Dec. 4, 1951 J. S. MOHR 2,577,428

OPEN-HEARTH FURNACE ROOF CONSTRUCTION

Filed Dec. 30, 1947 2 SHEETS—SHEET 1

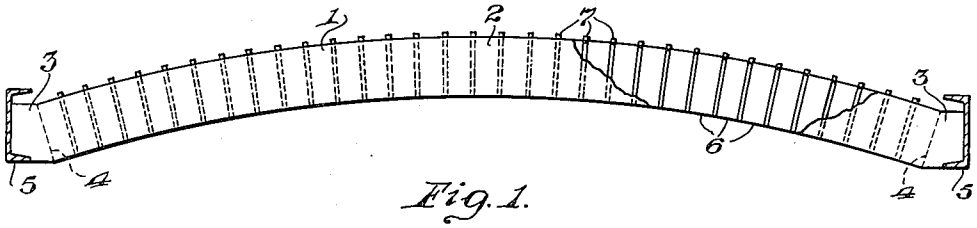


Fig. 1.

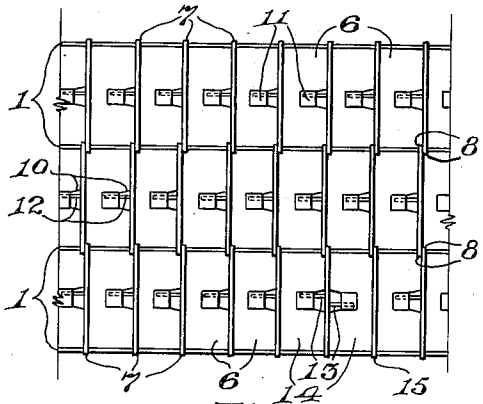


Fig. 2.

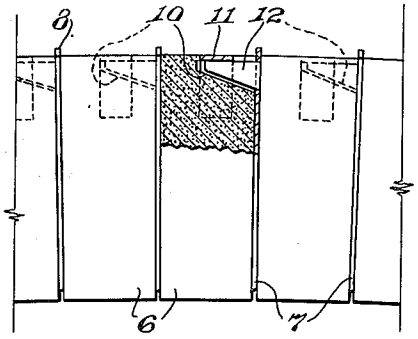


Fig. 3.

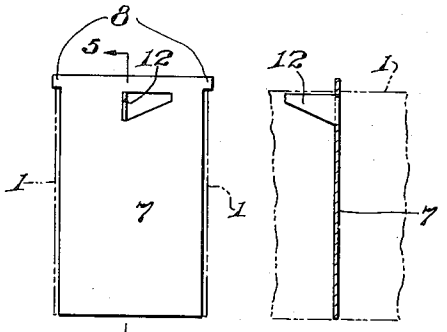


Fig. 4.

Fig. 5.

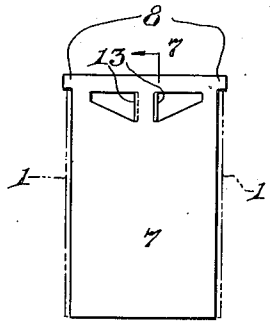


Fig. 6.

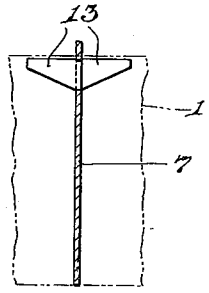


Fig. 7.

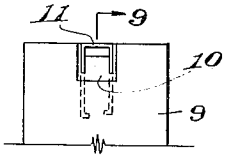


Fig. 8.

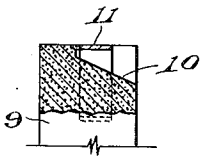


Fig. 9.

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OPEN-HEARTH FURNACE ROOF CONSTRUCTION

Filed Dec. 30, 1947 2 SHEETS—SHEET 2

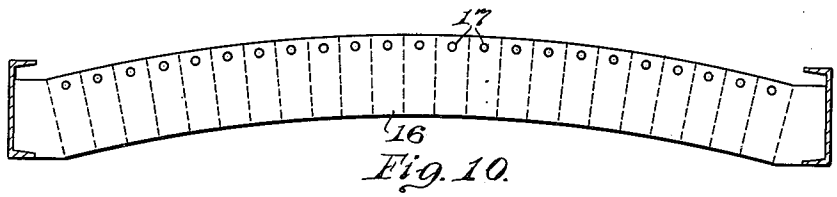


Fig. 10.

