United States Patent [19]

Longenecker

[11] **3,832,959**

[45] **Sept. 3, 1974**

[54] **SUSPENDED ROOF AND END WALL CONSTRUCTION FOR REVERBERATORY FURNACE**

[76] Inventor: **Levi S. Longenecker,** 61 Mayfair Dr., Pittsburgh, Pa. 15228

[22] Filed: **Sept. 21, 1971**

[21] Appl. No.: **182,409**

[52] **U.S. Cl.** ..... **110/99 R,** 110/1 A, 110/1 B

[51] **Int. Cl.** **F23m 5/06**

[58] **Field of Search** ..... 110/99 R, 99 A, 99 B, 1 A, 110/1 B

[56] **References Cited**

UNITED STATES PATENTS

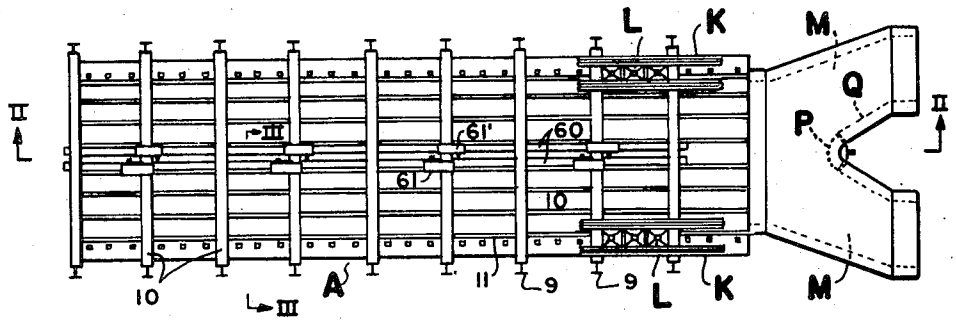
2,720,850	10/1955	Lanyon	110/99
3,045,616	7/1962	Reich	110/99
3,240,173	3/1966	Bunge	110/99
3,345,962	10/1967	Longenecker	110/99

Primary Examiner—Kenneth W. Sprague
Attorney, Agent, or Firm—Green, McCallister & Miller

[57] **ABSTRACT**

A refractory furnace construction is provided with a panelized roof using a hooked-on post or gooseneck type of suspension, as distinguished from a so-called piggy-back or cantilevered type. Each roof panel comprises a group of refractory tile members and their hanger castings constructed for unitized mounting within the roof construction. In addition to supporting metal structural framework, a cover assembly is provided to enable cleaning the upper surfaces of and, if desired, to provide a continuous cooling of the upper reaches of the refractory tile members of the roof. Refractory side wall parts converge towards each other and cooperate with a nose part to enclose an uptake end of the furnace. The nose part is constructed for unitized removal and insertion with respect to the side wall parts.

