Oct. 23, 1945. L. S. LONGENECKER 2,387,594

FURNACE DOOR

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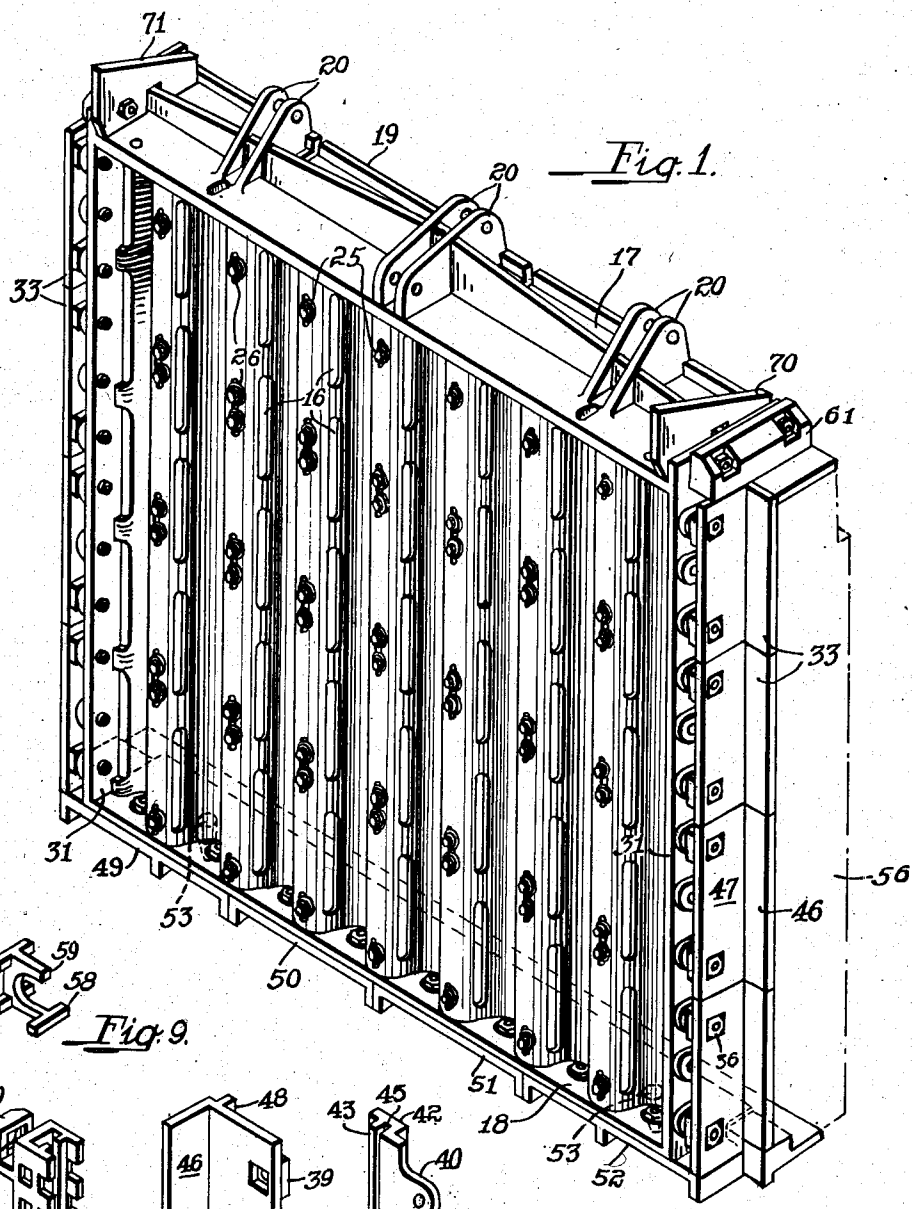


Fig. 1.

Fig. 9.

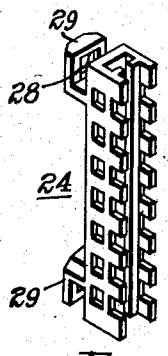


Fig. 10.

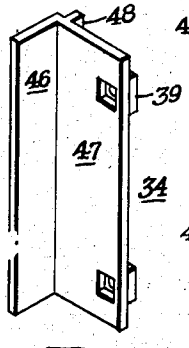


Fig. 11.

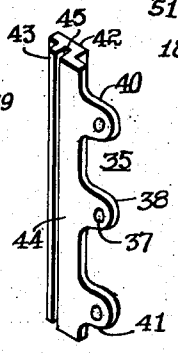


Fig. 12.

