

April 27, 1954

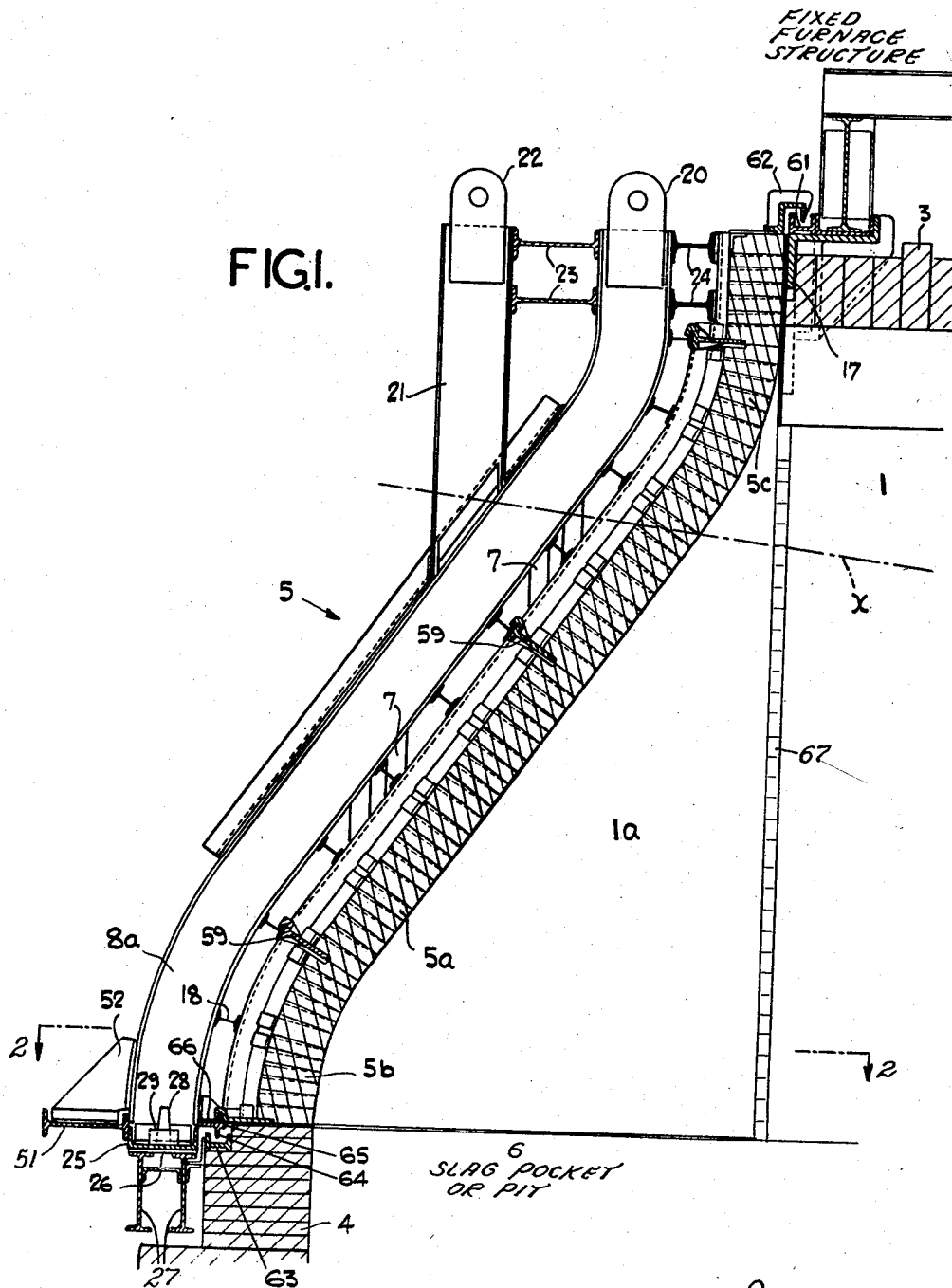
H. JONES
OPEN HEARTH FURNACE

2,676,793

Filed July 11, 1950

3 Sheets-Sheet 1

FIG. 1.



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FIG. 4.

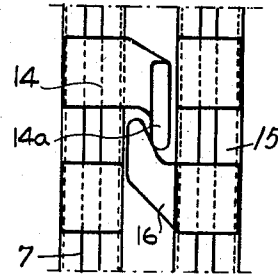


FIG. 2.

