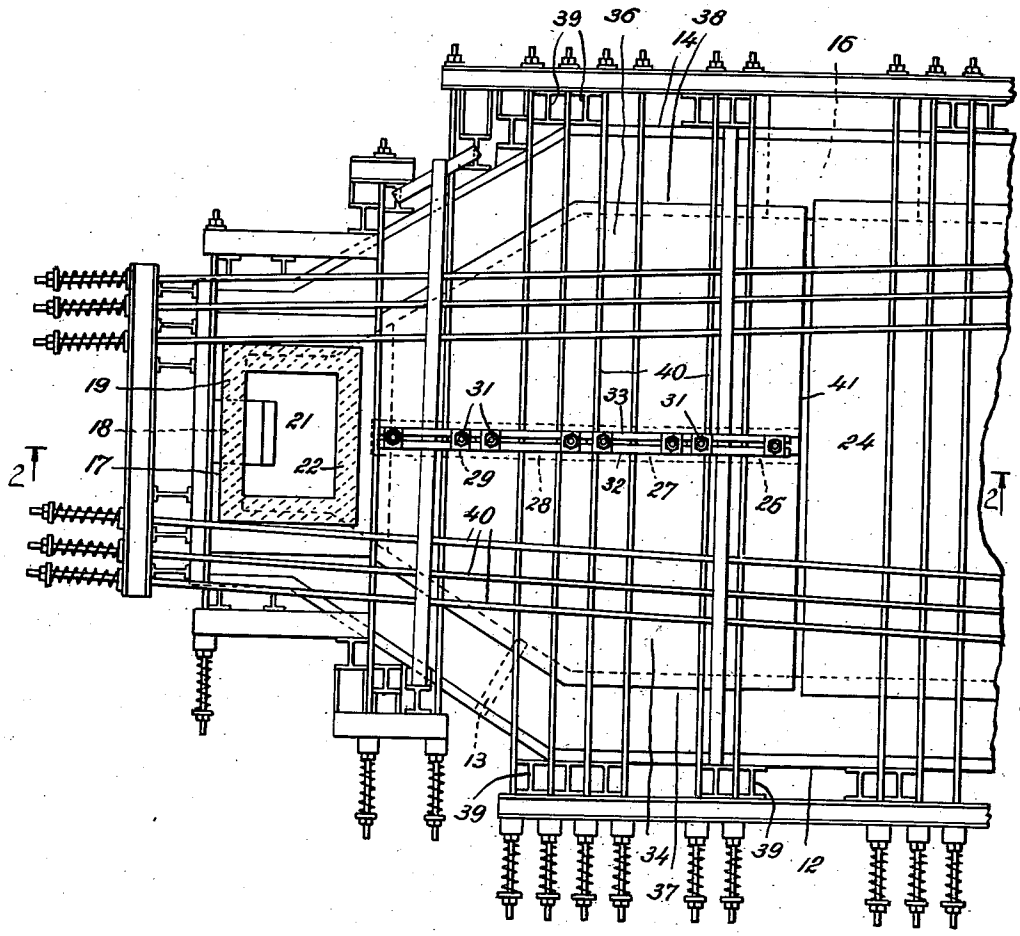
Nov. 4, 1941. R. H. MILLER 2,261,397

FURNACE CONSTRUCTION

Filed June 22, 1939 3 Sheets-Sheet 1

Fig. 1,



INVENTOR

Roy H. Miller

BY

Penrose Davis Mercer & Edmonds

ATTORNEYS

Nov. 4, 1941. R. H. MILLER 2,261,397

