Jan. 5, 1954 G. C. SORENSEN 2,664,838

PERMANENT HINGED BULKHEAD

Filed March 12, 1951 4 Sheets-Sheet 1

FIG. 1

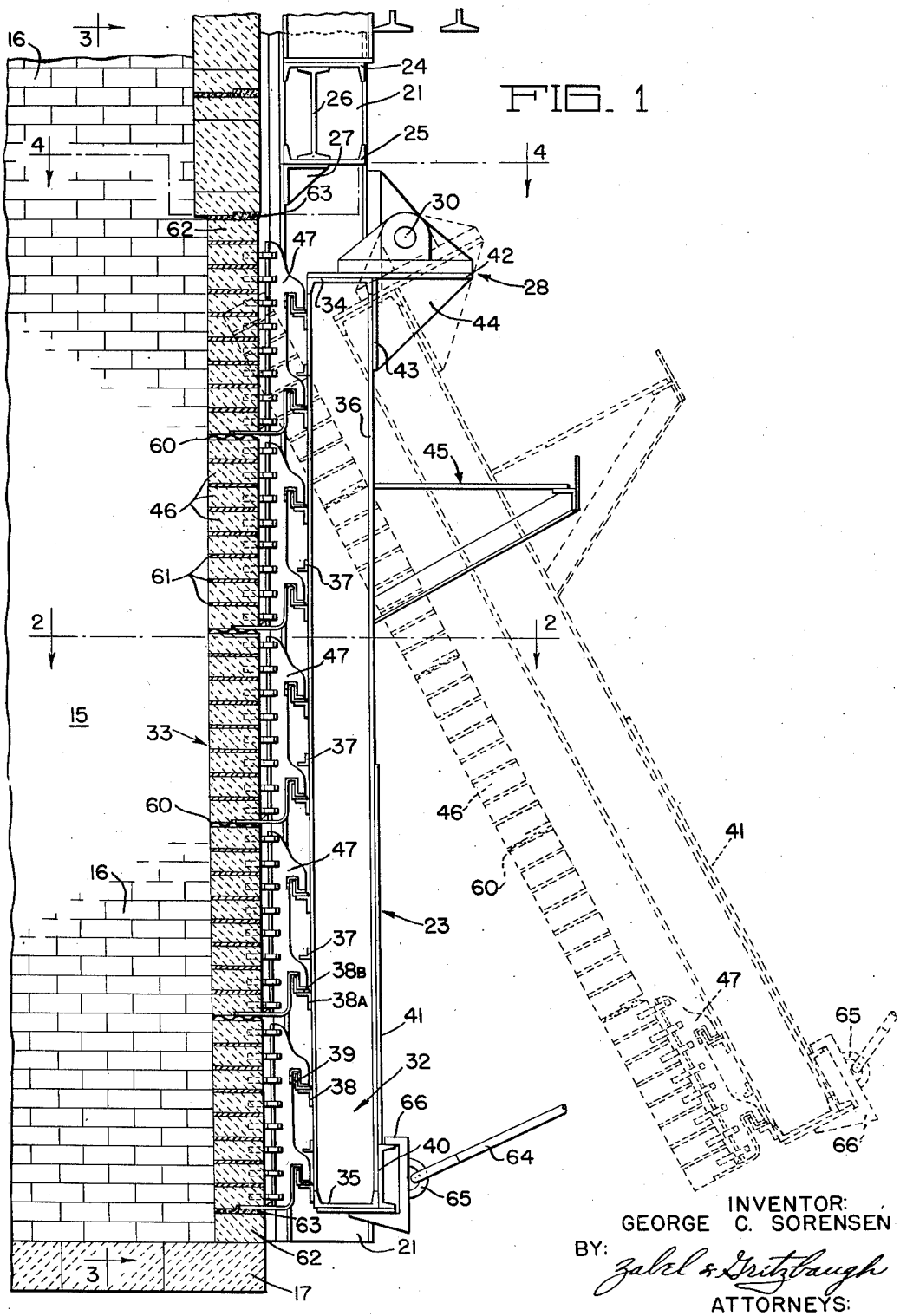

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FIG. 2

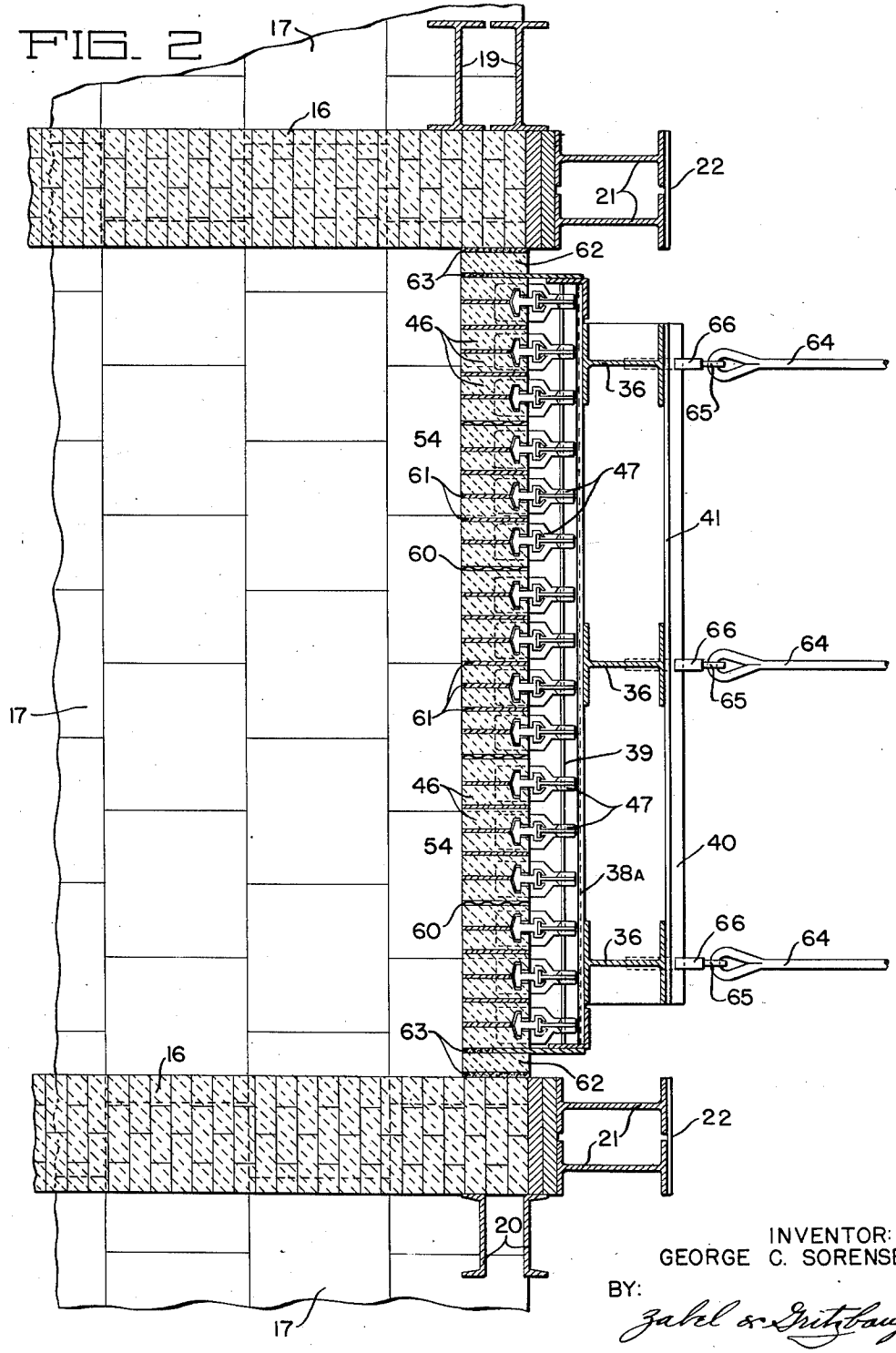

