

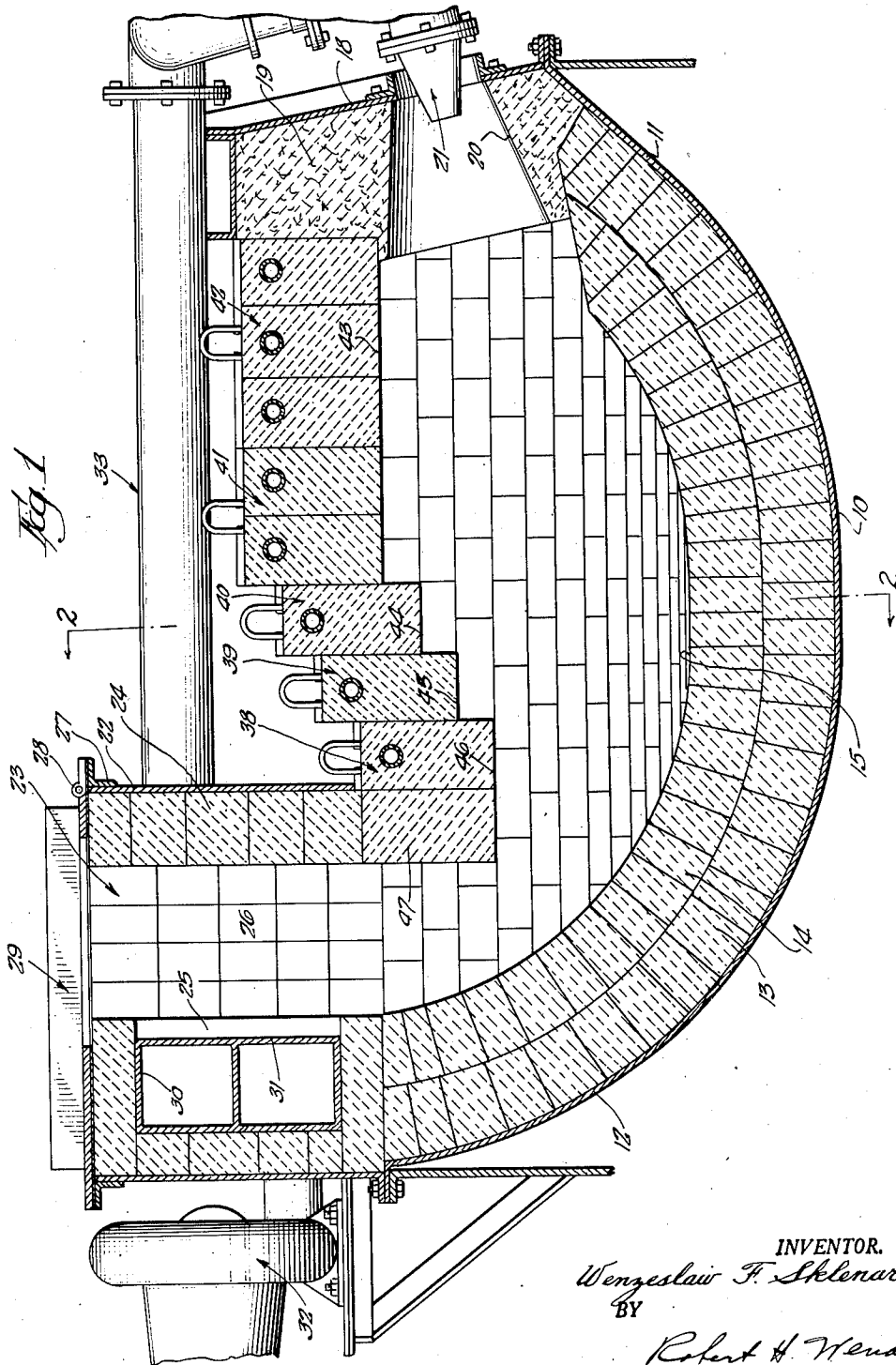
May 17, 1949.