FURNACE CONSTRUCTION

Filed June 22, 1939 3 Sheets-Sheet 2

Fig. 2,

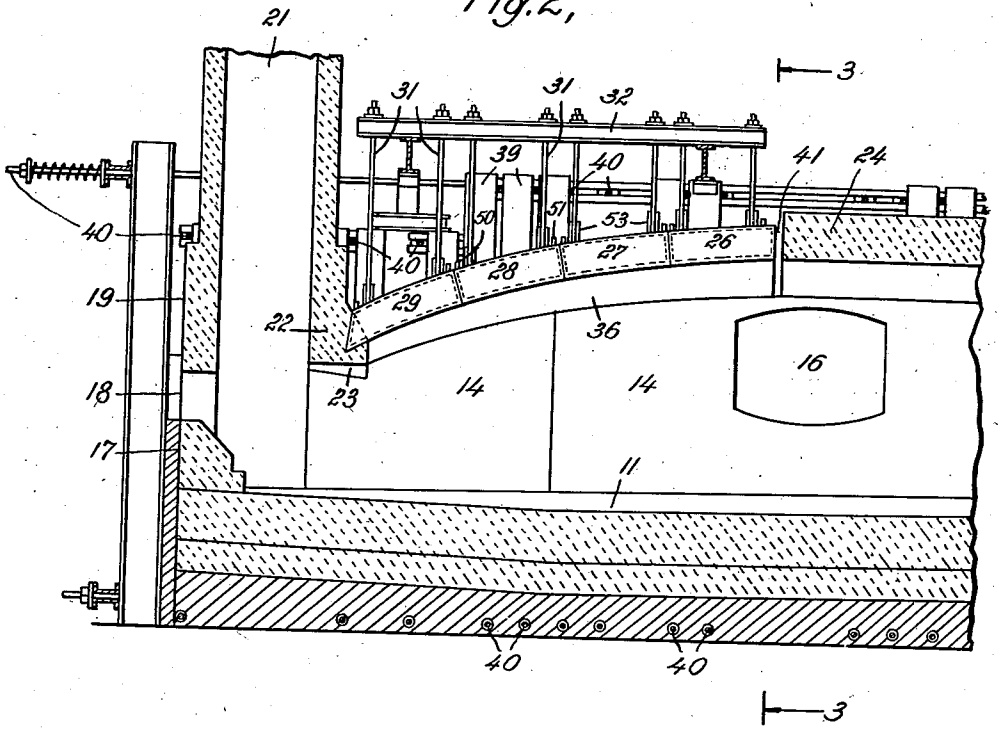


Fig. 5,

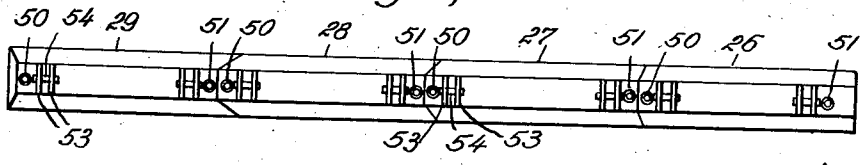


Fig. 7,

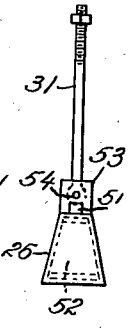
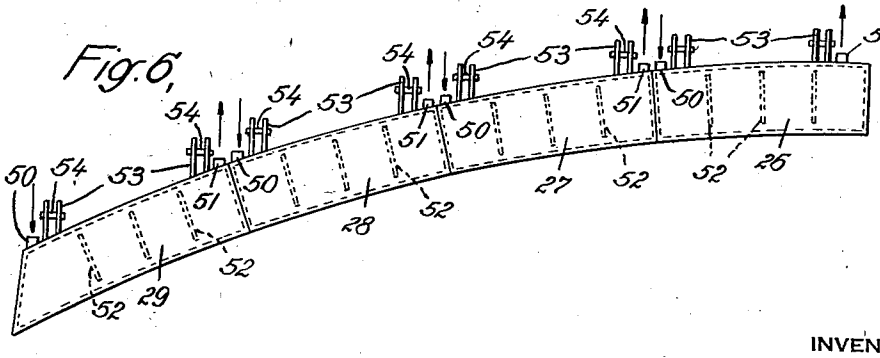


