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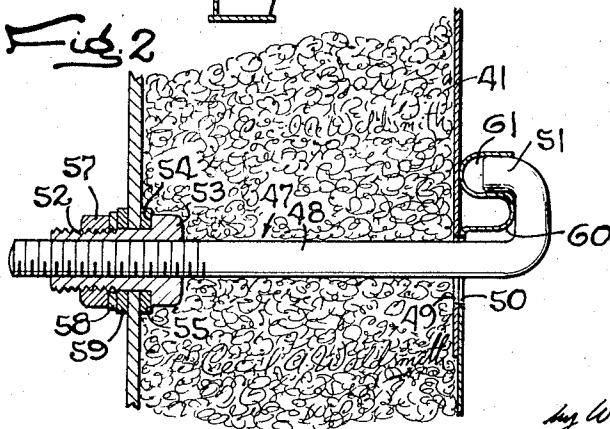
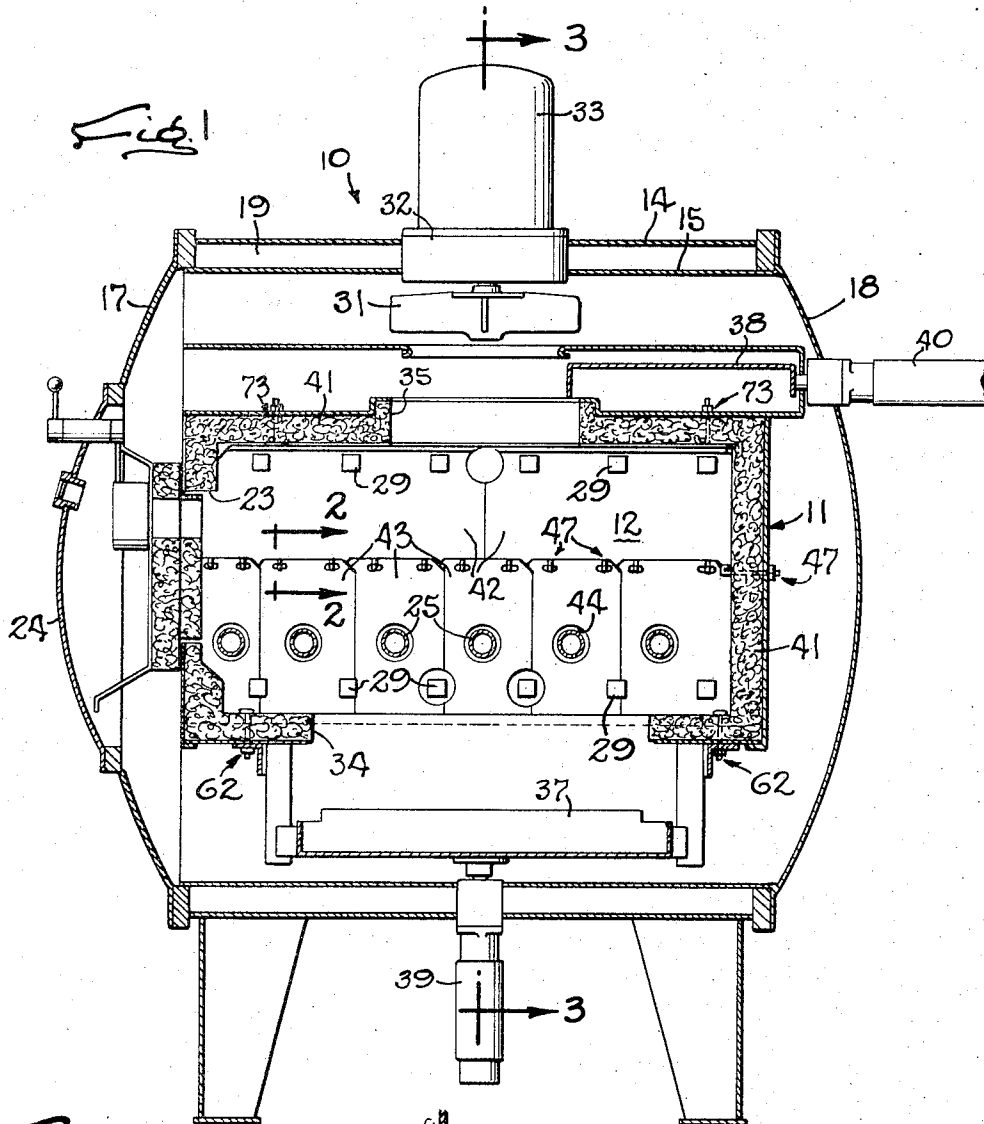
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3,368,802