W. F. SKLENAR
REVERBERATORY FURNACE

2,470,728

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3 Sheets-Sheet 1



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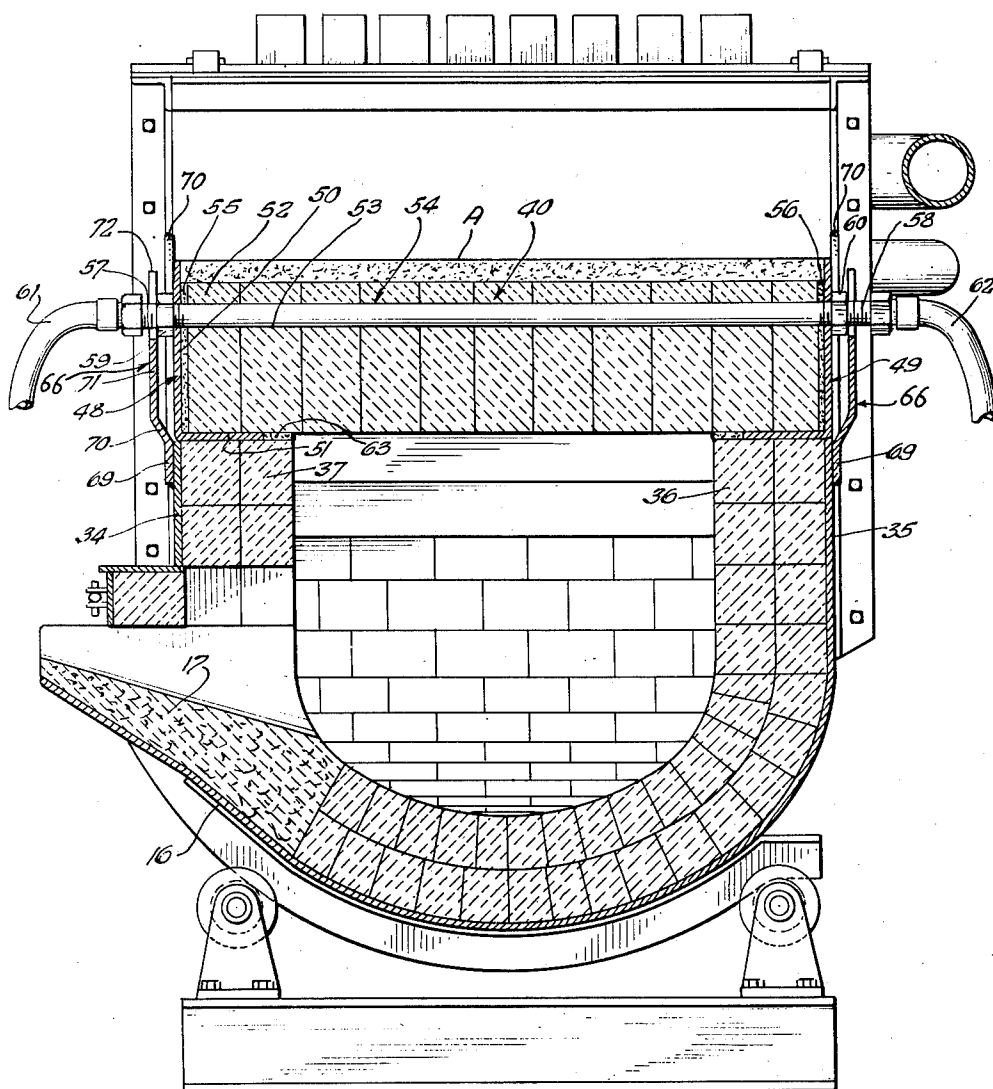
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Fig. 2



