

[54] **PANELIZED SUSPENDED FURNACE ROOF
AND IMPROVED FEED HOLE**

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

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[51] Int. Cl. **F23m 7/00**

[58] Field of Search. 110/173; 432/250

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Primary Examiner—John J. Camby

Attorney, Agent, or Firm—Parmelee, Miller, Welsh &
Kratz

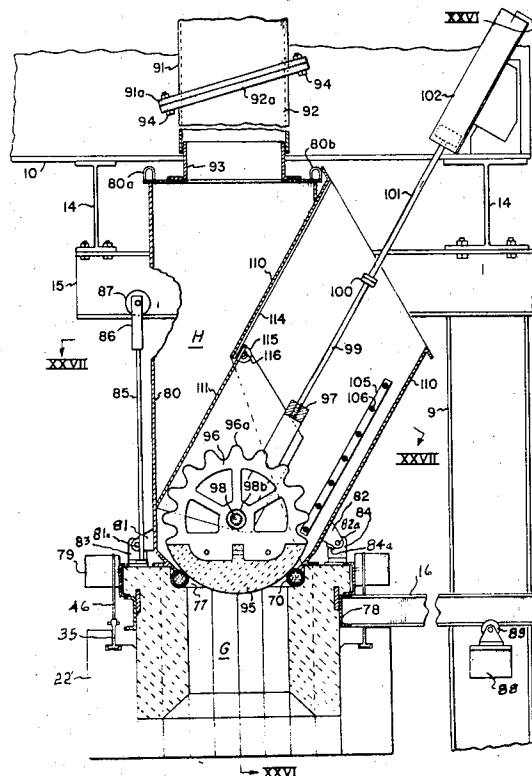
[57] **ABSTRACT**

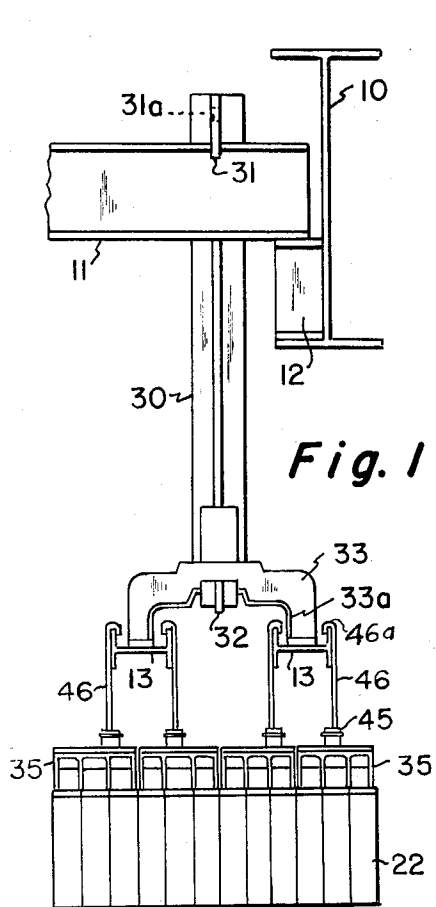
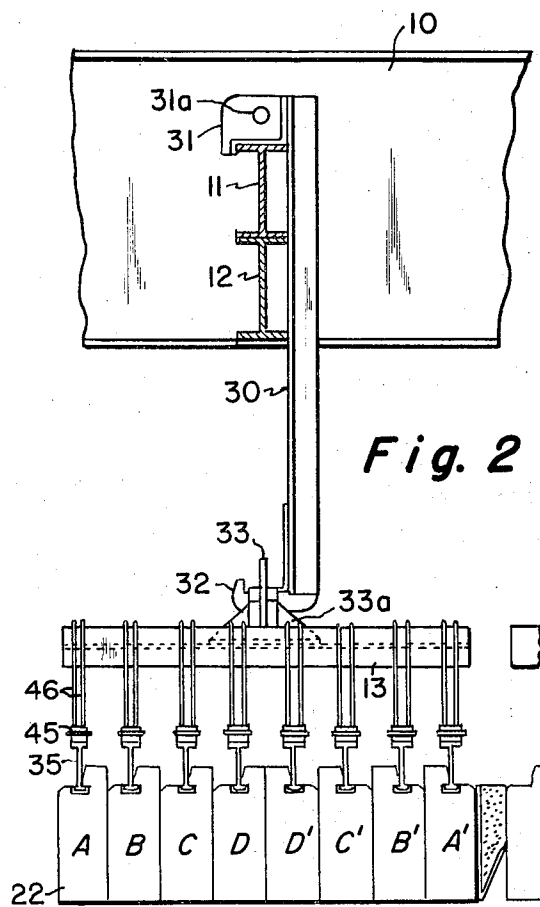
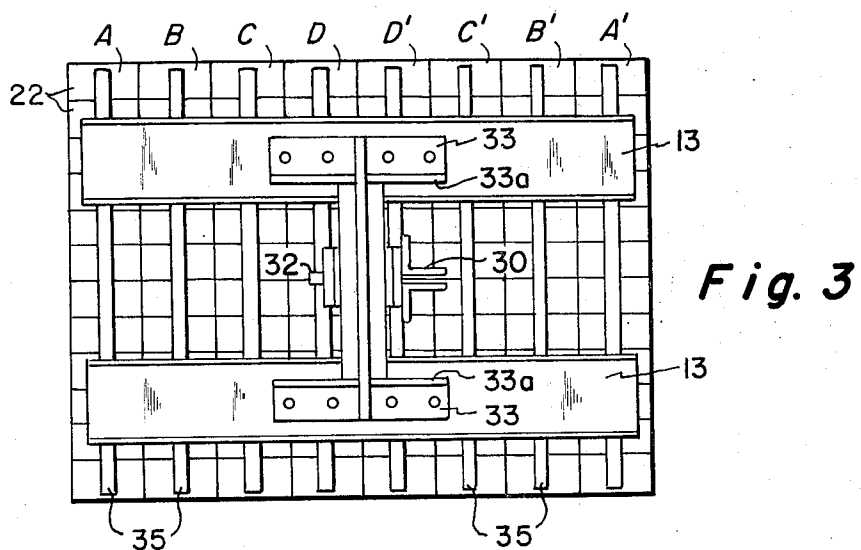
A suspended furnace roof is disclosed having an overhead metal framework involving spaced-apart cross-extending girders and longitudinally extending spaced-apart beams that are adapted to extend between the

girders and to be adjustably positioned in the spacing therebetween. A basically three-part hanger assembly is detachably suspended from the beam members and projects downwardly therefrom to detachably carry refractory tile members that may be assembled and shipped as a palletized group and, as such a group, mounted on such a hanger assembly at the construction site and while carried thereby, moved into a mounted position on an associated beam to close-off a portion of the furnace roof. A tertiary or uppermost hanger part of each assembly has a transverse yoke-like arm that at each of its ends has a flanged member from which opposed rows of secondary hanger parts are suspended to carry tile-suspending primary hanger parts.

For feeding charging materials, the furnace roof may have at least one feed hole construction. This construction is shown as a pivotally and removably mounted feed and closure door and sealing ring assembly, and as employed with an assembly of feed hole defining refractory blocks that are independently carried by a unitary metal frame. The block assembly is constructed to be moved as a truck unit on the unitary frame to one side of the furnace roof to facilitate construction, maintenance and repair work.