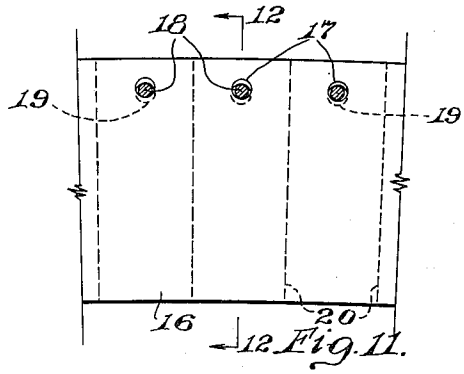


Fig. 11.

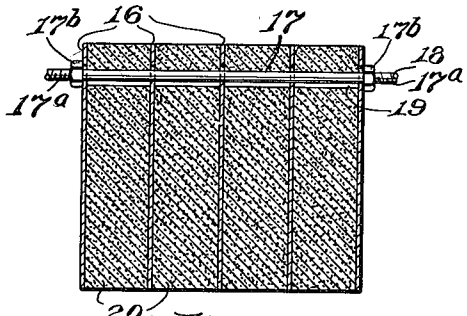


Fig. 12.

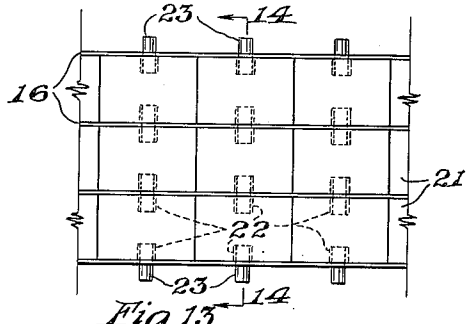


Fig. 13.

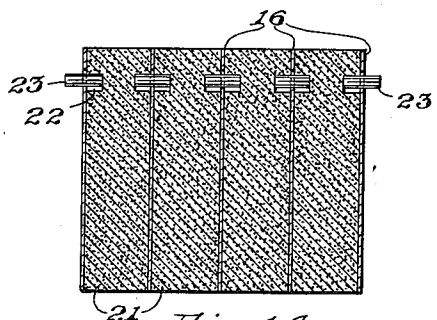


Fig. 14.

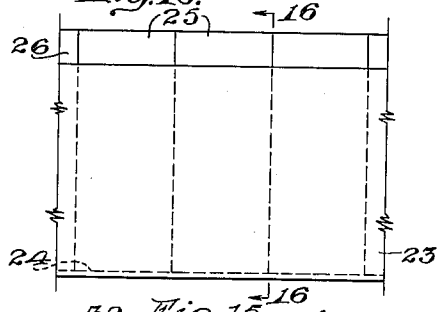


Fig. 15.

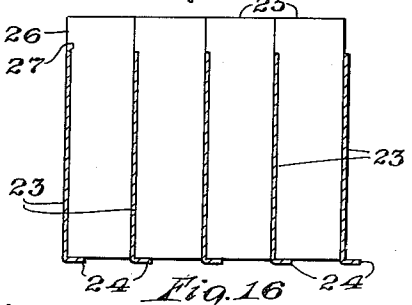


Fig. 16

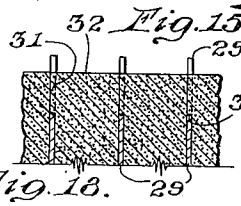


Fig. 18.

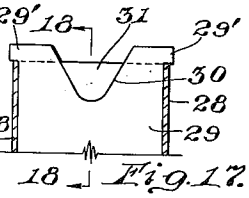


Fig. 17.

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UNITED STATES PATENT OFFICE

2,577,428

OPEN-HEARTH FURNACE ROOF CONSTRUCTION

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Application December 30, 1947, Serial No. 794,494

15 Claims. (Cl. 110—99)

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The object of the invention is to provide improvements in open hearth furnaces, and more particularly in a suspended roof therefor, while it can be also used as a combination of suspended and sprung arch construction.

Another object is to provide a self-contained suspended arch, comprising a plurality of spaced, relatively thin steel girder plates, that span the distance between the front and rear walls above which they are supported, in combination with wedges or combined wedges and straights positioned between pairs of adjacent plates, with means for supporting said bricks from said plates.

A further object is to provide in one embodiment of the invention the combination of spaced supporting girder plates, with intervening, transversely positioned spacer plates that hang upon or are otherwise supported by said girder plates, and which in turn support between them the wedges and/or straights that are required to complete an arch of a given radius.

Still another object is to provide a construction of this character in which the transverse spacer plates are provided adjacent to their uppermost portions with one or more angularly directed lugs, adapted to enter and support the bricks singly or in pairs, each of said bricks being provided, if desired, with an opening in at least one of its side surfaces defined upwardly by an inverted metal stirrup embedded within its mass to engage and rest upon the supporting lug of an adjacent spacer plate.