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Fig. 3

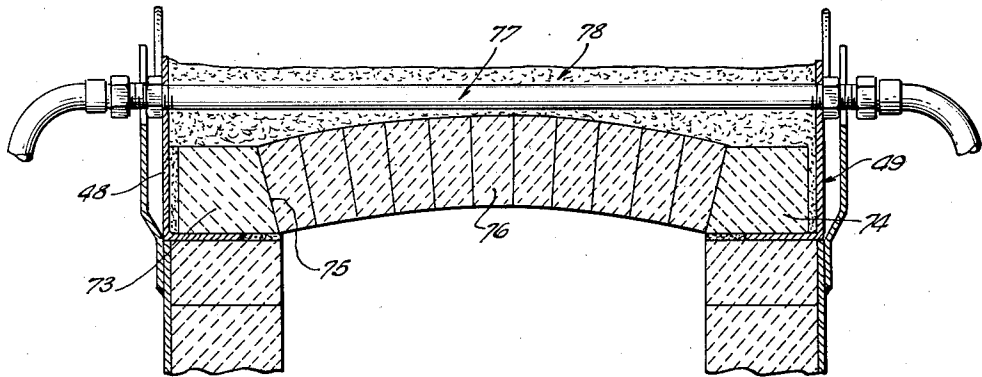
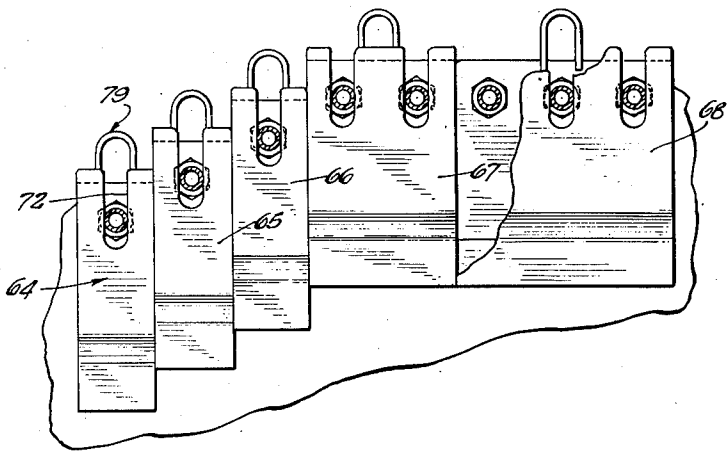


Fig. 4



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UNITED STATES PATENT OFFICE

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REVERBERATORY FURNACE

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8 Claims. (Cl. 266—33)

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The present invention relates to reverberatory furnaces, and is particularly concerned with the structure of an improved reverberatory furnace of the type covered by my prior applications, Serial No. 664,865, Serial No. 672,080, and Serial No. 693,688, now Patent 2,436,124 issued February 17, 1948.

One of the objects of the invention is the provision of an improved furnace for melting metals.

Another of the objects of the present invention is the provision of an improved reverberatory furnace which is provided with a plurality of improved arch units adapted to be installed and removed as a unit, so that access may be had to the interior of a furnace for repair, and so that arch units which need repair may be repaired or replaced with a minimum loss of time and a minimum amount of labor.

Another object of the invention is the provision of an improved arch unit for reverberatory furnaces of the class described, which is adapted to be cooled artificially by passing air or other cooling fluids through the channels which are provided in the arch unit to carry off the heat and maintain the temperature of these units at a predetermined suitable level.

Another object of the invention is the provision of improved arch units for reverberatory furnaces of the class described which are more durable and adapted to be used for a longer period of time, and which do not require repair so often by reason of the fact that they are adapted to be cooled and prevented from attaining excessive temperatures.

Where highly siliceous bricks are used, as, for example, in steel-melting or open-hearth furnaces, silica brick arches are subject to high rates of expansion and contraction. During intermittent working or use of such furnaces it often happens that the arches might collapse unless special means were provided to permit the expansion and contraction, which varies as much as one-eighth of an inch up to three-sixteenths of an inch, depending on the temperature of the furnace.

One of the objects of my invention is the provision of an improved arch construction which permits such expansion as takes place, but which tends to reduce the expansion by effecting a better cooling of the silica bricks, and which also provides for the permanent support of the bricks of the arch upon a penetrating member, which may also serve as a cooling conduit so that the arch can never collapse, due to excessive contraction after expansion. With the silica bricks and the high temperatures which are attained in such furnaces, the difference in volume of the bricks

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between their condition when fully expanded and that when contracted might otherwise be sufficient to permit the tongues and grooves between the bricks to get out of engagement with each other, thus permitting the arch to collapse, which could never take place with my improved arches, because of the fact that the bricks are penetrated by the cooling tube, which also serves the useful purpose of reducing the otherwise too high temperatures.

