April 25, 1939. A. J. BOLAND 2,156,008

CONTINUOUS FURNACE

Filed Jan. 12, 1938 3 Sheets-Sheet 1

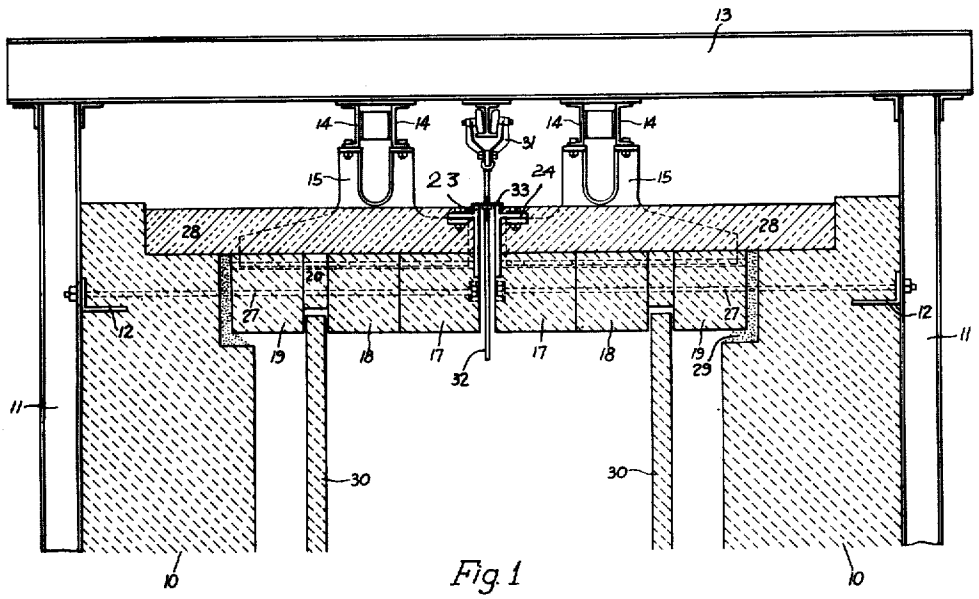

Fig. 1

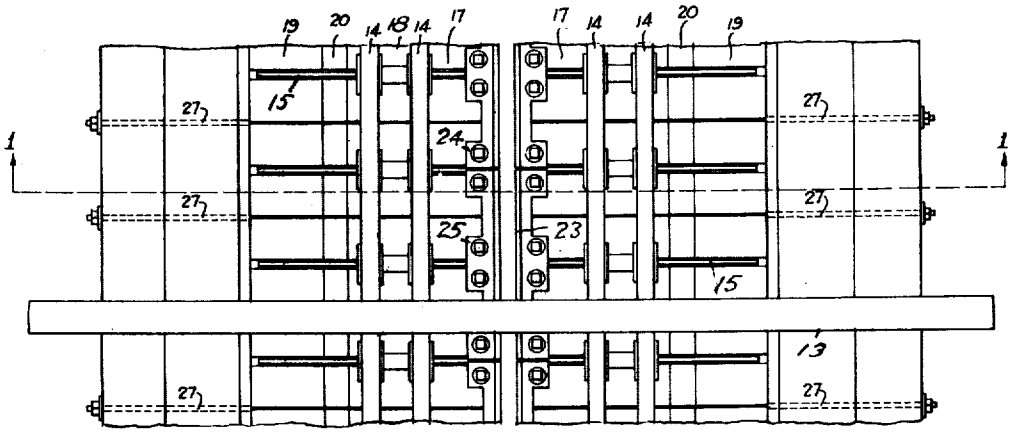

Fig. 2

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Fig. 3

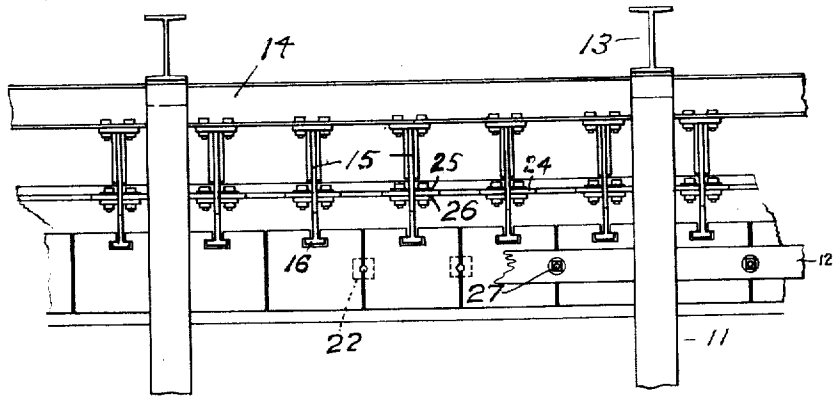