27 Claims, 37 Drawing Figures





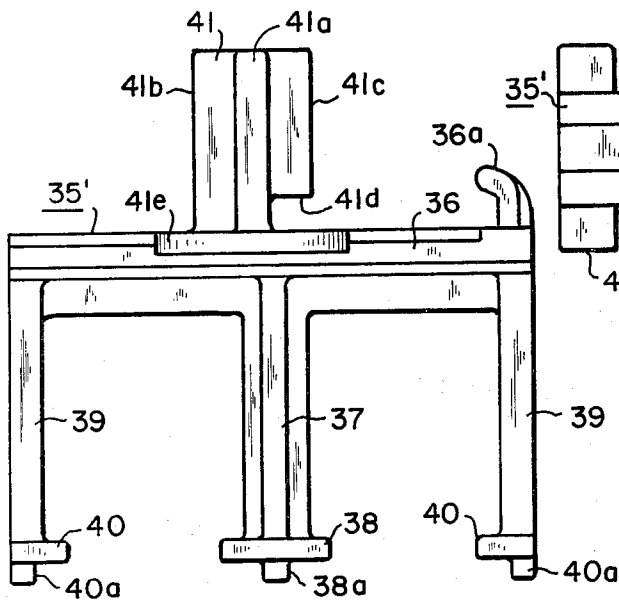


Fig. 4

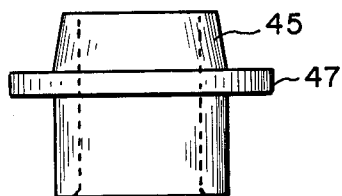


Fig. 7

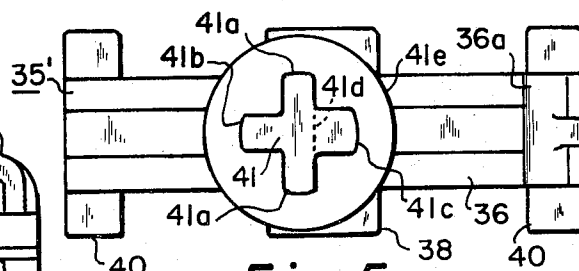


Fig. 5

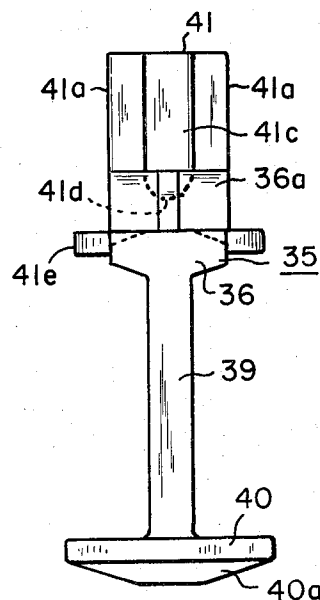


Fig. 6

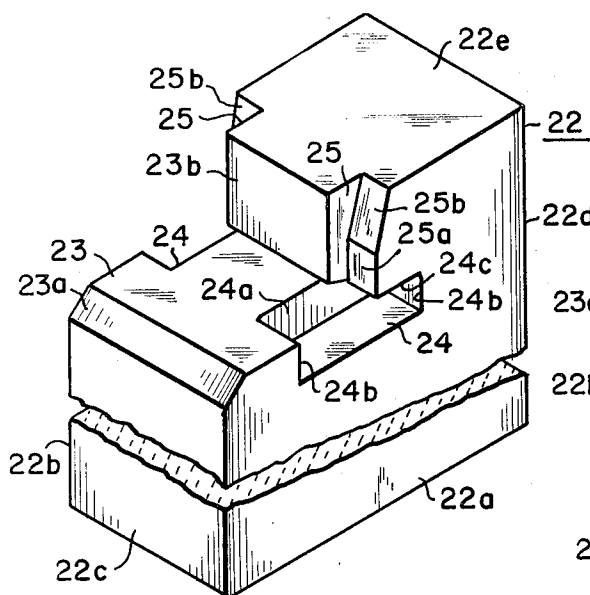


Fig. 8

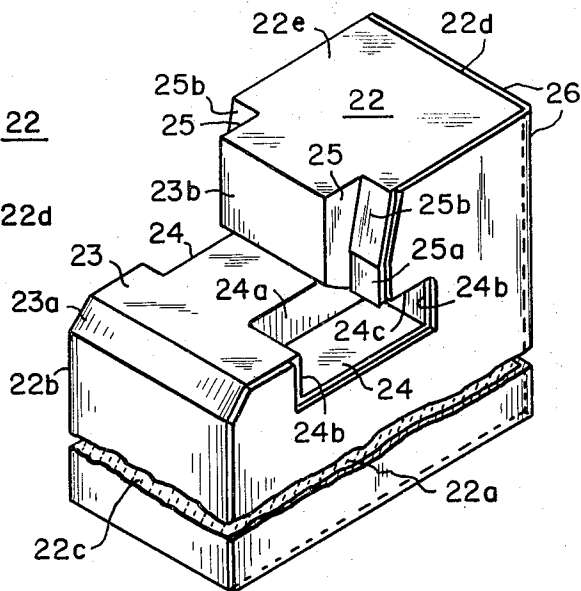
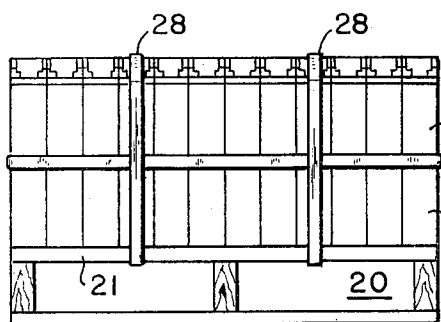
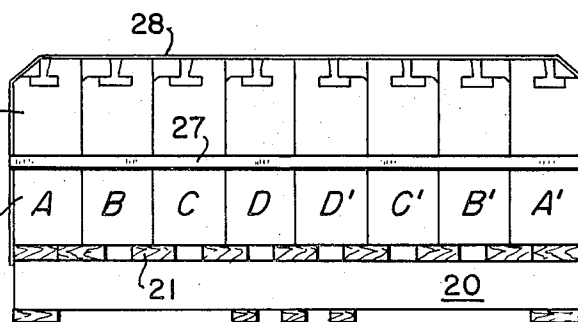
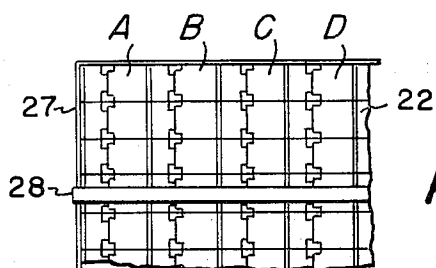
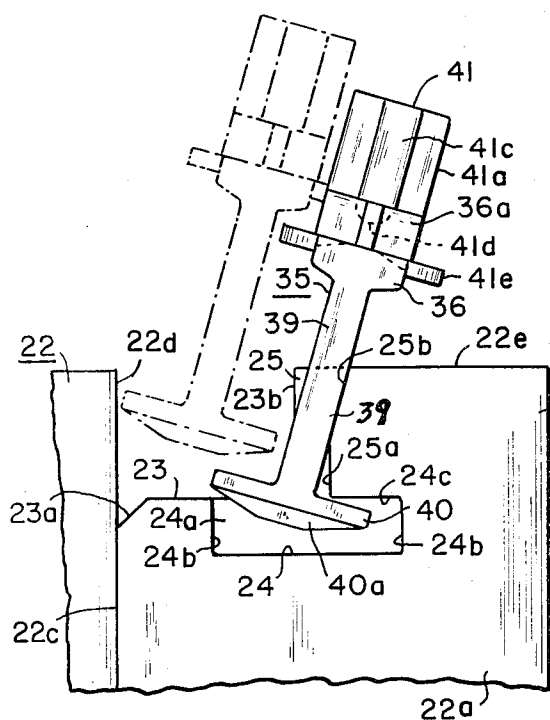
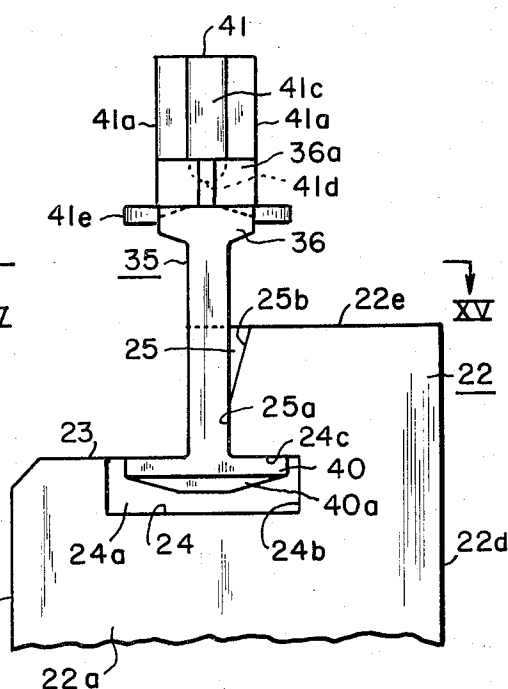