Other objects and advantages of the invention will be apparent from the following description and the accompanying drawings, in which similar characters of reference indicate similar parts throughout the several views.

Referring to the drawings, of which there are three sheets,

Fig. 1 is a vertical longitudinal sectional view through a furnace embodying the invention.

Fig. 2 is a vertical transverse sectional view taken on the plane of the line 2—2 of Fig. 1.

Fig. 3 is a fragmentary vertical sectional view similar to Fig. 2, showing a modified form of curved arch.

Fig. 4 is a fragmentary side elevational view showing the provision made for receiving the cooling fluid conduits in the supporting plates at the sides of the furnace.

Referring to Figs. 1 and 2, these are views showing the structure of one of the reverberatory furnaces for melting metal of the type covered by my prior applications in which such an improved arch may be employed. The furnace may include a metal shell 10 which is curved longitudinally so that it extends upwardly at the front or right end at 11, and upwardly at the rear end or left end 12, and the lower shell 10 may be lined by a plurality of layers 13, 14, of suitably curved and tapered firebrick, to form a metal wall or cavity 15 centrally of the furnace.

At one side the bottom shell 10 is formed with a metal trough shell 16 which surrounds and protects a suitably shaped brick forming the spout 17 by means of which the metal is poured out when the furnace is tilted. Suitable tracks and rollers, as shown by my prior application, are provided to tilt the furnace when it is a furnace of the tilting type, or it may, in the stationary type of furnace, be provided with a fixed supporting frame.

The front end of the furnace is provided with an end plate 18 having a refractory lining 19 and provided with a tapered burner aperture 20 for receiving the fluid fuel burner 21. The opposite end of the furnace is formed with a four-

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sided rectangular shell 22 forming the protecting shell of an uptake 23, which is also lined with firebrick 24, 25, 26. The upper end of the uptake 23 may have a rectangular angle frame 27 which has hinged to it, at 28, a grille 29.

The grille 29 serves as a partial closure, permitting sufficient of the combustion gases to pass, but restricting their passage so as to prevent them from passing too freely.

The rear firebrick wall 25 of the uptake 23 preferably has a plurality of backwardly and forwardly extending passages 30, 31 located in the wall to pass air which is to be preheated. This preheated air is supplied to the passage 31 by the blower 32, whence it passes at the opposite end into the passage 30 and thence into a longitudinally extending pipe 33 which carries it forwardly to the burners 21 which are supplied with preheated air and fluid fuel, such as fuel oil, gas, or powdered fuel.

The sides of the furnace shell are formed by the sheet metal plates 34, 35 (Fig. 2), the upper edges of which extend to the top of the furnace side walls which are lined with one or more layers of firebrick 36, 37.

According to the present invention, the roof of the furnace becomes gradually lower toward the rear of the furnace from the front, and the side wall linings 36 and 37 support a plurality of arch units 38, 39, 40, 41 and 42.

The arch units rest on the upper surfaces 43—46 of the side wall linings 36 and 37, which step downward toward the rear end of the furnace. The lower uptake fire bricks 47 also rest upon top surface 46 of the side wall.

The arch units 38—42 may consist of a single course of bricks, as exemplified in units 38—40, or of two bricks, as shown in unit 41, or three bricks, as in unit 42, or more. In relatively large furnaces, straight arches are preferably employed, but in the smaller furnaces, curved arches may be employed, as shown in Fig. 3.

Referring to Fig. 2, each arch unit, such as the arch unit 40, may consist of a pair of supporting angle irons 48, 49, each of which has a vertical flange 50 and a horizontal flange 51. The horizontal flange 51 is, in each case, arranged under the lower surfaces of the end bricks 52 so as to give them support, and to serve as a lifting member for the whole arch unit.