19 Claims, 42 Drawing Figures



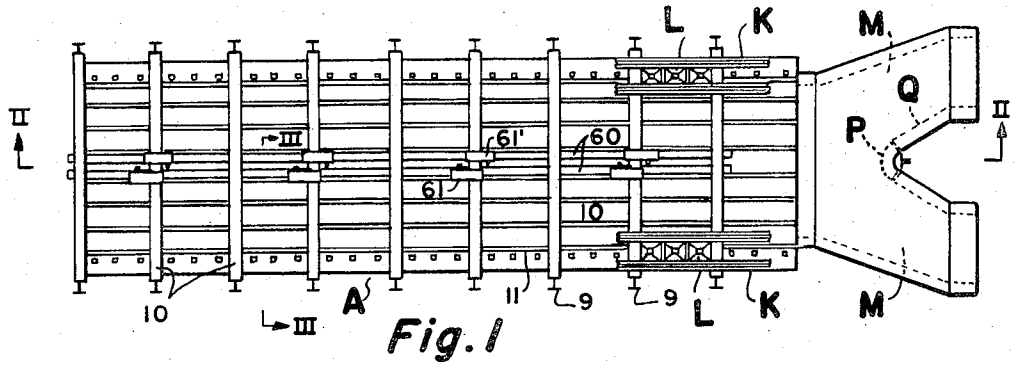


Fig. 1

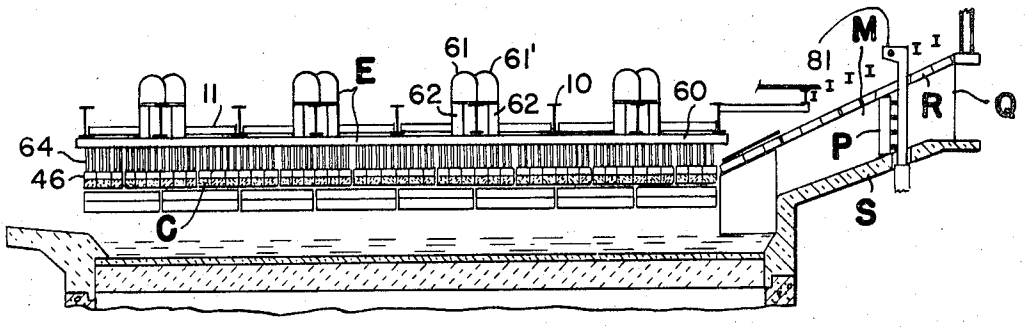


Fig. 2

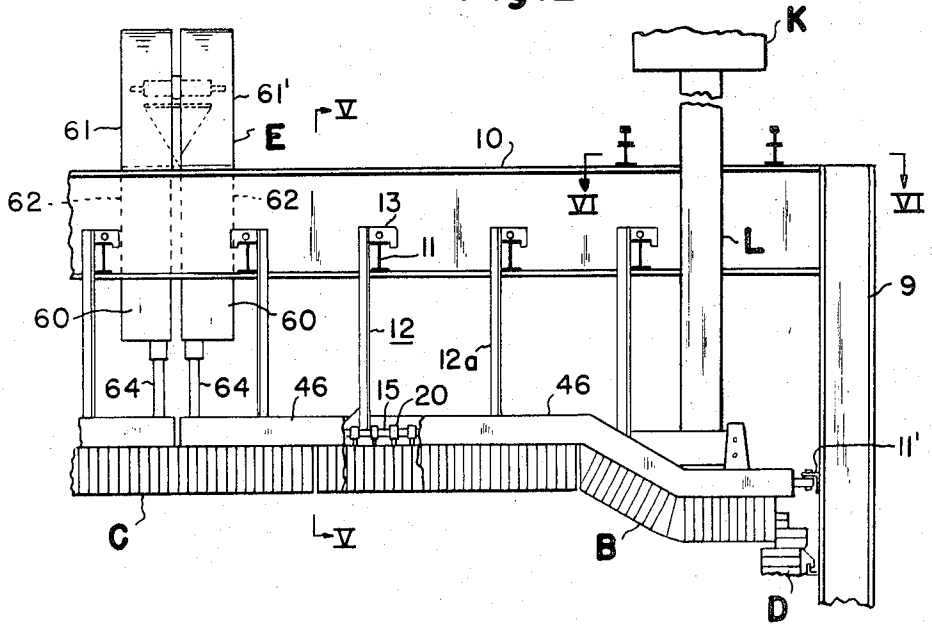


Fig. 3

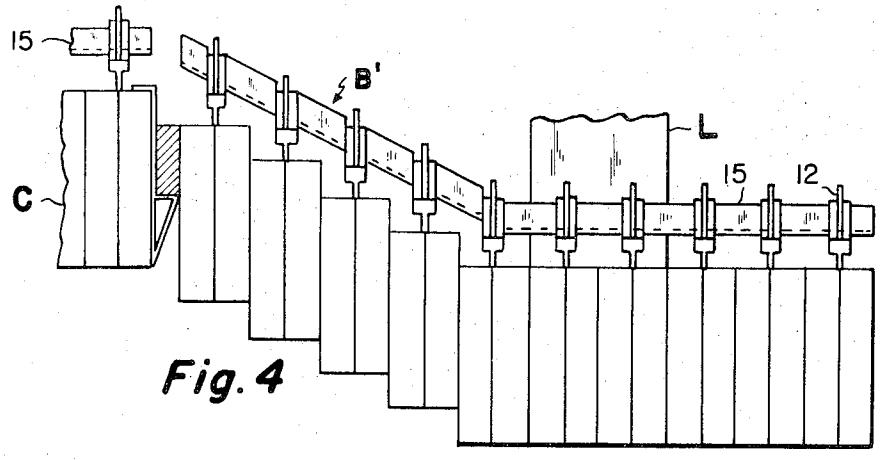


Fig. 4

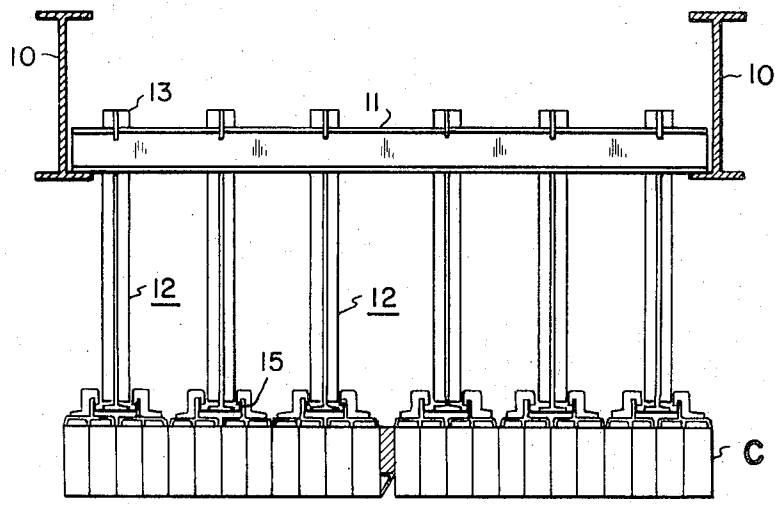


Fig. 5

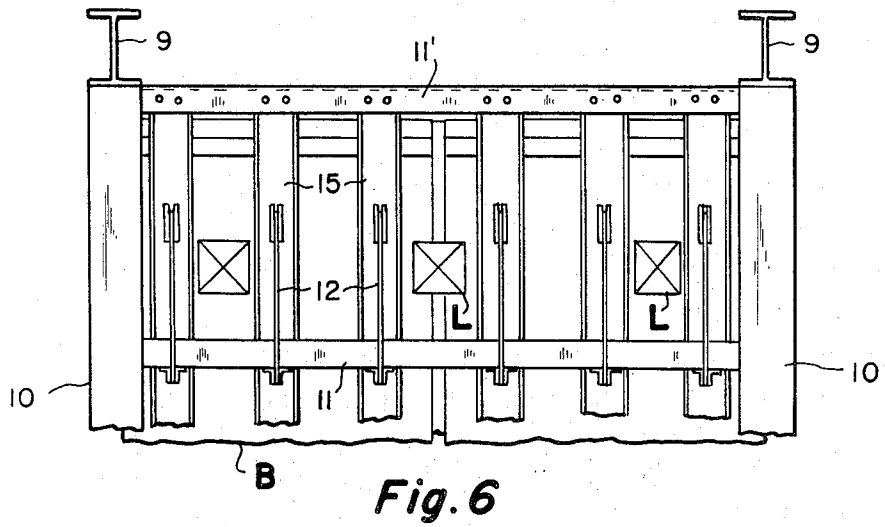


Fig. 6

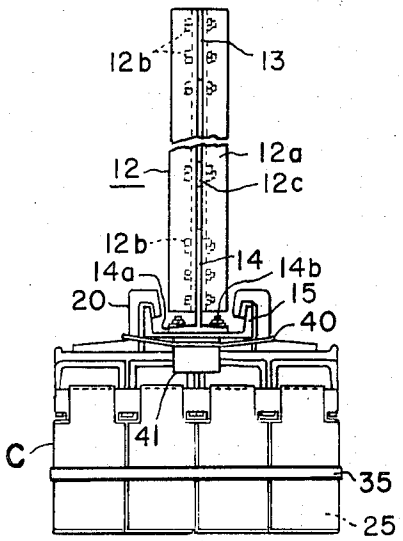


Fig. 7

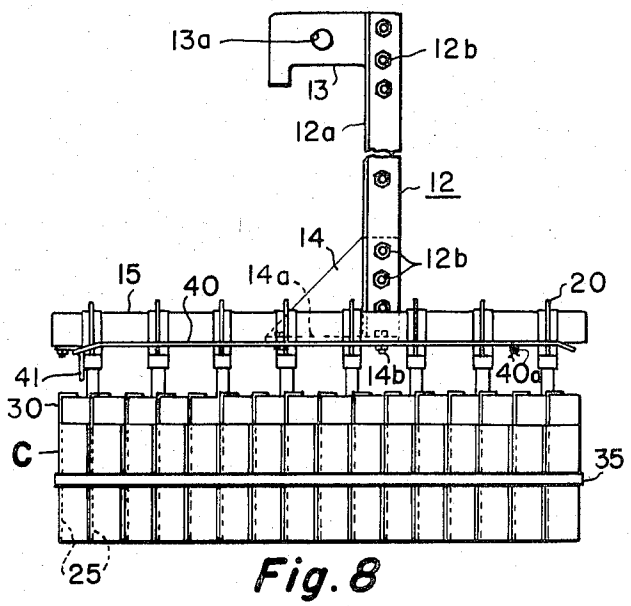


Fig. 8

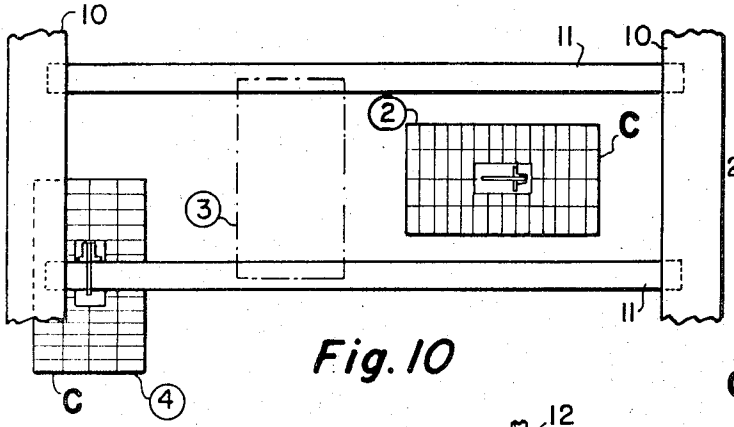


Fig. 10

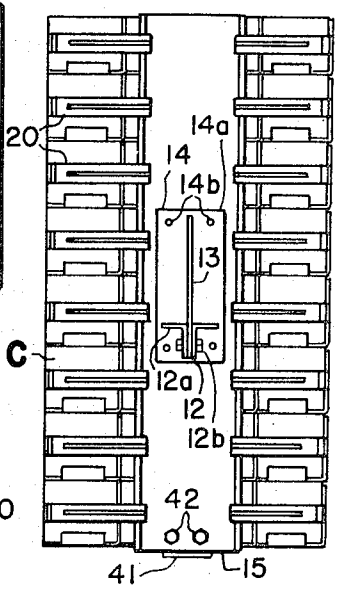


Fig. 9

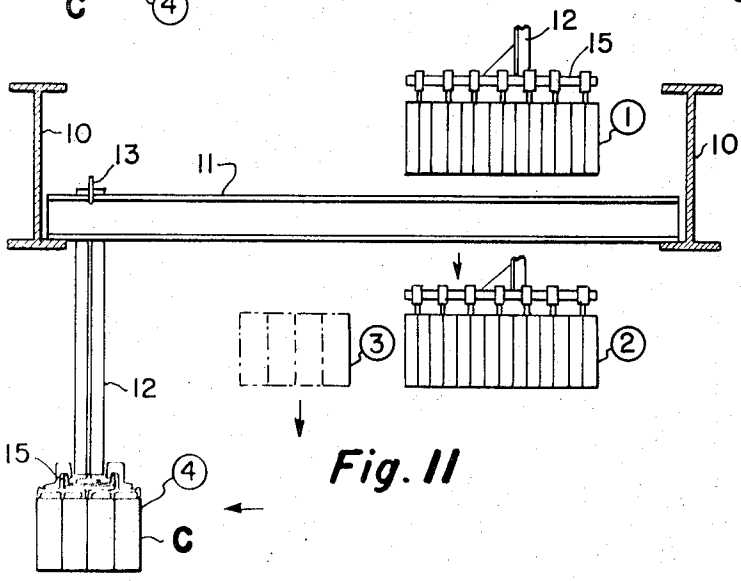


Fig. 11

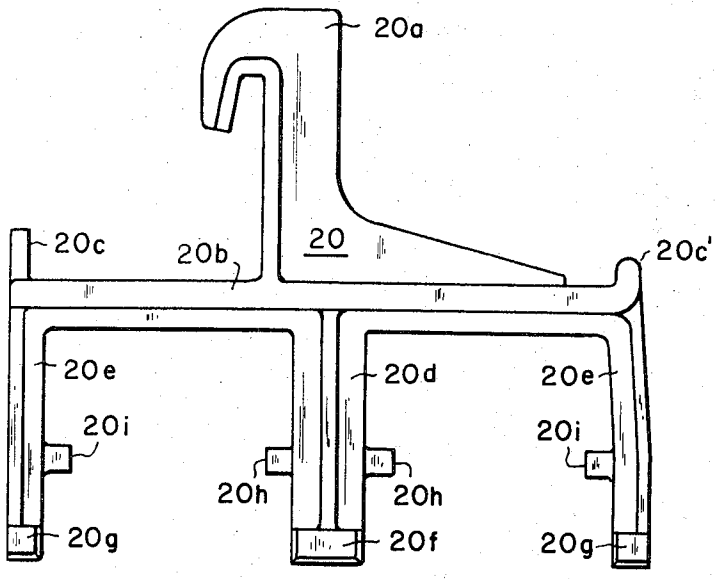


Fig. 12

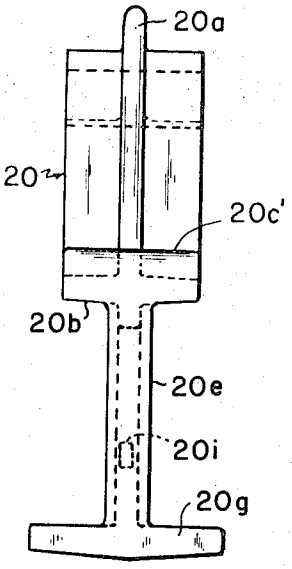


Fig. 13

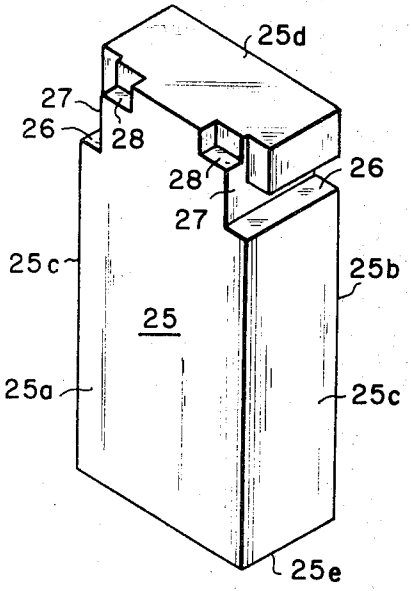


Fig. 14

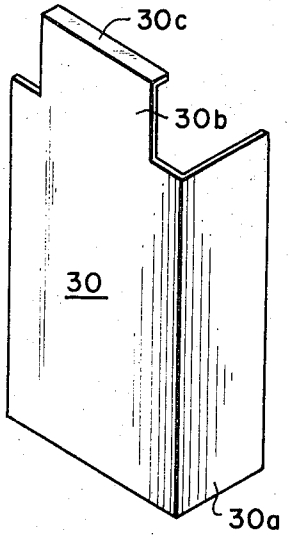


Fig. 15

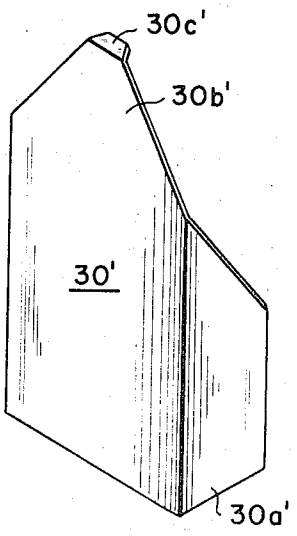


Fig. 16

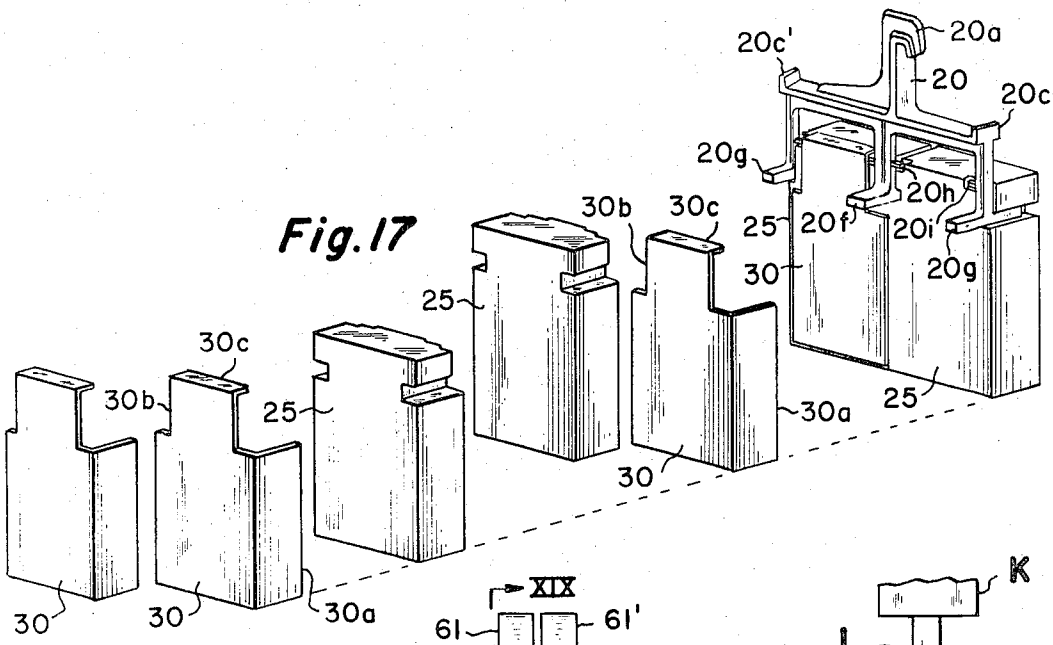


Fig. 17

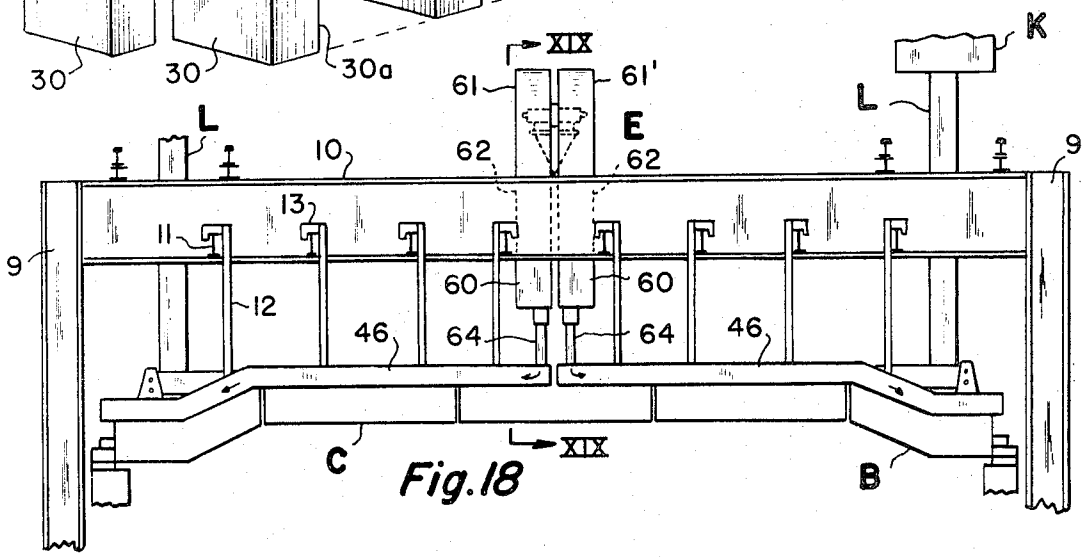


Fig. 18

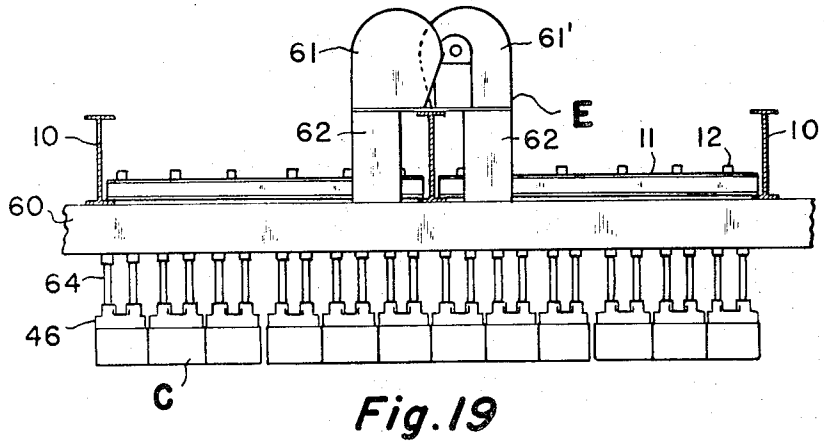


Fig. 19

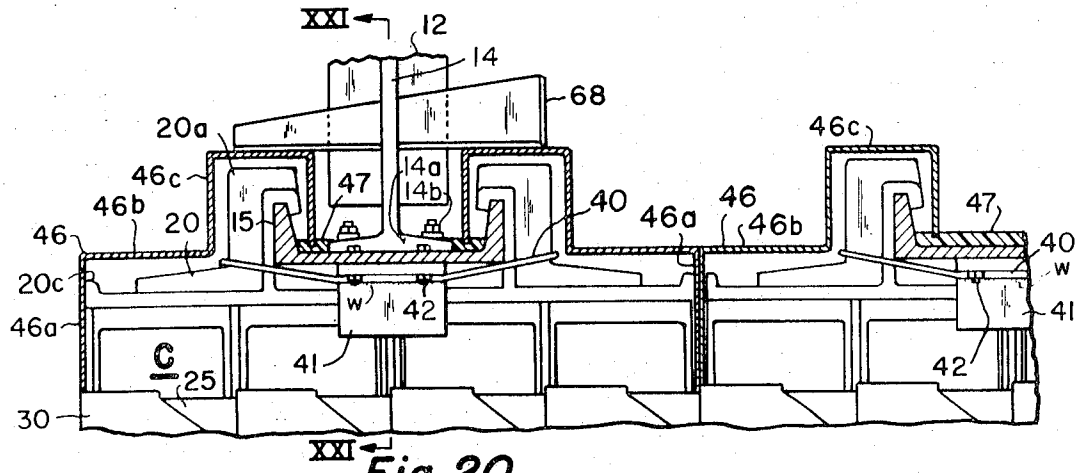


Fig. 20

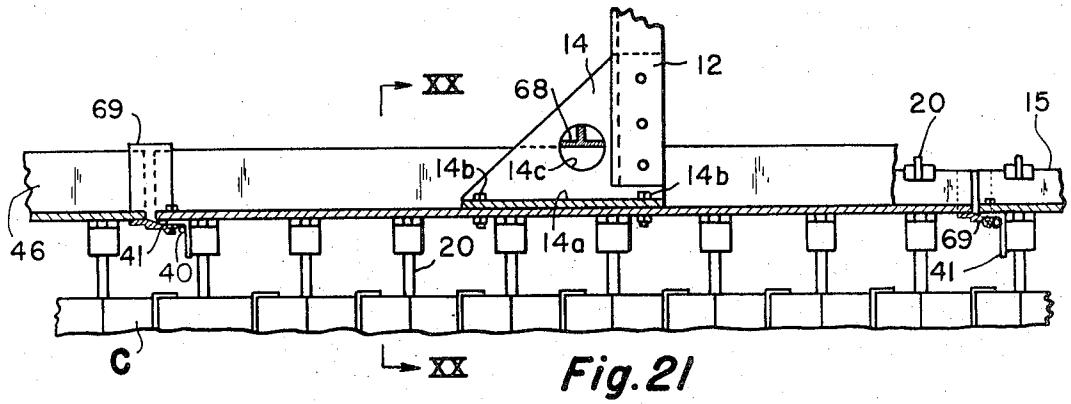


Fig. 21

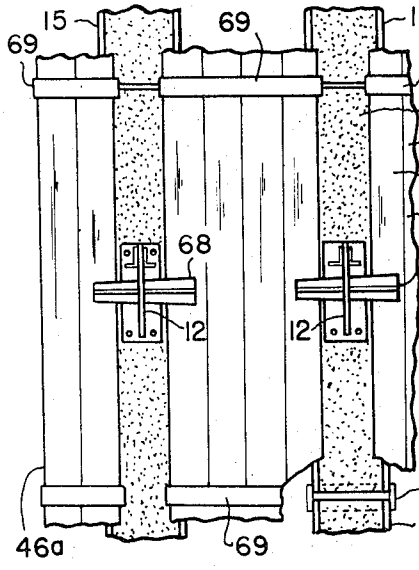


Fig. 22

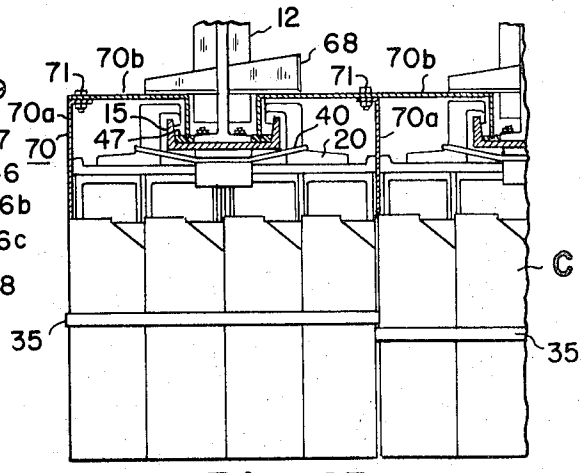


Fig. 23

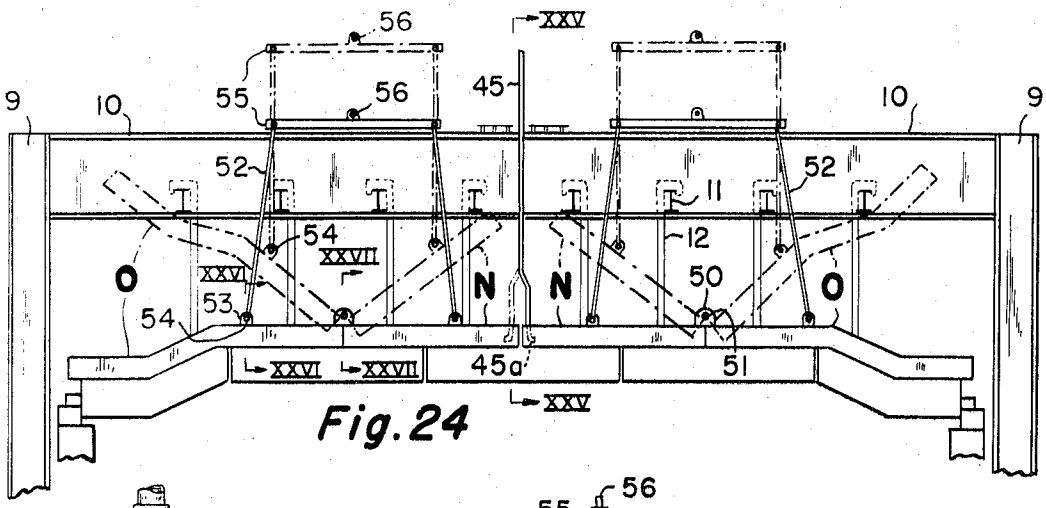


Fig. 24

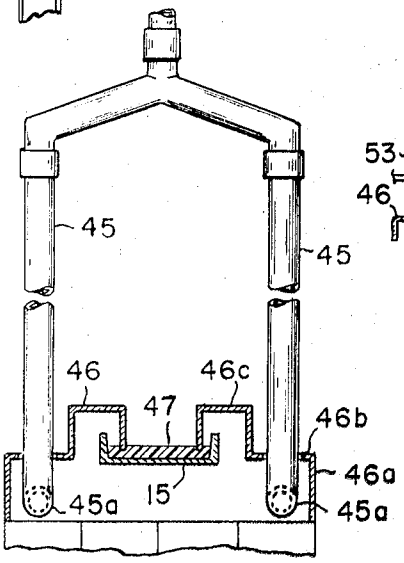


Fig. 25 C

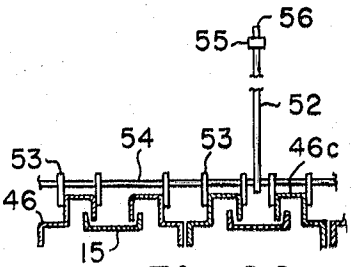


Fig. 26

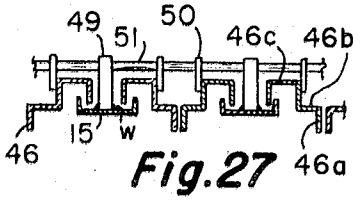


Fig. 27

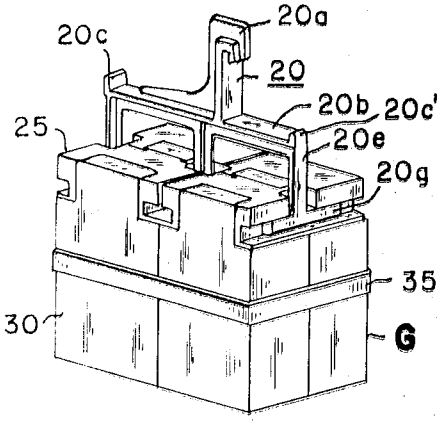


Fig. 28

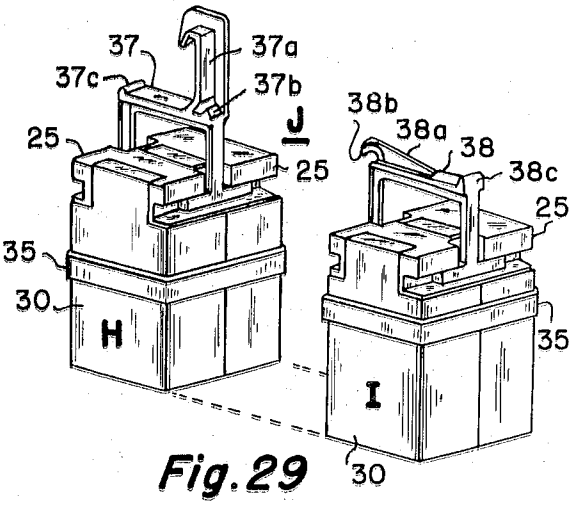


Fig. 29

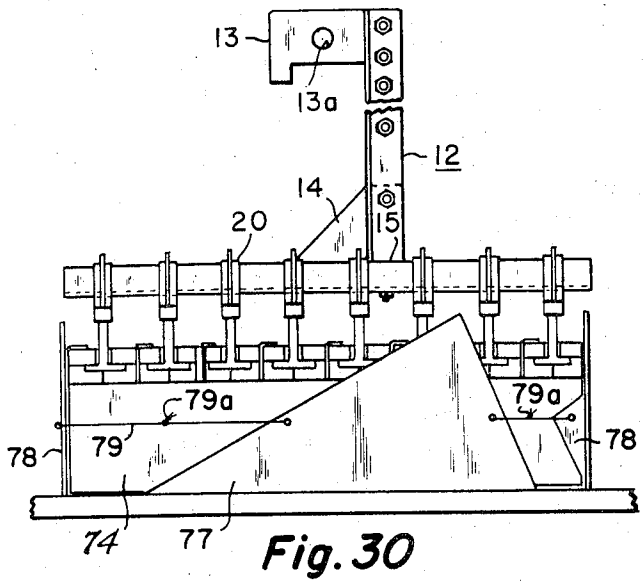


Fig. 30

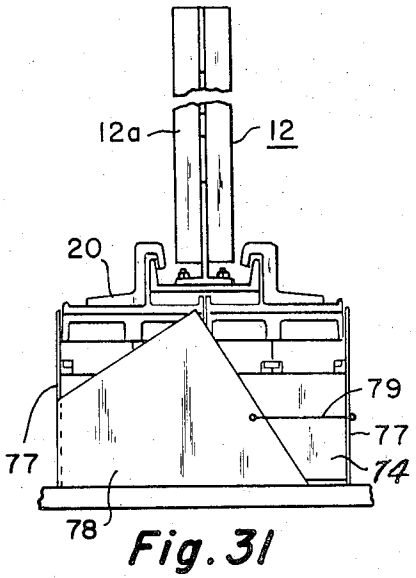


Fig. 31

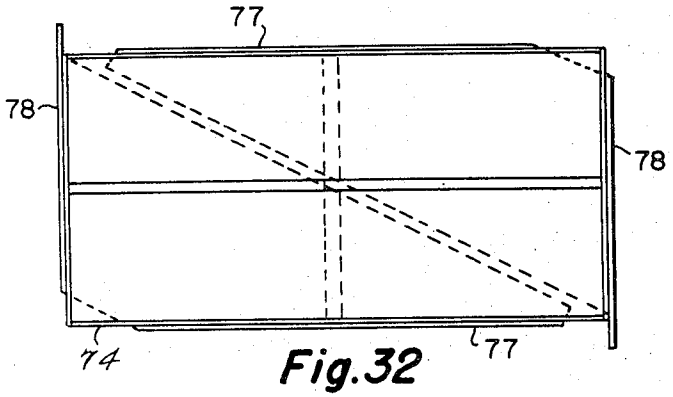


Fig. 32

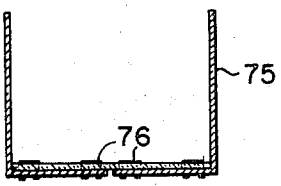


Fig. 34

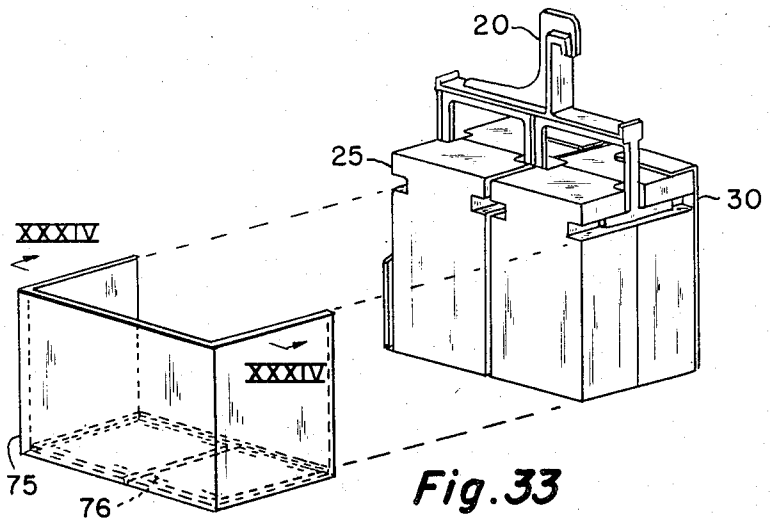


Fig. 33

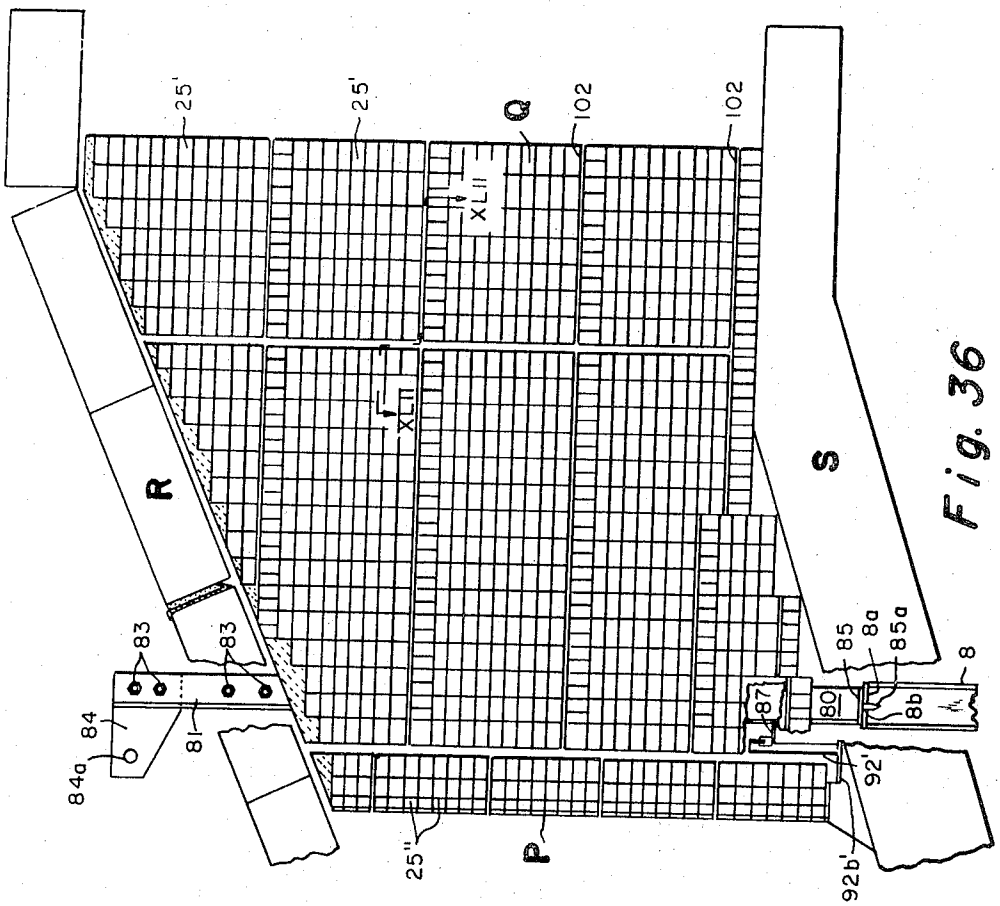


Fig. 36

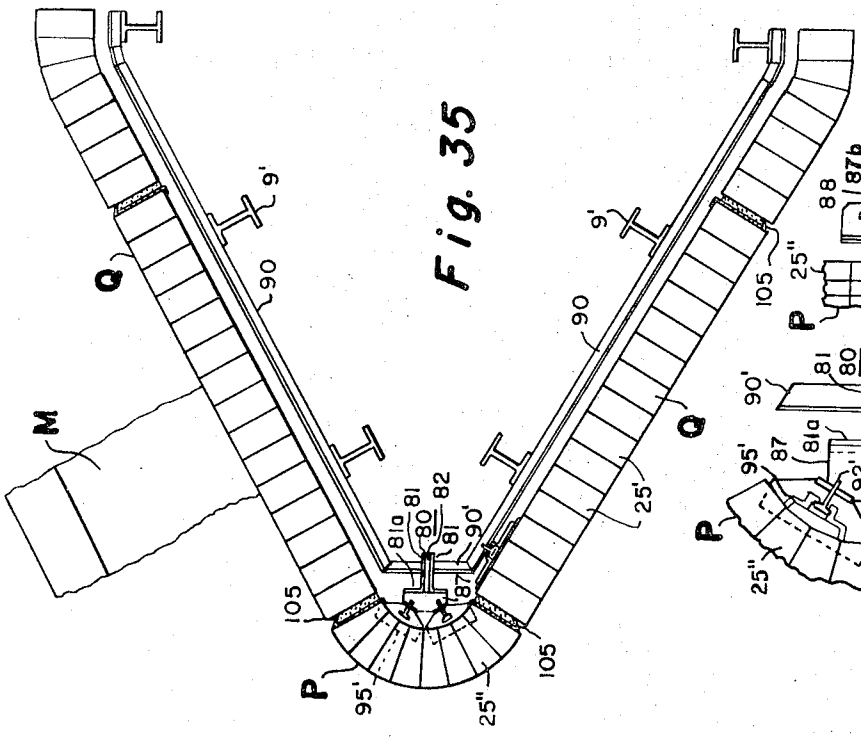


Fig. 35

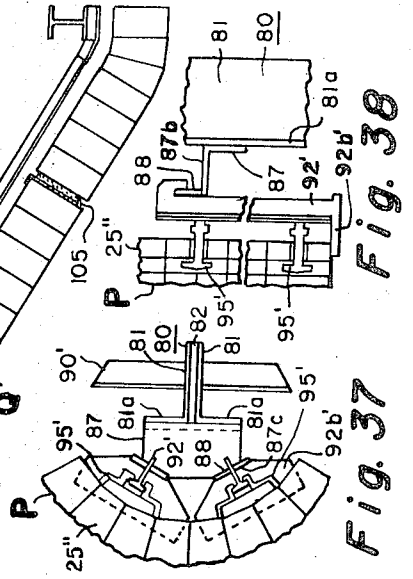


Fig. 38

Fig. 37

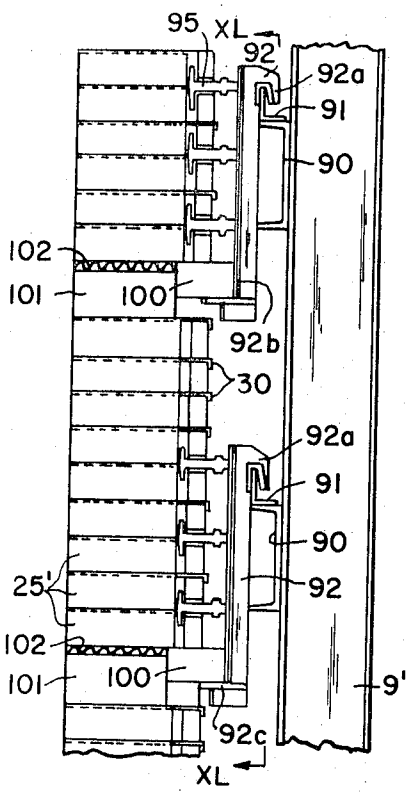