A still further object is to provide a modified construction comprising spaced girder plates that rest upon the furnace walls and are provided in their upper portions with aligned apertures, intervening bricks of the wedge and straight classifications also having apertures, and rods extending through said plates and said bricks to cause the bricks to be supported by the plates. A modification of this arrangement comprises bricks having oppositely directed recesses into which extend the ends of short rods or pins, that are centrally supported by the elongated plates through whose apertures they extend.

With these and other objects in mind, the invention comprises further details of construction hereinafter fully brought out in the following description, when read in conjunction with the accompanying drawings, in which Fig. 1 is a transverse elevational view of an arch constructed in accordance with one embodiment of the invention; Fig. 2 is an enlarged fragmentary portion of the same in plan; Fig. 3 is an enlarged side elevational view of the same, showing the upper portion of one of the bricks in section, and the cooperation between a supporting plate lug and the metal stirrup of the brick; Fig. 4 is a side elevation of the cross or transverse plate shown in Figs. 1, 2 and 3 and having a single lug; Fig. 5 is a vertical section of the same on line 5—5 of Fig. 4; Fig. 6 is a side elevation of the same type of cross plate but having a pair of oppositely directed brick-supporting lugs; Fig. 7 is a vertical section on the line 7—7 of Fig. 6; Fig. 8 is an upper fragmentary portion of one of the bricks having a lateral recess and an inverted metal stirrup in elevation; Fig. 9 is a section of the same on the line 9—9 of Fig. 8; Fig. 10 is a transverse elevational view of an arch comprising elongated girder plates with a modified form of brick-supporting means; Fig. 11 is an enlarged fragmentary portion of the same in side elevation; Fig. 12 is a section of the same on the line 12—12 of Fig. 11 and additionally slightly modified; Fig. 13 is a view similar to Fig. 11 but showing a modified form of brick-supporting pins or abbreviated rods in use; Fig. 14 is a sectional view of the same on the line 14—14 of Fig. 13; Fig. 15 is a side elevational view of a further modification of brick-supporting construction; Fig. 16 is a section of the same on the line 16—16 of Fig. 15; Fig. 17 is a fragmentary portion of a still further modified form of brick supporting structure and associated portions of a supporting cross plate and adjacent girder plates by which the cross plate is carried; and Fig. 18 is a section on the line 18—18 of Fig. 17.

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Referring to Figs. 1 to 9 inclusive, the invention initially comprises a multiplicity of elongated girderlike plates 1, having in general the outline of the transverse section of the furnace arch, and consisting of a central arched section 2 and oppositely directed end sections 3, that conform substantially to the outline of the usual skews 4, and adjacent to but not necessarily in contact with the skewback channels 5. These plates, hereinafter referred to as girder plates, for a roof of twenty feet span are approximately three-sixteenths of an inch in thickness, in order

to support the weight of the bricks in addition to their own weight. Shorter spans obviously permit the use of thinner plates, as both their own weight and that of the bricks required to cross the span are approximately proportionately less.

These girder plates are spaced apart the width of the wedge, or combination of wedge and straight, bricks 6 and are connected by spacer plates 7, that are positioned transversely of the spaces between adjacent girder plates, or longitudinally of the axis of the arch. Each spacer plate is in this embodiment of the invention provided at its upper limit with oppositely projecting lugs, ears, or shoulders 8, that rest upon the upper edges of adjacent girder plates, while their opposite vertical edges abut directly against the adjacent surfaces of said girder plates, and thereby function as spacing means to prevent transverse buckling or warping of said last-mentioned plates under load and the operating heat of the furnace.

The bricks forming the major part of the roof and carried by said girder and spacer plates may be of any desired construction to permit their being operatively and detachably supported, but for purposes of illustration the bricks 9 here shown are of the unfired variety and provided with recesses 10 that extend inwardly from one side surface adjacent the topmost portion of the brick, and are at least partially enclosed at their otherwise open upper portions by inverted steel stirrups 11, that are anchored in the body of the bricks and provide a thin but unyielding means for attaching the brick to the supporting plates. For this purpose each spacer plate is provided with any suitable shape of lug 12, that may if desired be punched and angularly directed outwardly from the plane of the spacer plate, as indicated in Figs. 4 and 5 which show a single such lug, or in Figs. 6 and 7, which show a pair of oppositely directed lugs 13. In Fig. 2 all of the bricks are shown as being supported by plates provided with single lugs 12, except in one instance in which two adjacent bricks 14 are supported by the double lugs 13 of a single spacer plate, in which case a plain spacer plate 15 is provided at the opposite side of one of the said pair of supported bricks.