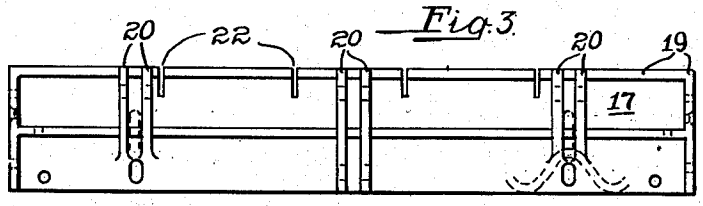
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FURNACE DOOR

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Fig. 3.



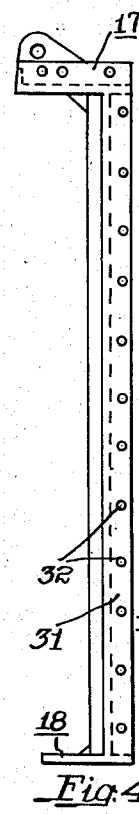


Fig. 4.

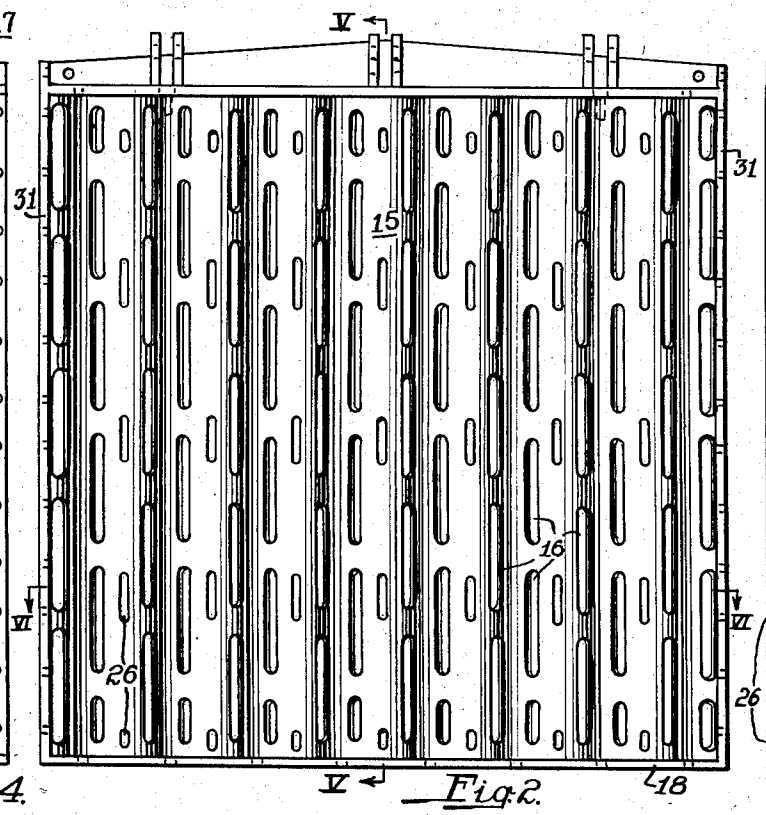


Fig. 2.

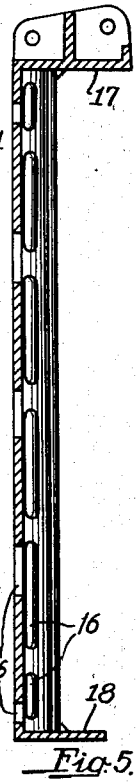


Fig. 5.

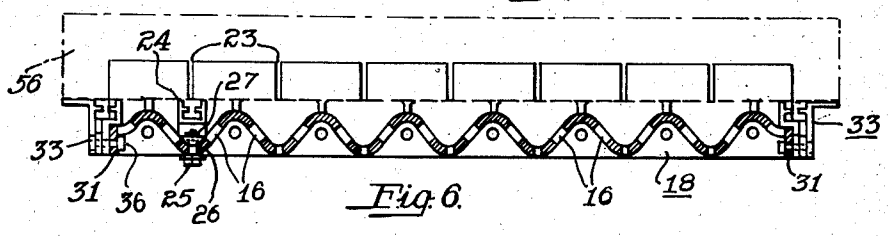


Fig. 6.