Fig. 39

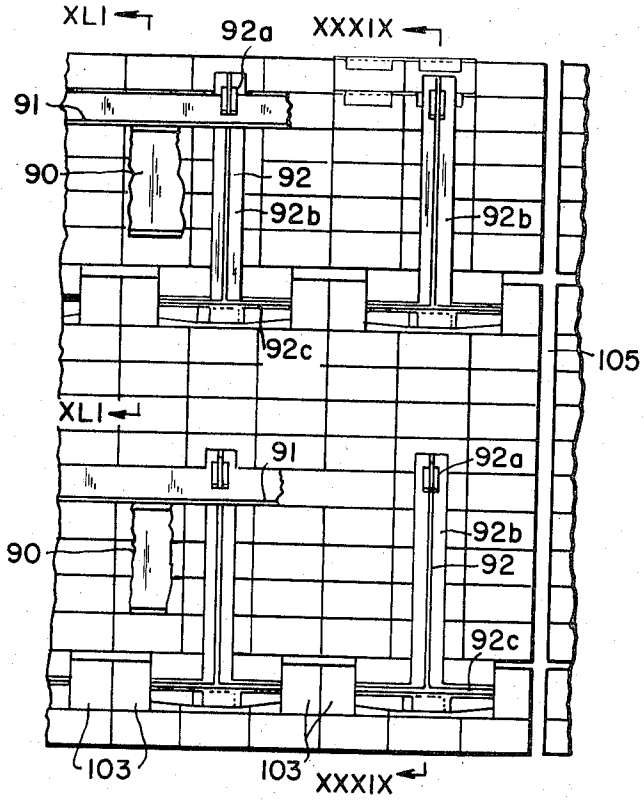


Fig. 40

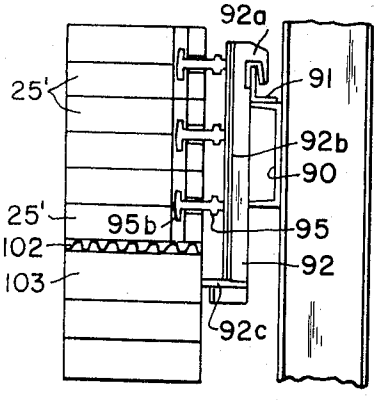


Fig. 41

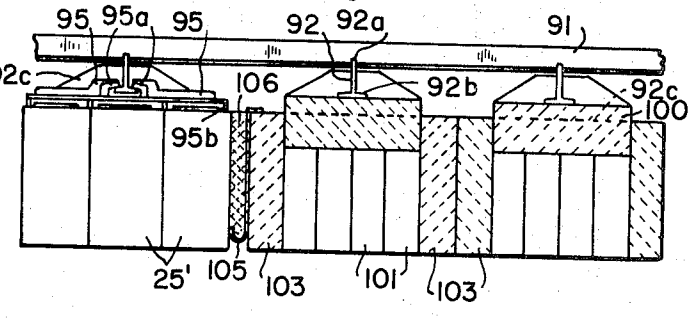


Fig. 42

SUSPENDED ROOF AND END WALL CONSTRUCTION FOR REVERBERATORY FURNACE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention pertains to a new and improved roof suitable for refractory furnaces, such as used in the refining of copper, and to an improved roof construction that utilizes a so-called gooseneck type of suspension and that will facilitate construction, patching, cooling and cleaning of its refractory tile members. A phase of the invention relates to a refractory wall and nose construction that may be utilized with the furnace.

2. Description of the Prior Art

In my earlier U.S. Pat. No. 3,589,316, I disclosed a furnace roof construction which utilizes a cantilever or piggyback type of suspension which has many advantageous features. The present invention deals with providing advantageous and improved features in a so-called gooseneck suspended type of furnace roof and to improved furnace wall and nose construction that may be used therewith.

SUMMARY OF THE INVENTION

It has thus been an object of the present invention to devise an improved panelized roof and wall construction for furnaces using a so-called gooseneck or vertical hanger post suspension.

Another object of the invention has been to make practical a pendulum-like suspension for a panelized refractory tile member assembly that will facilitate furnace construction and repair.

Another object of the invention has been to devise a furnace nose construction which, as assembled, may be inserted and removed without disturbing other parts of a wall assembly for which it serves as a connecting unit.

A further object of the invention has been to provide a panelized refractory wall construction which may have radially connected parts and which will utilize so-called keyhole tile members for facilitating its construction and repair.

