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HEAT TREATING APPARATUS

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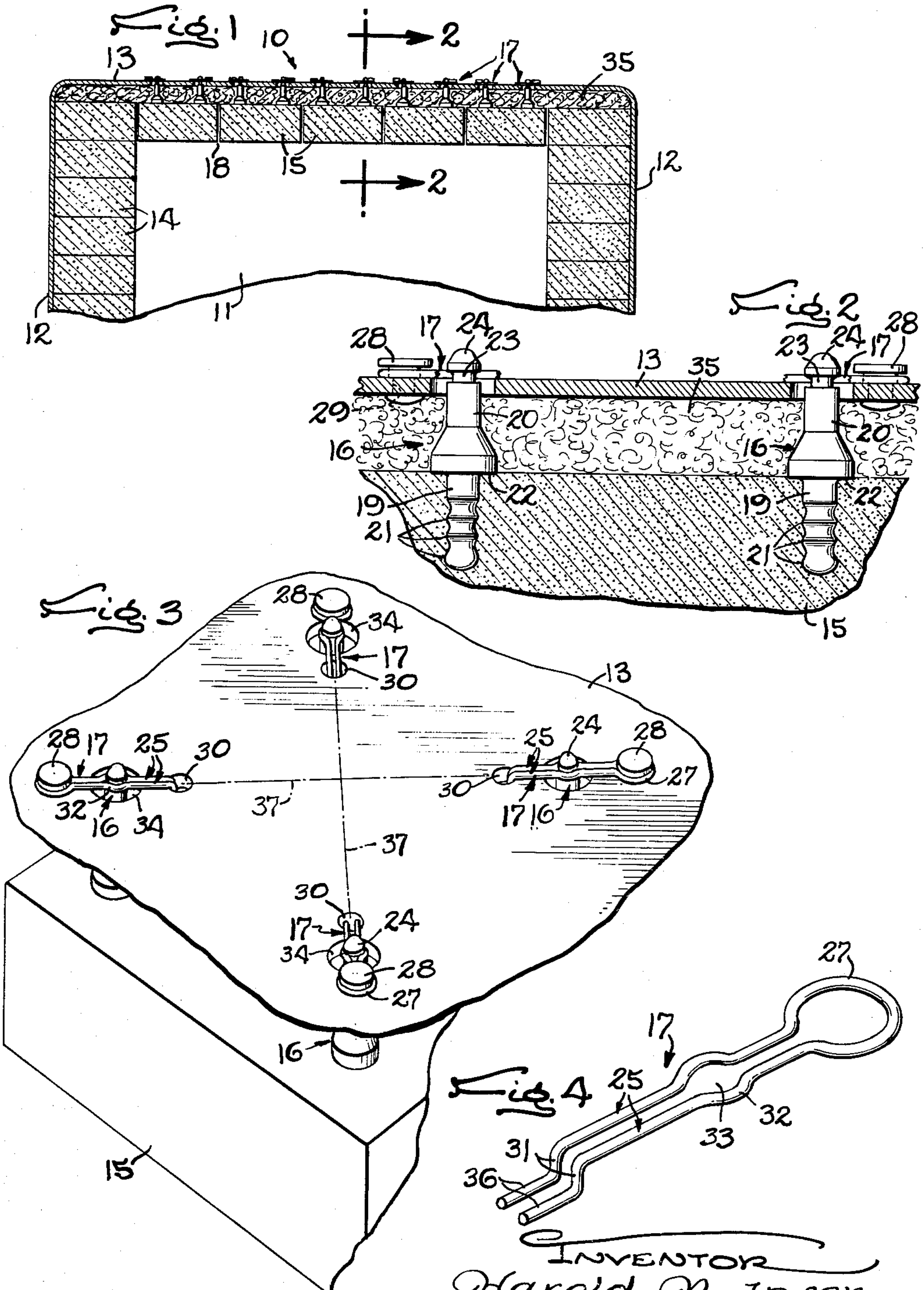

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HEAT TREATING APPARATUS

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This invention relates to heat-treating apparatus generally and, more specifically, to the insulating refractory linings provided for the heating chambers of high-temperature heat-treating furnaces. To form insulating linings capable of withstanding the extreme temperatures developed in such furnaces, the linings have been composed of refractory blocks stacked along the sides of the chamber and arranged in an arch over the ceiling of the chamber, the arch providing support for the blocks while permitting relative movement of the individual blocks to accommodate expansion and contraction during heating and cooling of the lining.