Fig. 6,



INVENTOR

Roy H. Miller

BY

Penrose Davis Marion & Edmonds

ATTORNEYS

Nov. 4, 1941. R. H. MILLER 2,261,397

FURNACE CONSTRUCTION

Filed June 22, 1939 3 Sheets-Sheet 3

Fig. 3,

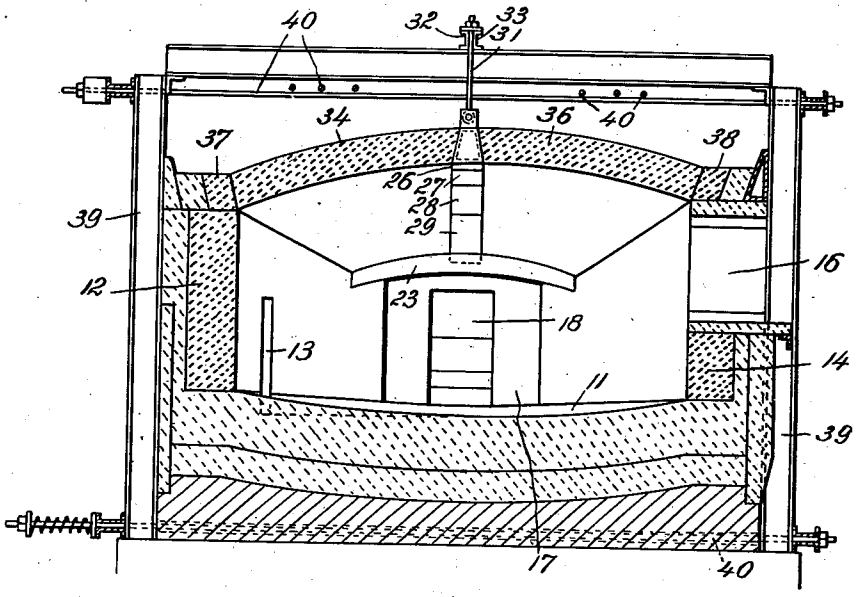
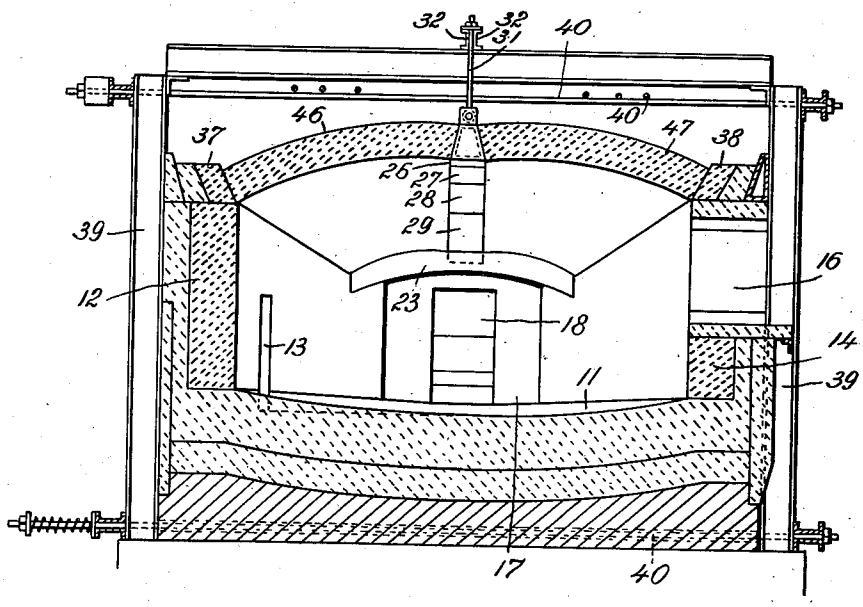


Fig. 4,



INVENTOR
Roy H. Miller
BY
Pennie Davis Marvin & Edmonds
ATTORNEYS

Patented Nov. 4, 1941 2,261,397

UNITED STATES PATENT OFFICE

2,261,397

FURNACE CONSTRUCTION

Roy H. Miller, Great Falls, Mont., assignor to Anaconda Copper Mining Company, a corporation of Montana

Application June 22, 1939, Serial No. 280,453

2 Claims. (Cl. 122—6)

This invention relates to furnaces, and is concerned particularly with the provision of an improved roof structure for metallurgical and other furnaces.