CONSTRUCTION OF INSULATED FURNACE WALL

Filed June 11, 1965

4 Sheets-Sheet 1



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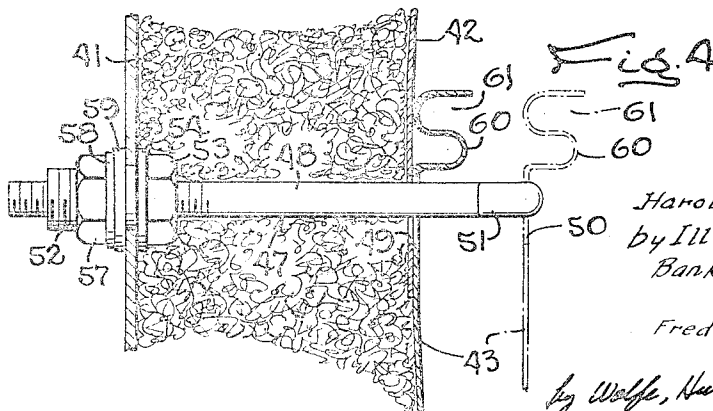
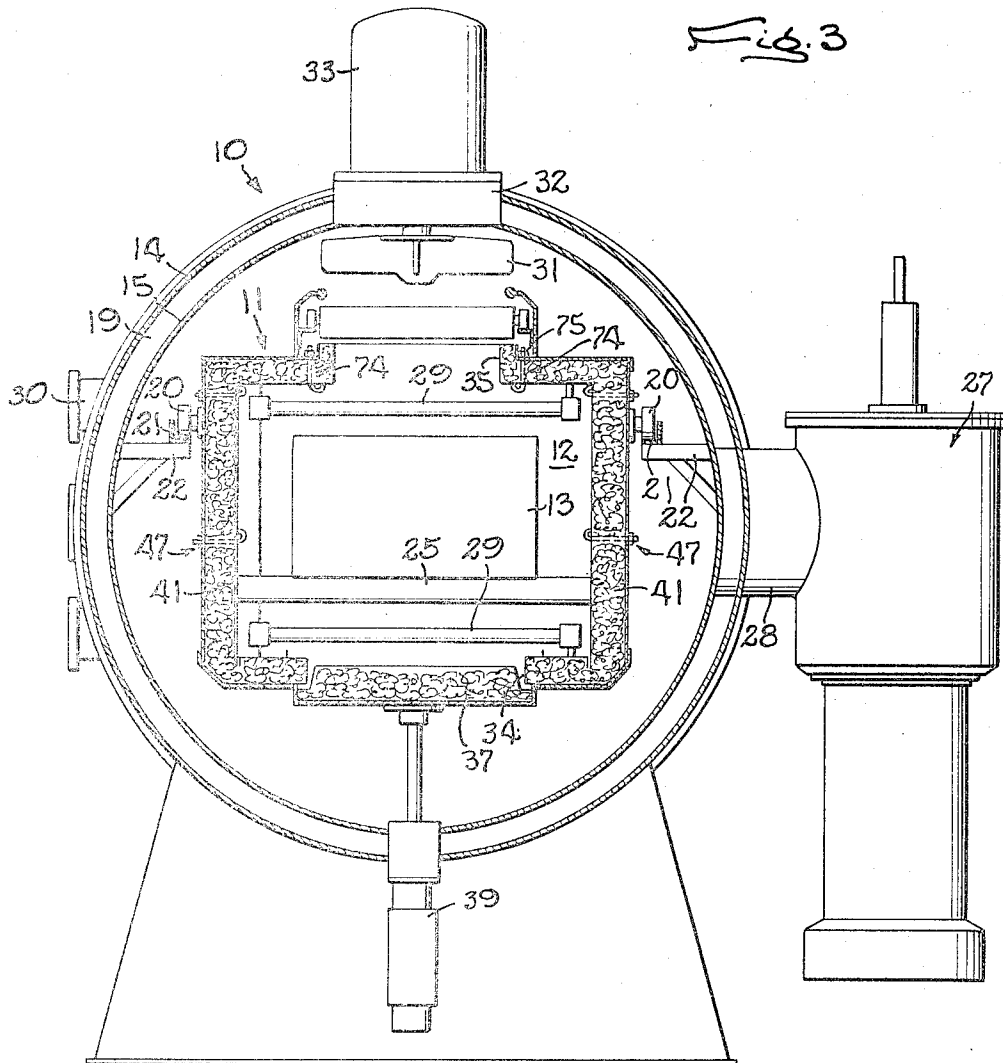