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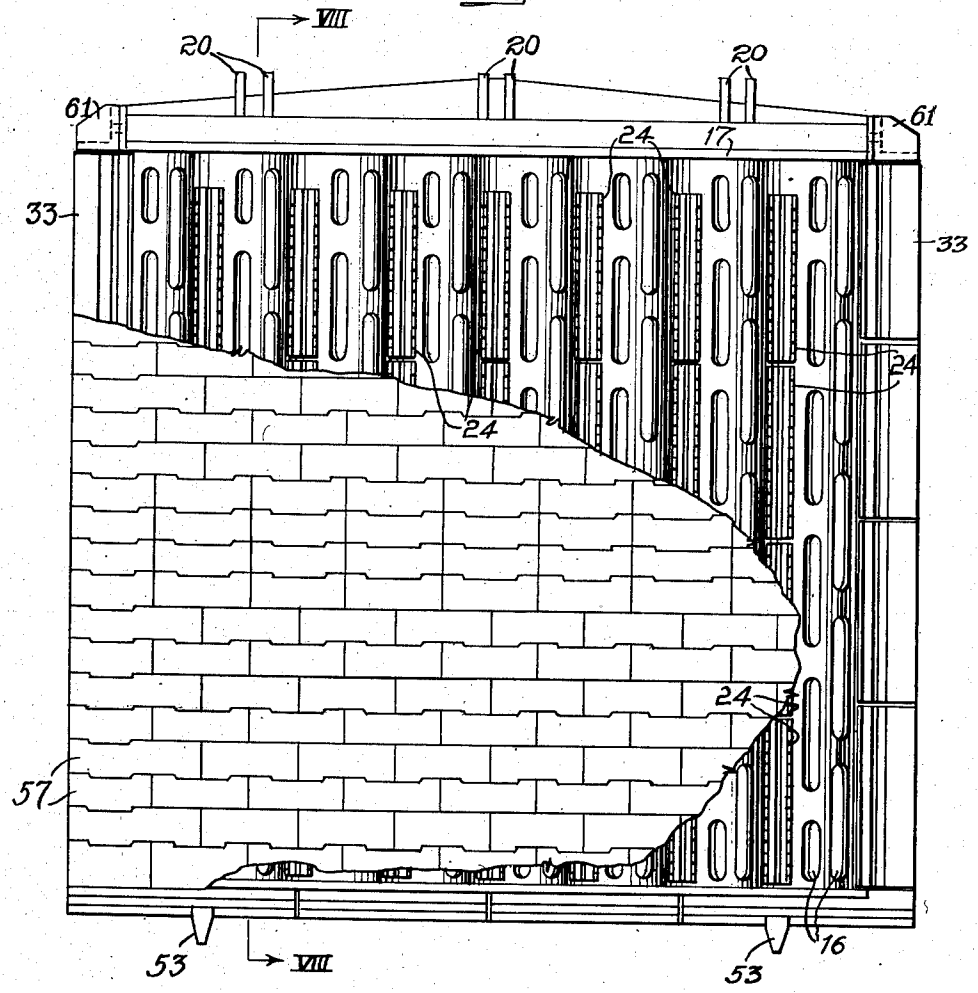
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FURNACE DOOR

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Fig. 7.



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FURNACE DOOR

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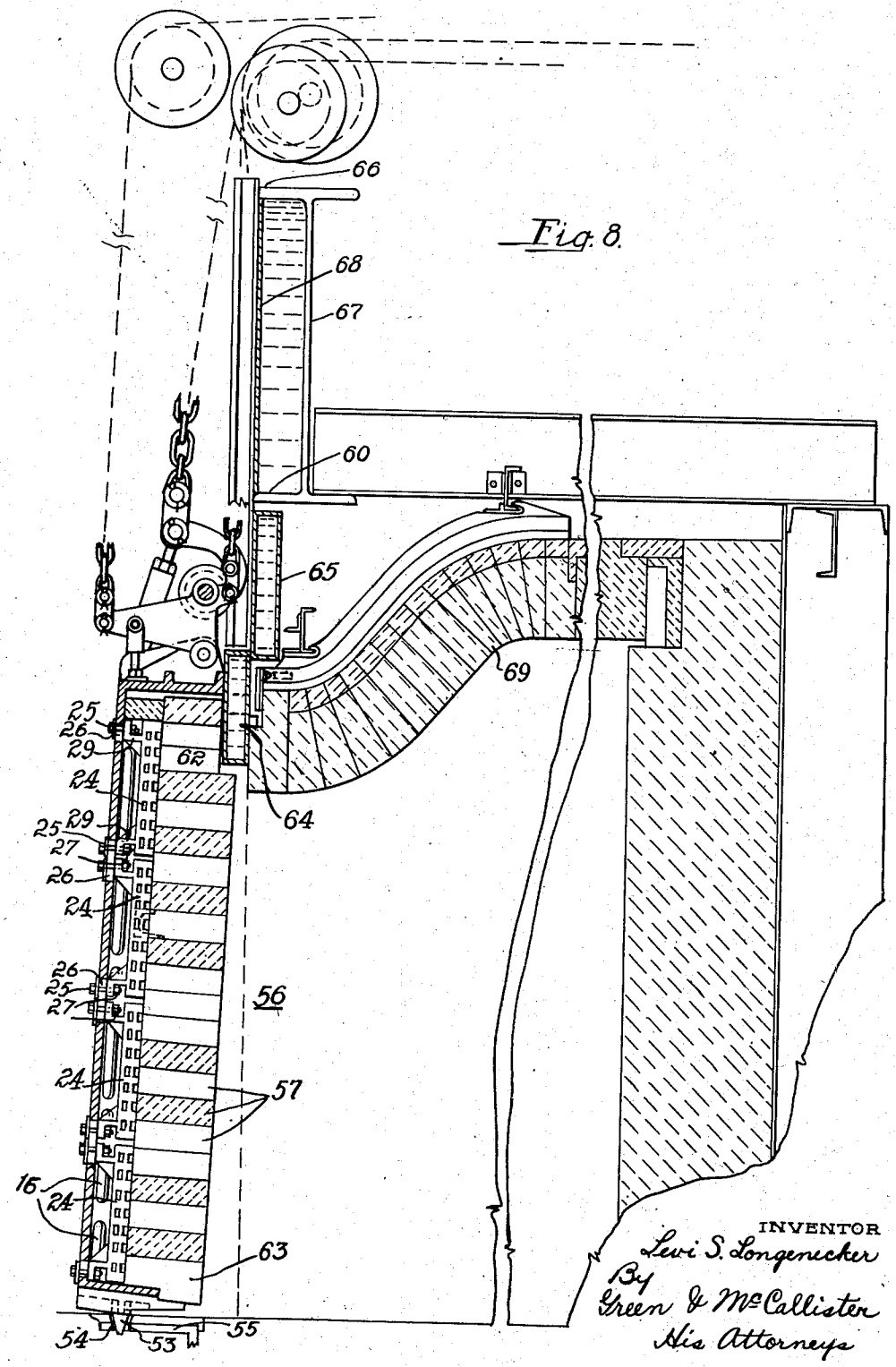