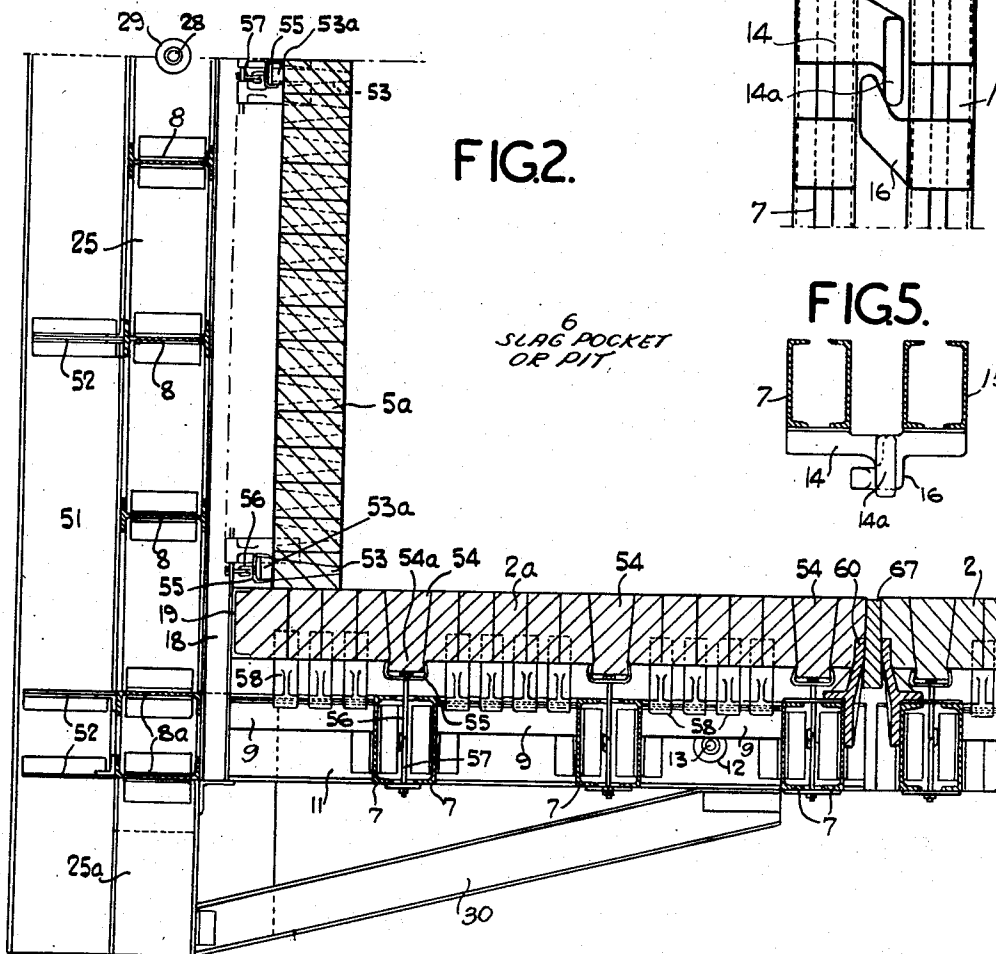
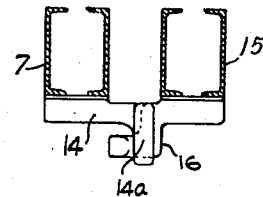


FIG. 5.