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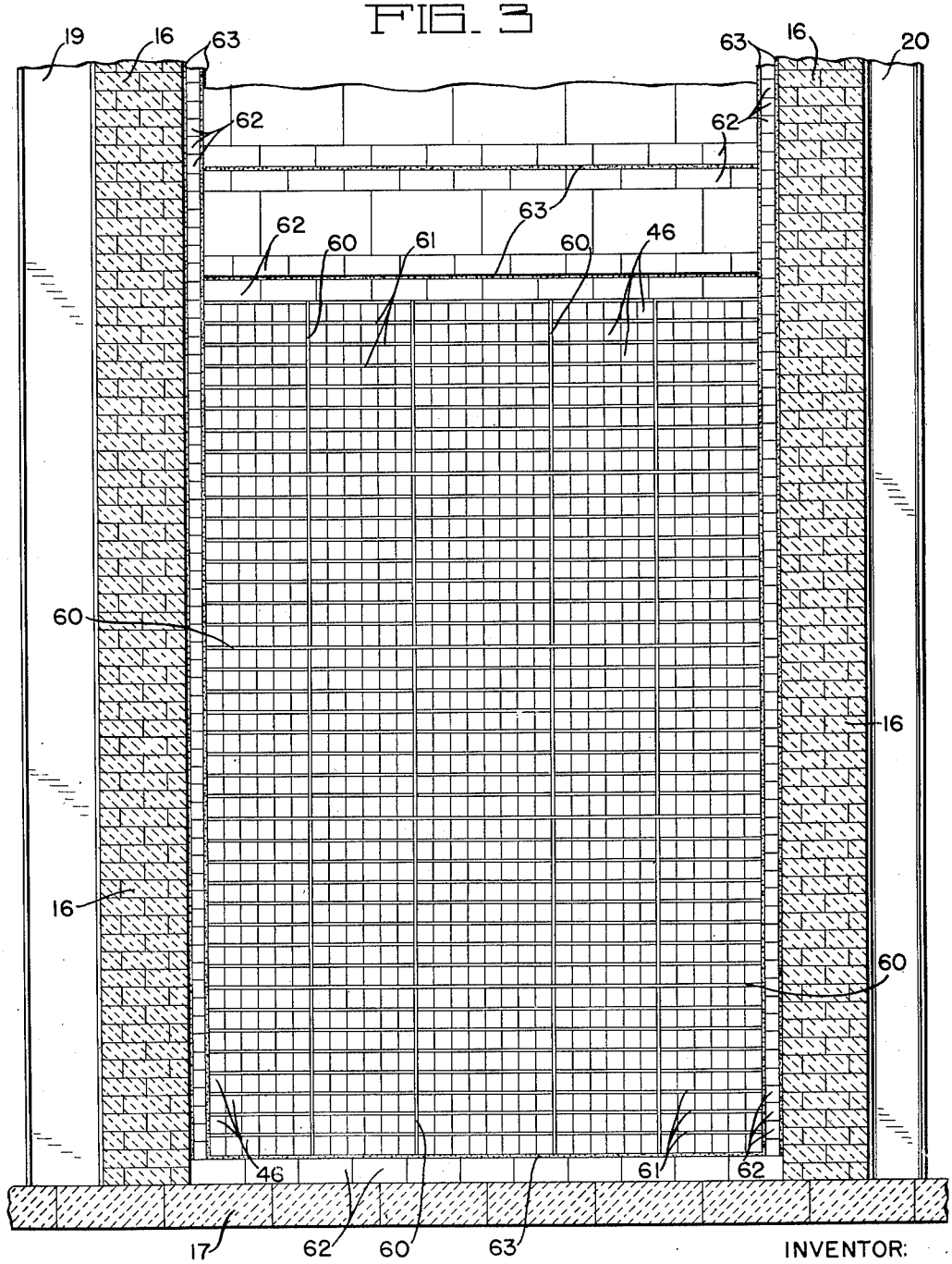
FIG. 3