Referring to Figs. 10, 11 and 12, the girder plates 16 are provided with aligned apertures 17 through which extend steel rods 18, that also extend through apertures 19 in the intervening bricks 20, it being unnecessary to employ spacer plates in this modification of the invention, though it may offer greater difficulty to insert the rods through all of the aligned apertures of both the girder plates and the intervening bricks, than to independently hang the individual bricks upon the spacer plate lugs hereinbefore described. However, with this modification, as shown in Fig. 12, it is possible to thread the opposite ends of the rods at 17a and by means of nuts 17b engaged with said threads to tension said rods, so as to thereby more solidly clamp the girder plates and bricks into a rigidly solid unitary mass.

Referring to Figs. 13 and 14, the same type of apertured girder plates 16 are used, but in this modification instead of the bricks having apertures that extend all of the way through them, each brick 21 is provided with a pair of oppositely directed, axially aligned bores 22 into a pair of which extend pins 23 after passing through intervening girder plates. This construction eliminates both the longitudinally extending rods of Figs. 10 to 12, and the spacer plates of Figs. 1 to 7.

Referring to Figs. 15 and 16, the girder plates 23 are provided with angularly directed lower edge flanges 24 upon which the bricks 25 initially rest while being assembled, while each of said bricks is provided with a shallow upper lateral extension 26, providing a shoulder 27 that permanently rests upon the upper edge of one of the pair of supporting girder plates between which it is positioned. Thus, after the flanges 24 have melted away the bricks remain operatively and positively supported by their shoulders resting directly upon said girder plates as shown.

Referring to Figs. 17 and 18, the girder plates 28 in this instance directly support the intervening spacer plates 29 through the medium of oppositely directed lugs 29' integrally carried by the latter, while the spacer plates in this instance are provided with upwardly opening, substantially U- or V-shaped cutouts 30 into which extend laterally projecting shoulders 31 carried integrally by each of said bricks. Thus, the several forms herein described illustrate how it is possible to use various combinations of the several elements involved, so as to thereby satisfy the different demands both of local conditions and the many different furnace operators.

While the improved construction has been described with particular reference to its application to open hearth roofs, this term is to be broadly considered as anticipating its use in other types of roofs, such for example as soaking pits, heating and tempering furnaces, hot metal mixers and the like. Also the term "suspended" has been used in the broad sense that the bricks comprising the roof are in general suspended individually from their upper portions, whether by lugs, rods, pins, etc., it being realized that the roof as a unit is in fact "supported" by the side (or front and rear) walls of the furnace through the medium of the spaced girder plates, as distinguished from individual brick and roof units that are fully suspended, in the sense that they hang from a superposed framework.

Furthermore, it will be appreciated that the girder plates, instead of being supported only at their ends upon the furnace walls, may have at least a portion of their weight and the weight of the brick which they carry borne by a superstructure, as by having the central or spaced intermediate portions of said girder plates actually suspended by rods or the like from above, thus permitting the use of girder plates of lighter or thinner gauge, while sectional girder plates comprising fractional parts of the total span may be used, in which case the adjacent ends of such segmental plates occurring between and in spaced relation with the furnace walls would have to be suspended from above.

An additional advantage of the new construction resides in the fact that when heated and thereby expanding, the relatively smooth initial contour of the roof is maintained, whereas it frequently happens that fully suspended roofs rise unequally, causing bulges or local rises, with resulting disturbance to the original relationship of the brick and maintenance of their predetermined joints.

Having thus described my invention, what I claim and desire to protect by Letters Patent of the United States is:

1. An open hearth furnace roof, comprising a

girder plate structure supported at its ends, a plurality of bricks to span the arch of the roof, and means to detachably suspend said bricks from the upper portion of said girder plate structure, the lower edge of said girder plate structure extending substantially to the plane of those surfaces of said bricks that are directly exposed to the furnace heat.

2. An open hearth furnace roof, comprising a plurality of parallel girder plates supported at their opposite ends, a plurality of bricks between said plates forming an arch, and means to detachably suspend said bricks between and from the upper portions of said plates, the lower edges of said plates extending substantially to the plane of those surfaces of said bricks that are directly exposed to the furnace heat.

3. An open hearth furnace roof, comprising a plurality of parallel spaced sheet metal girder plates supported vertically at their opposite ends, a plurality of transverse sheet metal spacer plates supported by and between said girder plates, bricks in rows between adjacent pairs of said girder plates and individually between pairs of said spacer plates, and means to detachably suspend said bricks from said spacer plates.