Fig. 6

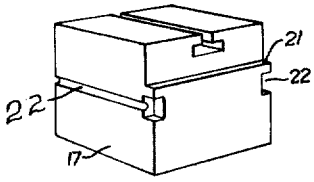


Fig. 7

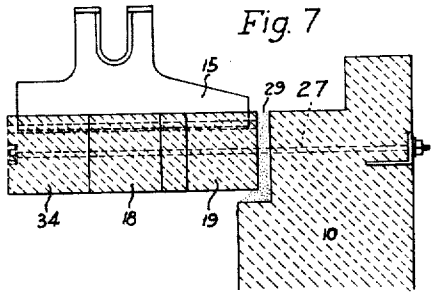
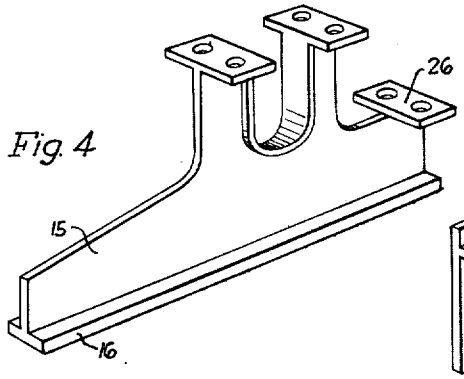


Fig. 4



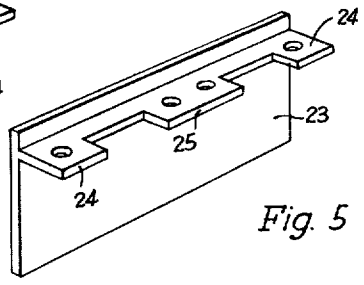


Fig. 5

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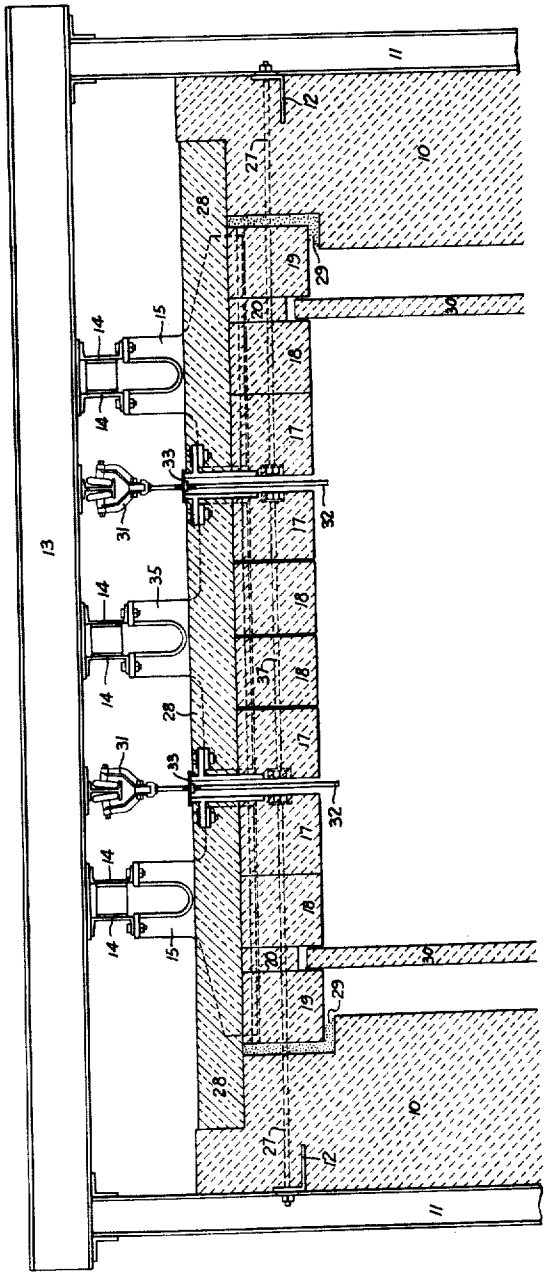