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Filed March 12, 1951 4 Sheets-Sheet 4

FIG. 4

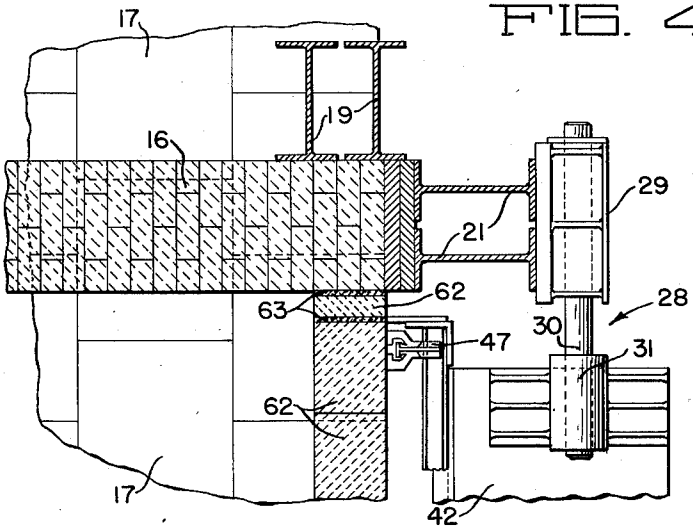


FIG. 5

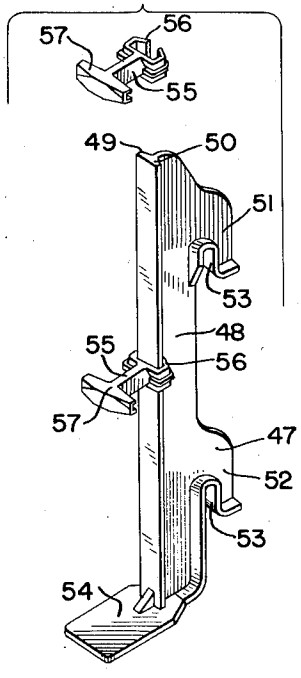


FIG. 6

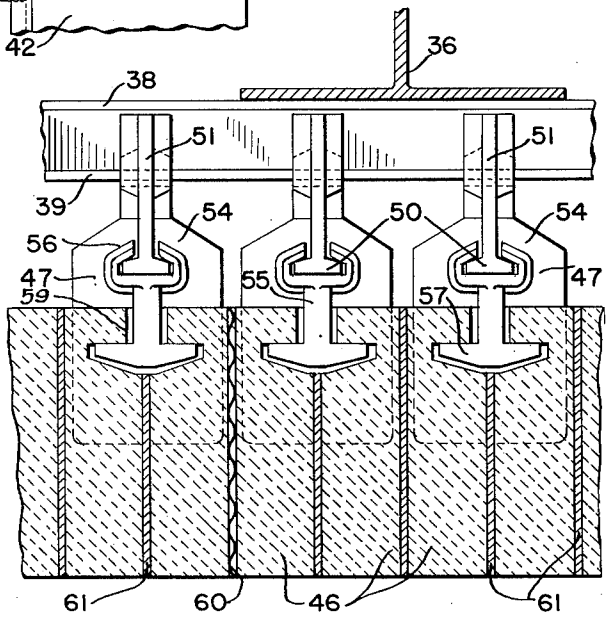
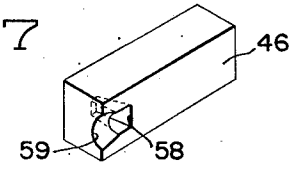


FIG. 7



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UNITED STATES PATENT OFFICE

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PERMANENT HINGED BULKHEAD

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Application March 12, 1951, Serial No. 215,079

6 Claims. (Cl. 110—173)

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The present invention relates to open hearth furnaces and particularly to a hinged bulkhead for closing slag pockets of such furnaces.