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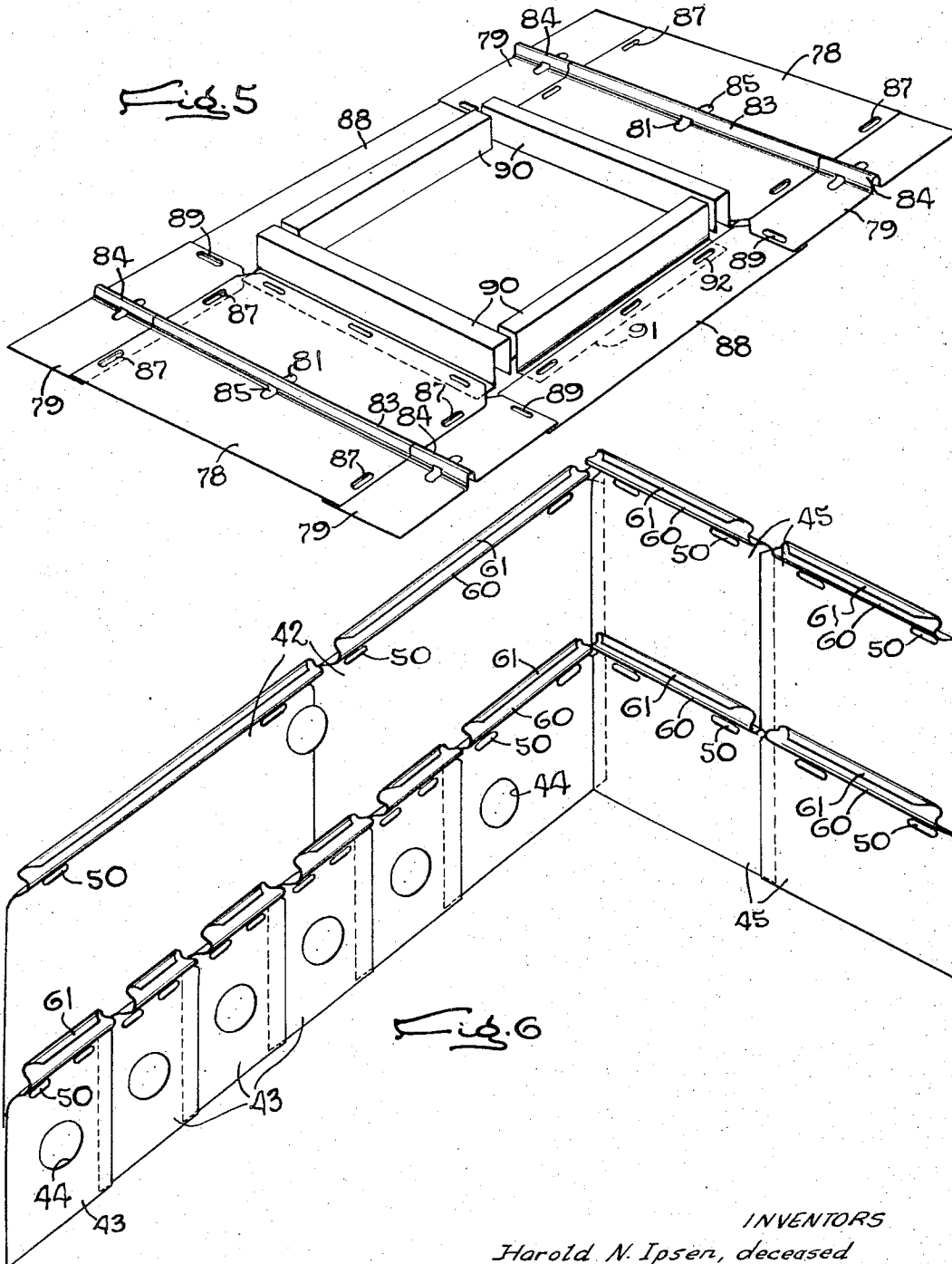
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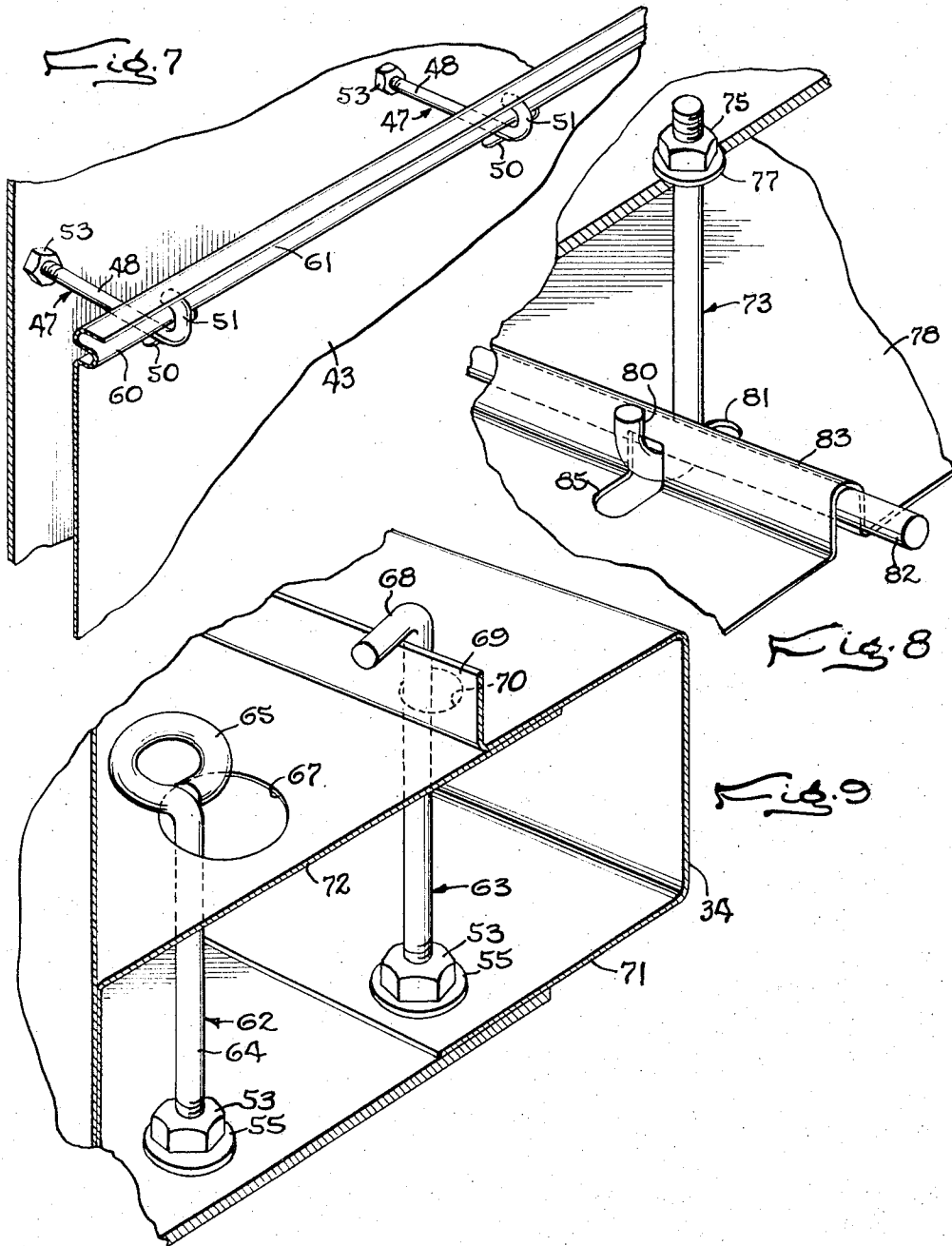
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CONSTRUCTION OF INSULATED FURNACE WALL