Fig. 9



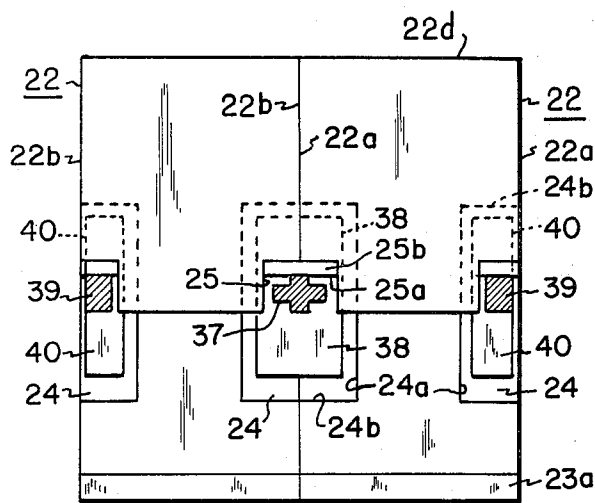


Fig. 15

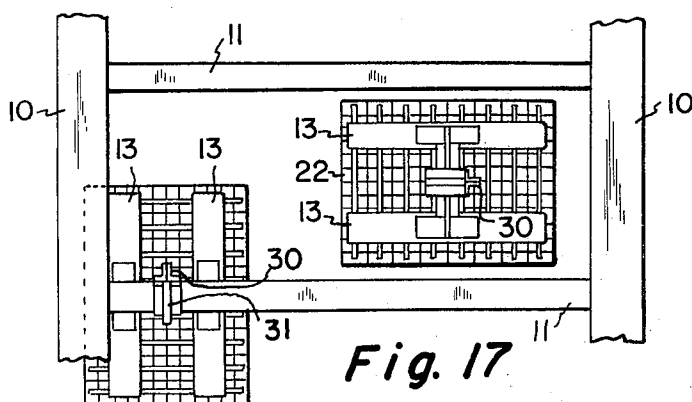


Fig. 17

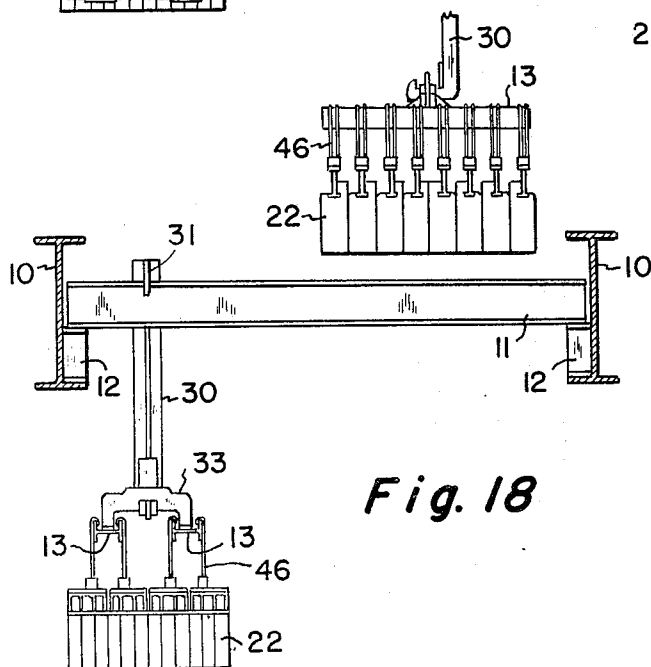


Fig. 18

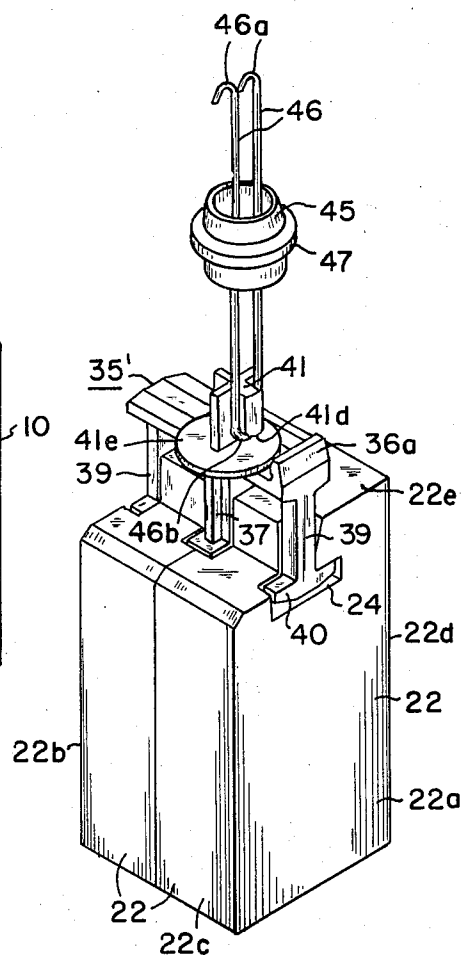


Fig. 16

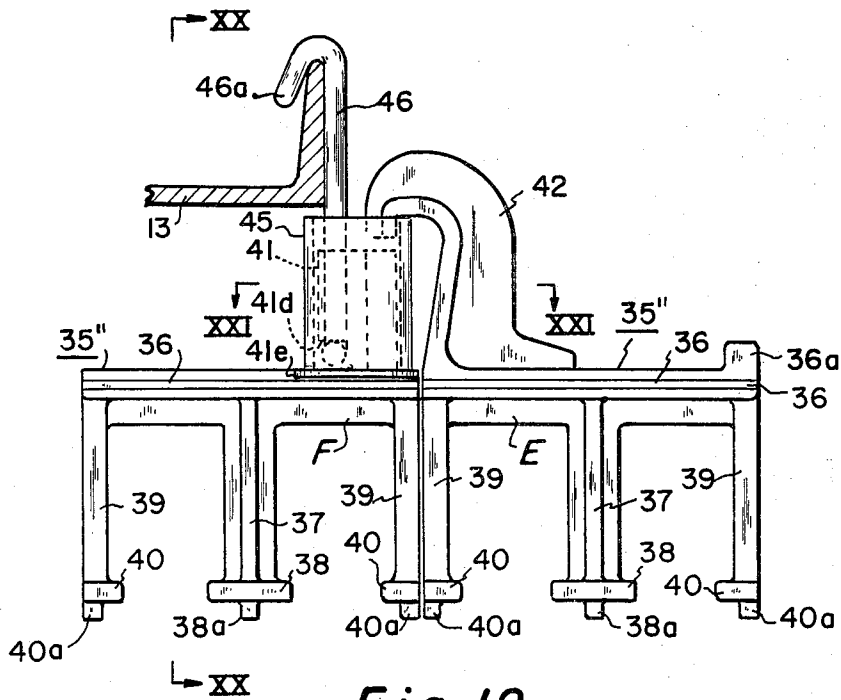


Fig. 19

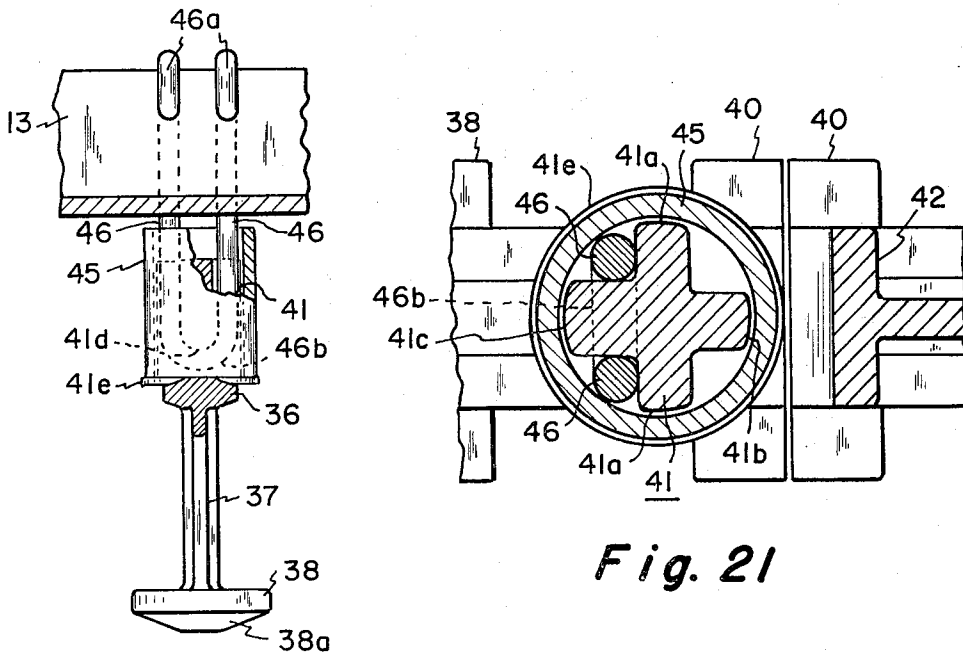


Fig. 21

Fig. 20

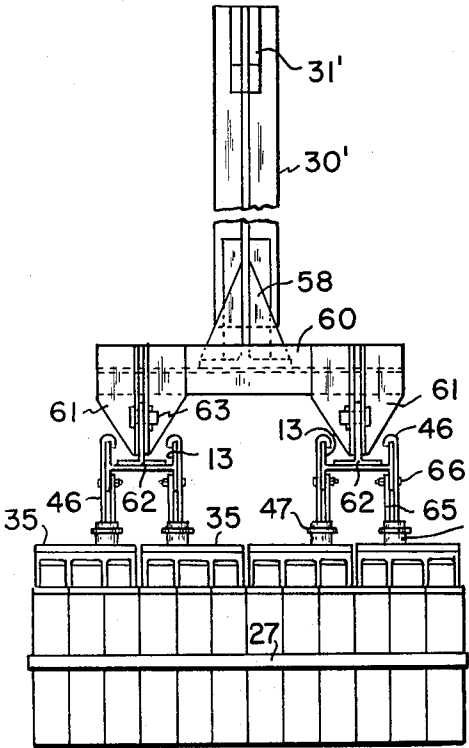


Fig. 22

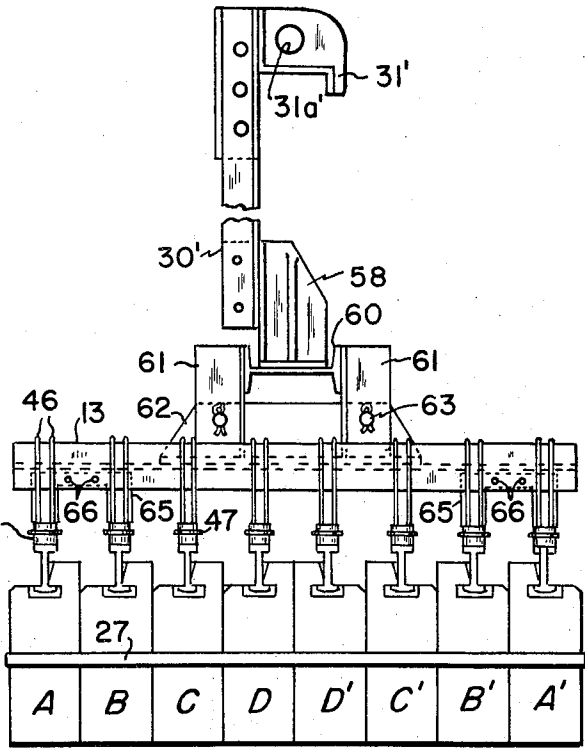


Fig. 23

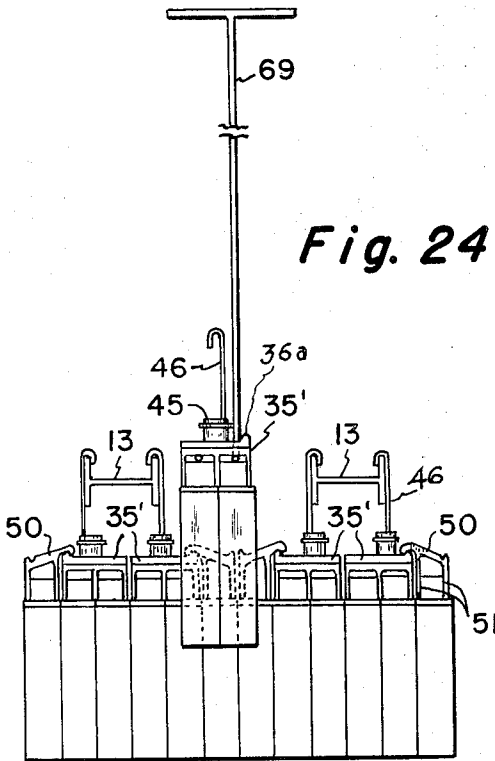
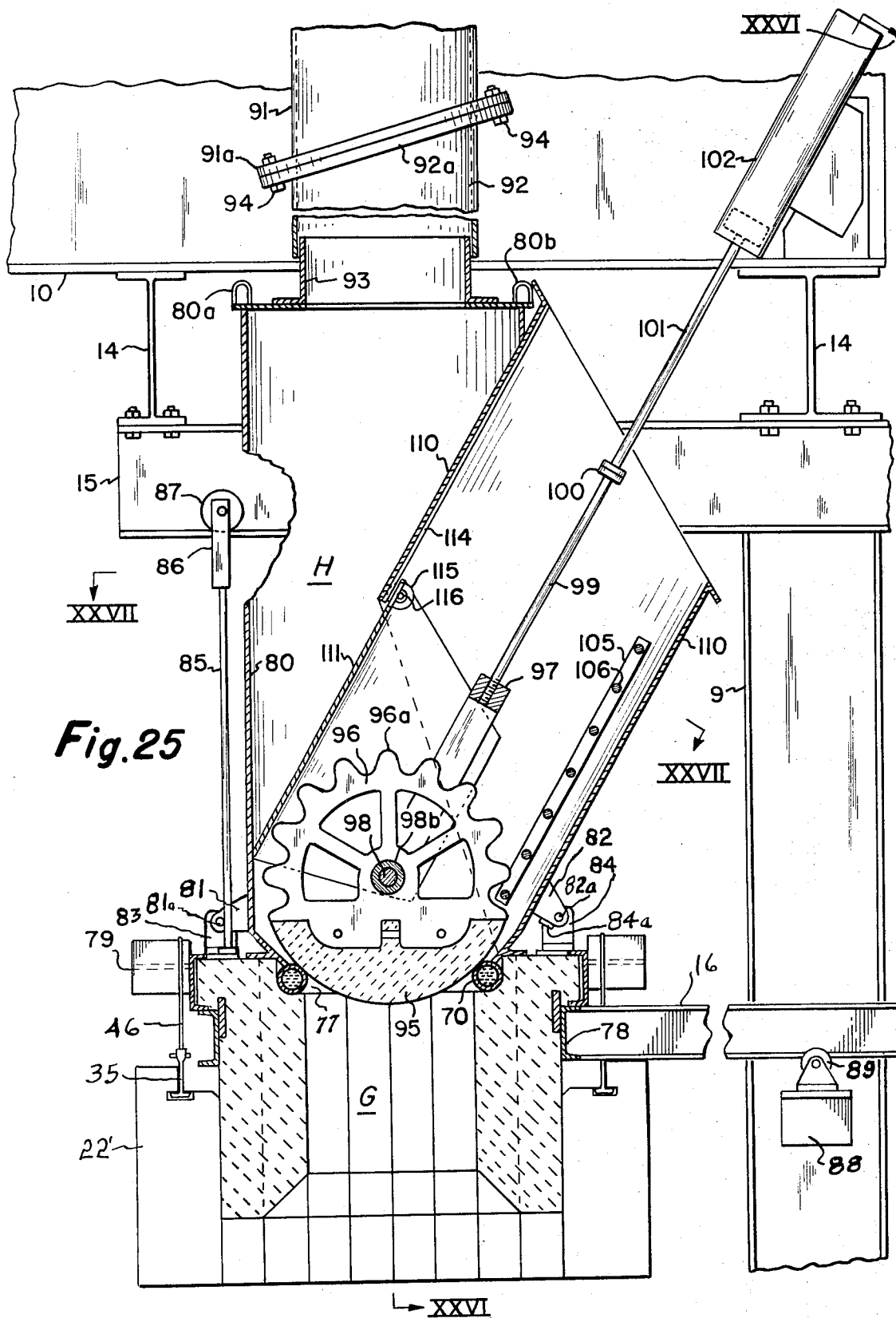