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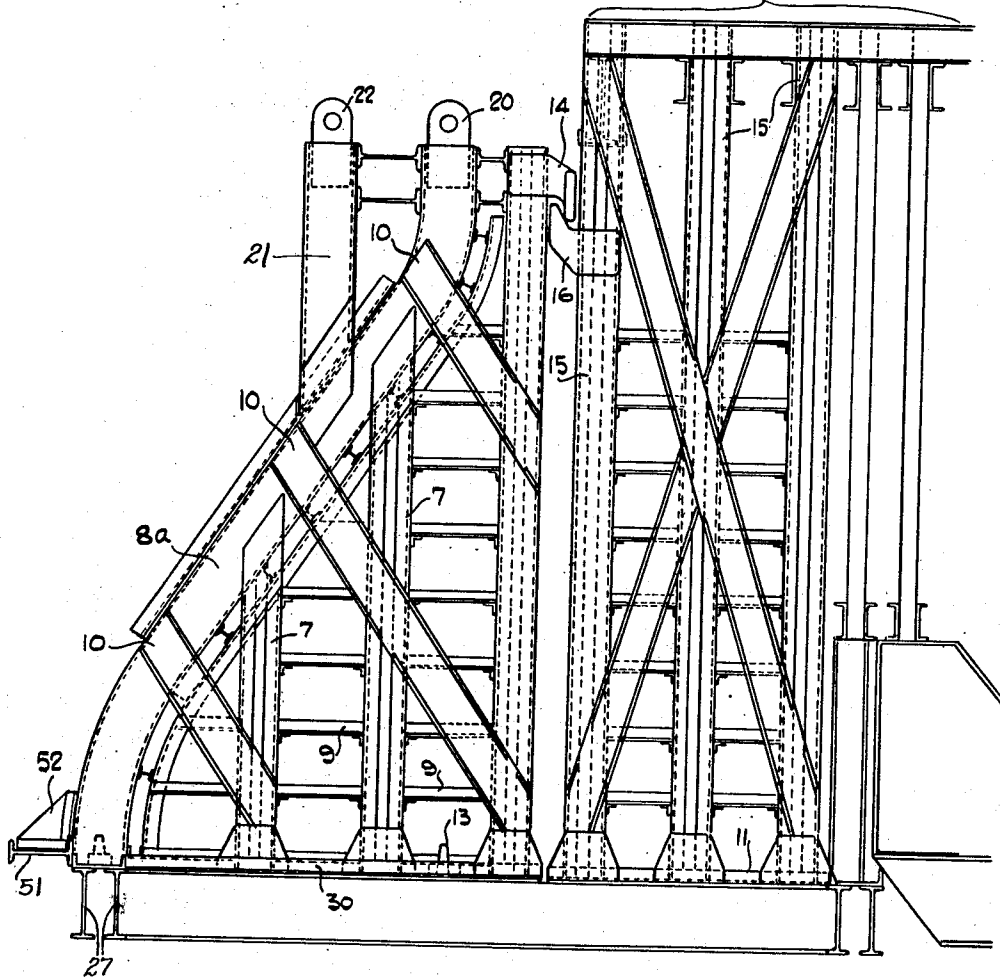
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FIG. 3.

FIXED FURNACE STRUCTURE



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UNITED STATES PATENT OFFICE

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OPEN HEARTH FURNACE

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3 Claims. (Cl. 266—34)

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This invention has reference to open hearth furnaces.

When such furnaces are in operation, hot waste gaseous products in which particles of foreign matter are suspended, flow at high velocity from an end of the hearth into a slag pocket which extends below the latter and down which the said products and particles are caused to pass. As a consequence, the products and suspended particles are caused to make a considerable change, of approximately 90°, in their direction of travel and, in making this change, they impact on the corresponding end wall of the furnace with considerable force. The condition of the end wall therefore deteriorates rapidly and necessitates repairs being carried out at frequent intervals.

It will be appreciated that before an end wall of the furnace can be demolished, or partly demolished, by manual labour, it is necessary to shut down the furnace and allow it to cool down to a considerable extent.

The principal object of the present invention is to minimise the period during which an open hearth furnace need be shut down when an end wall becomes defective.

A further principal object of the invention is to enable that section of an end wall of an open hearth furnace which deteriorates the most rapidly when the furnace is in use, to be removably assembled in the furnace structure.

Another object of the invention is to ensure that a removable section of an open hearth furnace end wall can be removed and replaced by an identical portion in a minimum of time.

Still another object of the invention is to ensure that a removable section of an open hearth furnace end wall can be accurately and quickly aligned with the fixed structure upon being assembled to the furnace.

Yet another object of the invention is to ensure that a removable section of an open hearth furnace end wall is sealed to the fixed structure in a gas tight manner.

Another object of the invention is to enable a removable end wall section of an open hearth furnace to be bodily assembled to the fixed structure and dismantled from the said structure without damage.

With these and other objects in view, which will become apparent as this specification proceeds, the construction of an end wall of an open hearth furnace will now be described with reference to the accompanying drawings which illustrate a preferred embodiment of the invention.

In the drawings:

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Figure 1 is a sectional elevation of the upper removable section of an end wall of an open hearth furnace.

Figure 2 is a section taken along the line 2—2, Figure 1.

Figure 3 is an elevation, on a smaller scale, showing the skeleton metal framework of the removable wall section shown in Figures 1 and 2, and the metal framework of the adjoining portion of the fixed furnace structure.