In the past the furnace slag pockets have been closed by bulkheads made up of brick laid in fire clay and it has been the practice to build these closing walls directly on the job. Each time it has been necessary to clean out the slag pocket, which normally occurs every sixty to ninety days, it has been necessary to tear down this bulkhead to permit access to the slag pocket. The slag and iron oxide carry-over from the furnace are removed after the furnace has been cooled sufficiently to permit the necessary entrance to the slag pocket and then the pocket bulkheads must be rebuilt by laying the bricks one by one until the wall is completed. Each time this is done a large quantity of new expensive fire brick is required.

One of the greatest time consuming operations in open hearth furnace practice has always been the removal of slag from the slag pockets. Over a period of time much effort has been concentrated on improvements designed to expedite the actual cleaning operation and such equipment needs as mechanized handling devices have been developed that can remove large quantities of slag at one time. In many plants, however, the actual time consumed in removing the slag is only a small fraction of that required to first tear down the bulkheads and then to rebuild them after the cleaning operation has been completed. Also the time required to cool the pocket after the bulkhead has been torn down has been a large contributing factor in the total time required to complete the operation. As much as twelve to twenty-four hours are normally required to tear down conventional bulkheads and then rebuild them after the cleaning operation has been completed. This does not include the time required to actually remove the slag from the pocket.

The present invention effects a great saving in overall time for cleaning out slag pockets and this saving is accomplished in connection with those operations that have actually taken the greatest amount of time in conventional practice. Where many hours have previously been required to tear down the bulkheads to gain access to the slag pockets, only four or five minutes are required where the present invention is employed. This causes the slag pocket to commence cooling down as soon as the bulkhead is open and consequently access into the slag pocket can be had much more quickly. After the conventional bulkheads have been torn down, both time and labor have been required to effect the removal and disposal of the discarded bricks. All of this last mentioned consumption of time is eliminated where the present invention is used. Where many hours had been required to rebuild

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the bulkhead under conventional practice, only about thirty minutes are needed to seal and close the pocket in the case of the present invention. This represents a very substantial reduction in time. Accompanying all of this time reduction there is also a substantial saving in labor that was formerly required for the tearing down and rebuilding of the bulkheads.

The bulkhead embodying the present invention assumes the form of a door-like wall weighing two or more tons swung from above on a horizontal axis or from a vertical axis at one side of the bulkhead. The structure of the bulkhead is made of steel, on the inside face of which is a lining of fire and heat resisting brick, such as basic brick or fire brick. When the bulkhead is closed provisions are made for sealing the closure to prevent air from the outside leaking into the bulkhead.

The foregoing constitute some of the principal objects and advantages of the present invention, others of which will become apparent from the following description and the drawings, in which

Fig. 1 is a fragmentary vertical, sectional view taken through the slag pocket of an open hearth furnace and illustrating a hinged bulkhead both in its closed position and in a partially open position;

Fig. 2 is a fragmentary, horizontal, sectional view taken through the slag pocket and the hinged bulkhead taken on line 2—2 of Fig. 1;

Fig. 3 is a fragmentary sectional view of the wall of an open hearth furnace, taken on the line 3—3 of Fig. 1, the view being taken from inside the slag pocket and showing in elevation the inside face of the hinged bulkhead illustrated in Fig. 1;

Fig. 4 is a horizontal sectional view through a portion of the wall of the furnace, the view being taken along the line 4—4 of Fig. 1;

Fig. 5 is an enlarged perspective view of a hanger bracket used for supporting refractory brick, the view also illustrating a pair of brick holding members, one of which is illustrated in exploded relationship with respect to the hanger bracket;

Fig. 6 is an enlarged, fragmentary, horizontal, sectional view taken through the bulkhead, the view illustrating three hanger brackets in their assembled positions supporting refractory brick; and

Fig. 7 is a perspective view of one of the refractory bricks used for lining the inside face of the bulkhead.