4. An open hearth furnace roof, comprising a plurality of parallel spaced sheet metal girder plates supported vertically at their opposite ends, a plurality of transverse sheet metal spacer plates supported by and between pairs of adjacent girder plates, bricks in rows between said girder plates and also between said spacer plates and a lug carried by the upper portion of each of said spacer plates interengaged with and supporting one of said bricks, the supported bricks including portions located between their lower surfaces and supporting lugs, shielding the supporting lugs from the heat of the furnace.

5. An open hearth furnace roof, comprising a plurality of parallel spacer sheet metal girder plates supported vertically at their opposite ends, a plurality of transverse sheet metal spacer plates supported by and between pairs of adjacent girder plates, bricks in rows between said girder plates and also between said spacer plates, each of said bricks having a generally downwardly directed surface, and a lug carried by the upper portion of each of said spacer plates and detachably engaging said surfaces to operatively support said bricks in unitary relation, the supported bricks including portions located between their lower surfaces and supporting lugs, shielding the supporting lugs from the heat of the furnace.

6. An open hearth furnace roof, comprising a plurality of parallel spaced sheet metal girder plates supported vertically at their opposite ends, a plurality of transverse sheet metal spacer plates supported by and between pairs of adjacent girder plates, bricks in rows between said girder plates and also between said spacer plates, the upper portion of each of said bricks having a recess bounded upwardly by an embedded stirrup, and the upper portion of each of said spacer plates being provided with a lug extending into the adjacent recesses and detachably engaging said stirrups to operatively support said bricks indirectly by said girder plates.

7. An open hearth furnace roof, comprising a plurality of sheet metal girder plates supported vertically at their opposite ends, a plurality of sheet metal spacer plates spanning the distance between each pair of adjacent girder plates and provided with oppositely extending lugs to rest upon the upper edges of said girder plates and with laterally projecting lugs, and bricks having recesses in their upper portions bounded upwardly by an embedded stirrup that rests upon said last-mentioned lug, to operatively support the bricks between adjacent girder plates and individually between said spacer plates.

8. An open hearth furnace roof, comprising a plurality of parallel spaced sheet metal girder plates supported vertically at their opposite ends and provided with aligned apertures, bricks having bores in their upper portions and positioned between said plates, and rods extending through said apertures and said bores to operatively support said bricks in rows between said plates, to provide a unitary structure.

9. An open hearth furnace roof, comprising a plurality of parallel spaced sheet metal girder plates supported vertically at their opposite ends and provided with apertures, bricks between pairs of said plates and provided with recesses in their upper portions, and pins extending through said plate apertures and entering said recesses to demountably support said bricks between said plates.

10. An open hearth furnace roof, comprising a pair of parallel spaced sheet metal girder plates supported vertically at their opposite ends and provided with longitudinally spaced apertures, bricks between said plates having recesses in their upper portions, and pins extending through said plate apertures and entering said recesses to support said bricks between said plates.

11. An open hearth furnace roof, comprising a sheet metal girder plate supported vertically at its opposite ends and having longitudinally spaced apertures, bricks having recesses, and pins extending through said apertures and entering the recesses of pairs of oppositely positioned bricks, to support them upon the opposite sides of said girder plate.

12. An open hearth furnace roof, comprising a plurality of spaced sheet metal girder plates, and bricks positioned between adjacent pairs of said plates and provided with shoulders that rest upon said plates, to prevent them from dropping from between said plates.

13. An open hearth furnace roof, comprising a plurality of spaced sheet metal girder plates having laterally projecting flanges at their lower edges, and bricks positioned between adjacent pairs of said plates and provided with shoulders to rest upon said plates, said bricks also initially resting upon said flanges while being assembled and until said flanges are burned away, after which said bricks are supported solely by their shoulders engaging said plates.

14. An open hearth furnace roof, comprising a pair of spaced sheet metal girder plates supported at their opposite ends, spaced sheet metal spacer plates extending transversely of the space between said girder plates and provided upwardly with oppositely directed shoulders that rest upon the upper edges of said girder plates and with intervening cutouts, and bricks having lateral extensions resting in said cutouts, whereby said bricks are operatively supported by said spacer plates between said girder plates.

15. An open hearth furnace roof, comprising a plurality of parallel spaced sheet metal girder plates supported at their opposite ends and provided with aligned apertures, bricks having bores and positioned between said plates, and rods extending through said apertures and said bores to operatively support said bricks in rows between said plates, to provide a unitary structure, and means engaging said rods to apply compression

to said girder plates and intervening bricks to solidify the structure.

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