Fig. 24



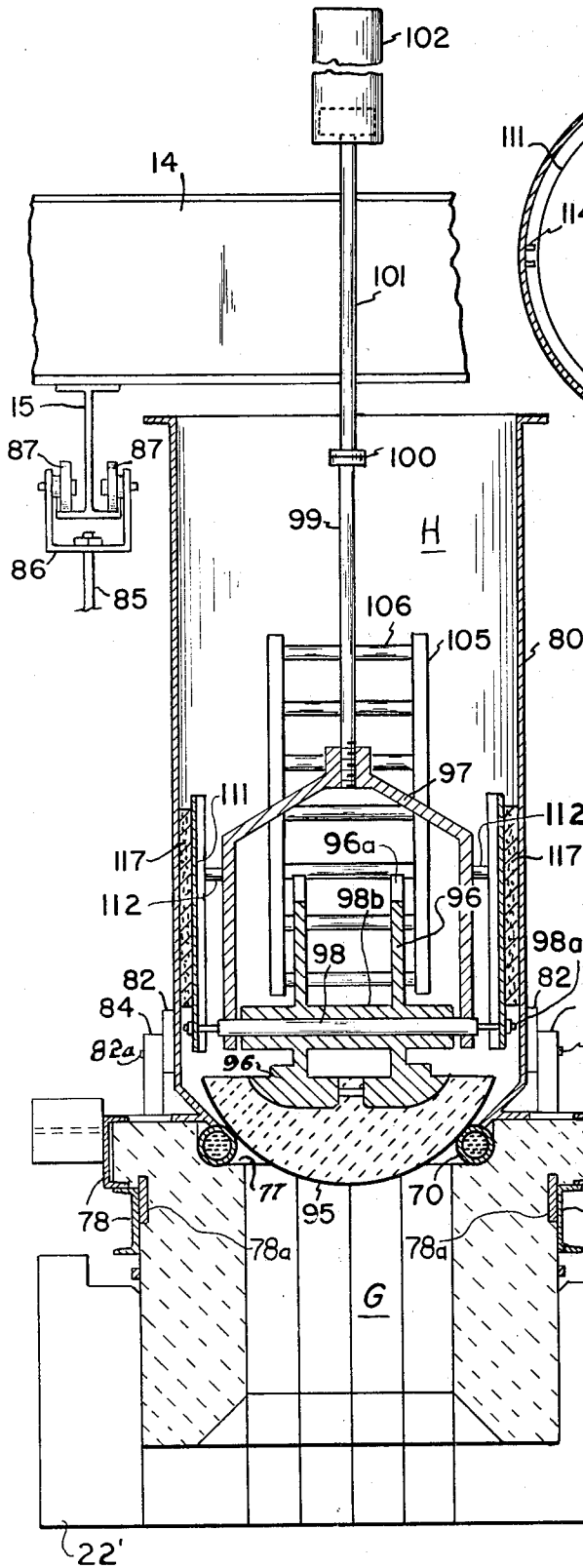


Fig. 26

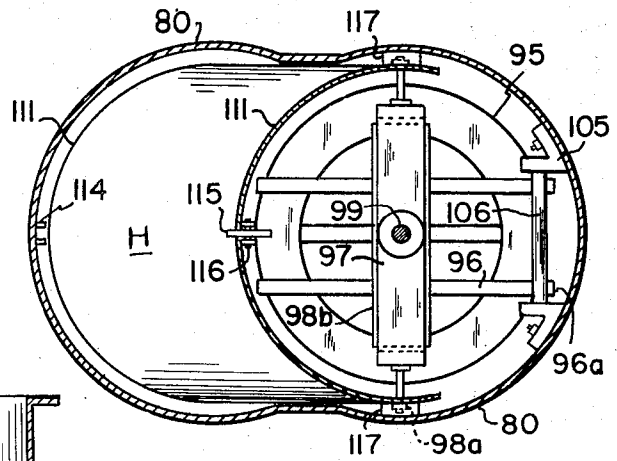
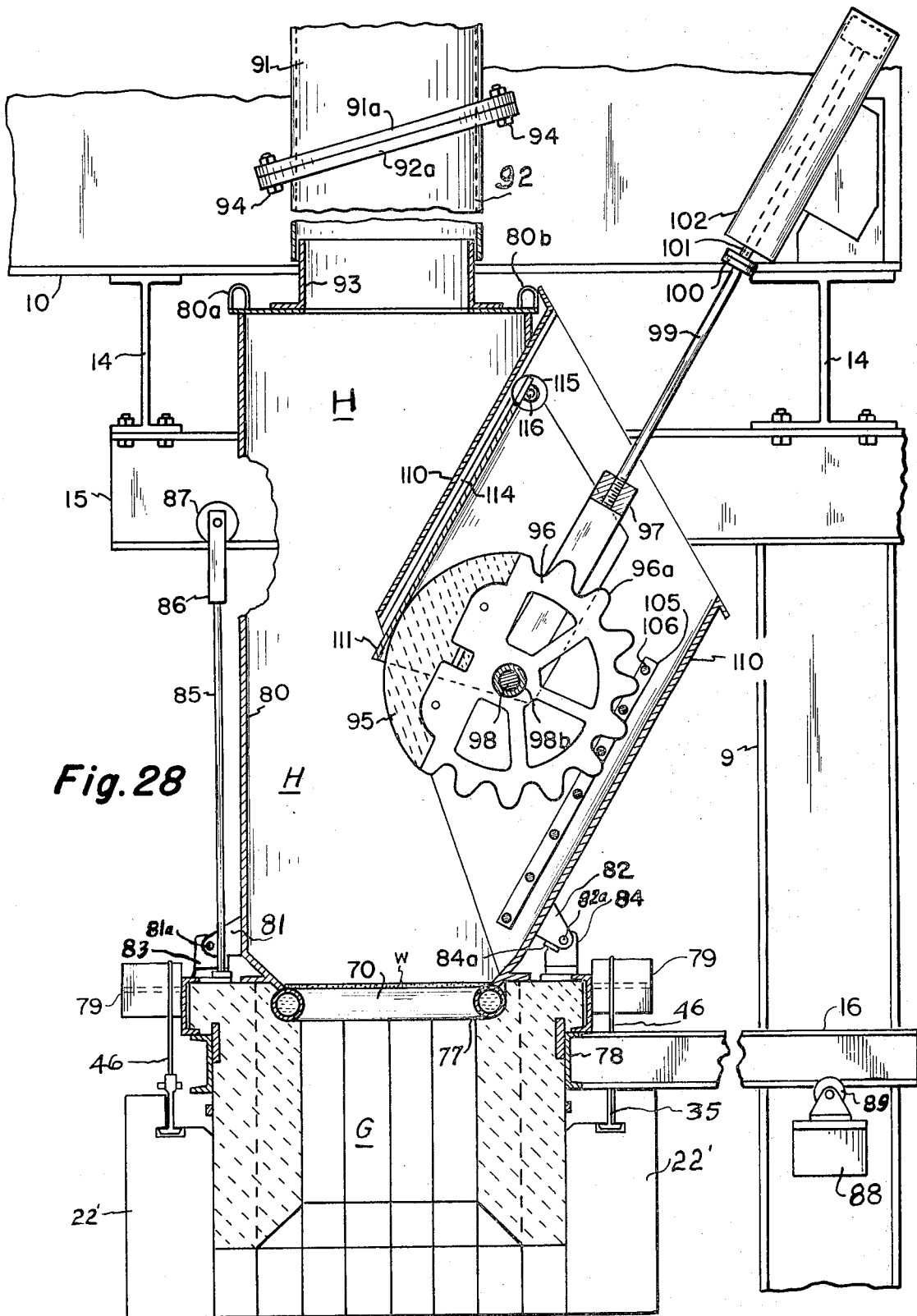
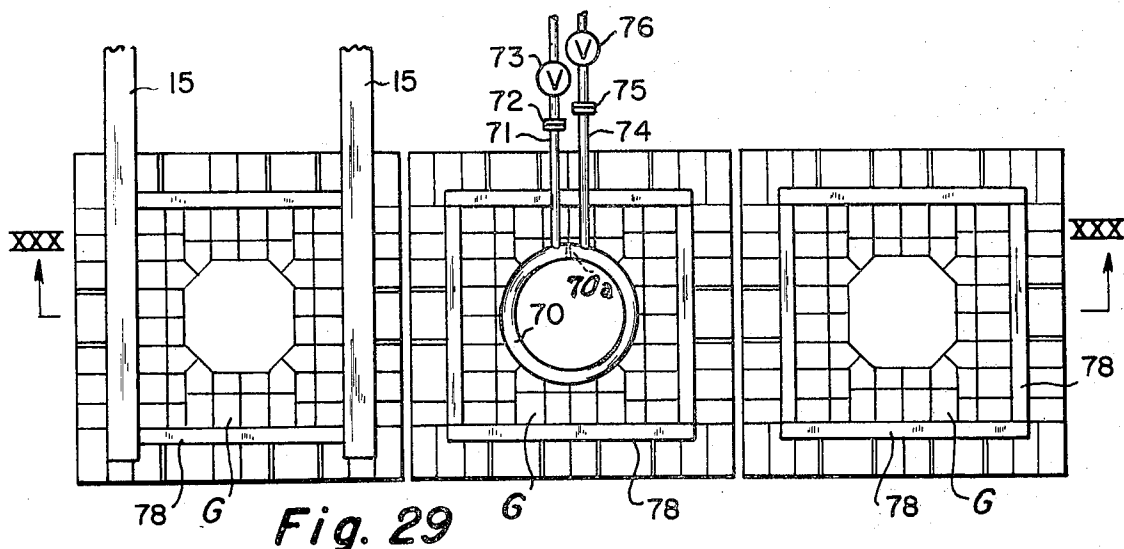
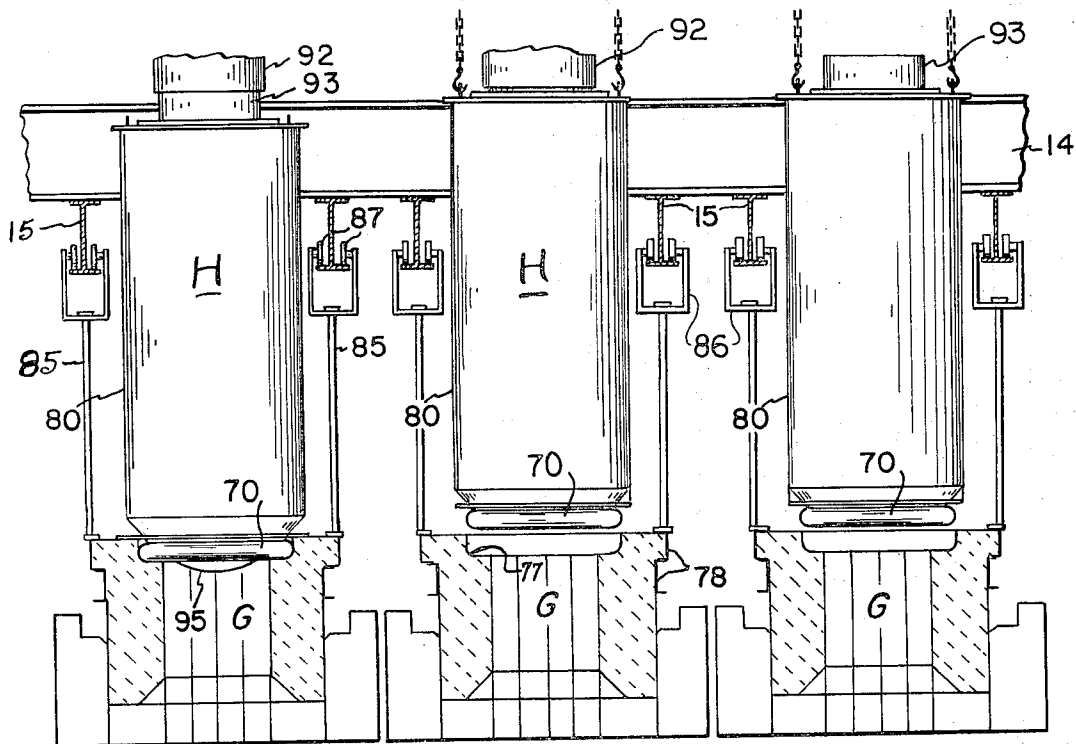
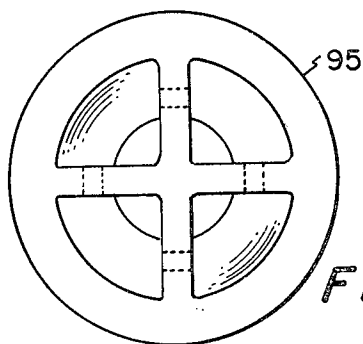
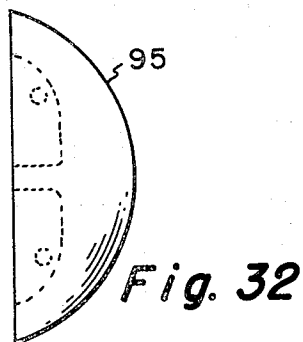


