim 2]

The construction method according to claim 1, wherein the plurality of fixed refractory tiles are divided into a plurality of tile sets forming rectangular and
15 comprising a plurality of the refractory tiles arranged in the up-down direction or in the horizontal direction,

the construction method further comprising:

embedding a refractory expansion allowance filler in the predetermined interval between two adjacent tile sets among the plurality of tile set and

20 applying refractory joint material in the predetermined interval between two adjacent refractory tiles included within one of the tile set.

[Claim 3]

The construction method according to claim 2, wherein the reference hook is
25 a hook that engages a refractory tile positioned at the lowermost row within the tile set or at the lowermost row and at either one of the two ends thereof.

[Claim 4]

The construction method according to claim 3, wherein the tile set is one or
30 more tile sets selected from: a first tile set having three refractory tiles in the up-down direction and three in the horizontal direction, a second tile set having two in the up-down direction and two in the horizontal direction, a third tile set having three or more in the up-down direction and two in the horizontal direction, or, a fourth tile set having two in the up-down direction and three or more in the horizontal direction, a
35 fifth tile set having refractory tiles arranged in a single row only in the up-down direction, a sixth tile set having refractory tiles arranged in a single row only in the horizontal direction, or a combination of multiple types among the first to sixth tile sets.

[Claim 5]

The construction method according to claim 4, wherein the refractory tile comprises: a first fitting-type refractory tile having a fitting protrusion protruding
5 upward from a central portion and a fitting recess formed below the central portion and capable of receiving the fitting protrusion of other refractory tile, a second fitting-type refractory tile identical in shape to the first fitting-type refractory tile except lacking the fitting recess, and a third fitting-type refractory tile identical in shape to
10 the first fitting-type refractory tile except lacking the fitting protrusion, and

in the first tile set, the third tile set, or the fifth tile set in which three or more
refractory tiles are fixed in the up-down direction, the second fitting-type refractory
tile is fixed at the lowermost row in the up-down direction, the third fitting-type
refractory tile is fixed at the uppermost stage in the up-down direction, and the first
fitting-type refractory tile is fixed at all stages from the second stage upward but
15 below the uppermost stage,

in the second tile set, the fourth tile set, or the fifth tile set in which two
refractory tiles are fixed in the up-down direction, the second fitting-type refractory
tile is fixed at the lowermost row, and the third fitting-type refractory tile is fixed at
the uppermost stage.

[Claim 6]

The construction method according to any one of claims 1 to 4, wherein the
refractory tile has a plurality of recesses for engaging hooks and covers the upper
surfaces of three or more boiler water pipes.