Fig. 8

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UNITED STATES PATENT OFFICE

2,156,008

CONTINUOUS FURNACE

Albert J. Boland, St. Louis, Mo.

Application January 12, 1938, Serial No. 184,671

15 Claims. (Cl. 263—8)

My invention relates to improvements in continuous furnaces having a conveyor slot in the roof, such as are used in the manufacture of enameled ware, and the improvements are directed more particularly to the roof suspension and the slot construction.

One object of the invention is to provide a flat arch roof having a slot, the refractory blocks or tile being suspended from arch brackets in such a way as to maintain the slot opening at the proper width and alignment, despite expansion and contraction.

Another object is to provide a furnace roof of simple construction in which comparatively few parts are employed and in which replacements are easily made.

A further object is to provide a furnace with a roof having a slot which is faced with slot castings designed to prevent the insulation on the roof from falling through the slot into the furnace and also to provide a smooth support for the slot sealing device which slides on said castings.

Another object is to provide a furnace roof construction in which all the high temperature suspension castings are protected from direct exposure to the heat of the furnace.

An additional object is to provide a furnace roof construction in which the movement of the tile, caused by expansion from heating, is away from the slot and is taken up by an expansion joint whereby the slot is not constricted or thrown out of proper alignment.

Other objects and advantages will be apparent from a consideration of the following description, in conjunction with the drawings in which several embodiments of the invention are illustrated.

Fig. 1 is a transverse section on the line 1—1 of Fig. 2 through the upper part of a single flow furnace;

Fig. 2 is a plan view thereof;

Fig. 3 is a side elevation with certain parts broken away;

Fig. 4 is a perspective view of an arch bracket;

Fig. 5 is a perspective view of a slot casting;

Fig. 6 is a perspective view of a roof tile;

Fig. 7 is a partial transverse section through a modified form of furnace, and

Fig. 8 is a transverse section of a counterflow furnace.

In Fig. 1 only the upper part of the furnace is shown as the improvements are concerned primarily with the roof construction. The furnace comprises suitable side walls 10 of masonry which are reinforced by vertical steel columns 11 such as I-beams or channel members. A horizontal angle iron 12 is secured to these columns on each side of the furnace with a horizontal flange imbedded in the masonry. On top of the columns are mounted transverse steel members 13 which may be in the form of I-beams and which support the roof and the conveyor. Longitudinal steel supports 14, which may be made of channel members, or other suitable sections, are welded, bolted, or otherwise fastened to the lower flanges of the I-beams 13. Roof brackets or arch brackets 15 are provided, which are secured to and supported by the channel members 14, and which are arranged preferably transversely with respect to the longitudinal axis of the furnace and are spaced apart at regular intervals, as shown in Fig. 2. A perspective view of one of these arch brackets is shown in Fig. 4, which shows also the preferred form of tile supporting device in the form of a horizontal flange 16 at the bottom of the bracket. These brackets are mounted in pairs, as shown in Fig. 1 for example, the inner ends of a pair of brackets being spaced apart to provide a clearance or slot.

The refractory blocks or tiles 17, 18, 19 and 20, in the preferred form, have suitable inverted T slots in the upper part, whereby they may be slid directly onto the flange 16 and supported by the bracket 15, which bracket provides a rigid suspension member. Any number of tiles may be employed suitable for a furnace of given dimensions. The particular furnace shown, in which the burning chamber or muffle may be assumed to be about three feet wide and about four and a half feet high, has a comparatively small number of such blocks. The drawings show three fairly large blocks of approximately the same size and one small one, on each side of the center line, there being an advantage in using fairly large tiles with correspondingly few joints between the same. The complete transverse row, in this instance, comprises eight blocks of the same width (i. e. viewed longitudinally of the furnace) and the roof is made up of a plurality of such transverse rows, and arranged side by side. Longitudinal expansion of the roof is provided for by slight clearance spaces between said rows, as shown in Fig. 3. The tiles 17 on opposite sides of the slot, are preferably recessed or rabbeted at 21, as shown more particularly in Fig. 6. Each of said tiles also has transverse grooves 22 on opposite faces, each formed with an end enlargement to receive the head of a tie rod, hereinafter described.