Fig. 27





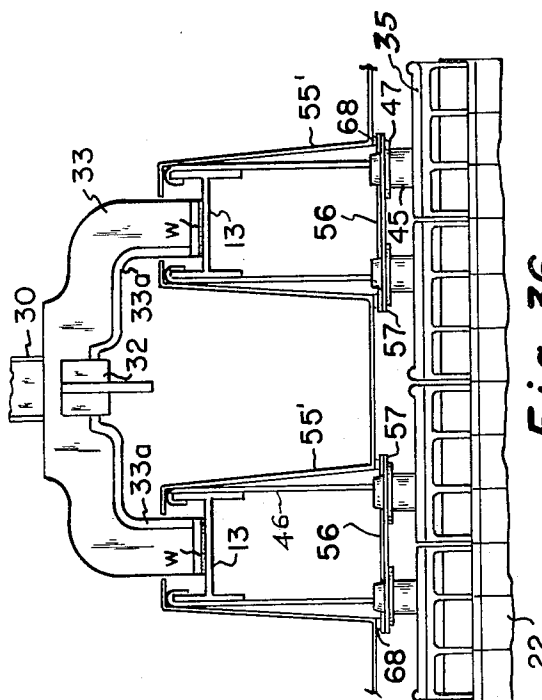


Fig. 33

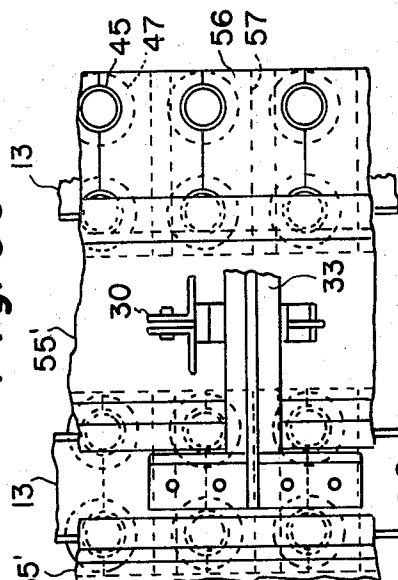


Fig. 34

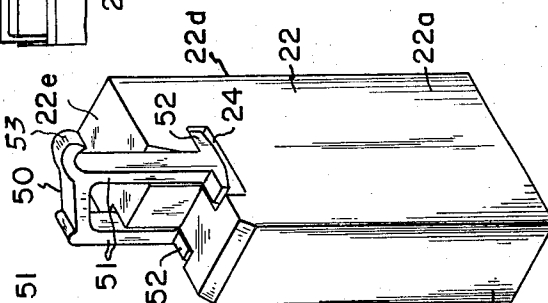


Fig. 35

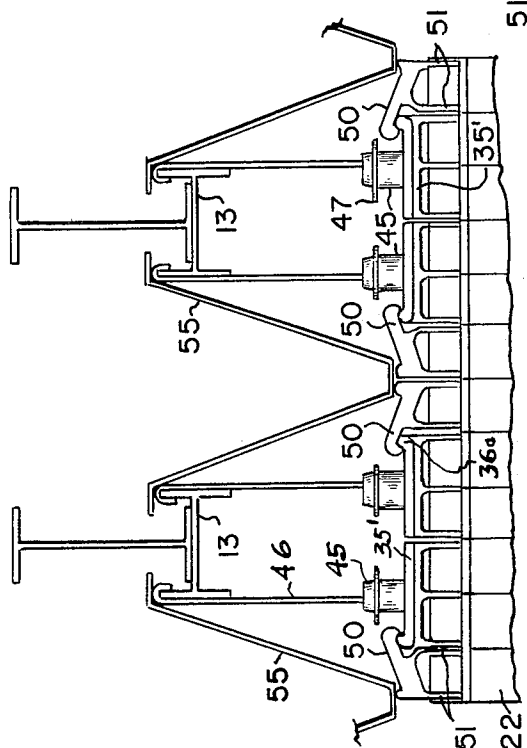


Fig. 36

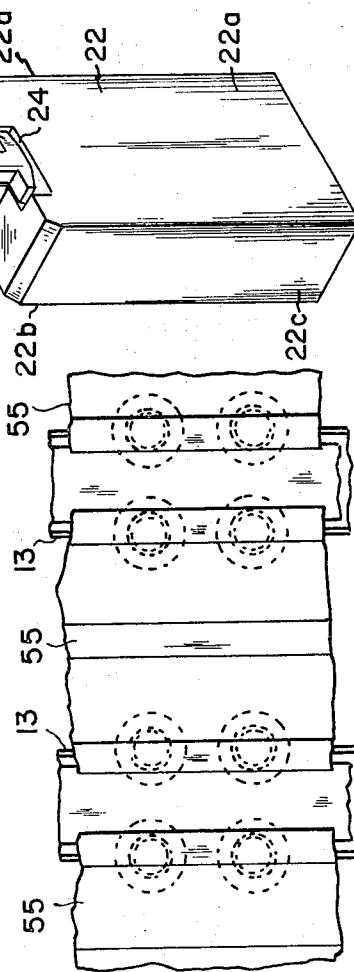


Fig. 37

PANELIZED SUSPENDED FURNACE ROOF AND IMPROVED FEED HOLE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention pertains to an improved suspended furnace roof construction and particularly, to a construction that is simplified in its metalwork and tile assembly and that facilitates maintenance and replacement of refractory tile members. A further phase of the invention relates to an improved feed hole construction for a furnace roof whose door carrying feed housing may be swung into and out of position with respect to a feed opening, and whose feed opening defining refractory block assembly is movable as a truck unit into and out of position in the roof.

2. Description of the Prior Art

In my U.S. Pat. No. 3,345,962 I have shown a so-called link and yoke refractory roof construction in which cross-extending beam members are detachably carried by transversely extending overhead girders of the metal framework structure, with looped or so-called link types of hangers being suspended from the beam members and carrying primary hanger castings that are provided with a plurality of spaced-apart latching leg and foot portions. Each of the refractory tile members has an open latching portion at its upper end that cooperates with the latching leg and foot portions of an associated hanger casting to enable the tile to be mounted by individually rotating it into a suspended position thereon. In this manner, a group of tile members may be successively tilted into latching engagement with a second and third set of latching leg and foot portions of the same associated hanger casting.

The need today is for a metal structure assembly that will maximize distance between the tile members and the heavy overhead metal framework for isolating the high temperature portion of the furnace from the framework and for maximizing heat transfer from the top of the tile members and away from suspending hanger members. An improved structure dealing with this problem has been set forth in my co-pending application Ser. No. 182,409 of Sept. 21, 1971. This disclosure shows the use of so-called gooseneck hangers that, in effect, isolate the overhead beam and girder structure from immediate hanger castings and tile members, and which enable an assembly of tile members, as carried by a gooseneck hanger, to be manipulated into a suspended position with respect to an associated beam member. Such structure also facilitates the use of cooling means and of partitions or covers for dust and dirt collection and for providing cooling fluid flow passages along upper reaches of the refractory tile members.

Present day furnace feed or charging holes have been heretofore formed by leaving out enough roof tile or brick members to provide the size of hole, with a cast iron pipe being inserted into the hole and equipped with a slide gate at a spaced location above the hole. In order to give the metal pipe a reasonable life under the high temperature conditions, the gate is generally left partly open to allow negative furnace pressure to draw in some air for cooling purposes. Such drawn-in air also serves to preserve the suspended roof brick and the hanger castings which are relatively close to the hot edge. Now ecology has demanded that openings in the furnace be sealed and that higher pressures be used for

more efficient combustion and a minimization of atmospheric contamination. Thus, the bleeding of air is now impractical. I have determined that the above form of feed hole arrangement is wholly inadequate to handle high furnace temperatures or positive furnace pressures.

SUMMARY OF THE INVENTION

It has been an object of the present invention to devise a suspended furnace roof construction in which its assembly of suspending metal members will enable a better flexibility in maximizing the distance between upper reaches of the refractory tile members and the overhead metal framework structure, and also enable flexibility in the number of tile-receiving latching leg and foot portions carried by primary metal hanger castings.

Another object of the invention has been to facilitate the storage, shipment and handling of tile members as an assembled group and for mounting them as a group on metal hangers to form a manipulative unit that may be handled as a unit for moving it in a suspended relation into position on an overhead support or beam member of the metal framework of a roof construction.

A further object of the invention has been to devise a construction of primary hangers or hanger castings and cooperating refractory tile members, such that a hanger casting having a depending group of latching leg and foot portions may, itself, be rotated into a position such that its group of leg and foot portions will simultaneously latchengage within a cross-aligned group of tile members.

A further object has been to maximize the number of tile members that may be suspended in an assembled relation from a single tertiary overhead hanger member.

A still further object of the invention has been to devise new and improved means and a method of utilizing a palletized assembled group of refractory tile members for mounting their metal hangers in position with respect thereto before maneuvering them in a suspended relation on the hangers into a supported position on a beam member of the roof construction.

A still further object of the invention has been to devise a new and improved feed hole construction that will enable the use of higher furnace pressures, enable a substantially fully closed-off operation of a furnace, that will greatly facilitate maintenance and repair of the furnace roof, and that will have an improved form of opening and closing operation.

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

FIG. 1 is a fragmental side view in elevation of a portion of a furnace roof constructed in accordance with the invention and showing a three-part hanger utilization for suspending refractory tile members from an overhead metal framework which may include transverse girder, longitudinal support beam and vertical buckstay members.

FIG. 2 is a fragmental end view in elevation on the scale of FIG. 1 and taken at right angles thereto. In this view, the tile members have been assembled in a series of rows given alphabetical numbering and correspond-

ing to rows of palletized assembly, such as illustrated in FIGS. 10, 11 and 12.

FIG. 3 is a top plan view of a slightly enlarged scale with respect to FIGS. 1 and 2, showing a unitized assembly of tile members on supporting metal hangers of these figures, but for clarity, omitting members of the overhead framework. This complete unit is of a type that may be maneuvered into a suspended mounted positioning in accordance with procedure illustrated in FIGS. 17 and 18.

FIG. 4 is a greatly enlarged view in elevation taken from the wide side of a representative basic form of primary hanger casting that is constructed principally for replacement utilization in a furnace construction. The basic features involve the use of a cross-extending shoulder, downwardly extending and spaced-apart latching parts, and a centrally disposed, upwardly-projecting latching lug part.

FIG. 5 is a top plan view and FIG. 6 is a narrow end view in elevation on the scale of and of the hanger of FIG. 4.

FIG. 7 is a view in elevation on the scale of FIGS. 4 to 6 showing a latching collar for, in effect, detachably suspending a primary hanger, such as shown in FIG. 4 in a manner illustrated in FIGS. 19 to 21. As shown in FIG. 19, such collar may also serve as a latching means for an upper hook-shaped end part of a replacement type of primary hanger construction.

FIG. 8 is a top perspective view on the scale of FIGS. 4 to 7 showing the construction of a tile member of the invention and as adapted to receive a pair of latching parts of an associated primary hanger casting in the manner illustrated in FIGS. 13 and 14.

FIG. 9 is a view similar to FIG. 8, particularly illustrating metal cladding that may be employed with a tile member of the invention.

FIG. 10 is a narrow side view in elevation and FIG. 11 is a wide side view in elevation on the same scale and on the scale of FIGS. 22 and 23 showing a palletized assembly of tile members. In these figures, banding means is shown for both retaining the tile members in an upright assembled positioning with respect to each other and for retaining the assembly on the pallet during handling and shipping thereof.

FIG. 12 is a fragmental top plan view on the scale of FIGS. 10 and 11 and of the palletized assembly shown thereby.

FIGS. 13 and 14 are greatly enlarged fragmental side views in elevation illustrating rotational mounting of a primary hanger member or casting within a group of tile members of an aligned row while, for example, they are being retained in an assembled relation on a pallet such as shown in FIGS. 10 and 11, but after vertical banding or strap members have been removed.

FIG. 15 is a reduced top plan view taken across latching leg portions of a three-legged primary hanger casting, such as illustrated in FIG. 16, where such hanger is in a fully mounted position such as shown in FIG. 16.

FIG. 16 is a vertical perspective view showing a pair of tile members with their wide side faces in aligned abutment, and as carried in a suspended or latched positioning by the form of primary hanger shown in this figure and in FIG. 4; this hanger is of a type suitable for small fill-in roof spaces or for furnace repair or maintenance work. A latching collar is shown in an upper, unlatched position on a secondary hanger.

FIGS. 17 and 18 are greatly reduced somewhat diagrammatic views illustrating procedure that may be employed in mounting and removing a unitized, panel-assembled group of hanger-suspended tile members such as illustrated in FIGS. 1, 2 and 3. FIG. 17 is a top plan view and FIG. 18 is a side view in elevation.

FIG. 19 illustrates a modified form of primary hanger casting construction which has two parts for facilitating furnace repair; as illustrated, the two parts may be suspended from the same secondary hanger so as to, in effect, provide a primary hanger assembly having five latching leg parts.

FIG. 20 is an end view in elevation on the scale of and taken along the line XX—XX of FIG. 19.

FIG. 21 is a horizontal section on an enlarged scale taken along the line XXI—XXI of FIG. 19.

FIG. 22 is a narrow side view in elevation on the scale of FIG. 10 showing a palletized, unitized assembly ready for mounting in the manner shown in FIGS. 17 and 18.