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3,368,802

CONSTRUCTION OF INSULATED FURNACE WALL

Fred W. Morgan, South Beloit, Ill., and Harold N. Ipsen, deceased, late of Rockford, Ill., by The Illinois National Bank and Trust Company, executor, Rockford, Ill., assignors, by mesne assignments, to Alco Standard Corporation, Philadelphia, Pa., a corporation of Ohio
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ABSTRACT OF THE DISCLOSURE

A heat treating furnace having a vacuum-tight, water-jacketed vessel and an inner enclosure formed by an inner wall composed of a plurality of overlapping flexible shingles, and outer wall, a layer of compressible fibrous insulation between the walls, and fasteners turnably mounted on the outer wall and projecting through the insulation and the inner wall with radially offset, J-shaped inner end portions overhanging the inner sides of the shingles and locked in grooves formed in the shingles, thereby holding the assembly together. The enclosure is formed with ports for the circulation of quenching gas by a fan inside the vessel, and the ports are opened and closed by reflector doors operated by reciprocating actuators.

This invention relates to the construction of the inside walls of heat treating furnaces and, more particularly, to the construction of an enclosure having inner walls composed of heat resistant sheet material defining the heating chamber and backed by a layer of insulation disposed between the sheet material and the outer supporting walls of the enclosure.