For purposes of illustration one embodiment of the present invention will be described hereinafter but it is recognized that many modifications may be made in this particular embodiment without departing from the intended scope and spirit of the invention.

Referring first of all to Figs. 1 and 3 there is

shown a portion of an open hearth furnace that includes the slag pocket indicated at 15 in Fig. 1. This slag pocket 15 is formed by spaced apart side walls 16 (Fig. 3), a bottom wall or floor 17 (Fig. 1) and a top wall or ceiling (not shown) and a rear wall (not shown), all of which walls are made of brick. As shown in Fig. 2 the furnace wall framing around the slag pocket includes a pair of I-beams 19 that are vertically disposed along one side of the side walls 16 of the slag pocket and a pair of channel beams 20 vertically disposed along the other side wall 16 of the slag pocket. Against the front face of each of the side walls 16 of the slag pocket are disposed a pair of I-beams 21 against the front face of which is a plate 22.

The slag pocket 15 is provided with an opening over which a hinged bulkhead 23 can be disposed for closing and sealing the opening. Above this opening and across the face of the furnace wall is framework that includes upper and lower channel beams 24 and 25, respectively, between which is an I-beam 26. These channel beams 24 and 25 form part of the framing around the slag pocket opening that includes the I-beams 21 previously mentioned in connection with Fig. 2. Suitable angle members 27 are provided to hold the structure together and to supply suitable reinforcing.

The hinged bulkhead 23 is a massive structure weighing several tons. This bulkhead is pivoted or hinged as illustrated in Fig. 4 at 28, this hinge connection including at each side of the bulkhead a stationary bracket member 29, one of which is illustrated in Fig. 4 and is suitably secured to the I-beam structural members 21. Mounted in this stationary bracket member 29 is a shaft 30 upon which is mounted a bracket 31 that is secured to the bulkhead 23. The hinged member 28 shown in Fig. 4 is located at one of the upper corners of the bulkhead and a second hinge member of the same type (not shown) is located at the other upper corner of the bulkhead. It is contemplated that the entire bulkhead can swing from a vertically closed position illustrated in solid lines in Fig. 1 to an open position, one partially open position being illustrated in broken lines in Fig. 1. During this movement of the bulkhead the entire structure pivots about the axes of the shafts 30 of the two hinged members 23. As shown in Fig. 1 these hinge members 28 are disposed at the top of the bulkhead but it is recognized that they may be arranged at the top and bottom of the bulkhead along one side of the bulkhead so that the bulkhead may swing about a vertical axis disposed along one of the sides thereof.

The hinged bulkhead 23 comprises generally a metal framework generally indicated at 32, upon which is supported a refractory lining or facing generally indicated at 33 in Fig. 1. The metal framework 32 comprises spaced upper and lower horizontal channel bars 34 and 35 respectively, between which are disposed a plurality of vertical and parallel I-beams 36. Across the inner faces of the I-beams 36 are a plurality of stiffener angle bears 37 disposed horizontally and spaced throughout the height of the I-beams 36. These angle bar stiffeners 37 are secured to the flanges of the I-beams 36. Also mounted on the inner faces of the I-beams 36 are horizontally disposed angle members 38 that extend throughout the width of the framework 32 and are spaced at regular intervals from the bottom to the top of the I-beams 36. These angle bars 38 face downwardly so that each has a downwardly projecting flange 38*a* and an outwardly projecting flange 38*b*. On each of the outwardly projecting flanges 38*b* is mounted an upwardly extending angle bar 39. These angle bars 39 are also horizontally disposed and extend throughout the entire width of the framework 32. Across the bottom of the framework 32 on the opposite face of the I-beams 36 is a channel member 40 that extends horizontally throughout the width of the framework 32. A plate 41 is disposed directly above this channel member 40 and covers the lower portions at least of the I-beams 36.