Furnace roofs ordinarily are constructed in the form of a single arch sprung between the side walls of the furnace. Metallurgical furnaces of the reverberatory type, for example, usually are provided with an arched brick roof sprung in the form of a continuous arch between skewbacks mounted on the side walls of the furnace. Hot combustion gases flow lengthwise through the furnace for the purpose of heating the charge in the furnace, and the arch of the roof preferably is made quite flat so as to keep the hot gases as near as possible to the charge.

In the case of copper-refining furnaces of the reverberatory type, the roof usually is constructed of silica brick, whereas magnesite brick often is used for at least a part of the side walls. Magnesite brick is superior to silica brick for use in these furnaces because of its greater resistance to attack by copper oxide and other corrosive agents present in the furnace. During operation of the furnace, particularly during the oxidation and poling periods, the molten charge is violently agitated. Oxidation (to remove oxidizable impurities) is carried out by blowing air under pressure into the furnace charge. The air pressure may be limited, but splashing of the molten copper is unavoidable. During the poling period wooden poles are introduced into the furnace to eliminate reducible impurities, and vigorous destructive distillation of the wood at the high temperature of the molten charge causes violent agitation of the copper. As a result, the sides and roof of the furnace in the oxidizing and poling zones are splashed and sprayed with copper oxide which is always present in the charge. Copper oxide fluxes with silica, and in consequence silica portions of the roof and walls are rapidly fluxed away in the poling zone. This section of the furnace therefore is likely to be burned out much more quickly than any other part, necessitating shutting down the furnace for repairs when the rest of the furnace is in good condition and would last for many days without rebuilding.

Since magnesite brick is affected very little, if at all, by copper oxide, it would be desirable to use magnesite brick instead of silica brick in the roof over the poling zone. Because of the excessive weight of magnesite brick, however, and the possibility of the brick slipping and causing the roof to fall in while the furnace is in operation, it has theretofore been impractical to use magnesite brick in a sprung arch roof for large copper-refining furnaces, which in some cases are 15 to 18 feet wide.

Various roof structures have been developed to make magnesite brick or other heavy brick available for use in such furnace roofs, among which may be mentioned the Dietrich type suspended roof, in which each brick is suspended from a system of rods or bars above the furnace. This type of roof is not particularly satisfactory, however, and it is difficult to install on furnaces designed for a sprung arch roof and not for the suspended type of roof.

In accordance with the present invention, there is provided an improved furnace roof structure by means of which it is possible to employ heavy brick of magnesite or other desirable material in the construction of roofs for relatively wide furnaces. The new roof is made up of a plurality of arched roof sections each substantially narrower than the furnace, and a supporting member suspended from a structure above the furnace disposed between adjacent pairs of the arched roof section. The supporting member is so configured as to receive the adjacent side edges of the arched roof sections and carry at least a part of the weight thereof. Preferably this supporting member, which generally extends lengthwise of the furnace, is shaped to present side surfaces sloping upwardly toward each other so as to receive the adjacent side edges of the neighboring roof sections after the fashion of an inverted keystone.

The supporting member is most advantageously constructed of metal to provide adequate strength in carrying a part of the weight of the roof, and is water-cooled so as not to be damaged by the high temperatures maintained within the furnace. Preferably the supporting member is generally trapezoidal in cross-section and is suspended from a structure above the furnace with the wider of its parallel sides facing the interior of the furnace. The non-parallel sides slope upwardly toward each other and present bearing surfaces for receiving the side edges of the adjacent arched roof sections in such manner that the weight thereof is carried in part by the supporting member.

In the complete roof the lateral thrust of the arched refractory roof sections is received at the side walls of the furnace, and a part of the weight of the roof is carried at this point. There is substantially no resultant lateral thrust exerted on the suspended supporting member, inasmuch as the neighboring roof sections exert

substantially equal and opposite lateral thrusts thereon, but at least a part of the weight of the roof is carried by this member.

The invention will be better understood from a consideration of the following description of a preferred embodiment, considered in conjunction with the accompanying drawings, in which

Fig. 1 is a plan of the front end portion of a metallurgical furnace of the reverberatory type equipped with a roof structure embodying the invention;

Fig. 2 is a longitudinal section of the front end portion of the furnace, taken substantially along the line 2—2 of Fig. 1;

Fig. 3 is a cross-section of the furnace, taken substantially along the line 3—3 of Fig. 2;

Fig. 4 is a cross-section through a furnace embodying a modified roof structure;

Fig. 5 is a plan of a preferred type of metallic member employed in construction of the new roof;

Fig. 6 is an elevation of the metallic member shown in Fig. 5; and

Fig. 7 is a view of the end of the metallic member shown in Figs. 5 and 6.