Fig. 8.

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FURNACE DOOR

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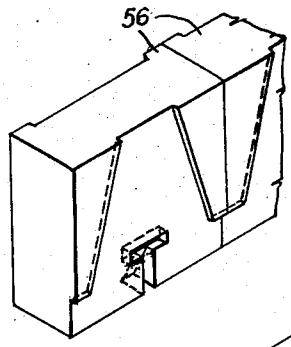


Fig. 14.

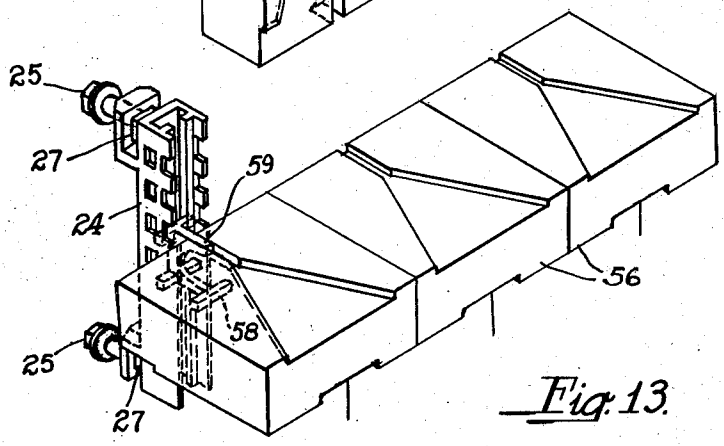


Fig. 13.

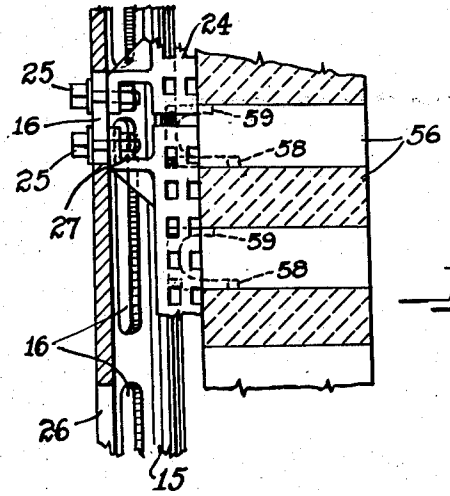


Fig. 15.

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Patented Oct. 23, 1945

2,387,594

UNITED STATES PATENT OFFICE

2,387,594

FURNACE DOOR

Levi S. Longenecker, Mount Lebanon, Pa.

Application May 13, 1942, Serial No. 442,873

11 Claims. (Cl. 110—173)

This invention relates to furnace doors and more particularly to doors for the charging openings of open hearth, heating and other metallurgical furnaces.