Figure 4 is an enlarged scale elevation and Figure 5 is a sectional plan showing means for securing the upper end of the removable end wall section to the fixed furnace structure.

In the embodiment of the invention shown in the drawings, an open hearth furnace comprises a fixed back wall part of which is shown at 1 (Figure 1), a fixed front wall part of which is shown at 2 (Figure 2), a fixed roof or arch part of which is shown at 3 (Figure 1), and two fixed end walls a part of one of which is shown at 4 (Figure 1), each fixed end wall being associated with an upper and removable wall section 5.

Each end wall 4 serves as one wall of a slag pocket or pit 6 which is provided in the corresponding end of the furnace outwardly of the hearth (not shown) and below hearth level; the said pocket or pit receives the hot waste gaseous products and particles of solid foreign matter suspended therein, discharged horizontally from the hearth at a high velocity when the furnace is in operation. The throat of the said pocket or pit is defined partially by inclined end wall 5a of the removable section 5 and the inclination of the said wall 5a assists in changing the flow of the said gases from the horizontal path along which they travel from the hearth, into a vertical or substantially vertical path downwardly of the said throat and into the said pocket or pit.

The removable section also includes a back wall 1a and a front wall 2a which are located in the planes of the back and front walls 1 and 2 respectively of the furnace structure. Thus, in elevation, the removable section is of a shape somewhat resembling a right-angled triangle of which the wall 5a forms the hypotenuse. However, as shown in Figure 1, the wall 5a is not straight but is formed at or in the region of its lower edge with a convex portion 5b so that the face of the said edge is horizontally disposed and is at right angles to the inner face of the fixed end wall 4; also, at or in the region of its upper edge, the wall 5a is formed with a convex portion 5c so that the upper extremity of its inner face is vertical and is adapted to mate with and sit flat upon the adjacent end edge of the arch or roof 3.

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The removable section 5 is carried by and within a skeleton metal framework which comprises, forwardly and rearwardly of the front and back walls 2a, 1a, a system of upright buckstays 7, of box-like or double-channel cross-section, and, endwardly of the inclined wall 5a, a system of H-section girders 8 of which the upper and lower ends are swept or curved to conform to the shape of the upper and lower portions of the said wall 5a.

The buckstays 7 are of successively diminishing height (see Figure 3) from the edges of the section 5 which are adjacent the back and front walls 1 and 2 of the fixed structure, to the girders 8; the buckstays 7 are interconnected and braced by varying numbers of superimposed and spaced horizontal tie-bars 9. The feet of all the said buckstays on the front of the removable section are secured to and internally of a horizontal channel-section beam 11 and the buckstays at the rear of the section are similarly secured to an identical beam. The beams 11 seat upon the upper edges of the fixed back and front walls of the pocket or pit 6 and each is provided with a hole or socket 12 through which extends a complementary spigot on dowel pin 13 provided on the said fixed wall edges.

The upper end of the longest buckstay 7, at the front and rear of the removable unit, is provided with an angle claw 14 which extends towards vertical buckstays 15 incorporated in the skeleton framework of the fixed furnace structure. The claw consists of one arm which is fixed to the said longest buckstay and a second arm 14a which projects outwardly of and is arranged at right angles to, the said longest buckstay; the said arm 14a engages (as shown most clearly in Figures 4 and 5) behind a complementary claw 16 fixed to the adjacent buckstay 15 and having an upper edge which is inclined upwardly and away from the said adjacent buckstay; hence, the engagement of the claw arm 14a with the fixed claw 16 forces the upper end of the removable section towards the fixed furnace structure and takes the vertical inner surface of the upper wall portion 5c into close abutting contact with a facing plate 17 (Figure 1) on the corresponding end edge of the arch or roof 3.

The girders 8 are arranged in spaced parallel relationship across the removable section and are interconnected at their inner edges (that is, the edges adjacent the wall 5a) by straight and horizontal spaced I-beams 18.

Adjacent each end of, and at right angles to, the said I-beams 18, and on the inner side thereof, there is fixed a channel section beam 19 (Figure 2) which is of the same shape, in elevation, as the girders 8. The sides or flanges of each beam 19 respectively embrace the adjacent end edges of the back wall 1a and front wall 2a of the removable section thereby providing a positive key between the end wall 5a and the said back and front walls.