The bricks are, preferably, in every case, of the type having horizontally extending tongue-and-groove formations, tending to maintain the alignment of the bricks, and the bricks preferably have the through cylindrical bores 53 at their upper ends located to be aligned with each other and to receive the steel tube 54.

At each end of the brick assembly of an arch 40 there is provided a cushion member 55, 56 of asbestos, such as a multiplicity of layers of asbestos fabric. The ends of the steel tube 54 are threaded, as indicated at 57, 58, and a nut 59, 60 is threaded on each end of the tube 54 into engagement with the angles 48, 49, clamping the bricks 52 together. Thus the bricks 52, which may be made of silica or a highly siliceous compound, are resiliently clamped along with the cushions 55, 56, and the combined expansion of the tube 54 and the contraction of the cushions 55, 56 under pressure permits the necessary expansion of the bricks 52.

Furthermore, the tubes 54 which pass through the bricks positively prevent their getting out of alignment, and positively prevent the collapse of the arch under any conditions, and the tubes

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54 may be used for the passage of cooling air, which may be conducted to these pipes by suitable flexible hoses 61, and carried away by the hose connection 62.

Suitable manifolds may connect the hoses 61 and 62 so as to simplify the air connections.

The arches 38—42 may be located at various desired elevations by removing or inserting bricks from the side walls, or by using small layers of initially plastic refractory, and the inner edges of the angle iron flanges 61 are protected by a refractory composition 63. Thus the arches may be adjusted to any height to suit the characteristics of the furnace to the type of metal which is being melted.

In order to prevent the arches from shifting when the furnace is tilted, each of the side plates 34, 35 may be provided with a plurality of resilient arch-engaging plates 64—68 (Fig. 4). Each of these arch-engaging plates has a lower attaching flange 69 which may be welded to a side plate, such as side plate 34, 35.

Above the attaching flange 69, each of the plates 64—68 has a diagonally outwardly extending offset 70 which supports a vertical body flange 71. The offset 70 brings the body flange 71 out beyond the nuts 59 and 60, and the body flange of each plate is provided with one or more elongated vertical slots 72 of sufficient width to pass the tubes 54. The slots 72 are deep enough to allow the adjustment which might be desired in adjusting the arches vertically while still engaging the tubes 54 and preventing the arches from shifting forwardly or backwardly, as well as preventing any lateral shifting.

To prevent the lateral shifting, the body flanges 71 engage the nuts 59 or 60 of the arch units.

Referring to Fig. 3, this is a modified form of curved arch which is provided with the same angle iron plates 48, 49, but the arch is built up of specially shaped brick, with tongue-and-groove faces.

The two end bricks 73, 74 are provided with diagonally extending faces 75 for engaging the tapered arch bricks 76. In this case the transverse tube 77, which also serves as a tie rod, passes through a filling of initially plastic refractory 78 located above the arch bricks 73—76. The tube 77, which ties the angle irons 48, 49 together, and places end pressure on the arch, may also be used for passing a cooling fluid, such as air or water. In a particularly large furnace, water might be employed.

All of the arches are preferably provided with lifting members 79 which may take the form of a U-shaped steel rod having its legs extending parallel to and welded to the vertical angles 50 of the angle irons 48 and 49. The lifting members 79 are preferably centrally located, so that the arches will be balanced when lifted by these lifting members, by means of a crane or the like, and thus the arches may be removed most readily for repair or replacement, and to gain access to the interior of the furnace.

The attachment of the U-shaped members to the angle irons applies the lifting force directly to the angle iron members which pass under a portion of the arch, and serves to support the arches from one of the strongest parts of the structure.

It will thus be observed that I have invented an improved arch for reverberatory furnaces, and an improved furnace in which the detrimental effects of the expansion of silica bricks are minimized because the bricks may be cooled, and they

may be clamped under a cushioning action, which constantly keeps the arch bricks in engagement with each other.

The tubes which serve as tie rods for securing the bricks in an arch unit also serve for the passage of cooling air or fluids, and thus the bricks will not attain such high temperatures, and the expansion of the bricks will be limited.