The general object of the present invention is to eliminate the arch previously required in furnaces of this type thereby to simply the construction of the furnace.

A more specific object is to suspend the blocks from a furnace wall in a novel manner which greatly facilitates the initial installation and subsequent replacement of the blocks while at the same time, permitting individual and relative movement of the blocks during heating and cooling.

The invention also resides in the construction and arrangement of cooperating supporting members for the refractory blocks of the lining of a heat-treating furnace.

Other objects and advantages of the invention will become apparent from the following detailed description taken in connection with the accompanying drawings, in which

FIGURE 1 is a fragmentary cross-sectional view taken in a vertical plane through a heat-treating furnace embodying the novel features of the present invention.

FIG. 2 is an enlarged fragmentary cross-section taken substantially along the line 2—2 of FIG. 1.

FIG. 3 is an enlarged fragmentary perspective view taken from the top of the furnace in FIG. 1.

FIG. 4 is an enlarged perspective view of one of the gripping devices for supporting the blocks.

As shown in the drawings for purposes of illustration, the invention is embodied in a heat treating furnace 10 having a heating chamber 11 defined within a walled enclosure including laterally spaced side walls 12 and a top wall 13. The heating chamber is lined with insulating refractory material capable of withstanding the extremely high temperatures developed within the furnace during operation.

Customarily, the outer walls 12 and 13 are composed of sheet metal resistant to relatively low temperatures such as 600 degrees Fahrenheit or less, while the lining is formed in one or more layers of different material, the inner layer being resistant to the highest temperature to be developed within a particular furnace and usually being in the form of refractory blocks 14 and 15. In modern furnaces where operating temperatures may go as high as 4000 degrees, various types of foamed refractory material are used for the lining blocks and the type of foamed materials used varies with the temperature range. Two such materials are alumina and zirconia.

In view of the wide temperature differentials to which the blocks 14 and 15 are subjected, the construction must

be such that expansion of the blocks does not damage the lining or the outer walls. In prior high-temperature furnaces with refractory block inner linings, the ceiling blocks have been specially shaped and arranged in the form of an arch which provides support for the blocks while permitting them to move relative to each other during heating and cooling. Of course, the time and labor required to form and install the blocks for an arched ceiling add considerably to the overall cost of the furnace, and replacement of damaged blocks requires rebuilding of the entire arch.

The present invention contemplates a novel refractory ceiling structure which eliminates the necessity of providing an arch and greatly simplifies the construction and installation of the blocks 15 of the ceiling. For this purpose, the ceiling blocks are suspended below the top wall 13 by means of supporting elements 16 having lower end portions fast on the upper surfaces of the blocks and upper end portions projecting upwardly from the blocks and received and held in gripping devices 17 mounted on the top wall. With this arrangement, the ceiling blocks may be of simple rectangular cross-section and disposed in a common plane with adequate spaces 18 (FIG. 1) provided between adjacent blocks to accommodate expansion. At the same time, the entire interior surface of the refractory lining is composed of the high-temperature resistant material of the blocks and each block is individually replaceable with little difficulty.

In this instance, the supporting elements 16 are in the form of pins (see FIG. 2) having lower anchor portions 19 embedded in the bodies of the blocks and stems 20 projecting upwardly above the blocks. Each anchor 19 is cylindrical in cross-section and is formed with three axially spaced annular ribs 21 forming enlargements for holding the anchor securely in the block. The stem 20 preferably is thickened above the anchor to form a downwardly facing shoulder 22 for resting on the block, and tapers toward the upper end. Spaced below the upper end is an annular groove 23 encircling the stem and forming an enlargement 24 at the upper end of the pin which tapers upwardly to a rounded tip.