The reverberatory type furnace shown in Figs. 1 to 3 comprises a floor 11 preferably of silica, which is somewhat higher at the sides and ends of the furnace than at the center. A side wall 12, through which extends a tap hole 13, and an opposite side wall 14 provided with a charging door 16, rise from the side edges of the floor 11. A front end wall 17 of the furnace, in which is mounted a skimming and poling door 18, closes the front end of the furnace. The front wall 19 of a flue 21 rises above the front wall 17 of the furnace. The back wall 22 of the flue is supported above the floor by an arch 23. The back end of the furnace (not shown in the drawings) is constructed in the usual manner with suitable fuel burners extending into the furnace.

When in use the furnace is charged with copper to be refined through the charging door 16 and through such other working doors as may be provided. Hot combustion gases are introduced into the furnace at the back end (not shown). During the refining operation molten copper fills the interior of the furnace to such a depth that oxides and other impurities separated from the charge by oxidation may be removed through the skimming door 18. During the poling period poles are inserted through the door 18. The poles usually come in contact with the molten metal in that portion of the furnace beneath the back wall 22 of the flue 21, and may extend in contact with the metal about as far back in the furnace as the front end of the charging door 16. That portion of the interior of the furnace in and near which the poles come in contact with the molten charge and cause violent agitation of the charge is called the poling zone. The side and end walls in the poling zone advantageously are lined with magnesite brick for long life.

A sprung arched roof 24 of usual construction, which may be of silica brick, covers the portion of the furnace back of the poling zone. Over the poling zone the arched roof comprises a water-cooled metallic member running lengthwise of the furnace, and which, in the apparatus shown in the drawings, is made up of four individual members 26, 27, 28, and 29 abutting in end-to-end relation. These members, which are generally trapezoidal in cross-section, are suspended about mid-way between the furnace walls, with the wider of their parallel sides facing the interior of the furnace, by means of rods 31 secured to a structure above the furnace. This structure, in the apparatus shown, comprises a pair of channel irons 32 and 33 to which the rods 31 are fastened. The front end of the front section 29 of the metallic member abuts against the back wall 22 of the flue 21.

The supporting member comprising the several individual members 26, 27, 28, and 29 is flanked on either side by arched roof sections 34 and 36 of refractory material, preferably magnesite brick. The arched refractory roof sections are sprung between the sides of the supporting member and skewbacks 37 and 38 mounted over the side walls 12 and 14. The skewbacks receive the lateral thrust of the roof, and are braced therefor by the usual buckstays 39 and tie rods 40. A part of the weight of the arched roof sections is carried by the skewbacks at the side walls of the furnace, but at least a part of such weight is carried also by the supporting member, which receives the arched sections along their side edges in the manner of an inverted keystone. An expansion joint 41 separates the arched roof over the poling zone from the arched roof 24 over the portion of the furnace in back of the poling zone.

The modified form of apparatus shown in Fig. 4 is similar to that shown in Fig. 3 except that the supporting member (made up of the several individual members 26, 27, 28, and 29) is suspended lower in the furnace, and the arched refractory roof sections 46 and 47 are correspondingly lowered where they bear at their side edges against the supporting member. The roof structure shown in Fig. 4, accordingly, is flatter than that shown in Fig. 3, but the strength of the roof is not impaired because the refractory roof sections 46 and 47 are adequately arched to support their own weight.

A metallic supporting member of preferred form for use in furnace roofs in accordance with the invention is shown in Figs. 5 to 7. The preferred supporting member comprises a plurality of hollow water-tight members 26, 27, 28, and 29 of cast iron, steel, copper, or other suitable metal abutting in end-to-end relation. Each member is generally trapezoidal in cross-section, and is mounted for use with the wider of its parallel sides facing the interior of the furnace. The complete supporting member made up of the several individual members thus in effect is an inverted keystone with its non-parallel sides sloping upwardly toward each other to provide bearing surfaces for the side edges of adjacent refractory roof sections.