Mounted on the upper portion of the framework 32 at each corner thereof is the bracket 31 previously mentioned that includes a horizontally disposed plate 42 that is secured to the upper channel member 34. A downwardly projecting flange 43 is attached to the front face of the adjacent I-beam 36 and a reinforcing web 44 is provided between the downwardly projecting flange 43 and the outwardly projecting portion of the plate 42. Also mounted on the front face of the framework 32 is a walk generally indicated at 45.

The refractory lining 33 includes a plurality of refractory brick or basic brick 46 that are carried on hanger brackets 47, which in turn are supported on the angle bars 39. Each hanger bracket 47 as best shown in Fig. 5 comprises a vertically disposed body or web portion 48 provided with laterally extending flanges 49 and 50. A pair of ears 51 and 52 is provided, ear 51 being located adjacent the top of the hanger bracket and ear 52 adjacent the lower portion of the bracket. Each of these ears provides a socket 53 which receives the upstanding flange (see Fig. 1) of one of the angle bars 39. At the base of the hanger bracket 47 is a platform member 54 that is adapted to support the weight of the brick.

As shown in Fig. 5 a brick holding member 55 is provided at one end with jaw-like elements 56 and at the other end with a T-head 57 that is tapered at both sides. This brick holding member 55 is adapted to slide over the upper ends of the flanges 49 and 50 and is thus connected to the hanger bracket as best illustrated in Fig. 5.

Referring to Fig. 7 there is shown a brick 46 that is recessed at 58 so as to receive one of the tapered ends of the T-head 57 (Fig. 5) of the brick holding member 55. The brick 46 is grooved or slotted at 59 to facilitate mounting the brick on the brick holding member 55.

Each of the hanger brackets 47 as shown in Fig. 1 is adapted to accommodate eight brick holding members 55 and each of the brick holding members 55 carries two bricks 46 as shown in Fig. 6. Thus each hanger bracket 47 as illustrated herein is able to support sixteen bricks. When the assembly has been completed the bricks 46 are supported in a vertical direction on the platforms 54 of the hanger brackets 47 and when the bulkhead is moved to an open position as illustrated in broken lines in Fig. 1 or even in a completely open position, the bricks are suspended on the brick holding members 55 so that the structure holds together as a complete unit.

As shown in Figs. 1, 2 and 3, the lining 33 of the bulkhead is divided up into areas, each of which areas is bounded by corrugated steel plates 60. These corrugated steel plates 60 are disposed both vertically and horizontally. Mounted between adjacent bricks 46 are flat horizontally disposed steel plates 61. These steel plates 61 to-

gether with the bricks **46** provide a rigid structure that can support itself, both when the bulkhead is in its vertically closed position and in its open position. The corrugated steel plates **60** permit the normal expansion that takes place when the brick and steel are heated up and also these corrugated plates tend to collapse and thus provide room for the growth that takes place due to the formation of iron oxide when the brick and metal are exposed to high temperatures.

In order to permit the bulkhead **23** to be readily opened and closed, space must be provided on the sides, across the top and at the bottom. After the bulkhead is closed, it is essential before the furnace is placed into operation to seal these openings and consequently a plurality of fire brick or other heat resisting brick **62** are inserted in the opening along the bottom of the bulkhead, in the openings at both sides of the bulkhead extending throughout its height and in the opening across the top of the bulkhead. A fire clay mud indicated at **63** is then packed in around these loose bricks **62** to completely seal these openings.

The bulkhead **23** may be swung between its open and closed positions by means of cables, a portion of one of which is illustrated at **64** in Fig. 1. Each cable is secured to an eyelet **65** that may be fastened on a bracket member **66** which in turn is secured to the bottom portion of the framework **32** of the bulkhead.

I claim:

1. A hinged bulkhead for furnaces comprising a steel frame, pivot means adjacent a margin of the frame for hingedly mounting the frame to swing about a fixed axis between open and closed positions, brick holding members, heat resistant brick mounted thereon, and means between the inside face of said frame and said holding members for mounting said brick holding members on said frame in spaced relation to the inside face thereof, said brick forming a wall spaced from the inside face of said frame and completely lining said face thereof.