The upper part of the slot in the roof is faced

with metal in the form of slot castings 23 having projecting lugs or flanges 24, 25, which are bolted to a horizontal seat 26 on each of the brackets 15. The vertical plate comprising the main part of each slot casting is received within the recess 21 of the tile immediately facing the slot and thus forms a reinforcement therefor, not only to protect the tile against abrasion, due to contact with the conveyor, but also to prevent inward movement of the tile such as would tend to constrict the slot or vertical opening in the roof. These slot castings also aid in maintaining a perfectly straight slot through the roof of the furnace from one end thereof to the other.

As a further means of maintaining the proper width of the slot, tie rods 27 may be employed, as shown in Fig. 1, for example. Each tie rod is received in the two half recesses 22 in adjacent blocks, with the head of the tie rod in the non-circular enlargements shown in dotted lines in Fig. 3. The opposite end, in each case, passes through the angle iron 12, thus bolting the tile to the steel frame at the side of the furnace and preventing any substantial inward movement thereof toward the slot, during expansion or contraction caused by changes in temperature.

The roof of the furnace is covered with suitable insulating material 28, as shown in Fig. 1, which material may fill also the clearance space between the vertical face plate 23 and the end of the bracket 15.

With the construction described, any movement of the roof tile would have to be away from the slot, and such movement, due to expansion and contraction, is taken up by a filler 29 in the right angled recess or clearance space immediately adjacent the two outside blocks 19 in each horizontal row. It will be understood, as stated in part above, that these transverse rows of blocks are substantially in contact with each other when the furnace is hot, thus forming a continuous flat arch or roof from one end of the burning chamber to the other, except for the slot which is preferably located centrally with respect to the roof of said chamber, i. e. it follows the longitudinal axis thereof.

The side walls of the burning chamber or muffle walls 30 may extend upwardly into a recess or groove in the roof, formed by making the blocks 20 of somewhat less height vertically than the remaining blocks. This groove may be omitted when a muffle is not needed, as for example in an electrically fired enamelling furnace or any annealing furnace using an overhead conveyor. Also, the tie rods 27 may be omitted where desired, as the slot castings 23 serve, in many cases, to maintain the width of the slot without the auxiliary fastening means afforded by these tie rods.

An overhead conveyor 31 is secured to the transverse steel beams 13 and may be of any suitable construction. The usual depending rods or hangers 32 extend downwardly through the slot into the burning chamber and support the articles onto which the enamel is being fused. Suitable cover plates 33 normally cover the slot to prevent loss of heat through this slot. Where said slot covers travel with the conveyor, they slide on the smooth upper side of the vertical plates 23.

The advantages of the construction thus far described, include the following: a straight slot is provided of uniform width and well defined side walls, means are provided for keeping the roof insulation from falling through the slot into the burning chamber, a smooth and effective track or base is provided on which the conveyor slot seal may slide, roof bracket castings are protected from direct exposure to the furnace heat, positive alignment of the conveyor and of the conveyor slot is assured at all times, a simple but effective seal is provided for the muffle wall where it extends into the groove in the roof tile, and tile movement caused by expansion from heating is minimized at the slot, whereby the expansion tends to take place toward the expansion joint between the side wall of the furnace and the outer roof tile. The design of the roof brackets is such as to make installation and replacement a comparatively simple matter and instead of an intricate arrangement of numerous small parts, the present design employs relatively few pieces, which are assembled in a simple manner.