These and other objects of the invention will appear to those skilled in the art from the illustrated embodiments and the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings,

FIG. 1 is a top plan view illustrating a furnace constructed in accordance with an embodiment of the invention.

FIG. 2 is a side section in elevation on the scale of and taken along the line II—II of FIG. 1; this view is taken longitudinally of the furnace construction.

FIG. 3 is an enlarged transverse section in elevation taken along the line III—III of FIG. 1 and illustrating a so-called radially sloped type of side hip.

FIG. 4 is a further enlarged fragmental transverse view in elevation illustrating a stepped type of furnace side hip.

FIG. 5 is a side view in elevation of intermediate scale taken between a pair of overhead cross-extending and longitudinally spaced-apart girders of the roof framework construction, illustrating how assembled panel units are suspended from and between a pair of girder members.

FIG. 6 is a top plan view on the scale of and of the panelized structure shown in FIG. 5.

FIG. 7 is an end view in elevation and FIG. 8 is a side view in elevation on the same scale, showing a complete panel assembly which has four rows of refractory tile members in a banded relation and supported by two rows of hanger castings that are, in turn, carried or suspended by a gooseneck hanger and its cross extending support channel.

FIG. 9 is a top plan view on the scale of and of the panel assembly of FIGS. 7 and 8.

FIG. 10 and 11 are greatly reduced somewhat diagrammatic views illustrating procedure that may be employed in mounting and dismounting a unitized panel such as illustrated in FIGS. 7 to 9, inclusive.

FIG. 12 is a greatly enlarged side view and FIG. 13 is an end view in elevation showing the construction of hanger castings used in the furnace roof.