FIG. 23 is a wide side view in elevation on the same scale as FIG. 22, taken at right angles thereto and in the same direction as FIG. 11.

FIG. 24 is an elevation on the same scale as FIG. 22, illustrating a modified form of tile suspension assembly such as may be used in repairing a furnace roof. This view is somewhat diagrammatic, in that it illustrates the use of a hand tool for carrying a group of suspended tile members and their primary and secondary hangers.

FIGS. 25 and 26 are vertical view in elevation and partial section illustrating a feed hole construction that includes an upper housing assembly for feeding the furnace, having a door operable therewithin, and provided with a jacketed sealing ring for the door. A unitized refractory block assembly that defines a feed hole opening and that is adapted for movement as an independently framed unit out of position in the roof is also illustrated. Both of these figures show the door and an inner telescopic housing part in a fully lowered, sealing and closing-off position. FIG. 26 is a section along the line XXVI—XXVI of FIG. 25.

FIG. 27 is a horizontal section on the scale of and taken along the line XVII—XVII of FIG. 25.

FIG. 28 is an elevation in partial section on the scale of and of the same apparatus as FIGS. 25 and 26 and taken in the same direction as FIG. 25, but showing the door and the inner housing part in their fully raised or open positions to provide a charging passageway into the furnace roof opening.

FIG. 29 is a reduced top plan view of a portion of a furnace roof showing three hole or opening defining units to illustrate parts of a hole-defining block assembly, such as shown in FIGS. 25 to 28, inclusive.

FIG. 30 is an elevation section taken along the lines XXX—XXX of FIG. 29 and on the same scale as the latter figure. The extreme left hand feed hole is shown with its housing assembly and its sealing ring in their lowermost or operating positions, at which time the door may be open to enable charging the furnace or may be closed as shown in FIG. 25. The middle and the right hand feed holes of this figure show the housing assembly and sealing ring in a raised position with respect to the feed hole, such as may be utilized in moving the assembly out of the way when the refractory feed hole assembly is to be, for example, moved out of position in the furnace roof on its truck frame.

FIG. 31 is a top plan view and FIG. 32 is a side view of the refractory part of a rotary door construction on the scale of and such as used with the door unit of FIGS. 25 to 28.

FIG. 33 is a fragmental side view in elevation of a hanger casting assembly similar to the assembly shown in FIG. 24, but with cover plate or trough-like partition members in position thereon for collecting dust and charge spillage and for facilitating movement of cooling fluid above upper reaches of the tile members. In this view, secondary hangers are carried by flanged support beams rather than through the agency of tertiary hangers.

FIG. 34 is a fragmental top plan view on the scale of and of the assembly of FIG. 33.

FIG. 35 is a vertical perspective illustrating the use of a single tile carrying primary hanger casting that is adapted to over-latch an adjacent hanger and which may be used as an end filler hanger for suspending one tile member in an assembly such as shown in FIG. 33.

FIG. 36 is a view on the scale of FIG. 33 and from the same side, but illustrating a unitized assembly such as disclosed, for example, in FIGS. 22 and 23, wherein four-legged primary hanger castings are utilized for carrying three tile members, as in the initial construction of a furnace roof. This figure is also illustrative of a suitable form of cover plate, trough assembly for this type of construction. Punch plates are shown having holes therein to fit over latching collars and rest on mounting pads or washers, and asbestos pads are shown used as air seals between covers, plates and the hangers.

And FIG. 37 is a fragmental top plan view on the scale of and of the construction shown in FIG. 36.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In carrying out one phase of the invention, a conventional three by four foot pallet 20 having a relatively planar platform 21 of a suitable material such as wood may be utilized for assembling or stacking a group of refractory brick or tile members 22 in an upright position thereon (see FIGS. 10, 11 and 12 of the drawings). Employing a conventional size of tile member 22 will enable forming eight rows of tile members as made-up of wide-face abutting members that extend (see FIG. 10) along the shorter dimension of the pallet and whose narrow side faces are positioned in a cross-aligned manner along the wider dimension of the pallet 20 (see FIG. 11). The construction of the tile 22 and of primary hangers 35 and 35' (hanger castings) is coordinated to enable the hangers to be rotated into and out of a latched and suspending positioning simultaneously with respect to one, two, three or four tile members of a row such as A.

In FIG. 22, each hanger 35 is shown carrying three tile members, thus requiring four primary hangers for a full length of twelve tile of each tile row, such as for rows A, B, C and D of one-half of the pallet assembly and for rows A', B', C' and D' of the other half thereof. For facilitating the insertion and latch-mounting of primary metal hangers 35 (see FIGS. 1 and 13) or 35' (see FIG. 4) or 35'' (see FIG. 19), each tile member 22 (see FIGS. 13 and 14) has an open ledge 23 that extends across one planar narrow side face thereof and is open to its planar top face 22e and to its planar pair of wide

side faces 22a and 22b, but closed with respect to its other planar narrow side face 22d. As shown in FIGS. 8 and 9, latching slots 24 and 25 are open to the ledge portion 23 and to an adjacent wide side face 22a and 22b.

Initially, in installing a furnace roof, it is contemplated that a hanger casting 35 will be used that has a longitudinally extending shoulder part 36 provided with a group of four, downwardly-projecting latching leg and foot portions as noted in FIG. 22. The hanger casting or primary hanger 35' of FIG. 4 is exemplary and is shown as having an intermediate latching leg part of full section comprising a latching leg portion 37, a cross-extending latching foot portion 38 which extends at right angles to the leg portion, and a tapered bottom end portion 38a which extends from the foot portion. Each end latching leg part is shown as comprising a downwardly projecting leg portion 39, a cross-extending latching foot portion 40, and a tapered bottom end portion 40a. It will be noted that the end latching leg parts are substantially half sections of the intermediate latching leg parts.

A suspension upper latching lug part 41 of cruciform shape is adapted to extend or project substantially centrally upwardly in a balanced relation from the shoulder part 36. A latching collar 45 having an annular flange 47 is adapted to have a downward slide fit over the latching lug 41 to retain cooperating parts in a latch-engaging relation. Its flange 47 serves as a lift means and as a position support for cover members (see FIGS. 33 and 36). As particularly illustrated in FIGS. 4, 5 and 6, the part 41 is of somewhat cruciform shape, looking downwardly, as provided by cross-extending wings 41a, 41b and 41c. The wing 41c is cut-out or recessed adjacent its lower end to provide a latching recess portion 41d to receive a connecting loop portion 46b of a secondary hanger 46, as particularly shown in FIGS. 19 to 21.

The secondary hanger 46 is shown as of a double-loop, rodlike construction wherein its two vertical portions extend in a spaced relation, are connected at their lower ends by the loop 46b and, at their upper ends, are bent-over to provide claw, hook-over or latching portions 46a. Each secondary hanger 46 is of a construction that minimizes heat pick-up and that maximizes heat dissipation. The upper hook or claw end portion 46a is adapted to latch-engage-over and suspend each hanger 46 from an upwardly projecting flange of a flanged support or longitudinally horizontally extending channel part 13, as particularly illustrated in FIGS. 1, 2 and 3. The secondary hangers 46, as shown in FIGS. 1 and 2, are employed as oppositely spaced-apart pairs along a pair of line rows. Each row, as shown in FIG. 2, has the hangers 46 suspended in a spaced-apart relation along one flanged side of the associated flanged support member 13. The hangers 46 are thus assembled in what may be termed hanger row pairs along the full length of the associated flanged support part or member 13, with each member 13 carrying two hanger rows in which the individual hangers 46 of each row have an opposite and crossaligned relation with respect to hangers of the other row that are suspended by the same member 13.

A tertiary hanger construction 30 which may be termed a gooseneck type, has a hook-over, latching or neck portion 31 (see FIGS. 1 and 2) at its upper end that is provided with a cross-extending eyelet 31a for

receiving the hook of an overhead hoist or crane (not shown) when a previously palletized unit assembly of suspended tile members, such as illustrated in FIGS. 17 and 18 is being moved into a mounted relation on a longitudinally extending support beam member 11. As illustrated in the latter figures, each unitized pallet assembly may be carried by one tertiary hanger 30, by two support members 13, by four rows of secondary castings 46, and by four rows of primary hangers 35 that extend in the direction of the shorter pallet dimension, see FIGS. 22 and 23.

In utilizing a pallet 20 for assembling tile members 22, such as shown in FIGS. 10, 11 and 12, the tile may be assembled in the upright position and secured together as an assembly, by an encircling, banding metal piece 27 and held in position on the pallet 20 by a pair of vertically encircling metal banding pieces 28. This dual banding may be accomplished at the tile factory and may be retained during storage and shipment of the members from the refractory factory to the furnace location or point of installation. Although the primary hangers 35 may be installed at the brick factory or kiln before shipment and before the vertical banding members 28 are installed, the preferable procedure is to install all of the metal work at the place of installation of the furnace, but while the tile members are retained in an assembled relation on the floor 21 of the pallet 20. In this case, the vertical banding members 28 are removed, but the horizontal member 27 may be retained until the hanging or suspending operation of FIG. 18 has been completed.

The construction of the latching portions of the tile members 22 shown in FIGS. 8 and 9 is such as to enable the latching leg and feet portions of a particular hanger 35 or 35' to be rotated, as illustrated in FIGS. 13 and 14, into and out of a fully suspended latching position with respect to a group of tile members of a given row, starting with the rows such as D or D' of FIGS. 11 and 12. After all of the primary castings 35 or 35' have been thus mounted, then the secondary hangers 46 are mounted in position in a manner indicated in FIGS. 1, 2, 16, 20 and 21. It will be noted that each hanger 46 has a latching collar or cylinder 45 slidably mounted thereon, whose inside diameter is slightly larger than the outer circumference defined by the lug portions 41a, 41b and 41c of the upper latching part 41 of a primary casting hanger 35, 35' or 35''. When, as shown in FIG. 16, the connecting loop portion 46b is inserted under the shelf end of the recess portion 41d of the lug 41c, then the collar 45 may be dropped downwardly to enclose the cruciform shape, to remain in position thereon by resting on a mounting pad or washer 41e. The pad or washer 41e is secured, as by welding, to the upper side of the shoulder part 36 of an associated primary hanger 35, 35' or 35''.

The construction of the refractory brick or tile members 22 is particularly shown in FIG. 8. Each tile member 22 has a pair of opposed, planar, wide side faces 22a and 22b, a pair of opposed, planar, narrow side faces 22c and 22d and a planar upper end face 22e. Recessed ledge part 23 is fully open to the upper face 22e and to the narrow side face 22c, and has a beveled or sloped front edge 23a at the narrow side face 22b. A back face or riser portion 23b extends from the recess step or ledge of 23 and terminates at its upper end at the top face 22e. A transversely-elongated latching slot portion 24 is provided along each wide side face

22a and 22b, is sidewise-open thereto, and is upwardly-open to the step or ledge of the part 23. The latching slot portion 24 has a pair of opposed end faces 24b, with the innermost end face cooperating with a top face 24c and a side face 24a to define a latching recess.

A vertical leg-receiving slot portion 25 extends vertically along each wide side face from the latching slot portion 24 and terminates at the top face 22e to which it is open. The leg-receiving slot portion 25 has a lower, straight, vertical back face 25a and an inclined or sloped upper back face portion 25b.

Referring to FIGS. 4, 13 and 14, the foot portions 38, 38a or 40 and 40a of a hanger casting such as 35, 35' or 35'' are adapted to be entered into the latching slot portion 24 of tile members through the open-end part 23, with the leg portion 37 or 39 tilting on the backwardly sloped face 25b of the leg receiving slot portion 25. When the hanger casting is fully mounted in a tile suspending relation, as shown in FIG. 14, its foot portion 38 or 40 engages the upper inner face 24c and the side face 24a of the latching slot portion 24, and its leg 37 or 39 engages the vertical back face 25a of the leg receiving slot portion 25. The tile of FIG. 9 is of the same construction as the tile of FIG. 8, but has been provided with a steel cladding facing 26 along one wide side face 22a and one narrow side face 22d that may be cemented thereto.