One or more of these pins 16 may be embedded in the top of each block 15 in the manner shown in FIG. 2 as the blocks are being molded and while the refractory material still is in a plastic state. Thus, the material flows around and between the ribs 21 and anchors the pin securely in the block. The blocks are fired with the pins in place. Herein, the pins are composed of a suitable ceramic material such as mullite porcelain capable of withstanding the range of temperatures developed above the lining blocks.

As shown in FIGS. 3 and 4, the gripping devices 17 are spring clips each comprising a single piece of spring wire bent intermediate its ends to form two closely spaced and generally parallel legs 25 joined together by an arcuate bend 27 extending through nearly a full circle and thus forming an eye for receiving the shank of a fastener such as a rivet 28 for securing the clip to the furnace wall 13. Herein the clip is disposed outside the furnace wall with the rivet projecting upwardly through a hole 29 in the wall and through the eye, the outer end of the rivet being upset to form an external head.

The two legs of the clip 17 extend radially outwardly from one side of the eye 27 in closely spaced parallel relation to a position over a second hole 30 (FIG. 3) in the wall 13 where the free end portions of the legs are bent at right angles to hook downwardly at 31 through the hole and then laterally at 36 under the furnace wall thereby to hold both legs securely against the top of the wall.

Approximately midway between the eye 27 and the hooked end, each spring leg 25 is bent at 32 to curve outwardly away from the other leg and then back to form a split annular seat 33 for receiving the upper end portion of a pin 16 with the bends 32 straddling the stem and pressed tightly in the groove 23. This seat is formed above and in vertical alinement with a third hole 34 in the top wall 13 through which the upper end portion of the pin projects as shown in FIG. 2. The normal spacing of the spring legs, of course, is less than the cross-sectional width of the enlargement 24 so that the legs firmly grip the pins. It should be apparent that the clips 17 could be mounted with the legs 25 disposed beneath the wall and hooking up through the hole 30 without departing from the present invention.

It is well known that ceramic pieces such as the pins 16 are relatively strong when acting either in tension or in compression but are much weaker in shear. To minimize the shearing forces applied to the pins in service use as a result of expansion and contraction of the blocks 15 during heating and cooling, the four pins used herein for each block are positioned along dot-dash lines 37 shown in FIG. 3 and extending diagonally of the top surface of the block. Thus, the components of expansion or contracton of a block combine to produce a resultant movement of each pin along the diagonal line 37 on which it lies. To take advantage of this controlled motion, each clip 17 is secured to the furnace wall 13 with its two legs 25 disposed on opposite sides of and paralleling the aforementioned diagonal of the top of the block. Consequently, all movement of the pins relative to the clips is along paths paralleling the legs so that the legs are able to accommodate the movement by spreading slightly, movement of the pins transversely of the spring legs being minimized or eliminated.

With clips 17 mounted on preselected locations on the top wall 13 and pins 16 anchored in corresponding locations on the tops of the blocks 15, the refractory ceiling is assembled simply by raising each block into the proper position adjacent the top wall and pressing the upper ends of the pins through the alinged holes 34 and into the alined seats 33. The rounded tip of each pin cams the bends 32 apart and bows the spring legs away from each other far enough to permit the enlargement 24 to pass between the bends. When the groove 23 is between the legs, the latter close about the stem and become seated in the groove. The hooked ends 31, 36 of the spring legs hold the latter against excessive upward yielding during assembly of the ceiling.

Similarly, replacement of a damaged block 15 in service use is accomplished simply by removing the damaged block individually and fitting a new block upwardly into its place. In response to a greater than normal downward force, the undersides of the enlarged upper ends 24 cam the associated spring legs 25 apart to release the stems 20. The spring legs are braced by the top wall 13 against bending downwardly as the pin is withdrawn. Assembly of the replacement block is the same as the original installation.