Fig. 7 shows a modification in which the slot castings are omitted. The tiles are hung from the arch brackets as before and the same numbers have been used to indicate corresponding parts except for the inner tile, indicated at 34, which has no recess in its inner face. The width of the slot is maintained, however, by the tie rod 27. Also, in this view there is no groove in the under side of the ceiling roof for the muffle wall to enter, although such groove may be provided. In this form of construction as well as in the one previously described, the side masonry wall has a shoulder or shoulders near the top. The lower shoulder is overhung by the roof tile to form a clearance space which is right angled in cross section, as shown also in Fig. 1, and the expansion material 29 occupies both the horizontal and the vertical passageway.

Fig. 8 shows a counterflow furnace, i. e. one in which there are two slots in the roof. Three arch brackets are arranged in alignment in this case instead of two, the end brackets 15 being preferably the same design as those previously described and the middle bracket 35 being of the same general design but being symmetrical with respect to its center line. The roof tiles, and the slot castings indicated by the same references as those used previously, are substantially the same as those previously described. However, the tiles hung from said middle bracket are spaced apart slightly, as shown in the drawing, to provide for expansion, whereas the tiles which are hung from the two side brackets 15 are in contact with each other. These roof tiles, at the two ends, may be held against inward movement by the tie rods in the same manner as previously explained, or said rods may be omitted in certain cases. The tiles in the middle section of the roof are held together by additional tie rods 37. The middle roof section is hung from the steel frame in the same manner as the two side sections. The muffle walls may enter grooves in the under side of the furnace ceiling, as previously described.

Substantially all of the advantages ascribed to the other forms of the invention discussed, inhere also in this construction.

1. In a furnace roof construction, a supporting metal frame above the roof, metal arch brackets depending therefrom, each extending from a point near the side wall of the furnace to a point near but terminating short of the center line of said furnace, and tiles each slotted in the upper surface thereof to receive the lower part of one of said brackets and depend therefrom, said tiles substantially engaging each other

to form a closed roof structure but spaced apart at said center line to provide a slot.

2. In a furnace of the class described having a burning chamber, a plurality of transverse rows of supporting brackets mounted above said burning chamber and extending from one side thereof to the other, a plurality of brackets in each row in alignment with each other and spaced at the ends from each other to provide a plurality of clearance spaces, and transverse rows of refractory blocks supported by said brackets, the blocks in each row being in contact with each other, except at said clearance spaces and each row being substantially in engagement with the adjacent rows at the sides thereof, to constitute the roof of said burning chamber, said roof having a plurality of longitudinal slots therein provided by said clearance spaces.

3. A furnace as in the preceding claim, with the addition of means for confining said blocks against transverse expansion to thereby maintain the minimum width of said slot.

4. A construction as in claim 2 in which the furnace is provided with masonry side walls having a shoulder near the top which said room overhangs but without contacting the same, thereby providing a clearance space, and expansion material in said space to provide an expansion joint.

5. In a furnace roof construction, transversely hung rows of tile, each row being divided to provide two half rows with a straight slot between them, the two tiles on opposite sides of said slot in each row having a recess in the upper part of the sides which face each other, metal plates spaced apart and each received in one of said recesses to provide reinforced side walls for said slot, and arch brackets each supporting one of said plates and an adjacent half row of tiles.

6. In a furnace roof construction, transversely hung rows of tile, each row being divided to provide two half rows with a straight slot between them, the two tiles on opposite sides of said slot in each row having a recess in the upper part of the sides which face each other, metal plates spaced apart and each received in one of said recesses to provide reinforced side walls for said slot, and heat insulating material covering said tiles, the upper edge of each of said plates extending above said heat insulating material to prevent the latter from falling into said slot.

7. In a furnace construction having a roof with a longitudinal slot therein, metal reinforcing plates arranged in alignment for reinforcing the side walls of said slot, each of said plates having lateral supporting brackets thereon, and arch brackets for supporting the roof of said furnace and having flanges thereon to which said brackets are secured.

8. In a furnace of the character described having a flat arch roof with a slot, arch brackets supported from above for sustaining said roof, said brackets being arranged in right and left pairs aligned with each other transversely of said furnace but spaced apart at said slot and each having a horizontal supporting lug thereon, a length of metal facing for said slot secured to each of said lugs, each bracket having also a horizontal flange disposed transversely of said furnace for supporting tile.