The general object of the present invention is to provide a new and improved enclosure construction of the above character in which the inner walls are more easily replaced and repaired in service use and are less susceptible to damage due to buckling as a result of expansion of the inner walls during high temperature operation of the furnace.

A more specific object is to form each of the inner walls with a plurality of smaller panels or shingles and support the shingles on the outside walls in a novel manner permitting relative movement of the shingles during heating and also facilitating removal and replacement of singles that have been damaged in service use.

Another object is to utilize the resiliency of fibrous insulation in locking the shingles releasably in place in the inner wall of the enclosure.

A further object is to minimize the difficulty and amount of repair occasioned by breakage of shingles or various elements projecting into the heating chamber through the shingles.

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 cross-sectional view taken in a vertical plane extending longitudinally of a furnace embodying the novel features of the present invention.

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

FIG. 3 is a fragmentary cross-sectional view taken along the line 3—3 of FIG. 1.

FIG. 4 is a view similar to FIG. 2 with the parts in moved positions.

FIG. 5 is an enlarged perspective view of the top wall of the heating chamber.

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FIG. 6 is an enlarged perspective view showing side and end walls of the heating chamber.

FIG. 7 is an enlarged fragmentary perspective view of part of the side of the enclosure.

FIG. 8 is an enlarged fragmentary perspective view, partially in section, of the top of the enclosure.

FIG. 9 is an enlarged fragmentary perspective view of part of the bottom of the enclosure.

As shown in the drawings for purposes of illustration, the invention is embodied in a vacuum heat treating furnace of the type comprising a vacuum-tight outer vessel 10 and a box-like insulated enclosure 11 within the vessel having heat-resistant inner walls defining a heating chamber 12 in which a work load 13 (see FIG. 3) may be heated in a vacuum or other non-oxidizing atmosphere and subsequently quenched by a flow of cooling gas. In such furnaces, the outer vessel preferably is formed by two coaxial cylindrical shells 14 and 15 closed at their ends by outwardly dished covers 17 and 18 and spaced apart to define a water jacket at 19 between the shells. The enclosure 11 is supported within the vessel by means of rollers 20 (FIG. 3) on its upright sides riding on horizontal tracks 21 on brackets 22 along the vessel walls, and has an opening 23 in one end aligned with a door 24 in the cover 17 through which workpieces to be treated are loaded into the furnace and onto a hearth comprising a series of horizontal rollers 25 spanning and journaled in the sides of the enclosure.

Evacuation of the vessel preparatory to a heat treating operation is accomplished by a vacuum pumping apparatus 27 (FIG. 3) of well known construction communicating with the interior of the vessel 10 through a pipe 28 opening through one side of the vessel. The work load 13 is heated by radiant heaters 29 spaced around the heating chamber, and quench gas is admitted into a vessel through a duct 30 for circulation by a centrifugal fan 31 suspended below a mounting plate 32 fitted in the top of the vessel and supporting the fan motor in a case 33 outside the vessel.

As shown most clearly in FIGS. 1 and 3, the enclosure 11 herein is of rectangular cross-section and is formed with inlet and outlet ports 34 and 35 in its bottom and top on opposite sides of the position occupied by the work load during treatment, the outlet port being positioned immediately below the fan 31. During the heating operation, both ports are closed by reflector doors 37 and 38 positioned over the ports to reflect heat evenly back toward the work load for more uniform heating of the latter. When the heating is completed, the doors are moved away from the ports by selectively operable reciprocating actuators 39 and 40 (FIGS. 1 and 3) to permit full and free gas circulation through the chamber by the fan 31 which draws hot gas from the heating chamber 12 through the outlet port 35 and forces the gas outwardly and downwardly around both sides of the enclosure toward and into the inlet port 34 for recirculation through the heating chamber. In passing around the enclosure, the circulating gas is cooled by contact with the inner shell 15 prior to recirculation past the work load in the chamber. Thus, the work load is rapidly quenched in the heating chamber.

To confine the heat within the chamber 12 for more uniform and efficient heating of the work load 13, the heat-resistant inner walls of the enclosure 11 are backed by a layer of insulation 41 such as lightweight alumina wool disposed in the spaces between the inner walls and the outer walls, the latter being spaced outwardly from and generally parallel to the associated inner walls. The rollers 20 are journaled in the outer walls to support the enclosure in the vessel, and the inner walls are supported on the outer walls.