Silica brick arches in furnace constructions of the prior art are subjected to high expansion and contraction, and during intermittent working it often happens that such arches of the prior art collapse. The expansion varies as much as one-eighth of an inch up to three-sixteenths, according to the temperature of the furnace, and unless special provision is made for maintaining a clamping force on the contracted bricks and for supporting them together as an arch unit, these difficulties would be encountered when silica brick arches are employed.

Since the clamping member, which is also a cooling tube, passes through a portion of the arch structure, the bricks are thus held on the clamping member and cannot collapse, no matter how much expansion and contraction takes place.

While I have illustrated a preferred embodiment of my invention, many modifications may be made without departing from the spirit of the invention, and I do not wish to be limited to the precise details of construction set forth, but desire to avail myself of all changes within the scope of the appended claims.

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

1. In a reverberatory furnace for melting metals, the combination of a curved bottom shell, said shell being lined with refractory material and forming an elongated chamber with a well for metal having a burner opening at its front end and an uptake at its rear end, with a pair of side walls each comprising a metal shell member and a refractory lining, the said side walls having upper supporting surfaces, the surfaces being stepped downwardly toward the uptake, and a plurality of arch units laid side by side engaging each other on said supporting surfaces to form a closed roof, the said arch units each comprising a pair of clamping plates and a cooling tube member joining said plates and placing a predetermined pressure upon a plurality of bricks forming the arch, the said arch units each having a compressible pad between said plates and the end bricks whereby the expansion and contraction of the bricks is permitted and taken up by said pad.

2. In a reverberatory furnace for melting metals, the combination of a curved bottom shell, said shell being lined with refractory material and forming an elongated chamber with a well for metal having a burner opening at its front end and an uptake at its rear end, with a pair of side walls each comprising a metal shell member and a refractory lining, the said side walls having upper supporting surfaces, the surfaces being stepped downwardly toward the uptake, and a plurality of arch units laid side by side engaging each other on said supporting surfaces to form a closed roof, the said arch units each comprising a pair of clamping plates and a tension member joining said plates and placing a predetermined pressure upon a plurality of bricks forming the arch, the said arch units each having a compressible pad between said plates and the end bricks whereby the expansion and contraction of the

bricks is permitted and taken up by said pad, the said tension member comprising a tube passing through the arch unit and adapted to be used for the passage of cooling fluids, whereby excessive temperatures and excessive expansion are substantially avoided.

3. In a reverberatory furnace for melting metals, the combination of a curved bottom shell, said shell being lined with refractory material and forming an elongated chamber with a well for metal having a burner opening at its front end and an uptake at its rear end, with a pair of side walls each comprising a metal shell member and a refractory lining, the said side walls having upper supporting surfaces, the surfaces being stepped downwardly toward the uptake, and a plurality of arch units laid side by side engaging each other on said supporting surfaces to form a closed roof, the said arch units each comprising a pair of clamping plates and a tension member joining said plates and placing a predetermined pressure upon a plurality of bricks forming the arch, the said arch units each having a compressible pad between said plates and the end bricks whereby the expansion and contraction of the bricks is permitted and taken up by said pad, the said tension member comprising a tube passing through the arch unit and adapted to be used for the passage of cooling fluids, whereby excessive temperatures and excessive expansion are substantially avoided, the said tube being provided with threaded members engaging said plates.

4. In a reverberatory furnace for melting metals, the combination of a curved bottom shell, said shell being lined with refractory material for metal having a burner opening at its front end and forming an elongated chamber with a well end with an uptake at its rear end, with a pair of side walls each comprising a metal shell member and a refractory lining, the said side walls having upper supporting surfaces, the surfaces being stepped downwardly toward the uptake, and a plurality of arch units laid side by side engaging each other on said supporting surfaces to form a closed roof, the said arch units each comprising a pair of clamping plates and a tension member joining said plates and placing a predetermined pressure upon a plurality of bricks forming the arch, the said arch units each having a compressible pad between said plates and the end bricks whereby the expansion and contraction of the bricks is permitted and taken up by said pad, the said tension member comprising a tube passing through the arch unit and adapted to be used for the passage of cooling fluids, whereby excessive temperatures and excessive expansion are substantially avoided, the said tube being provided with threaded members engaging said plates, the said plates being provided with transverse supporting flanges passing under end portions of the arch unit.