Each of the individual members 26, 27, 28, and 29 is equipped with an inlet conduit 50 for introducing cooling water near one end of the top face thereof, and with an outlet conduit 51 for withdrawing water from the other end. A plurality of baffles 52 are mounted transversely within each of the hollow sections of the metallic member to insure proper flow of cooling water through the sections and so provide effective cooling thereof.

Lugs 53 are secured to the upper face of each of the sections 26, 27, 28, and 29 for attachment to the rods 31 by means of which the sections are suspended in place. The rods 31 are advantageously in the form of eye-bolts secured to the lugs 53 by pins 54, thus providing relatively flexible supporting means for the sections.

For reasons of mechanical strength, the supporting member is preferably made of metal, but in some cases this member may be of non-metallic refractory material. For example, the supporting member may be composed of magnesite brick of suitable shape in which wires or rods are embedded in order to suspend such bricks from the supporting structure above the furnace.

The supporting member, whether of metal or of refractory, need not be made up of a plurality of individual sections, as described above. A supporting member made up of a plurality of individual members is preferred in furnaces of moderate and large sizes, but a one-piece supporting member may be used in small-sized furnaces or in furnaces where only a small portion of the roof is constructed in accordance with the invention.

Although the metallic member preferably is trapezoidal in cross-section in order to provide suitable bearing surfaces for the side edges of the refractory roof sections, its shape may be modified without departing from the invention. For example, the top face of the member may be at an angle to the bottom face without altering the mechanical effectiveness of the member. Alternately, the supporting member may be in the form of an inverted T, with triangular bricks mounted thereon to provide bearing surfaces for the arch sections.

The roof structure of the invention may be used with advantage on any type furnace of considerable width where a flat arch is desired. In accordance with the invention the degree to which each refractory section of the roof is arched may be made adequate to insure proper strength without making the overall height of the arch excessive, even in cases where very heavy brick are used without a mortar bond between them. Although the invention has been described above with particular reference to roofs employing only one supporting member with two flanking refractory sections, it is apparent that two or more spaced supporting members may be employed in conjunction with three or more arched refractory sections. In this manner arched refractory roofs may be applied to furnaces of a width greater than it has heretofore been possible to cover with roofs of this type, and at the same time the advantages of a relatively flat roof structure may be secured.

The invention may be used with particular advantage in copper-refining furnaces, with respect to which it has been particularly described above. In such furnaces the invention makes possible the use of magnesite refractory roofs which greatly outlast the silica brick heretofore necessarily employed. The invention is not limited in its utility, however, to these particular furnaces, but may be used as well on many other types of furnaces employed in both metallurgical and non-metallurgical operations.

I claim:

1. An arched roof structure curving downwardly from the central portion toward the flue of a reverberatory furnace having side walls comprising a water-cooled hollow metallic member extending longitudinally of the furnace throughout the length of the curved roof structure and suspended from a structure above the furnace substantially mid-way between the side walls thereof, said metallic member being generally trapezoidal in cross-section with the wider of its parallel faces facing the interior of the furnace and being provided with a plurality of baffles mounted transversely within the hollow metallic member, and refractory roof sections arched between said metallic member and the furnace side walls in such manner that the lateral thrust and a portion of the weight of the roof is taken at the side walls of the furnace and at least a part of the weight of the roof is carried by said metallic member.

2. An arched roof structure curving downwardly from the central portion toward the flue of a reverberatory furnace comprising a hollow metallic member generally trapezoidal in cross-section suspended from above the furnace substantially midway in the arched roof structure with the wider of its parallel sides facing the interior of the furnace, said metallic member being composed of a plurality of hollow metallic sections provided with a plurality of baffles disposed transversely therein and mounted in end-to-end relation extending longitudinally of the furnace throughout the length of the curved roof structure, means for circulating cooling water through each of said hollow sections, and arched roof sections of refractory brick bearing against opposite sides of said metallic member in such manner that a part of the weight of said arched roof sections is borne by said metallic member.

ROY H. MILLER.