It will be evident that the inner walls are subjected to the high operating temperatures of the furnace and must be capable of withstanding such temperatures in service use. Accordingly, the inner walls are composed of sheet material such as molybdenum or those known as Inconel and UC900. The particular material chosen for a furnace, of course, will depend upon the maximum temperature to be developed in service use and the types of material commercially available for use in the furnace. The outer walls of the enclosure also are sheet metal but may be composed of less expensive material because the temperatures developed at the outer walls are substantially lower. The doors of the enclosure also are of insulated sheet metal construction.

The present invention is concerned with the construction of the walls of the enclosure 11, and contemplates a novel enclosure construction in which the inner walls are less susceptible to damage as a result of buckling during heating of the furnace and the accompanying wall expansion in service use, and also are more easily repaired and replaced when damaged. For these purposes, each of the inner enclosure walls comprises a plurality of smaller panels or shingles supported on the outside enclosure walls for edgewise movement relative to each other and also for quick and easy individual removal and replacement in service use.

In this instance, the inner side walls and the end wall remote from the loading opening 23 (see FIG. 6) are divided vertically into two rows of shingles, and each row comprises a plurality of shingles overlapping each other and also overlapping the adjacent shingles of the other row. As shown in FIGS. 1 and 6, the upper portion of each side wall herein comprises two relatively large elongated shingles 42 overlapping at their adjacent ends, and the lower portion of the wall comprises six smaller shingles 43 having top edges overlapping the lower portions of the upper shingles 42 and side edges overlapping each other. One lower shingle is provided for each of the hearth rollers 25 and is formed with a circular opening 44 through which the roller projects. The lower edges of these shingles extend somewhat below the level of the bottom wall of the chamber as shown in FIG. 9 and the shingles at the ends of each row extend beyond the end wall of the chamber (see FIGS. 1 and 6). The top edges of the shingles in the upper row are disposed immediately beneath the side edge portions of the top wall of the chamber. As shown in FIG. 6, the end wall comprises two rows of two shingles 45 each generally similar to those forming the side walls except in the size of the shingles and the openings therein.

To hold these shingles 42, 43 and 45 in their proper positions during service use of the furnace, fasteners 47 (see FIGS. 2, 4 and 7) are mounted on the outer enclosure walls with shanks 48 projecting inwardly through the insulation 41 and loosely through aligned apertures 49 and 50 in the shingles forming the inner walls and with abutments 51 on the inner end portions of the fasteners engaging the inside surfaces of the shingles to hold the latter against movement away from the outer walls while permitting edgewise movement of the shingles during heating and cooling of the furnace. In the preferred form shown in FIGS. 2, 4 and 7, the fastener is a J-shaped pin having a shank threaded at its outer end through a sleeve 52 (see FIG. 2) projecting through the outer wall and having a head 53 on the inside of the wall forming a shoulder 54 abutting against a washer 55 between the head and the wall. A nut 57 is threaded onto the sleeve outside the wall and tightened against two washers 58 and 59 to secure the sleeve in the wall. In this manner, the pins are rotatably mounted on the outer walls and are held against inadvertent longitudinal movement relative to the wall.

The apertures 49 and 50 are horizontally elongated slots long enough to admit the reversely curved and hook-shaped inner end portions of the fastener pins 47 through

the shingles 42, 43 and 45 in one angular position of the pins (FIG. 4) but narrower than the effective width of the inner end portions in the turned position shown in FIGS. 2 and 7 so that the inner end portions form the abutments 51 overhanging the shingles and abutting against the inner sides of the latter in the turned positions. The slots are sufficiently wider than the diameter of the shanks of the pins to leave a substantial clearance around the pins for edgewise movement of the shingles in service use.

Means are provided on the shingles 42, 43 and 45 for locking the fastener pins 47 releasably in the turned positions thereby preventing accidental release of the shingles in service use. Herein, this is accomplished by bending a rib 60 inwardly from the plane of the shingle along one side of the slots 50 therein to form an abutment around which the inner end portion of the pin hooks in the turned position. As shown most clearly in FIG. 7, the ribs preferably are formed by parts of S-shaped bends extending completely across the upper edge portions of the shingles and defining not only the ribs but also grooves 61 for receiving the free inner ends of the pins. The slots 50 are formed immediately below the ribs.

With this arrangement, the fasteners 47 first are mounted in the desired positions on an outer wall of the enclosure and the insulation 41, in blanket form, is pressed over the fasteners and thus held temporarily in place on the outer wall. The threaded sleeves 52 hold the fasteners in their proper positions during installation of the insulation. Then the shingles 42, 43 and 45 for the inner wall are placed over the inner ends of the fasteners as shown in FIG. 4 and the fasteners are turned to swing the radially offset hooked ends 51 out of alignment with the slots and into alignment with the grooves 61.