Some of these furnaces are provided with relatively short charging openings which are controlled by one door, while others have charging openings which extend throughout substantially the full length of the furnace chamber, are unobstructed throughout their length and are controlled by a number of doors arranged in side by side relation.

In United States patents granted to me on Dec. 17, 1935 and June 30, 1936 and numbered 2,024,649 and 2,045,661 and 2,045,662, I disclose metallurgical furnaces having charging openings which extend substantially throughout the length of the furnace chamber and doors which are not only designed to be used in side by side relation to control these relatively long charging openings, but which can be used for controlling relatively short or individual charging openings as well.

An object of this invention is to produce an improved door for furnaces such as open hearth furnaces, heating furnaces and other metallurgical furnaces.

Another object of this invention is to produce a novel and improved ventilated or air cooled frame for furnace doors provided with a refractory block or tile lining.

A further object is to produce a door for metallurgical furnaces in which, during operation, there will be substantially no distortion or warpage.

A still further object is to produce a door for metallurgical furnaces, which includes interlocking refractory blocks or tile and a cast metal frame for supporting such blocks or tile and which is of such construction that no part thereof is subjected directly to the furnace temperatures when the door is in use.

These and other objects which will be apparent to those skilled in this particular art, I attain by means of the structure described in the specification and illustrated in the drawings accompanying and forming part of this application.

In a general way, the furnace door of this invention comprises a frame which is preferably cast from steel as a unitary structure comprising top and bottom members and a back member which joins the top and bottom members, is of substantially uniform thickness, with alternating furrows and ridges in opposite sides thereof extending at right angles to the top and bottom members and having slot-like ventilating openings in their sides. Interlocking refractory tile or blocks are arranged in courses between the top and bottom members and are tied to the back member of the door by means of hangers which are slid to position within brackets secured in place within the furrows in the inner or furnace side of the back member.

In the drawings, which illustrate the preferred embodiment of this invention:

Figure 1 is a perspective view looking toward the back and one end of a furnace door embodying this invention;

Fig. 2 is an elevational view looking toward the back of the main casting of the door of Figure 1;

Fig. 3 is a top plan view of the casting of Fig. 2;

Fig. 4 is an end view looking toward the left hand side of the casting;

Fig. 5 is a sectional view taken on line V—V of Fig. 2;

Fig. 6 is a sectional view taken on line VI—VI of Fig. 2;

Fig. 7 is an elevational view looking toward the inner or furnace side of the door of Fig. 1 with some of the refractory blocks or tile omitted;

Fig. 8 is a transverse sectional view of a furnace equipped with a door embodying this invention. The door of this view is in section and is assumed to be taken on line VIII—VIII of Fig. 7, but with all of the refractory blocks or tile in place. The door is shown in closed position tilted toward the furnace and the mechanism for operating the door is graphically illustrated.

Fig. 9 is a perspective view of a hanger such as is used to secure the refractory blocks or tile to the brackets, which are located within the furrows of the furnace side of the back member and between the top and bottom members of the door of Fig. 1;

Fig. 10 is a perspective view of one of the brackets for receiving the hangers of Fig. 9. These brackets are bolted in place within the furrows in the furnace side of the back member of the door;

Figs. 11 and 12 are perspective views of castings which are used co-operatively in forming a section of the end brackets of the door of Fig. 1.

Fig. 13 is a perspective view of three refractory blocks, a bracket and a hanger by means of which one of such blocks is secured to the bracket;

Fig. 14 is a perspective view of a full block

and a portion of another block and shows the hanger side of such blocks; and

Fig. 15 is a view showing a portion of the structure of Fig. 8 on an enlarged scale.

The door frame, the main portion of which is cast in one piece, preferably from steel or steel alloy is illustrated in detail in Figs. 2–6 inclusive and includes a back member 15, the outside face of which is shown in Fig. 6. This back member is of substantially uniform thickness and resembles a corrugated plate having alternately arranged uniform furrows and ridges in opposite sides thereof. These furrows and ridges when the door is in position on a furnace, extend vertically, and the sides of these furrows and ridges are provided with slot-like ventilating openings 16.

The top and bottom members of the frame, which are respectively numbered 17 and 18, extend at right angles to back member 15, and, as shown in the drawings have their outer side edges flush with the tops of the ridges of the outer side of the back member.

The top member 17, on its ends and furnace side, is provided with an upstanding flange 19, has a series of spaced ears 20 for accommodating the door operating mechanism and a central bracing flange 21 which connects with said ears and the upstanding flange at its ends. The top member is also provided with slit-like openings or slots 22 which extend a distance inwardly from its furnace side to provide for expansion and contraction due to changing temperature conditions.