The space between the top wall 13 and the top surfaces of the blocks 15 preferably is filled with insulation 35 such as alumina wool capable of withstanding the temperatures that are developed above the layer of blocks. The required spaces 18 between the blocks will vary with the type of refractory material used for the blocks but in any event will be quite small, these spaces being shown on a somewhat exaggerated scale in FIG. 1. Although the illustrative embodiment is shown with four pins per block and with the pins used only for the ceiling blocks, it should be evident that different numbers of pins and other applications are possible.

From the foregoing, it will be seen that a refractory ceiling constructed in accordance with the present invention eliminates the necessity of providing the usual fairly complex and expensive arch and greatly simplifies the construction and installation of the ceiling blocks. Each block is fitted quickly and easily into its place adjacent the top wall and thereafter is supported securely on the wall. Of course, with each block supported independently, it is possible to space the blocks to accommodate expansion during heating. Moreover, the particular arrangement of the clips 17 and pins 16 relative to the blocks 15 minimizes the application of shearing forces to the ceramic pins during expansion and contraction and thereby reduces the danger of breakage of the pins in service use. In addition, the individually releasable support for the blocks makes possible the quick and easy removal and replacement of damaged blocks.

I claim as my invention:

1. In a heat treating apparatus, the combination of, a walled enclosure including a top wall, a refractory lining within said enclosure including a ceiling comprising a plurality of edge-to-edge rectangular blocks of refractory material spaced apart to accommodate expansion and contraction of the blocks in response to temperature variations in said enclosure, a plurality of ceramic pins having lower ends secured to said blocks and necks projecting upwardly from the tops of the blocks, each of said pins being positioned along a diagonal of the top surface of a block, spring clips mounted on said top wall and each having two legs spaced apart to straddle the neck of one of said pins, and an enlargement on each of said pins above said legs of greater width than the spacing of said legs whereby said clips suspend said blocks from said top wall, said legs being generally parallel to the diagonal on which the associated pin is positioned to permit shifting of the neck along said legs during expansion and contraction of the blocks.

2. In a heat treating apparatus, the combination of, an enclosure having a top wall, a block of refractory material disposed beneath said wall, a ceramic pin having one end portion embedded in said block and a neck projecting upwardly from said block toward said wall, a spring clip mounted on said wall above said block and having two elongated spring legs extending along said wall in closely spaced side-by-side relation and straddling said neck, an enlargement on the upper end of said pin above said legs whereby said slip grips said pin and suspends said block from said wall, and a fastener securing said clip to said wall on one side of said pin, said legs having hooked free end portions extending generally vertically through said wall and then laterally along the side of the wall remote from said block to hold said free end portions against swinging away from the wall.

3. The combination defined in claim 2 in which said legs curve away from each other and then back intermediate their ends to form a split annular seat for receiving and gripping said neck below said enlargement.

4. The combination defined in claim 2 in which said neck projects upwardly through said wall, said clip being disposed above said wall with said free end portions hooking downwardly through and under said wall.

5. In a heat treating apparatus, the combination of, a wall, a refractory lining inside said wall including a block of refractory material disposed adjacent said wall, a ceramic pin having one end secured to said block and a neck extending away from said block toward said wall, a spring clip mounted on said wall and having two elongated spring legs extending along the wall in closely spaced side-by-side relation and straddling said neck, and an enlargement on the free end of said neck abutting against said legs whereby said clip suspends said block from said wall, said legs being positioned to parallel the line of resultant movement of said pin during expansion and contraction of said block in response to temperature variations and permit shifting of said neck along said legs.

6. In a heat treating apparatus, the combination of, a wall, a refractory lining inside said wall including a block of refractory material disposed adjacent said wall, a ceramic pin having one end secured to said block and a neck extending away from said block toward said wall, a spring clip mounted on said wall and having two elongated resiliently flexible spring legs extending along the wall in closely spaced side-by-side relation transversely of and straddling said neck, and an enlargement on the free end of said neck abutting against said legs whereby said clip suspends said block from said wall and accommodates movement of said pin longitudinally of said legs by spreading of the legs and also accommodates limited transverse movement of the pins by lateral flexing of the legs.

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