It will be seen in FIGS. 2 and 4 that this arrangement takes advantage of the flexibility of the sheet metal shingles and the resilient compressibility of the insulation 41 in the installation and retention of the shingles. For this purpose, the thickness of each blanket of insulation is sufficient to hold the shingles firmly against the free ends of the fastener pins 47 after assembly. During installation of the shingles, however, the insulation is compressed by bending the shingles outwardly, that is, into the insulation (see FIG. 4) far enough to permit turning of the pins into their locking positions. Then, when the shingles are released, they spring inwardly and are pressed against the pin ends to lock the latter in the grooves 61. If it becomes necessary to replace one or more shingles, the shingle to be replaced is simply pressed inwardly to the position in FIG. 4 to move the rib away from the pin or pins holding the shingle, and the pins are turned to the release position to permit removal of the shingle. Installation of the replacement is the same as the initial installation.

The primary reason for forming only one hearth roller opening 44 in each of the shingles 43 is the simplification of the removal and replacement of shingles in this area. It usually is necessary to remove each roller projecting through a shingle before the replacement shingle can be installed. In the present instance, only one roller need be removed for the installation of any replacement shingle.

In FIG. 9, two alternate fasteners 62 and 63 are shown for holding the shingles of the bottom wall of the chamber 12 in place against the bottom layer of insulation 41. The fastener 62 has a shank 64 threaded at its lower end into a sleeve secured to the outside wall of the bottom of the enclosure, the fastener having a circular bend 65 offset radially from and disposed in a plane perpendicular to the shank of the pin. When this type of fastener is to be used, a circular aperture as at 67 is formed in the shingle to pass the bend through the shingle in one angular position of the pin. Then, when the pin is turned out of this position, the bend overhangs the shingle and holds the latter down, the pin being held against turning only by the friction between the bend and the shingle.

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The fastener 63 is a hook with a right-angle bend 68 which overlies the inside wall of the chamber 12 and an upturned flange 69 in the specific instance shown in FIG. 9. The shank of this fastener projects through a circular opening 70 in the inside wall, and is inserted and removed from the inside of the furnace.

It will be seen that the inlet opening 34 may be defined by U-shaped shingles or channels 71 similar to the one shown in FIG. 9. These channels are telescoped sideways over the outside bottom wall and the shingles 72 forming the inside bottom wall, and are held in place by the fasteners 63. The loading opening 23 may be formed in a generally similar manner.

The shingles of the top wall of the chamber, shown in FIG. 5, are suspended from the top of the enclosure by a plurality of hooks 73 and 74 (see FIGS. 3 and 8) which extend upwardly through the enclosure top and are held against downward movement by nuts 75 threaded onto the outer end portions of the hooks above washers 77 (FIG. 8) thereon. Two large shingles 78 adjacent the ends of the top wall and smaller shingles 79 on both sides of these large shingles are supported primarily by three hooks 73 having upwardly curving end portions 80 (FIG. 8) extending downwardly through slots 81 in the three shingles, under a transverse carrier rod 82 fitted in a downwardly opening groove formed by aligned inverted U-shaped bends 83 and 84 in the shingles, and then upwardly through slots 85 on the opposite side of the carrier rod.

The end portions of the large shingles 78 overlie the adjacent edge portions of the smaller shingles 79, and hooks 74 are passed through aligned elongated slots 87 in the overlapping portions and suspended from the top of the enclosure. These hooks have lower end portions that simply bend under the shingles in the manner of the hook 63 shown in FIG. 9. The top wall is completed by two narrow shingles 88 along the sides of the wall with end portions underlying the ends of the shingles 79 and supported by L-shaped hooks 74 inserted through aligned slots 89 in the overlapping portions of the shingles 79 and 88. All the hooks for the top portion may be assembled simply by pushing the shanks upwardly through the shingles, the insulation 41 and aligned holes in the enclosure top. The hooks 74 may be turned into and out of alinement with the various slots for easy removal of the shingles.

To define the outlet port 35 in the top wall of the enclosure 11, four sheet metal bars 90 of rectangular cross-section are disposed along the four edges of the opening defined by the shingles 78 and 88, the bars being formed with flanges 91 that overlap the adjacent shingles as shown in FIG. 5. L-shaped hooks 74 with horizontal lower end portions engaging the undersides of these flanges extend upwardly through aligned slots 92 in the flanges and the overlapping portions of the shingles and are secured to the enclosure top by nuts outside the top of the enclosure.