The two end girders 8a of the removable section 5, are of box-like or double channel section (see Figure 2) and each has an eyed bracket 20 secured in its upper extremity. Outwardly of the said girder ends, an upright 21 is fixed by its foot to the corresponding girder 8a, the said upright also being of box-like or double channel section and having an eyed bracket 22 secured in its upper extremity. The upper end of each girder 8a is braced to the corresponding upright 21 and to the upper extremity of the wall 5a, by horizontal I-beams 23 and 24 respectively. The

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eyed brackets 20, 22 serve as anchorages for engagement by lifting tackle, such as hooks on the end of a crane cable.

The feet of the girders 8, 8a are secured to and internally of a horizontal channel-section beam 25 which is located in spaced and parallel relationship to the lower edge of the wall 5a and is adapted to seat upon a plate 26 carried upon transverse I-beams 27 incorporated in the upper edge of the fixed end wall 4. A spigot or dowel pin 28 provided on the said plate 26 projects through a hole or socket 29 formed in the beam 25. The engagement of the holes or sockets 12 and 29 in the horizontal beams 11 and 25 respectively, by the complementary spigots 13 and 23 on the upper edges of the fixed wall portions 1, 2 and 4 of the furnace structure ensures that the removable section 5 is positioned correctly in relation to the fixed structure and also that one or more burners (not shown) located in the plane x (Figure 1) and carried by the said section 5, is or are disposed in their predetermined correct relationship to the furnace hearth.

The two box or double-channel sectioned end girders 8a are located respectively in the planes of the buckstays 7 at the front and back of the removable section 5. The removable section is reinforced by laterally inclined beams 30 which are located in a horizontal plane and are secured to and between the channel beams 11 and extensions 25a of the channel beams 25, and by inclined beams 10 which are located in vertical planes and are secured to the said buckstays 7 and end girders 8a; the upper ends of all but the tallest buckstays 7 are also secured to the said end girders (see Figure 3). An I-beam 51 extends alongside and is coextensive with the channel beam 25 and is fixed to the outer edge of the feet of girders 8 and 8a by webbed angle brackets 52.

As a consequence, the entire skeleton framework of the removable section 5 is made strong and inherently rigid and can therefore be lifted into and out of position on the fixed structure without danger of temporary distortions or deflections capable of damaging the brickwork of the walls 1a, 2a and 5a built into the said framework.

The said brickwork includes, in a known manner, bricks or blocks 53 and 54 having tapered and outwardly projecting heads 53a, 54a (Figure 2). Each tapered brick head is held by a jawed plate 55 which is anchored to the said skeleton framework of the removable section in a manner which permits limited relative movement of the said brickwork due to expansions and contractions thereof as its temperature varies from time to time. For this purpose, the crown of each jawed plate is provided with a hooked rod 56 which engages a hooked rod 57 rigidly secured to the framework. The rods 57 which assist in the anchorage of the walls 1a, 2a to the framework, extend through and are bolted to the buckstays 7, whereas the rods 57 which assist in the anchorage of the wall 5a, are bolted to the adjacent sides or flanges of the horizontal channel beams 18. In addition, the weight of the walls 1a, 2a is carried by a system of horizontal plates 58 which are inserted into certain of the courses of the bricks or blocks from the outside of the brickwork, the external ends of the said plates being formed with jaws which engage the edges of the tie-bars 9. Similar jawed plates 59 (Figure 1) engaging the edges of correspond-

ing horizontal beams 18, are inserted into certain of the courses of the end wall 5a.

A flange or lip 60 (Figure 2) is provided along and projects inwardly from each of the tallest buckstays 7 into overlapping relationship to the edge of the corresponding wall 1a or 2a; the said flange or lip enters and is secured in a recess formed in the edge of the corresponding wall which is adjacent the fixed walls 1 and 2 of the furnace structure.

The ties effected by the hooked rods 56, 57, and by the flanges or lips 60 ensure that the brickwork of the removable section is securely anchored to the skeleton framework of the structure.

To ensure that gas-tight seals are effected between the removable section and the fixed furnace structure, sand seals are provided between the upper end of the wall 5a and the roof or arch 3, and between the lower ends of walls 1a, 2a and 5a and the fixed walls 1, 2 and 4. Thus, as shown in Figure 1, a sand trough 61 is provided along the outside of the roof or arch 3 and, as the section 5 is lowered into position, the free edge of an inverted channel section flange 62 (which is fixed to section 5) enters the said trough and becomes embedded in sand in the trough. Similarly, a sand trough 63 is provided along the upper edge of the fixed end wall 4 and a lip 64 which depends from a plate 65 carried on the underside of a horizontal bar 66 spanning the inner edges of the girders 8, 8a, enters the said trough 63; troughs (not shown) identical to the trough 63 are provided on the back wall 1 and front wall 2 of the fixed structure for receiving depending lips of plates (also not shown) spanning the feet of each system of buckstays 7.