Bottom 18 of the frame extends inwardly beyond the ridges on its furnace side, and this inwardly extending portion is provided with slit-like openings or slots 23 to provide for expansion and contraction of the bottom member due to changing temperature conditions.

A series, consisting of four brackets 24 (Fig. 10), arranged end to end and slightly spaced, as shown in Fig. 7, is located within each of the full depth furrows in the furnace side of back member 15. These brackets are secured in place by bolts 25 which extend through slots 26 in the back member in line with said brackets. The nuts 27 for such bolts are located within depressions 28 formed in lugs 29 of each bracket member. These lugs fit within the furrows and space the brackets away from the back member.

Each series of brackets terminates a slight distance below top member 17 to provide a space which permits hangers 30, such as illustrated in Fig. 9, attached to the refractory blocks or tile, to be inserted within the hanger slots of the top brackets and slid down to position, as will be later described.

The door frame casting at each end is provided with a narrow flat end member 31 which joins the top and bottom members 17 and 18 and is provided with a series of bolt holes 32 which are preferably cored.

Secured in place against each end member 31 is a series of sectional brackets such as shown at 33, Fig. 6. These brackets are made up of parts 34 and 35 (Figs. 11 and 12).

In assembling and securing these sectional brackets in place against end members 31, parts 35 of each series are bolted in position by means of bolts 36 which pass through cored holes 37 in the center ears 38 of parts 35. These bolts are inserted from the inside of the end members 31; the nuts for the bolts contacting with the outside faces of ears 38. With each member 35 secured in place by its bolt 36, parts 34 are next placed in position with their lugs 39 in contact with ears 40 and 41 of parts 35. Bolts are then inserted, also from the inside of end members 31, through openings 32 which register with the cored holes in ears 40 and 41 of parts 35. These bolts pass through cored holes in the lugs 39 of parts 34. The outer ends of these cored holes are squared and countersunk or depressed to receive the nuts for these bolts.

Each part 35 is provided with a portion 42 which extends toward the furnace side of the door and is provided with a right angled flange 43 spaced from its body portion 44 to provide part of a groove 45 for receiving the end hangers for the end refractory blocks or tile.

Each part 34 has a flange 46 which extends outwardly at right angles to its body portion 47, and body portion 47 has a right angled flange 48 which co-operates with flange 43 of part 35 to form another part of the hanger groove of end brackets 33 at the ends of the door frame.

Since the door of this invention is adapted to be supported in an inclined position against the furnace when closing the furnace opening, as shown in Fig. 8, the bottom member 18 has bolted against its underside a series made up of the cast metal members 49, 50, 51 and 52. These members form the support for the door when in closed position and serve as renewable wear members. Each of the end members 49 and 52 is provided with a downwardly extending tapered pin-like projection 53.

These pins 53, when the door approaches the lower limit of its travel, enter holes 54 formed for their reception in door sill 55.

The door frame on its furnace side is provided with a refractory lining 56 made up of refractory blocks or tile 57 which alone are exposed to the furnace temperature and hot gases.

These blocks or tile are preferably of the type disclosed in my United States Patent 1,590,303 of June 29, 1926 and Patent 1,913,168 of June 6, 1933. The latter patent discloses modified forms of refractory blocks or tile embodying the invention of said earlier patent; such modifications adapting the blocks or tile for use with individual support hangers in the construction of suspended roofs and walls. Such hangers are also disclosed in connection with the apron wall illustrated in my United States Patent 1,977,799, of October 23, 1934.

Refractory lining 56 comprises multiple courses of interlocked and bonded refractory blocks or tile 57. Each tile is formed with a T-shaped groove in one of its faces adjacent the outer end thereof for the reception of the T-shaped leg 58 of a hanger such as disclosed in Fig. 9. A recess formed in its opposite face is formed for reception of leg 59 of said hanger. When the hanger is attached to a block or tile, the T-shaped leg 58 as well as leg 59 are in effect embedded in the refractory material. The outer end of each hanger is formed with a pair of lugs 60 which are adapted to slide within the grooves or slots of intermediate brackets 24 and end brackets 33.

In laying up the courses of the lining, the blocks or tile with hangers attached thereto are so positioned that the lugs 60 of the hanger register with the slot or slots in the brackets. A unit consisting of a block or tile and its hanger is then lowered to position. By laying up the blocks or tile in courses, the tongues of the blocks are positioned in the correspondingly shaped depressions

or recesses in the blocks disposed above or below the same, as the case may be. The joints between contiguous faces of the blocks are completely sealed, thus giving protection to back member **15** and the brackets and hangers from the heat and burning gases which come in contact with the furnace side of the refractory lining.

The refractory blocks are preferably bonded and interlocked, as disclosed in my United States Patent 2,045,661 of June 30, 1936, or in my United States Patent 2,272,217 of Feb. 10, 1942.