FIG. 14 is an isometric view in elevation showing a typical refractory roof tile which may be of basic or magnesite chromium construction and which is shown used in the panelized construction of FIGS. 7, 8 and 9.

FIGS. 15 and 16 are isometric views in elevation on the scale of FIG. 14 illustrating metal shields or plates that may be employed between the tile members. The face plate of FIG. 15 which may be of steel is a preferable type in that it utilizes intermediate-positioned and inwardly extending lugs or knobs of the hanger castings for its suspension; the construction of FIG. 16 is a simplified type that may be used, for example, where the replacement of burnt-out tile members is to be accomplished in the roof construction.

FIG. 17 is a perspective view which shows tile and metal plate members in an exploded relationship to illustrate how they may be assembled in constructing a typical four tile member assembly for each hanger casting.

FIG. 18 is a transverse view in elevation of a furnace roof construction on the scale of and corresponding to FIG. 3, but particularly illustrating a permanent air supplying manifold or duct and cover plate construction that may be employed in accordance with the invention.

FIG. 19 is a fragmental side sectional view in elevation on the scale of and taken along the line XIX—XIX of FIG. 18.

FIG. 20 is an enlarged fragmental side sectional view in elevation showing baffling or an enclosing plate construction for the furnace roof and a method of tying opposed rows of hanger castings together with respect to an associated gooseneck hanger (see also FIGS. 7 and 8). This view is taken along the line XX—XX of FIG. 21.

FIG. 21 is a transverse section on the scale of FIG. 20 and taken along line XXI—XXI thereof.

FIG. 22 is a fragmental top plan view on a reduced scale of the construction of FIGS. 20 and 21 and taken in the same longitudinal direction as FIG. 20.

FIG. 23 is a slightly enlarged fragmental side view in elevation and partial section showing further details of the construction of FIG. 20.