In the foregoing manner, the inside walls of the enclosure 11 may be constructed almost entirely of easily removable panels or shingles held releasably in place by fasteners mounted on the outside enclosure walls and projecting inwardly through the insulation 41 and the various shingles with abutments on their inner ends engaging the inner sides of the shingles. Clearance is left around all the fasteners to accommodate movement in service use, and the shingles are movable edgewise relative to each other during such expansion to reduce buckling of the walls and increase the service life of the lining. Moreover, when it becomes necessary to replace one or more shingles, the replacement operation may be completed relatively simply and rapidly with a minimum of labor and material cost.

What is claimed:

1. In a heat treating furnace, an enclosure having an inner wall defining one side of a heating chamber, an

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outer wall spaced from and generally parallel to said inner wall, and a layer of resiliently compressible insulation disposed between said walls, said inner wall comprising a plurality of flexible sheet metal panels disposed in side-by-side overlapping relation and formed with elongated slots therein, J-shaped fasteners having shanks projecting inwardly from said outer wall through said insulation and said slots, the curved inner end portions of each of said fasteners being offset radially from the rest of the fastener and sized and positioned to pass through said slots in a first angular position of the fastener relative to the associated panel, means supporting said fasteners on said outer wall to turn out of said first position into a second position in which said inner end portion overhangs and abuts against the inside of the panel whereby said panels are held releasably adjacent said outer wall, and abutments on said panels alongside said slots for engaging said curved portions when the fasteners are in said second positions and holding the fasteners against turning to said first positions until the panels have been pressed into said insulation far enough to move said abutments out of engagement with said curved portions.

2. In a heat treating furnace, an enclosure having an outer wall, a layer of resiliently compressible insulation inside said wall, a panel composed of flexible sheet material disposed against the inner side of said insulation and having an elongated slot therein, a J-shaped fastener having a shank extending inwardly from said outer wall through said insulation and said slot and having a reversely curving and radially offset inner end portion sized and positioned to pass through said slot in a first angular position of said fastener relative to said wall and said panel and to overhang the inner side of said panel on one side of said slot in a second angular position of the fastener, means mounting said shank on said outer wall for selective turning between said angular positions, and a rib bent inwardly from said panel along said one side of said slot to abut against said offset portion and hold the fastener against turning back to said first position until said panel has been pressed into said insulation far enough to move said rib away from said inner end portion and release the latter.

3. A heat treating furnace as defined in claim 2 in which said rib is one part of an S-shaped bend in said panel also defining a groove for receiving the free inner end of the fastener.

4. In a heat treating furnace, an enclosure having an outer wall, a layer of resiliently compressible insulation inside said wall, a panel composed of flexible sheet material disposed against the inner side of said insulation and having an aperture therein, a fastener having a shank extending inwardly from said outer wall through said insulation and said aperture and having a radially offset inner end portion sized and positioned to pass through said aperture in a first angular position of said fastener relative to said wall and said panel and to abut against the inner side of said panel in a second angular position of the fastener, a sleeve projecting through said wall in alinement with said aperture and having a shoulder abutting against one side of the wall, and a nut threaded on said sleeve on the other side of the wall to secure the sleeve in the wall, said shank being threaded into said sleeve and thereby held on said wall for selective turning between said first and second positions while being held against inadvertent axial movement.

5. In a heat treating furnace, an enclosure having an outer wall, a layer of resiliently compressible insulation inside said wall, a first panel composed of flexible sheet material disposed against the inner side of said insulation and having an aperture therein, a second panel composed of flexible sheet material disposed against the inner side of said insulation and having one edge portion overlapping a portion of said first panel, aligned apertures in the overlapping portions of said panels, a fastener having a shank extending inwardly from said outer wall through

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said insulation and said apertures and having a radially offset inner end portion sized and positioned to pass through said apertures in a first angular position of said fastener relative to said wall and said panels and to abut against the inner side of said second panel in a second angular position of the fastener, and means mounting said shank on said outer wall for selective turning between said angular positions, and means on said inner end portions and said panels holding said fasteners releasably in said second angular positions against turning back to said first positions.

6. In a heat treating furnace, an enclosure having an outer wall, a layer of resiliently compressible insulation inside said wall, a panel composed of flexible sheet material disposed against the inner side of said insulation and having an aperture therein, a fastener having a shank extending inwardly from said outer wall through said insulation and said aperture and having a radially offset

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inner end portion sized and positioned to pass through said aperture in a first angular position of said fastener relative to said wall and said panel and to abut against the inner side of said panel in a second angular position of the fastener, means mounting said shank on said outer wall for selective turning between said angular positions, and means on said panel for locking said fastener releasably in said second position.

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