When the removable section 5 is in its assembled position, a clearance exists between the removable back wall portion 1a and the removable front wall portion 2a, and this clearance is filled in with bricks 67 (Figure 2) in a manner which enables the said bricks to be readily and quickly removed.

When the furnace is in operation, the particle-laden hot gaseous waste products discharged from the hearth impinge upon the brickwork of the removable section 5 at considerable velocity; as a consequence the condition of the said brickwork deteriorates much more quickly than the brickwork of the fixed structure; when replacement becomes necessary, bricks 67 are knocked out and the said section 5 is lifted bodily from the furnace and is replaced by a new or re-built section. The replacement is effected quickly and without difficulty, since there are no bolted or similar connections to make and break; further, the exchange may be effected without having to wait for the furnace to cool down to any considerable extent. When a defective unit has been removed, it may be repaired at leisure for re-assembly in the furnace as and when required. Consequently, it will be appreciated that the invention enables the defective end wall of an open hearth furnace to be put in working order in a minimum of time thereby considerably reducing the total period during which the furnace has to be shut down for this purpose.

It is to be understood that the invention is not restricted to the specific embodiment described and shown and that any change of the construction shown may be made within the scope of the following claims and without departure from the scope of this invention.

I claim:

1. In an open hearth furnace having an end of which the upper portion is removable, the said end portion being built within and supported by a rigid skeleton framework comprising systems of buckstays and girders, the said framework and end portion forming an assembly separate from the stationary furnace structure, lifting brackets incorporated in and externally of the said framework, inter-engaging spigots and sockets on the lower edge of the framework and the upper edge of the stationary furnace structure which receives the said framework, and inter-engaging claws fixed on the upper forward edge of the framework and the adjacent edge of the stationary furnace structure, the said spigots, sockets and claws automatically locating the framework and end portion assembly in position relatively to the stationary structure when brought into engagement.

2. A unitary liftable wall member for an open hearth furnace, including a portion which is substantially vertical and is adapted to be aligned with and temporarily joined to the back wall of the furnace, another portion which is substantially vertical and is adapted to be aligned with and temporarily joined to the front wall of the furnace, a third portion which joins the other two portions and is inclined to the vertical and has its upper end adjacent the roof of the furnace and its lower end supported on the fixed lower end wall of the furnace, the three described portions of the unitary liftable wall member substantially closing the end of the furnace and together forming a wall member that is generally U-shaped in horizontal section except at the upper end where it is adjacent the roof of the furnace, means forming an integral part of the liftable wall member for facilitating lifting of the wall member away from the fixed furnace structure, locking means fixed to the upper and lower ends of said wall member and adapted to interlock with complementary locking members provided on the fixed furnace structure to hold the liftable wall member adjacent and in operative relation to the fixed furnace structure, said locking means being constructed and arranged to permit disengagement of the locking means from said locking member by mere vertical lifting of the unitary wall member.

3. An open hearth furnace comprising, in combination, a fixed furnace structure including a back wall, a front wall, a roof supported by the back and front walls, and the lower portions of end walls at the opposite ends of the furnace structure; and a unitary liftable end wall member at each end of the furnace structure, said unitary end wall member including a portion which is substantially vertical and is adapted to be aligned with and temporarily joined to the back wall of the furnace, another portion which is substantially vertical and is adapted to be aligned with and temporarily joined to the front wall of the furnace, a third portion which joins the other two portions and is inclined to the vertical and has its upper end adjacent the roof of the furnace and its lower end supported on said fixed lower portion of the end wall of the furnace, the unitary end wall member substantially closing the corresponding end of the furnace, means forming an integral part of the unitary wall member for facilitating lifting of the wall member away from the fixed furnace structure, locking means fixed to the upper and lower ends of said wall member, locking members complemen-

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tary to said locking means and being fixed to the fixed furnace structure, the locking means and locking members when engaged holding the unitary wall member adjacent and in operative relation to the fixed furnace structure, said locking means being constructed and arranged to permit disengagement of the locking means from said fixed locking members by mere vertical lifting of the unitary wall member.

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