FIG. 24 is a transverse end view in elevation across a furnace showing a modified type of air supply and ductwork arrangement; it illustrates a hinge-mounted cover construction which is suitable for cleaning the upper reaches of refractory tile members by means of pairs of blow lances. When the furnace is in operation,

the cover members will be retained in the upper dot and dash positions and will be lowered to their full line positions when a blow-cleaning operation is to be conducted.

FIG. 25 is an enlarged fragmental section in eleation taken along the line XXV—XXV of FIG. 24.

FIG. 26 is a vertical section on the scale of and taken along the line XXVI—XXVI of FIG. 24 and FIG. 27 is a vertical section taken along the line XXVII—XXVII of FIG. 24.

FIG. 28 is an isometric view in elevation showing a hanger casting and its associated tile members that are suspended thereby and which may form or provide an assembly for use in replacing burnt-out members in a roof construction. It will be noted that this assembly is provided with its own tile banding steel strap or strip and when a group of such assemblies are used, the banding strips will be staggered; in an initial installation, the construction shown in FIGS. 7 and 8 may be used wherein the banding strip surrounds all the tile members of a panel unit.

FIG. 29 is an exploded isometric view on the scale of FIG. 28 showing a slightly modified type of unit construction wherein the tile members are carried in pairs and the hanger casting is made in two interfitting interlatching parts. This form further facilitates repair of a furnace and is particularly suitable for roof end panel work.

FIG. 30 is an enlarged side view in elevation of a roof patching or repair panel unit showing a side-positioned expansion steel plate therefor.

FIG. 31 is an end view in elevation on the scale of the repair panel unit of FIG. 30 showing an end-positioned expansion steel plate therefor.

FIG. 32 is a top plan view on the scale of and showing the panel unit of FIGS. 31 and 30.

FIG. 33 is an exploded view in elevation showing how an asbestos heat shield of rectangular shape may be used with a four-tile bundle to accommodate for hot patching.

FIG. 34 is an end or transverse section on the scale of and taken along the line XXXIV—XXXIV of FIG. 33.

FIG. 35 is a horizontal section illustrating the construction of nose and side wall parts that may be used for the exhaust manifold or duct illustrated in FIG. 1; this construction may be used to form the vertical reaches of the pants-leg shaped duct.

FIG. 36 is a side view in elevation on the scale and of the construction of FIG. 35, showing the inner or refractory tile side of the wall and nose parts.

FIG. 37 is a fragmental horizontal view and FIG. 38 is a fragmental vertical view showing details of the construction of the nose part of FIGS. 35 and 36.

FIG. 39 is a slightly enlarged vertical side section in elevation on the scale of and taken along the line XXXIX—XXXIX of FIG. 40.

FIG. 40 is an outer side view in elevation taken along the line XL—XL of FIG. 39.

FIG. 41 is a fragmental vertical section taken along the line XLI—XLI of FIG. 40.

And FIG. 42 is a horizontal section on the scale of FIGS. 39 to 41, taken along the line XLII—XLII of FIG. 36.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring particularly to FIGS. 1 to 9, inclusive, I have shown a representative overall reverberatory furnace A of a so-called suspended basic roof type that may utilize magnesite-chrome chemically bonded or magnesia-coated oxide, directly bonded tile or refractory brick members 25 to form a panelized suspended roof construction. FIG. 3 illustrates a furnace having a radial sloping type of side hip B which terminates in a vertically extending wall part D. FIG. 4 illustrates an alternate stepped type of side hip construction B'. In FIGS. 1 and 3, K represents a pair of longitudinally extending conveyors and L represents feed hoppers leading down from the conveyors for supplying charging metals to the furnace A.

The roof of the furnace A is shown made up of assembled panels or panel units C (see FIGS. 7 and 8) consisting of refractory tile members 25 in four row groups that are supported by opposed pairs of metal hanger castings 20. As shown in FIG. 7, each row of hanger castings 20 carries a pair of tile member rows. It will be noted from FIG. 3 that tile and casting member rows of each panel C extend transversely of the furnace and that the narrow side faces of the tile members 25 face longitudinally of the furnace. Each row of hanger castings 20 of the row pairs of each panel C is carried and suspended from an associated side flange of a transversely extending, upwardly open, metal support channel 15 (see FIG. 7). Each channel 15 is suspended in a pendulum-like fashion by an associated gooseneck, hook-nose or L-shaped vertical post hanger or member 12 that, at its lower end, has a wing mounting member 14 secured thereto and projecting therefrom. Each wing member 14 has a bottom flange 14a that is secured within the web of the channel 15 by bolt and nut assemblies 14*b*.

The post hanger 12 (see also FIG. 9) has a mounted position such that the panel C is suspended in a balanced relationship from an overhead metal I-beam girder member 10. It will be noted in FIGS. 7 to 9 that each gooseneck hanger 12 has a pair of vertically extending, angle-shaped members 12*a* that are secured together by bolt and nut assemblies 12*b* and, at their lower end, receive the wing mounting member 14 therebetween. As shown in FIG. 7, spacers 12*c* are positioned between the pair of angle pieces or members 12*a*, so that they may be bolted together evenly and without distorting them. A horizontally forwardly extending metal latch member 13 is adapted to removably latch over an upper flange of a cooperating or associated I-beam support member 11 that extends longitudinally of the furnace A and, in turn, is carried on the bottom flanges of a pair of cross-extending I-beam girders 10. The hook member 13, like the wing member 14, extends between the two angle pieces 12*a* of the gooseneck hanger 12 and is secured therebetween by the bolt and nut assemblies 12*b*.

In order to provide a panel unit C that will have its hanger castings 20 and suspending gooseneck post or hanger 12 fully assembled and retained in such a relation for palletizing a pair of them on a common pallet for handling, shipping, etc., and for subsequent mounting as a panel unit in a furnace, the rows of refractory tile members 25 which in the construction shown comprise four rows, are shown banded together by a steel

banding strap or strip 35 about their outer reaches. It is also desirable to provide a wire tie 40 which is shown looped about the hanger castings 20 of each panel assembly C to hold them in a secured assembled relation on their associated suspension channel member 15. As shown in FIG. 8, the ends of the wire loop 40 may be twisted together at 40*a*. An end portion of loop 40 is shown secured, as by welding to an angle bracket 41. As shown in FIG. 20, the bracket 41 is adapted to be removably secured at its top flange to the web portion of an associated channel 15 by a pair of nut and bolt assemblies 42.

Referring particularly to FIGS. 1 to 6, inclusive, it will be seen that each panel assembly C is suspended in pendulumlike fashion from and slidably adjustable along an associated overhead, longitudinally extending beam 11. As shown, the beams 11 have a transversely spaced-apart relation with respect to each other, see particularly FIG. 3, and each is constructed to support or suspend a group of hanger casting and tile member panels C therealong. Each beam member 11 is mounted between and transversely, slidably, along outwardly extending bottom flanges of a longitudinally spaced-apart pair of adjacent cross-extending overhead girders 10 that constitute primary overhead members of the metal framework. The girders 10 are, in turn, secured at their ends to vertical buckstays 9.

FIGS. 10 and 11 are illustrative of how a panel C which has a greater length than width, for example, four by two feet, may be mounted in or removed from the roof construction. A panel C may be inserted lengthwise between a pair of support channel members 11 and moved downwardly from position (1) to position (2) below such members. The panel C may then be turned at right angles to extend crosswise of the members 11, as indicated by position (3) of FIGS. 10 and 11, and then moved to an aligned position with respect to an associated support member 11. The hook portion 13 of its gooseneck 12 will then be engaged over the upper flange of the member 11 to suspend the panel C as indicated by position (4). To remove the panel C, the operation is reversed. The manipulation may be effected by using an overhead hoist, as engaged within an eyelet portion 13*a* of the hook 13 (see FIG. 8).

FIGS. 12, 13 and 17 show the construction of the hanger castings 20. These castings, as indicated, are employed to support or carry a banded group of tile or brick members 25 in a manner such as illustrated in FIGS. 7, 8, 28 and 29. Each hanger 20 has a centrally disposed vertical hook portion 20*a* which is adapted to latch-over an adjacent upwardly projecting side flange of an associated support channel member 15. The hook portion 20*a* is carried by a horizontally extending shoulder portion 20*b* which, at its ends, has a pair of upwardly projecting lugs 20*c* and 20*c'* to serve as positioning means for ductwork or cover plate members.

In addition, the shoulder portion 20*b* carries a group of three, downwardly or forwardly extending tile member supporting legs 20*d* and 20*e*. Each side leg 20*e* has a transversely extending foot portion 20*g* at its lower or forward end that is adapted to, as shown in FIG. 17 taken in view of FIG. 14, engage within notch or slot portions 26 of a pair of back-to-back positioned tile members 25. Each leg 20*e* also has an inwardly projecting, intermediately positioned lug, knob, boss or side projecting portion 21*i* that is adapted to rest in a top end slot or notch 28 of an associated tile member 25. Central or intermediate leg 20*d* also has a cross-extending bottom foot portion 20*f* and a pair of intermediately positioned, horizontally extending lug, knob, boss or side projection portions 28 which are adapted to cooperate with the corresponding, aligned lugs 20*i* of the end or side legs 20*e* in engaging within top recesses or slots 28 of the tile members 25. The lugs 20*i* and 20*h* may also provide a metal support (see FIG. 17) for a top flange 30*c* of a still face plate 30 of FIG. 15. It will be noted from FIG. 13 that the leg and foot portions of each hanger casting 20 define an inverted T-shape.

Referring particularly to FIGS. 14 and 17, refractory tile members 25 of a basic type are shown provided with opposed wide side faces 25*a* and 25*b*, with opposed narrow side faces 25*c*, and with top and bottom or end faces 25*d* and 25*e*. The faces are shown as planar to define a rectangular-shaped tile member. Each tile member 25 has a horizontally cross-extending latching slot or recess 26 adjacent the upper end or top face 25*d* that extends between and is open to opposite wide side faces 25*a* and 25*b* that is open fully along an associated narrow side face 25*c*. A vertical latching slot recess 27 extends upwardly from an associated horizontal slot 26 at one end thereof, along one wide side face 25*a*. Each vertical extending slot 27 extends upwardly from an associated slot 26 and is open to the top end face 25*d* and to a top or upper end slot or recess 28. The slots 26, 27 and 28 provide latching assemblies on each narrow side face 25*c* and are shown of the same construction.