9. In a furnace construction, a burning chamber having refractory side walls, reinforcing metal uprights therefor and transverse metal members connecting said uprights above said walls, longitudinal metal members supported by said transverse members and forming therewith a roof-supporting frame, metal arch brackets depending therefrom and arranged transversely of said furnace in alignment with each other but having adjacent ends out of contact, tiles of large dimensions hung on said brackets and supported thereby out of contact with said side walls, said tiles being spaced apart near said ends to provide a slot, and means to hold the tiles facing said slot against inward movement such as would restrict the width of said slot.

10. A furnace as in claim 9 with the addition of tie members positively engaging said tiles adjacent said slots and extending transversely of said furnace, to prevent substantial movement of said tiles toward said slot, thus maintaining the desired width thereof.

11. In a furnace roof construction, a supporting metal frame above the roof, metal arch brackets depending therefrom in pairs, the brackets of each pair being in substantial alignment with each other and spaced apart at their adjacent ends, and tiles each slotted in the upper surface thereof to receive the lower part of one of said brackets and depend therefrom, said tiles being substantially in contact with each other to form a closed roof structure but spaced apart near said adjacent ends to provide a slot.

12. In a furnace of the class described having a burning chamber, a plurality of transverse rows of supporting brackets mounted above said burning chamber, each having its lower section as an inverted T, a plurality of brackets in each row in alignment with each other and spaced at the ends from each other to provide a clearance space, and transverse rows of refractory blocks each having an inverted T slot in which said lower section is received, the blocks in each row being substantially in contact with each other except at said clearance space, and each row being substantially in engagement with the adjacent rows at the sides thereof, to constitute the roof of said burning chamber, said roof having a longitudinal slot therein provided by said clearance space.

13. In a furnace construction, a burning chamber having refractory side walls, reinforcing metal uprights therefor and transverse metal members connecting said uprights above said walls, longitudinal metal members supported by said transverse members and forming therewith a roof-supporting frame, metal arch brackets depending therefrom and arranged transversely of said furnace in alignment with each other but having adjacent ends out of contact, tiles hung from said brackets and supported wholly thereby, said tiles being spaced apart near said ends to provide a slot, and means to hold the tiles facing said slot against inward movement such as would restrict the width of said slot.

14. In a furnace roof construction, a supporting metal frame above the roof, metal arch brackets depending therefrom, each extending transversely from a point near the side wall of the furnace to a point near but terminating short of the center line of said furnace, and tiles recessed near the tops thereof to receive the lower part of said brackets and depend therefrom, said tiles being arranged closely adjacent each other to form a closed roof structure and protect said brackets from the heat, but spaced apart adjacent said center line to provide a slot.

15. In a furnace of the class described having a burning chamber, a plurality of transverse rows of supporting brackets mounted above said burning chamber, a plurality of brackets in each row in alignment with each other and spaced at the ends from each other to provide a clearance space, and refractory blocks having recesses therein above the bottom walls thereof, holding means on said brackets received in said recesses to suspend said blocks from said brackets with said holding means and brackets protected from the heat by said blocks, the blocks in each row being substantially in contact with each other except at said clearance space, and each row being substantially in engagement with the adjacent rows at the sides thereof, to constitute the roof of said burning chamber, said roof having a longitudinal slot therein provided by said clearance space.

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CERTIFICATE OF CORRECTION.

Patent No. 2,156,008. April 25, 1939.

ALBERT J. BOLAND.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, first column, line 26, claim 4, for the word "room" read roof; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 20th day of June, A. D. 1939.

Henry Van Arsdale

(Seal) Acting Commissioner of Patents.

15. In a furnace of the class described having a burning chamber, a plurality of transverse rows of supporting brackets mounted above said burning chamber, a plurality of brackets in each row in alignment with each other and spaced at the ends from each other to provide a clearance space, and refractory blocks having recesses therein above the bottom walls thereof, holding means on said brackets received in said recesses to suspend said blocks from said brackets with said holding means and brackets protected from the heat by said blocks, the blocks in each row being substantially in contact with each other except at said clearance space, and each row being substantially in engagement with the adjacent rows at the sides thereof, to constitute the roof of said burning chamber, said roof having a longitudinal slot therein provided by said clearance space.

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