5. In a reverberatory furnace for melting metals, the combination of a curved bottom shell, said shell being lined with refractory material and forming an elongated chamber with a well for metal having a burner opening at its front end and an uptake at its rear end, with a pair of side walls each comprising a metal shell member and a refractory lining, the said side walls having upper supporting surfaces, the surfaces being stepped downwardly toward the uptake, and a plurality of arch units laid side by side engaging each other on said supporting surfaces to form a closed roof, the said arch units each comprising

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a pair of clamping plates and a cooling tube member joining said plates and placing a predetermined pressure upon a plurality of bricks forming the arch, the said arch units each having a compressible pad between said plates and the end bricks whereby the expansion and contraction of the bricks is permitted and taken up by said pad, the said shell of the side walls being provided with slotted metal plates, the slots receiving said cooling tube member and said slotted metal plates engaging the arch unit to prevent shifting of the arch unit in any direction.

6. In a reverberatory furnace for melting metals, the combination of a curved bottom shell, said shell being lined with refractory material and forming an elongated chamber with a well for metal having a burner opening at its front end and an uptake at its rear end, with a pair of side walls each comprising a metal shell member and a refractory lining, the said side walls having upper supporting surfaces, the surfaces being stepped downwardly toward the uptake, and a plurality of arch units laid side by side engaging each other on said supporting surfaces to form a closed roof, the said arch units each comprising a pair of clamping plates and a cooling tube member joining said plates and placing a predetermined pressure upon a plurality of bricks forming the width of the arch, the said arch units each having a compressible pad between said plates and the end bricks whereby the expansion and contraction of the bricks is permitted and taken up by said pad, the said shell of the side walls being provided with slotted metal plates, the slots receiving said cooling tube member and said slotted metal plates engaging the arch unit to prevent shifting of the arch unit in any direction, the said clamping plates each being provided with a U-shaped lifting member having its legs welded to one of said clamping plates and being centrally located with respect to the arch unit.

7. In a reverberatory furnace for melting metals, the combination of a curved bottom shell, said shell being lined with refractory material and forming an elongated chamber with a well for metal having a burner opening at its front end and an uptake at its rear end, with a pair of side walls each comprising a metal shell member and a refractory lining, the said side walls having upper supporting surfaces, the surfaces being stepped downwardly toward the uptake, and a plurality of arch units laid side by side engaging each other on said supporting surfaces to form a closed roof, the said arch units each comprising a pair of clamping plates and a cooling tube member joining said plates and placing a predetermined pressure upon a plurality of bricks

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forming the arch, the said arch units each having a compressible pad between said plates and the end bricks whereby the expansion and contraction of the bricks is permitted and taken up by said pad, the said bricks being provided with through bores, and the said cooling tube member passing through said bores to maintain the arch bricks in position even under excessive contraction.

8. In a reverberatory furnace for melting metals, the combination of a curved bottom shell, said shell being lined with refractory material and forming an elongated chamber with a well for metal having a burner opening at its front end and an uptake at its rear end, with a pair of side walls each comprising a metal shell member and a refractory lining, the said side walls having upper supporting surfaces, the surfaces being stepped downwardly toward the uptake, and a plurality of arch units laid side by side engaging each other on said supporting surfaces to form a closed roof, the said arch units each comprising a pair of clamping plates and a tension member joining said plates and placing a predetermined pressure upon a plurality of bricks forming the arch, the said arch units each having a compressible pad between said plates and the end bricks whereby the expansion and contraction of the bricks is permitted and taken up by said pad, the said bricks being provided with through bores, and the said tension member passing through said bores to maintain the arch bricks in position even under excessive contraction, and said tension member comprising a tube with threaded members engaging said plates and connected to pass a cooling fluid for cooling the arch units and substantially eliminating excessive expansion or contraction on intermittent operation.

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