FIG. 17 illustrates how the feet and leg portions of a hanger casting member 20 are adapted to be positioned within the slotted or recessed portions of each tile member 25. It will be noted that each hanger 20 is constructed to accommodate the mounting of two pairs of tile members 25. This figure also illustrates how the second group of tile members 25 may be mounted in position, utilizing steel face plate or shielding separator members 30 (see also FIG. 15). As shown, the separator members 30 are adapted to be applied in one direction to individual tile members 25 of a banded group to serve as a single layer between wide side faces of a pair of adjacent tile members 25. Overlapping or top flange 30*c* of each member 30, in addition to resting on a portion of the top face 25d of an associated tile member 25, may have a greater width than the spacing between end slots 28 along one side face 25*a* of a tile member 25 for support by the intermediate lugs 20*h* and 20*i* of the hanger castings 20 in a metal-to-metal contacting relation. Neck portion 30*b* bypasses the feet portions 20*g* and 20*f* of the hanger casting 20 and bent-over upright or vertical side flange portion 30*a* is adapted to fit over and enclose a narrow side face 25*c* of a tile member 25. The flanges 30*a* thus also provide spacers between end faces of adjacent tile members 25, and main body portions of each face plate 30 serve as separating means between wide side faces of a pair of adjacent tile members 25. FIG. 16 shows a shielding separating member 30' whose side wing portion 30*a'* slopes at its upper edge into neck portion 30*b'*. The edges of the neck portion 30*b'* slope upwardly in a centrally conveying manner to a central top tab portion 30*c'* that is adapted to rest on the top face 25*d* of a tile member 25. The shield 30' of FIG. 16 may be used in patching a roof construction.

FIG. 28 shows a basic bundle construction G of four tile members, as carried by an individual hanger casting 20. Such a bundle may be used in forming a panel and, in which event, a metal banding strap or strip 35 will be used about the refractory tile members 25 of the panel, see FIG. 8, and will be staggered as shown in FIG. 23.

In FIG. 29, essentially the same arrangement is effected as in FIG. 28, except that half (two tile) bundles H and I are provided which are individually secured together by steel straps or bands 35 and in a staggered relation, in order that they may interfit closely with respect to each other. To enable such a two-tile assembly to be supported as one hanger casting assembly, the hanger J is formed of two parts 37 and 38 which are substantially of the same construction as the unitary of single-piece hanger 20 of FIG. 28 as far as its feet and leg portions, its shoulder and projecting portions are concerned. However, the central leg portion is, in effect, split in half at the shoulder portion. The half or part 38 has a horizontally extending reinforcing web portion 38*a* that terminates at its end in a slot or hook portion 38*b*. On the other hand, part 37 at the inner end of its shoulder is provided with an upwardly projecting triangular-shaped latching lug 37*b* that is adapted to be engaged by the hook portion 38b of the part 38. When the engagement is effected, then the two parts, 37, 38 act as a unit and are suspended by upwardly projecting, triangular-shaped latching hook portion 37*a* of the part 37.

FIGS. 30 to 32, inclusive, are illustrative of a modified panel construction that is particularly suitable for patching purposes. This construction is adapted to be carried into position by an overhead hoist-engaging gooseneck hanger 12 or other suitable form of hanger. As shown, each opposite wide side of the panel is provided with a pair of triangular-shaped steel plate members 77 that are adapted to be positioned along the narrow side faces of the tile members 25 of the panel. A pair of triangular-shaped steel end plate members 78 are also adapted to be positioned against the wide side faces of tile members 25 at each narrow end of the panel. As shown in FIGS. 30 and 31, the end pieces or members 78 have bent-over portions adapted to overlap the sides of the assembly. Also, tie wires 79 are secured about the outer reaches of the panel assembly and extend through holes in the pair of side members 77 and the pair of end members 78 and are shown provided in FIG. 30 with tightening loops 79*a*. FIG. 32 shows the overall construction wherein an asbestos liner 74 extends in a continuous manner about the outer reaches of the panel and is held in place by the outer steel plate members 77 and 78.

FIGS. 33 and 34 a boxlike or rectangular-shaped asbestos enclosure 75 is illustrated which may be used to enclose a basic group of four hanger-mounted tile members 25, such as shown in FIG. 33. The boxlike enclosure 75 is made up of folded-over portions of a strip of asbestos material in which a side flap of the full width of the enclosure is provided and end flaps of half the width are provided so as to, as shown in FIG. 34, form an enclosure having a dual thickness of bottom wall as secured together, for example, by wire or metal staples 76.

FIGS. 18 to 23 are exemplary of a system E for continuously cooling and cleaning-off the upper reaches of refractory tile members 25 in a roof panel C, as well as radial hip panels B of a furnace roof construction. It will be noted that metal air duct cover members or assemblies 46 extend over the entire roof beneath the gooseneck hangers 12 and, at their transverse ends, may be directed downwardly and outwardly to discharge the dirt, debris and the warmed air. The system E is a fixed air duct system that may constitute a stationary or more or less permanent type in which spaced-apart blower fan units 61 and 61′ are mounted as pairs about the structural framework and extend downwardly to deliver air longitudinally at spaced locations, substantially at mid positions, along the length of the furnace roof. Pipe or duct members 62 lead from the blowers 61 and 61′ through air manifolds 60 and outflow or delivery air pipes or tubes 64 that are connected to inner closed ends of metal air duct cover assemblies 46.

As shown in FIG. 20, each metal duct or cover member 46 has a vertical side skirt or apron portion 46*a* that projects downwardly between side feet of hanger castings 20 to rest at their bottom edges on upper reaches of tile members 25. An inwardly projecting, horizontal, connecting portion 46*b* extends from the apron portion 46a along lower portions of the hangers 20, and an offset, vertically extending, boxlike portion 46*c* is connected thereto and extends over the hook portion 20*a* of one of the opposite hangers 20. The portion 46*c* extends downwardly along the inside of an adjacent side flange of an associated support channel 15 to, at its inner edge, rest on sealing material 47 carried within the channel 15 between its opposite flanges.

A tie wire 40 is shown at its ends secured tightly in position around the upper hook portions of opposed pairs of hanger castings 20 and at one end is secured in position by an angle-shaped mounting bracket 41. As shown in FIG. 20, an end loop of the wire 40 is secured by weld metal to the bracket 41 within the connecting portion between its top and end flanges. As shown in FIG. 20, the bracket 41 is secured at its top flange under an end portion of the web of a support channel 15 by through-extending bolt and nut assemblies 42.

It will be seen that the cover members 46 of the ductwork cover the upper reaches of the refractory tile members 25 and provide an air flow spacing above upper reaches of the end faces of the tile members 25 and along the immediate parts of the metal supporting hanger members. Sealing tape 69 (see FIG. 21) may be used between joints of the cover members 46. The blowers or fans 61 and 61′ may be employed continuously, if desired, to supply cooling air along the upper reaches of the refractory tile. A periodic increased velocity movement of air may be employed when it is desired to blow dust from the covered or enclosed spacing or area.

FIG. 21 is further illustrative of the ductwork or enclosing cover construction 46 and shows seals between end portions of the members which may be taped. It also shows the use of wedge members 68 for clamping each section or member 46 in a "down" position. As shown in FIGS. 21, 22 and 23, the wedges 68 are adapted to extend through a hole portion 14*c* in the wing mounting part or plate 14 of each gooseneck hanger 12. In FIG. 23, a slightly modified form of cover or enclosing plate construction 70 is shown in which skirt or end portions 70*a* are formed separately from upper portions 70*b* and are secured together by bolt and nut assemblies 71.

FIGS. 24 to 27, inclusive, are illustrative of a modified form of cleaning assembly or construction wherein removable blow lances 45 may be located at longitudinally spaced positions along the length of the mid portion of the furnace A for supplying dust removing air when hinged cover assemblies O and N are in the solid line "down" positions of FIG. 24. As shown, each side half of the furnace has a pair of hinged cover members N and O. See connecting hinge lugs 50 and pivot pins 51. Lifting rods 52 have their lower ends mounted by pivot pins 54 on eye lugs 53 that extend from and are secured to the cover members O and N. The rods 52 extend from each cover member O and N upwardly and are, at their upper ends, tied-in a pivoted relation together by a cross-extending bar or bail member 55. As shown, the bail member 55 may be moved from its full line position of FIG. 24 to its dot and dash or upper and lid raising position of the same figure by any suitable means, such as an overhead hoist engaging within a centrally positioned eyelet 56.

Each blow lance 45 is provided with a pair of branch outlets 45*a*, one of which is directed or turned towards one side of the furnace underneath its ductwork, and the other is pointed or turned towards the other side thereof underneath its ductwork. Normally when the furnace is in operation, the lances 45 will be removed and the cover member assemblies O and N will be secured in their raised, upper dot and dash indicated positions.

FIGS. 35 and 36 illustrate a wall construction such as may be employed for the crotch portion of the exhaust duct M of FIGS. 1 and 2, and which includes a pair of vertically upwardly extending side wall parts Q that converge towards one end are connected together by a rounded or curvilinear vertical nose part P. The wall parts Q are shown as resting or mounted on a plant foundation S. In FIG. 36, refractory roof R for the exhaust port or gas venting uptake M may be of the previously described construction or may be constructed of removable sections or panels of any suitable conventional construction.

Vertically extending or upright I-beam members or buckstays 9' provide the basic outer members of the metal framework and are mounted at their lower ends on and extend upwardly from the foundation S. A metal base or post 8 extends upwardly through the foundation S and serves as a positioning member for a main, vertical supporting, T-shaped structural member 80 for the nose part P. The upright member 80 is made up of two angle pieces 81 whose web portions are secured together in a spaced relation utilizing a spacer piece or member 82 (see FIG. 35). At its lower end, the member construction 80 has a bottom foot plate 85 provided with a downwardly extending central lug projection 85*a*. The floor post 8 has a top plate 8*a* that is provided with a central slotted portion 8*b* to receive the lug projection 85*a* and thus, provide accurate alignment of the upright member 80 (see FIG. 36).

As shown particularly in FIG. 36, a nose lift wing member 84 extends from between the pieces 81 and is secured in position with respect thereto by bolt and nut assemblies 83. It will be noted that similar bolt and nut assemblies 83 secure the pieces 81 in their back-toback relationship in cooperation with the spacer piece 82. The wing member 84 has an eyelet or open portion 84a extending therethrough to receive the hook of an overhead crane for lifting the upright member 80 vertically into and out of position on the metal base or post member 8 of the foundation S. As will be hereinafter shown, the complete nose part P that is mounted on the base member 8 is adapted to be moved vertically into and out of position between the ends of converging vertical side wall parts Q by removing a portion of the roof R.

The wall parts Q, as particularly shown in FIGS. 37 to 40, have horizontally-extending and vertically spaced-apart channel members 90 that are secured at their web portions to project outwardly from the buckstay I-beam members 9' to provide supports for hanger-mounted refractory tile member panels or assemblies. An angle piece 91 is secured (see FIGS. 39 and 41), as by welding, to the top flange of each support channel 90 of the framework to serve as a latching tongue for receiving an upper hook end portion 92*a* of a vertical wall bracket or post hanger member 92 that is hung or latched to depend downwardly therefrom. Each post hanger member 92 has a centrally positioned, vertically extending flange portion 92*b* that is adapted to be engaged by a pair of opposed mounting fingers 95a of hanger castings 95 (see FIGS. 39 and 42). Each hanger 95 may be of the general type shown in FIGS. 20 and 21 of U. S. Pat. No. 2,738,744, and has leg and feet portions that are adapted to fit within latching slots of refractory tile members 25' (also of the construction shown in the reference patent).