Each end series of brackets made up of parts **34** and **35** extends upwardly to the level of the under face of top member **17**. This permits hanger anchoring of the end blocks of the upper course.

After these end blocks are in place, an angle casting **61** is bolted to each upstanding end flange of top member **17**. Each of these castings is so formed as to overlie the end tiles of the top course as well as end brackets **33**, as shown in Figs. 1 and 7.

From the drawings, and especially Figs. 1, 6, 7 and 8, it will be seen that the refractory lining extends outwardly beyond the top and bottom members of the door frame, and laterally beyond the door frame proper to the outer edges of flanges **46**.

The blocks or tile forming the three upper courses, as shown at **62** in Fig. 8, are made shorter than the remaining blocks or tile. The blocks or tile located below these short blocks including the blocks **63** forming the bottom course, which blocks are special so as to protect bottom member **18**, are of exceptional depth in order to provide a thick refractory lining.

Since the door, when closed, rests in inclined position against the furnace, as shown in Fig. 8, the relatively short tile **62** forms an offset which permits the upper courses of long tile to project inwardly under a water cooled lintel **64** which extends along the furnace above the charging opening.

The courses of short tile **62** extend close to or contact with the outer face of this lintel when the door is closed.

The door operating mechanism, a portion of which is disclosed in Fig. 8, is disclosed and claimed in an application filed by me on May 13, 1942 and serially numbered 442,874. This mechanism in a general way, but only in a general way, resembles the door operating mechanism of my United States Patent 2,045,662 of June 30, 1936. The door of the present invention, like the door of said patent, is designed to be righted to near vertical position by the door operating mechanism before it is raised.

The center of mass of the door is located toward the furnace and well beyond the sill contact portion of the door, and, since support plates **49**, **50**, **51** and **52** attached to the bottom member of the door frame incline upwardly from pins **53** toward the furnace, the door has a decided tendency to close, when supported on the door sill.

Pins **53** and holes or openings **54** form a pivotal connection between the door and sill when the door is in its lowered position, and it is about this connection that the door pivots when moving toward and from closed position against lintel **64**, or in other words, against the furnace.

Since the door is provided with wheels which run on rails during its travel to and from its down position, as in my Patent 2,045,662, a second lintel **65** located above lintel **64** is provided. The outer side edges of flanges **66** of I-beam **67** are closed by a plate **68**, thus providing a third cooling water chamber. This water chamber and lintels **64** and **65** protect the adjacent furnace parts against the heat of the refractory door lining when the door is in raised or open position.

In Fig. 8 of the drawings, the door is illustrated in connection with a furnace having a suspended roof or arch **69**, but it will be understood that the door may be used in connection with any other suitable type of furnace.

The side edges of the refractory lining, as will be seen from Fig. 1, are uncovered and because of this, the doors constituting a series arranged in side by side relation will be so positioned as to provide clearance between adjacent doors and between the end doors and the end walls of the furnace charging opening. The spaces formed by these clearances are closed by means of seals of the general type shown in my Patent 2,045,662. The specific type of seal which I prefer to use in connection with the doors of this invention are those shown in my said application Serial No. 442,874, and the supports for such seals are shown at **70** and **71**. These supports are secured to the end flanges of top member **17** of the door frame.

The sides of intermediate brackets **24** are reticulated as clearly shown in Figs. 8 and 9 in order to facilitate circulation of air therethrough and to the hanger parts located therein.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A furnace door comprising metal top and bottom members, a corrugated metal back member of substantially uniform thickness, with its ridges and furrows extending substantially at right angles to the top and bottom members, and having ventilating openings extending through the side portion of its ridges and furrows, a lining made up of refractory blocks, and lining anchoring means secured within furrows in the furnace side of the back member and anchored to at least some of such refractory blocks.

2. A furnace door comprising metal top and bottom members, a corrugated metal back member of substantially uniform thickness, with its ridges and furrows extending substantially at right angles to the top and bottom members, and having ventilating openings extending through the side portion of its ridges and furrows, a lining made up of interlocked refractory blocks, and lining anchoring means secured within furrows in the furnace side of the back member and anchored to such refractory blocks.

3. A furnace door comprising metal top and bottom members, a corrugated metal back member of substantially uniform thickness, with its ridges and furrows extending substantially at right angles to the top and bottom members, and having ventilating openings extending through the side portion of its ridges and furrows, a lining which extends outwardly beyond the bottom member on the furnace side thereof and laterally beyond the ends of such member and is made up of refractory blocks, and lining anchoring means secured within furrows in the furnace side of the back member and anchored to at least some of such refractory blocks.