With particular reference to FIGS. 1 to 3, inclusive, details of the construction of tertiary hanger 30 are shown. A yoke or cross-extending arm part 33 is hooked-over or supported in a centrally suspended relation from the lower end of the tertiary hanger 30 by means of a lower latching lug, foot or hook portion 32. Each arm or yoke part 33 has a mounting foot 33a at its opposite ends that is secured by weld metal w (see FIG. 36) to a central portion of a flanged support part or member 13 that may be of I-beam or a channel construction. Each flanged member 13 extends transversely of the furnace in a parallel relation with overhead girders 10 of the basic metal framework. Each member 13 serves to carry or suspend a pair of rows of spaced-apart secondary hangers 46, one row being suspended from each of its flanges, see particularly FIGS. 1 and 2. As a result, each yoke or cross-arm member 33 serves to suspend four lines or rows of secondary hangers 46 in a relative wide, space-providing relationship above the upper reaches of the tile members 22 that are being suspended.

As shown for example in FIGS. 1, 2, 17 and 18, the tertiary or gooseneck hangers 30 are adapted to be suspended from flanged support member 11 to extend between a pair of girders 10 of the main overhead frame structure. The hangers 30 may be adjusted as to their vertical relationship with respect to the members 11 by short length I-beam pieces, such as 12. The upper hook end 31 of each hanger 30 is adapted to hook or latch over the upper flange of an associated beam member 11. In the construction, the girders 10 may extend transversely of the furnace and be supported on conventional vertical buckstays or upright members, such as for example 9 of FIGS. 25 and 28. The flanged members or beams 11 which extend between the spacing provided by the girders 10 will thus extend longitudinally of the furnace structure.

As previously intimated, the primary hanger castings may be of a type 35 for initial furnace installation (see FIGS. 1 and 22), or of modified construction such as

35' (see FIGS. 4, 5, 6 and 16), or of a modified dual construction such as 35'' (see FIGS. 19, 20 and 21). The modified constructions are particularly devised for use in effecting maintenance and repair of a furnace roof (see for example FIG. 24). Although initial installation primary hangers 35 have been provided with two intermediate latching leg parts 37 and two end latching leg parts 39, it will be apparent that any suitable number may be utilized. The construction of the type of hanger 35', shown in FIGS. 4, 5, 6 and 16, is provided with one intermediate leg part 37, with two end leg parts 39, and additionally with an upwardly projecting latching ledge portion 36a at one end of its shoulder 36. As shown in FIGS. 24 and 33, each latching ledge portion 36a is adapted to receive a hook end 53 of an auxiliary filler hanger 50 (see FIG. 35) which may be used as a single tile member support for form a complete hanger assembly with an adjacent two tile member supporting hanger 35'.

In the two-part type of hanger construction 35'' shown in FIGS. 19, 20 and 21, one part or half F is provided with an upwardly projecting latching lug part 41 of cruciform shape, while the other cooperating second hanger part or half E is provided with an upper, cooperating, latching hook 42. As shown particularly in FIG. 19, the two hanger parts E and F, although constructed to permit individual insertion of them within a furnace installation, actually, in a cooperative final latching positioning, form the equivalent of a unitary hanger 35'' having three intermediate latching leg parts 37 and 39 and a pair of end latching leg parts 39. As will be noted, the hook 42 is adapted to engage within an upper open end of latching collar 45 when it is in its "down" position on pad or washer 41e. Thus, in this construction, the collar 45 serves both to assure a proper latching suspension of the hanger part E from an associated secondary hanger 46, as well as to carry the other hanger part F in a cooperating, endwise-aligned and abutting relation.

FIG. 35 illustrates the construction and mounting of an end casting member 50 which may be employed in the manner shown in FIG. 24, and particularly to facilitate roof repair. The casting 50 has a pair of legs 51, with each leg having a cross-extending foot 52 that is adapted to latch within an associated latching slot 24 of the tile member 22. The shoulder of each casting has a hook-like latching end portion 53 that, as shown in FIG. 33, is adapted to latch over the end lug 36a of an associated hanger 35 or 35'.

FIGS. 33 and 34 are illustrative of one form of cover plate means 55 which utilizes V-shaped members to isolate the upper reaches of the tile members 22 with respect to, for example, the support and beam members of the overhead supporting metal frame structure. In this manner, dust and charging material spillage may be collected and kept off the assembly of hangers 46, 35 and 35', etc. At the same time, cooling air flow passageways are provided beneath the cover members 55. A suitable representative means for supplying and exhausting cooling fluid has been shown and described in my copending application Ser. No. 182,409, filed Sept. 21, 1971, with particular reference to FIGS. 1, 2, 3, 18, 19, 20 and 21 thereof. FIGS. 36 and 37 of the present application show a modified type of cover plate construction 55', 56 that is particularly adapted for use in connection with primary hanger castings 35, such as used in an initial roof installation. Sealing means, such

as asbestos pads 68 may be interposed between the plates 55 or 55', 56 and adjacent metal parts or members of the furnace roof construction, such as punched-out plates 57 on which they rest.

FIGS. 35 through 32, inclusive, are illustrative of a new and improved form of feed hole closure or door assembly H. As shown in FIGS. 29 and 30, one or a group of such assemblies may be utilized as desired. Instead of using conventional refractory roof tile members to define the immediate feed opening, a special feed hole refractory block assembly G is provided. As shown, for example in FIG. 29, the block assembly G may define an octagon-shaped hole portion within the furnace. Such hole defining or ringing refractory blocks, as illustrated in FIGS. 25, 26, 28 and 30, are provided with inner offset recess portions that in the assembly for each hole, define an annular or circular seating ledge 77 to removably receive a ring-shaped, hollow, sealing and seating, tube-like member 70 thereon. The member 70 is preferably water-jacketed, and is adapted to receive a refractory door 95 that is adapted to be rotated into and out of closing-off or seating engagement therewith. The seating position is illustrated in FIGS. 25 and 26.

With reference to FIG. 29, the sealing-seating ring 70 is shown provided with an in-flow cooling fluid or water supply pipe or line 71 that is connected through a fluid coupling 72 and a control valve 73 to a suitable source of cooling fluid. The outflow of warmed fluid or water is accomplished through outlet pipe or line 74, fluid coupling 75 and control valve 76. As will be noted in FIG. 29, the ring member 70 may be provided with a cross-extending partition 70a so as to assure a full circular flow of cooling fluid or water counterclockwise from the inlet pipe 71 about and along the hollow interior of the ring to discharge out through the outlet pipe 74.

Referring to FIG. 25, the hole defining refractory block assembly G is supported on a unitary metal frame 78 that is shown made up of channel members and as having a pair of spaced-apart horizontal, sidewise-extending track members 16 that may also be channels. One side of the frame 78 is suspended (see also FIG. 26) from a spaced pair of tracking beams 15. As shown in FIG. 28, the beams 15 are carried on beams 14 and overhead girders 10 of the supporting metal framework for the roof. A suspension rod 85 is secured at its lower end to the frame 78 and at its upper end has a bifurcated trolley bracket 86 that carries a pair of wheels 87. The wheels 87 are rotatably mounted in an opposed relation on opposite wings of the U-shaped bracket 86 to ride along a lower flange of an associated one of the pair of trackway beams 15. A pair of suspension rods 85 may be provided, one for each trackway beam 15.

Each track member 16 is adapted to ride on an associated flanged wheel 89 that is rotatably positioned on a mount or stand 88 that is secured on an associated one of a pair of horizontally spaced-apart buckstay or upright frame members 9. It will thus be apparent that the frame 78 is, in effect, a supporting or carrying truck for the independent feed hole defining block assembly G, and that the block assembly may be moved as a unit out of its roof position on such truck to facilitate repair and maintenance. The exposed opening may be covered with a heat shield at this time, and the operation of the furnace continued, making use of other remain-

ing feed hole assemblies G and H, see FIGS. 29 and 30.

To provide a maximum stability for the unit or assembly G, lower track members 16 may have the same spacing as and be aligned with upper or overhead track members 15. As shown in FIGS. 25, 26 and 28, short-length channel pieces 79 may be secured to extend from the unitary frame 78 to serve as suspension hangers for filler roof tile members 22'. The tile 22' may be removably suspended from the upper flanges of the pieces 79 by hangers 46 and 35 or 35'.

An upper housing assembly or unit H is shown as a vertically downwardly extending feed and door housing assembly that FIG. a fully vertical cylindrical feed member or housing part 80 and a secondary, downwardly inclined, cooperating, door-positioning cylindrical housing part 110. As illustrated in FIG. 28, the secondary or inclined housing part 110 has a lower end portion which is open into the primary housing part 80 through a side thereof and which carries a door operating and feed closing-off mechanism. A somewhat segmental cylindrical inner telescopic part 111 is open at both of its ends and is adapted to operate within the housing part 110 and to operatively carry a rotatable refractory door part 95. As shown in FIGS. 25, the inner telescopic part 111 is adapted in its lowermost position, in combination with the upper wall portion of the housing part 110, to fully close-off the feed passageway through the housing part 80. This is accomplished simultaneously with a downward rotatable movement of the refractory door part 95 into closing-off or seating engagement with the seating ring 70. The seating ring 70 is shown as an integral part of the housing assembly H and as extending downwardly from the lower edges of the bottom opening in such assembly.

The innermost housing part 111 serves as a variableposition mounting means for the door 95 and is provided with a roller 115 at its upper end that is pivotally mounted thereon to non-rotatably move the part 111 up and down and ride along an offset recess or groove portion 114 that extends longitudinally along the adjacent wall of the housing part 110. As shown in FIG. 26, asbestos sealing material 117 may be cemented on the inside of the feed housing 80 to provide a sealed relation between its face wall and the outer face of the telescopic, sloped and slidable innermost housing part 111 when the door 95 is in its fully closed position.

The refractory door 95 (see also FIGS. 31 and 32) is of segmental-rounded or hemispherical shape and is adapted to be removably cemented within and carried by a cast metal support wheel part 96 to, in effect, project from one relatively planar side thereof. The metal part 96 forms a substantially complete wheel-like shape with the door 95. The support part 96 is shown rotatably carried by its hub 98b on a sleeve bearing 98 of a cross extending shaft 98a (see also FIG. 26) that is secured between opposite sides of the wall of the inner member 111 and is adapted to be pulled upwardly and pushed downwardly by a mounting yoke 97 through which the shaft 98a also extends and which removably carries an operating piston rod 99 at its upper end. The piston rod 99 is shown connected through a flanged coupling 100 to a piston rod 101 of a reciprocating fluid motor, such as an air motor 102.

As indicated in FIG. 30, the two piston rod parts 99 and 101 may be disconnected at the coupling 100 when the door assembly H is to be raised. For the purpose of

guiding the door structure H and particularly, of controlling its opening and closing operation, a ladder or rack-like structure 105 is secured to the inner wall of the outer housing 110 and is provided with cross-extending spaced-apart rungs or bars 106 which serve as guiding cogs for rounded gear teeth 95a that are positioned about the outer periphery 96 the metal wheel 96 on which the refractory door 95 is carried. To give the innermost housing part 111 mounted stability, it is also shown secured at its upper end to the yoke 97 by cross-extending pins 112 (see FIG. 26).