It will be noted from FIGS. 39 and 40 that the post hanger members 92 are capable of longitudinal adjusting movement along their associated horizontally extending channel support member 90 and have a substantially vertically aligned relation and horizontally spaced-apart positioning along the framework of the side wall part Q. Each post hanger 92 has an inwardly, horizontally, projecting shelf or flange portion 92*c* at its lower end on which a pair of relatively short depth refractory filler tile members 100 are positioned to close-off end spaces forwardly or outwardly of a group of edge-mounted refractory tile members 101. In constructing the refractory portion of each side wall Q, filler tile members 100 of very short depth extent that have a horizontal length corresponding (as shown in FIG. 42) to the stacked width extent of a group of four edge tile members 101, rest on the bottom shelf or flange 92*c* of an associated post hanger 92.

Key hole refractory tile members 103 of rectangular shape and of a depth extent or of a length that corresponds to the length of the regular or main tile members 25' are positioned between the filler tile members 100 and the edge tile members 101 to close-off the end spacing between the shelf portions 92*c* of adjacent hanger post members 92. See particularly FIGS. 40 and 42. As shown in FIGS. 39 and 41, a metal corrugated expansion member or plate 102 is positioned between key hole tile members 103 and adjacent faces of regular tile members 25' of the wall part Q. As indicated in FIG. 36, the expansion plates 102 in effect define horizontal tiers of the refractory block or tile members. As shown in FIGS. 35 and 42, vertical spacing is provided between panel sections by means of a metal spacer strip 105 that, at one end, is turned-over to rest on the top face of an adjacent key hole tile 103 and, at its other end, is doubled-over to provide a retaining end wall for any suitable commercial filler material 106.

Referring particularly to FIG. 35, the nose part P is of the same general construction as the side wall parts Q out, of course, is provided with radial tile members

25'', see the type illustrated in the referenced U.S. Pat. No. 2,738,744. Radial hanger castings **95'** (see FIGS. **37** and **38**) are also the type illustrated for example in FIG. **2** of the reference patent. Instead of employing a conventional buckstay upright member such as **9'**, the nose part employs upright member **80** which has been previously described. Inner foot or flange portion **81***a* of each member or piece **81** of the upright member **80** have angle pieces **87** secured thereto at spaced vertical locations therealong to project inwardly therefrom at vertically spaced-apart locations that may correspond in extent to the spaced locations of the channel members **90** of the side wall parts Q. Post hangers **92'** are adapted to latch with a welded-on vertical piece or member **88** on the upper flange **87***b* of each angle piece **87** and receive and carry hanger castings **95'**. The flange **87***b* of each post hanger **87** has inclined or beveled corner portions **87***c* (see FIGS. **37** and **38**) and the vertical corner pieces or members **88** are secured thereat. As shown in FIG. **35**, short length channels **90'** may be secured to extend from opposite sides of the upright member **80** in alignment with and in a non-secured, corner-interfitting relation with ends of the channel members **90** of the wall parts Q.

The post hangers **92'** are of substantially similar construction to the post hangers **92** of the side walls Q. As disclosed in FIG. **36**, the panels or refractory tile member assemblies of the nose part P are preferably formed in a staggered relation from the standpoint of their horizontal separations with respect to adjacent panels of the side wall parts Q. In this connection, the post hanger supporting angle members or pieces **87** may have a different vertical positioning than the angles **91** of the side walls. The nose part P consisting of its refractory tile members **25''** and its metal structural framework has been unitized, so that it can be lifted into and out of position with respect to the pair of side wall parts Q. It will be noted that the refractory tile members **25''** of the nose part (see FIG. **35**) are separated from corresponding tile members **25'** of the wall parts by vertically extending metal separator members **105** and the sealing filling material **106**.

I claim:

1. In an improved furnace roof construction for mounting on an overhead metal framework, spaced-apart support beams extending across the roof and resting at their ends on the framework, downwardly extending hanger members mounted in a suspended relationship on and along said beams, each of said hanger members having a substantially horizontally extending flanged support member along its lower end, hanger castings suspended along both sides of said flanged support member, and rows of refractory tile members carried by said hanger castings.

2. In an improved furnace roof construction as defined in claim **1** wherein the framework includes overhead spaced-apart girders secured thereto, said support beams being mounted for horizontal adjustable movement along and between adjacent pairs of said girders, said hanger members being mounted for horizontal adjustable movement along an associated one of said support beams, and said hanger castings being mounted for horizontal adjustable movement along an associated one of said flanged support members.

3. In an improved furnace roof construction for mounting on overhead metal framework, spaced-apart support beams extending across the roof and resting at their ends on the framework, downwardly extending hanger members mounted in a suspended relation on and along said beams, each of said hanger members having a substantially horizontally extending flanged support member along its lower end, hanger castings along and suspended from said flanged support member, rows of refractory tile members carried by said hanger castings, each of said flanged support members being an upwardly open channel member, and said hanger castings beings suspended in rows along the flanges of an associated one of said flanged support members.

4. In an improved furnace roof construction as defined in claim **3**, tie means about the hanger castings of the rows suspended by each of said flanged support members.

5. In a suspended furnace roof construction for mounting between adjacent pairs of spaced-apart cross-extending overhead girder members, spaced-apart support beam members extending across between and resting at their ends on adjacent pairs of said girder members, refractory tile members arranged in longitudinal rows, panel assemblies each having a pair of rows of hanger castings with each row of hanger castings suspending at least one row of the refractory tile members therefrom, a support channel member for each pair of hanger casting rows, the hanger castings of one row being adapted to hook over one side flange of said support channel member and the hanger castings of the other row of the same pair being adapted to hook over the other side flange thereof, a gooseneck elongated hanger member secured substantially centrally on said channel member and extending upwardly therefrom, and said gooseneck hanger member having a hook-shaped upper end portion for removably latching over a flange of an upwardly aligned associated one of said beam members.

6. In a roof construction as defined in claim **5**, each said row of hanger castings suspending a pair of closely positioned adjacent rows of the refractory tile members therefrom.

7. In a roof construction as defined in claim **5**, banding means about the tile members to hold them together in a suspended relation from their associated hanger castings.

8. In a roof construction as defined in claim **7**, tie means secured about the hanger castings of each of said pair of rows and about an associated one of said support channel members.

9. In a roof construction as defined in claim **5**, said refractory tile having relatively wide opposed side faces that are in an aligned-opposed relation with respect to each other along each said tile row, and said refractory tile members having a pair of opposed narrow side faces that lie along opposite longitudinal sides of each said tile row.

10. In a roof construction as defined in claim **9**, a plurality of said panel assemblies with narrow side faces of their rows of refractory tile members being in a side-by-side facing relation with respect to narrow side faces of the rows of refractory tile members of adjacent panels of said assembly.

11. In a roof construction as defined in claim **10**, the hanger castings of each row of the row pairs of hanger castings facing towards the hanger castings of the other row of the same row pair and being suspended from a common support channel member.

12. In a roof construction as defined in claim 5, each of said panel assemblies having a greater length than width, with the width being of shorter extent and the length being of greater extent than the spacing between said support beam members, whereby each said panel may be inserted widthwise between a pair of said support beam members, lowered therebeneath, and thereafter turned at substantially right angles with respect thereto and moved into an aligned position beneath a support beam member for mounting said panel by its said gooseneck hanger member in a suspended relation from said support beam member.

13. In a roof construction as defined in claim 5, said roof construction being made up of a closing group of said panel assemblies, air duct cover members extending along and over said channel members and said hanger castings and the refractory tile members suspended therefrom to define ductwork having cross-extending air flow passageways along the upper reaches of the roof construction, and means for introducing air at a mid location along the roof construction into said ductwork and for flowing it towards opposite transverse sides of the furnace.

14. In a roof construction as defined in claim 13, means mounting said duct cover members on the furnace construction for hinged movement from aligned positions with respect to each other along the upper reaches of said refractory members to upwardly tilted positions above the furnace, whereby air may be blown under pressure beneath said duct cover members for flushing-off dirt from the top reaches of the roof construction when said duct cover members are in a down position, and whereby said duct cover members may be swung above the upper reaches and retained thereat during normal operation of the furnace.

15. In a roof construction as defined in claim 14, a pair of air-blowing jet members adapted to be moved downwardly into a central position with respect to the furnace roof to direct air flow streams from the central position within ductwork defined by said duct cover members for periodically removing dust, dirt and debris from top reaches of the refractory tile members.

16. In a roof construction as defined in claim 13, said ductwork being non-movably mounted in a position along the upper reaches of the roof construction, air blowers positioned above the refractory tile members and at spaced intervals along the length of the roof, said blowers being in pairs that are connected centrally to opposite duct work passages along said cover plate members for cooling and blowing-off dirt from upper reaches of said refractory tile members.

17. In a furnace roof construction as defined in claim 5, a metal platelike shield of angle-shape for each of said refractory tile members, each said shield member having a vertically extending wide side face and a connected vertically extending narrow side face that together define an angular shape, each said shield member also having an upwardly extending connecting neck portion and an upper mounting flange portion of angle-shape to rest upon the top face of an associated tile member, one of said shield members being provided for each tile member of each tile member row with its wide side face positioned between opposed wide side faces of adjacent tile members of each row and with its narrow side face positioned along the narrow side face of one tile member of the adjacent members, and the narrow side faces of all of the shield members extending along the narrow side faces of one longitudinal side of the associated tile row.

18. In a furnace roof construction as defined in claim 17, each of said hanger castings having a cross-extending shoulder, at least a pair fo spaced-apart leg portions extending from said shoulder, each leg portion having a cross-extending foot portion and cross-extending intermediate latching lug portion, each of said tile members having cooperating slot portions in its top face for receiving said lug portions and adjacent to and spaced below its top face for receiving said foot portions to mount the tile member on an associated hanger casting, said lug portions of the associated hanger casting being exposed to the top face of said tile member, and said upper flange portion of said shield member being adapted to rest on the top face of the associated tile member in engagement with said lug portions of the associated hanger casting.

19. In an improved suspended furnace roof construction, a spaced-apart group of support beam members, an upwardly open flanged member, an opposed pair of hangers suspended from and extending in hanger rows along side-flanges of said flanged member, at least a pair of rows of refractory tile members in a side-by-side adjacent relation with respect to each other on and suspended from said pair of hanger rows to provide an assembly having a greater length than width extent, a vertically extending gooseneck member, said assembly being centrally suspended by said flanged member from said gooseneck member; and said gooseneck member being adapted to suspend said assembly therefrom to insert said assembly downwardly widthwise into the spacing between an adjacent pair of support beam meembers to a position below and in an overhead cleared relation with respect to said pair of beam members, to thereafter turn the assembly about 90° with respect to said pair of beam members, to move said assembly crosswise of said pair of beam members until it is in alignment with one of said pair of beam members, and to thereafter hook on said one beam member and fully suspend said assembly therefrom.

* * * * *