2. A hinged bulkhead for furnaces comprising a steel frame, pivot means having a fixed pivotal axis adjacent a margin of the frame for hingedly mounting the frame to swing between open and closed positions about said axis, a plurality of hangers projecting from the inside face of the frame, heat resistant brick, and means for supporting said brick on the hangers to project endwise from the sides of said hangers remote from said frame in spaced relation to said frame, said brick forming a wall spaced from said inside face of said frame, the outer face of said wall being spaced inwardly from the inside face of said frame and completely lining said face thereof.

3. In combination with a furnace having a slag pocket having top, bottom and side walls defining an opening, of a hinged bulkhead for insertion into said opening to close the same, comprising a steel frame, pivot means having a fixed pivotal axis adjacent one side of the frame for hingedly mounting the frame on the furnace on said fixed pivotal axis, said frame being externally of said furnace in both open and closed position of said bulkhead, heat resistant brick supported on the frame to project therefrom toward said furnace in inwardly spaced relation to said frame and lining one complete face of the frame so as to lie between all portions of said frame and said furnace, said heat resistant brick lining being inwardly offset from said axis and projecting into said opening between said walls, and heat resistant material disposed between said walls and the periphery of said heat resistant lining when the bulkhead is closed.

4. A hinged bulkhead for furnaces comprising a steel frame having a plurality of vertical members, top and bottom members and a plurality of transverse stiffening members, pivot means having a fixed pivotal axis adjacent a margin of the frame and offset outwardly from the outer face thereof for hingedly mounting the frame to swing between open and closed positions about said fixed axis, a plurality of hangers supported on the frame and projecting from the inside face thereof, a plurality of heat resistant brick, and means between said brick and hangers for mounting said brick on the hangers in spaced relation thereto to form a heat resistant wall substantially co-extensive in height and width with the frame, said hangers and said mounting means being located between said brick and the inside face of said frame and spacing the outer ends of said brick from said face of said frame.

5. A hinged bulkhead for furnaces comprising a steel frame, pivot means having a fixed pivotal axis adjacent a margin of said frame and offset outwardly from the outer face thereof for hingedly mounting the frame to swing between open and closed positions, a plurality of hangers supported on the frame and projecting from the inside face thereof, a plurality of pairs of basic brick disposed on each hanger, steel plates between said pairs of bricks, means on said hangers for mounting said bricks on said hangers to project endwise therefrom in spaced relation to the side thereof remote from the inside face of said frame, the bricks being disposed throughout the length and height of the frame so as to form a heat resistant liner co-extensive with and spaced inwardly from the inside face of the frame, and corrugated sheets between bricks of adjacent pairs at spaced intervals in said wall.

6. A hinged bulkhead for furnaces comprising a steel frame, pivot means having a fixed pivotal axis adjacent a margin of said frame and offset outwardly from the outer face thereof for hingedly mounting the frame to swing between open and closed positions, a plurality of hangers supported on the frame and projecting from the inside face thereof, a plurality of pairs of basic brick disposed on each hanger, steel plates between said pairs of bricks, means on said hangers for mounting said bricks on said hangers to project endwise therefrom in spaced relation to the side thereof remote from the inside face of said frame, the bricks being disposed throughout the length and height of the frame so as to form a heat resistant liner co-extensive with and spaced inwardly from the inside face of the frame, vertically extending corrugated sheets between bricks of adjacent pairs at spaced intervals in said wall and horizontally extending corrugated sheets between said bricks at spaced intervals in said wall.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
678,282	Roe	July 9, 1901
890,175	Ries	June 9, 1908
1,034,328	White	July 30, 1912
1,427,862	Smith	Sept. 5, 1922
1,829,159	Sheahan	Oct. 27, 1931
2,045,662	Longenecker	June 30, 1936
2,561,933	Longenecker	July 24, 1951