In FIG. 28, the door is in its uppermost position, as accomplished by positively moving the piston rod 101 of the motor 102 to its uppermost position. At this time, as shown, the inner sleeve or housing 111 is also in its uppermost position and within the outer housing 110. Thus, the passageway through the feed duct 80 is at its maximum, in that the door 95 is substantially fully withdrawn within the housing 111 and in a raised position above its seating ring 70. Furnace feed through the door unit H may be effected from a feed conduit 91 which may be of a two-part connected construction, see flanges 91a and 92a and bolt and nut assemblies 94 that connect part 91 to a lower part 92. The lower half or part 92 is adapted to slidably telescope over an upwardly extending feed collar 93 that is carried by the upper end of the main duct or housing 80. With reference to FIGS. 28 and 30, the duct 80 is shown provided with hoist or lift eyelets 80a and 80b which may be engaged by the hook ends of a hoist chain for lifting the housing assembly H from its lower (left hand) position of FIG. 30 to a raised position such as illustrated in the central view of FIG. 30.

As shown in FIGS. 25 to 28, inclusive, the housing assembly H is both detachably and pivotally mounted on the frame 78. An upright mount or stand 94 is adapted to extend from the frame 78 to pivotally mount a downwardly projecting lug 82 that is secured to the housing 110 on one side of the housing assembly H, through the agency of a removable pivot pin 82a. A limit stop 84a is secured to project from the mount or stand 84 to limit the maximum down position of the lug 82. However, a full upward swing of the housing unit 45 A may be effected on the pin 82a. To anchor the unit H, a second mount or stand 83 projects upwardly from an opposite side of the block carrying frame 78 and is connected through a removably pivot pin 81a to a second mounting lug 81 that is secured to the housing 80 on an opposite side of housing assembly H. When the pin 81a is moved axially out of position, then the unit H may be pivoted upwardly to the right in FIG. 28 on the pin 82a. On the other hand, when it is desired to fully clear the area adjacent to or above the feed hole defining block defining assembly G, then both the pins 81a and 82a may be removed and the unit H raised out of position through the agency of an overhead hoist or similar means that has chains hooked through eyelets 80a and 80b. The unit G may then be moved horizontally out of position in the furnace roof. If desired, the hangers 46 and 35 and the tile members 22' may be first removed. The unit G may be pulled or pushed to one side or end of the furnace along trackway or rail members 15 and 16. For example, a fork lift truck operating on a walkway may be attached to the frame 78 for this purpose. The construction facilitates repair of the ring 70, replacement of the refractory door flapper

part 95, replacement of feed opening defining blocks of the assembly G, etc.

FIGS. 22 and 23 are illustrative of a modified form of hanger construction in which a vertical post or gooseneck hanger 30' is somewhat similarly constructed to the hanger 30 of FIG. 1, but its lower end is provided with a wing-like, angle-shaped mounting bracket 56 which is secured, as by weld metal, along its bottom flange centrally to the web of a short-length, cross-extending I-beam shaped support member 60. It also has a hook-nose 31' provided with an eyelet 31a'. A pair of adjacent, spaced-apart, angle-shaped mounting wings 61 is secured to each end of each vertically positioned flange of the support member 60 to project downwardly therefrom. This provides two opposite pairs of wings 61 along each side of each member 60 and at each end thereof. A half beam shaped connector 62 has its web positioned between an associated pair of wings 61 and is removably secured in position therebetween by suitable means, such as a cotter pin assembly 63. A second I-beam shaped support member 13 is secured somewhat centrally thereof along its web to the underside of the flange of the member 62 to extend horizontally therefrom. It will be noted that the member 13 is of greater length than and extends horizontally in a right angular relationship with respect to the member 60. As shown, there are two spaced apart and parallel support members 13 for each gooseneck hanger 30'. It will be noted that the support members 13 and 60 are positioned horizontally rather than vertically, with their webs being horizontal and their opposed flanges being vertical.

As shown in FIG. 23 adjacent side pairs (such as end pairs) of secondary hangers 46 may have their latching collars 45 positively held in downward latching engagement over the latching lug 41 of an associated primary hanger or hanger casting 35 by a U-shaped clip part or element 65. As shown in FIGS. 22 and 23, each clip part or element 65 may be removably secured in position to project downwardly from a side flange of the support member 13 by bolt and nut assemblies 66.

I claim:

1. In an improved furnace roof construction for mounting on a supporting metal framework having a horizontally and vertically extending member assembly, as assembly of refractory blocks in the form of a continuous rim wall that inwardly defines a feed opening for the furnace, a unitary metal frame suspended from the supporting metal framework and engaging outer peripheral reaches of said block assembly for carrying said block assembly on the supporting framework, and wheel-like door means rotatably carried by the supporting framework independently of said block assembly for movement into and out of a closing-off position with respect to the feed opening.

2. In an improved furnace roof construction as defined in claim 1, means movably positioning said unitary metal frame on the supporting framework for directly moving said block assembly longitudinally into and out of position in the furnace roof.

3. In an improved furnace roof construction as defined in claim 2, said movable means comprising wheel-like elements cooperating with said unitary frame and with horizontally extending members of said unitary frame and the supporting framework.

4. In an improved furnace roof construction as defined in claim 3, track means carried by said unitary

frame and by the supporting framework, and said wheel-like elements being operatively mounted for movement along said track means.

5. In an improved furnace construction as defined in claim 3, one set of said wheel-like elements being carried by the supporting framework adjacent a side of said block assembly, and a second set of said wheel-like elements being carried by said unitary metal frame and cooperating with the supporting framework adjacent an opposite side of said block assembly.

6. In an improved furnace roof construction as defined in claim 1, a group of refractory roof tile members positioned in a cooperative roof closing-off relation along an outer periphery of said refractory block assembly, and beam and hanger members carried by the supporting framework for removably suspending said tile members in the furnace roof independently of said refractory block assembly.

7. In an improved furnace construction for mounting on a supporting metal framework having a horizontally and vertically extending member assembly, an assembly of refractory blocks in the form of a continuous rim wall that inwardly defines a feed opening for the furnace, a unitary metal frame suspended from the supporting metal framework and engaging outer reaches of said block assembly for carrying the assembly on the supporting framework, said block assembly having a seating portion about an inner periphery of said rim wall, an overhead vertical feed housing assembly having a seating ring carried by a lower end portion thereof and adapted to fit on said seating portion, and door means having a refractory face operatively mounted with respect to said feed housing assembly for movement into and out of a seating position with said ring when said ring is positioned on said seating portion.

8. In an improved furnace roof construction as defined in claim 7, said unitary frame extending about said block assembly and having truck and track means carrying said block assembly for direct horizontal movement on the supporting framework into and out of position in the furnace roof.

9. In an improved furnace roof construction as defined in claim 8, means for moving said feed housing assembly out of position with respect to said block assembly preliminary to moving said block assembly on said truck out of position in the furnace roof.

10. In an improved furnace roof for mounting on a supporting metal framework having a horizontally and vertically extending member assembly, an assembly of refractory blocks carried by the supporting framework, said block assembly having a seat portion extending about an inner periphery thereof and defining a feed open portion, a seating ring adapted to rest on said seat portion, an overhead housing assembly, and a refractory door operatively carried by said housing assembly for movement into and out of a seating position with respect to said ring.

11. In an improved furnace roof as defined in claim 10, means for mounting said housing assembly on the supporting framework for movement into and out of a cooperating position with respect to said block assembly.

12. In an improved furnace roof construction as defined in claim 10, said housing assembly having a pair of cooperating telescopic door operating parts and a feed housing part, and means for moving one of said telescopic parts into a closing-off position within said

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feed housing part and for simultaneously moving said door into a seating position with respect to said ring.

13. In an improved furnace roof as defined in claim 12, a shaft rotatably mounting said door within said one telescopic part, and a yoke connected to said shaft for raising and lowering said one telescopic part within the other telescopic part.

14. In an improved furnace roof as defined in claim 13, said door being mounted on said shaft for rotative movement into and out of a seating position with respect to said ring.

15. In an improved furnace roof as defined in claim 10, means suspending said ring from a lower end portion of said housing assembly.

16. In an improved furnace roof as defined in claim 10, said ring being of hollow construction and having means for passing a cooling fluid therethrough.

17. In an improved furnace roof as defined in claim 10, said housing assembly comprising: a hollow substantially vertical first housing part, a hollow vertically sloped second housing part open at its lower end into said first housing part, and said refractory door being operatively carried for movement within at least one of said housing parts into and out of a seating position with respect to said ring.

18. In an improved furnace roof as defined in claim 17, said first housing part being adapted to pass charging materials therethrough into said feed open portion when said door is out of a seating position with respect to said ring, and said second housing part having means for carrying and guiding said door into and out of a seating position with respect to said ring.

19. In an improved furnace roof as defined in claim 18, a hollow sleeve-like member operatively positioned for up and down guided movement within said second housing part, and means for rotatably carrying said door within said sleeve-like member.

20. In an improved furnace roof as defined in claim 19, means carried by said sleeve-like member and cooperating with said second housing part to non-rotatably guide said sleeve-like member for up and down movement within said second housing part.

21. In an improved furnace roof as defined in claim 19, a shaft carried within said sleeve-like member, a metal wheel-like element rotatably carried on said shaft, said refractory door being secured on said wheel-like element and substantially defining a circular member therewith, said wheel-like element having teeth about its outer periphery, a rack extending along the inside of said second housing part for engaging said teeth and guiding said door into and out of a seating position with respect to said ring, and motor means connected to said shaft and positioned adjacent an upper end of said second housing for moving said sleeve-like member up and down therewithin and said teeth in a guided relation along said rack.

22. In an improved furnace roof as defined in claim 10, a unitary metal frame suspending said block assembly from the supporting metal framework, and means pivotally connecting said housing assembly to said unitary frame.

23. In an improved furnace roof as defined in claim 22, said means for pivotally connecting said housing assembly to said unitary frame being pin and lug means for pivoting said housing assembly with respect to said unitary frame and for disconnecting said housing with

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respect to said unitary frame.

24. In an improved roof as defined in claim 23, means suspending said unitary frame on the supporting framework for horizontal movement with respect to the furnace roof after said housing assembly has been disconnected from said unitary frame.

25. In an improved furnace construction for mounting on supporting framework having a horizontally and vertically extending member assembly, an assembly of refractory blocks in the form of a continuous rim wall that inwardly defines a feed opening for the furnace, a unitary metal frame engaging outer periphery reaches of said block assembly for carrying said block assembly on the support framework, door means carried by the supporting framework for movement into and out of a closing-off position with respect to the feed opening, an overhead track carried by the supporting metal framework, said unitary metal frame having a track extending therefrom, flanged wheel means extending from said unitary frame and cooperating with said overhead track and flanged wheel means mounted on a lower portion of the supporting framework to and cooperating with said extending track to carry said block assembly for direct horizontal movement on the supporting framework into and out of position in the furnace roof.

26. In an improved furnace roof construction for mounting on a supporting metal framework having a horizontally and vertically extending member assembly, an assembly of refractory blocks in the form of a continuous rim wall that inwardly define a feed opening portion for the furnace, a unitary metal frame extending from the supported metal framework and engaging outer reaches of said block assembly for carrying said assembly on the supporting framework, an overhead feed housing assembly having a seating ring carried by a lower end portion thereof and adapted to fit within the said feed opening portion, refractory door means operatively mounting within said overhead feed housing assembly for movement into and out of a seating position with said ring when said ring is positioned on said feed open portion, means for moving said unitary frame into and out of position within the furnace roof, and means for raising said feed housing assembly and said seating ring out of position with respect to said block assembly preliminary to moving said unitary frame out of position within the furnace roof.

27. In an improved furnace construction for mounting on supporting framework having a horizontally and vertically extending member assembly, an assembly of refractory block carried by the support framework, said block assembly having a seating portion extending about an inner periphery portion thereof and defining a feed open portion, an overhead housing assembly, a refractory door operatively carried by said housing assembly for movement into and out of a seating position with respect to said seating portion, said housing assembly having a pair of cooperating parts one of which is a feed housing part and the other of which is a door operating part, said door operating part having a pair of telescopic portions, and said pair of telescopic portions having means for moving said door into and out of a seating position with respect to the said seating portion and for also closing-off and opening said feed housing part.

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