4. A furnace door comprising metal top and bottom members, a corrugated metal back member of substantially uniform thickness, with its ridges and furrows extending substantially at right angles to the top and bottom members, and having ventilating openings extending through the side portion of its ridges and furrows, a lin-

ing which extends outwardly beyond the bottom member on the furnace side thereof and laterally beyond the ends of such member and is made up of interlocked refractory blocks, and lining anchoring means secured within furrows in the furnace side of the back member and anchored to such refractory blocks.

5. A furnace door comprising metal top and bottom members, a corrugated metal back member of substantially uniform thickness, with its ridges and furrows extending substantially at right angles to the top and bottom members and having ventilating openings extending through the side portions of its ridges and furrows, a refractory lining which extends outwardly beyond the bottom member on the furnace side thereof and laterally beyond the ends of such member and is made up of refractory blocks, brackets secured within furrows in the furnace side of the back member and hangers secured to such brackets and anchored to at least some of such refractory blocks.

6. A furnace door comprising metal top and bottom members, a corrugated metal back member of substantially uniform thickness, with its ridges and furrows extending substantially at right angles to the top and bottom members and having ventilating openings extending through the side portions of its ridges and furrows, a refractory lining which extends outwardly beyond the bottom member on the furnace side thereof and laterally beyond the ends of such member and is made up of interlocked and bonded refractory blocks, brackets secured within the furrows in the furnace side of the back member and hangers secured to such brackets and anchored to such refractory blocks.

7. A furnace door comprising a unitary casting made up of top and bottom members and a corrugated back member of substantially uniform thickness, with its ridges and furrows extending substantially at right angles to the top and bottom members and having ventilating openings extending through the side portions of its ridges and furrows; a refractory lining which extends outwardly beyond the bottom member on the furnace side thereof and laterally beyond the ends of such member and is made up of interlocked and bonded refractory blocks, brackets secured within furrows in the furnace side of the back member and which project beyond the crests of the ridges on the furnace side, and hangers secured to such brackets and anchored to such refractory blocks.

8. A furnace door comprising a unitary metal casting which includes top and bottom members and a corrugated back member of substantially uniform thickness, having its ridges and furrows extending at right angles to the top and bottom members and having ventilating openings extending through the sides of its ridges and furrows, a refractory lining made up of courses of interlocked and bonded refractory blocks, reticulated brackets secured within the furrows in the furnace side of the back member, having a major part thereof spaced from the bottom of such furrows and with their outer edges projecting beyond the crests of the ridges on such side, and hangers secured within such brackets and anchored to such refractory blocks; the construction and arrangement being such that the lining is spaced from the back member whereby free circulation of air is permitted between the back member and the lining and around and through such brackets.

9. A furnace door comprising a unitary metal casting which includes top and bottom members, end members and a corrugated back member of substantially uniform thickness, having its ridges and furrows paralleling the end members and having ventilating slots extending through the side portions of its ridges and furrows, a refractory lining which extends outwardly beyond the bottom member on the furnace side thereof and laterally beyond the end members and is made up of interlocked and bonded refractory blocks, brackets secured to said end members and each having as part thereof a removable angle that overlies the outwardly extending end portions of the lining, brackets secured within the furrows in the furnace side of the back member, extending outwardly beyond the crest of the ridges on such side and which are provided with means for spacing the major part thereof from the bottom of such furrows, and hangers secured within the brackets and anchored to the refractory blocks.

10. A furnace door comprising a unitary metal casting which includes top and bottom members, end members and a corrugated back member of substantially uniform thickness, having its ridges and furrows paralleling the end members and having ventilating slots extending through the side portions of its ridges and furrows, a refractory lining which extends outwardly beyond the bottom member on the furnace side thereof and laterally beyond the end members, and is made up of interlocked and bonded refractory blocks, brackets secured to said end members and each having as part thereof a removable angle that overlies the outwardly extending end portions of the lining, reticulated brackets secured within the furrows in the furnace side of the back member, extending outwardly beyond the crest of the ridges on such side and which are provided with means for spacing the major part thereof from the bottom of such furrows, and hangers secured within the brackets and anchored to the refractory blocks.

11. A furnace door having a height which is greater than the height of the furnace opening with which it is adapted to co-operate; said door comprising a unitary metal casting which includes top and bottom members and a corrugated back member of substantially uniform thickness, having its ridges and furrows extending at right angles to the top and bottom members and having ventilating openings extending through the sides of its ridges and furrows, a refractory lining made up of courses of interlocked and bonded refractory blocks, with the courses that are located above the furnace opening when the door is in closed position, of less width from front to back than the remainder of the courses, and lining anchoring means secured to the back member between the ridges on the furnace side thereof and anchored to the refractory blocks.

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