Oct. 2, 1956 J. D'AMBLY 2,764,887

METAL-LINED BRICK

Filed April 2, 1951

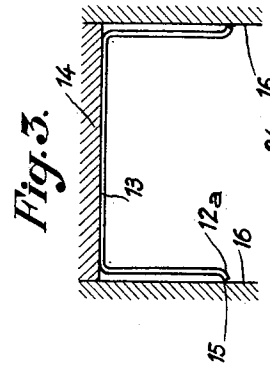


Fig. 3.

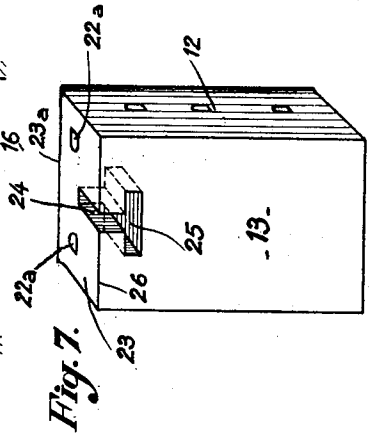


Fig. 7.

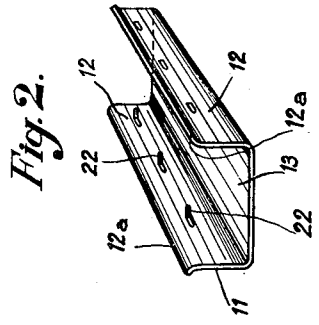


Fig. 2.

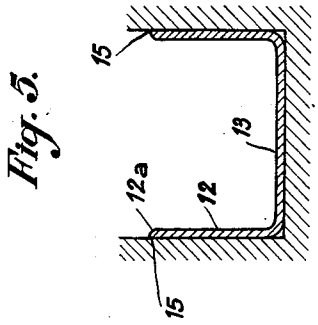


Fig. 5.

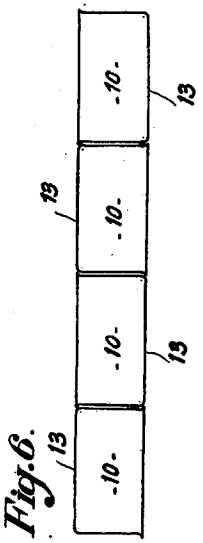


Fig. 6.

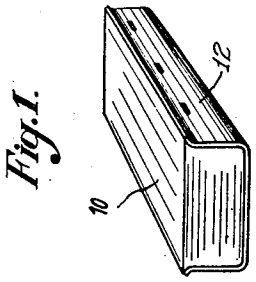


Fig. 1.

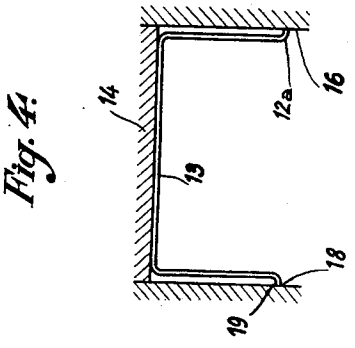


Fig. 4.

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United States Patent Office

2,764,887

Patented Oct. 2, 1956

2,764,887

METAL-LINED BRICK

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Application April 2, 1951, Serial No. 218,779

Claims priority, application France April 7, 1950

1 Claim. (Cl. 72—35)

This invention relates to basic bricks for the construction of metallurgical furnaces, of the type that are lined with or encased in an oxidizable metal-plate casing at least throughout a major portion of their surface.

Many types of structural elements for furnaces are known in which the refractory material is retained within a casing made of ordinary steel plate which will become oxidized to a greater or smaller depth in the areas thereof adjacent to the hot furnace walls. The purpose of such oxidizable linings or casings is two-fold: first, the increase in volume resulting from the oxidization of the metal on the hotter side of the element ensures the formation of a tighter seal at the joints between adjacent bricks towards the furnace chamber; and second, the non oxidized sheet plate on the cooler side provides a mechanical reinforcement for the furnace walls.

It is an object of this invention to provide a metal-lined brick encased on three or four of its sides by a process involving a direct compression of the refractory material into a U-shaped sheet-metal casing or channel liner possessing high mechanical strength in all its parts.

Another object is to provide a basic brick encased in a channel-shaped sheet metal casing wherein the refractory material is compressed directly within the casing in a direction normal to the base or web of the channel without producing any distortion or buckling in the flanges of the channel casing.

A further object is to provide a sheet-metal casing for the production of metal-lined basic bricks which is adapted to be inserted downwardly in inverted condition into a moulding cavity after refractory material has already been charged into said cavity, the flanges of the casing being so formed at their edges as to prevent any buckling or distortion of said flanges during the brick-manufacturing steps.

A further object of the invention is to provide a basic brick of the type intended to be suspended in the erected structure from a hanger, provided with a sheet metal casing lining three sides and one end face of the brick, and wherein the refractory material above the suspension means or hanger is retained by that part of the casing which lines the said one end face of the brick.

In the U. S. patent specification 1,106,725, a method of kiln construction was described using structural elements comprising a container of arbitrary shape filled with a core of basic material, the said elements being juxtaposed and retained in assembly by means of a suitable binder. The preferred embodiment of the structural element described in the said patent is of cylindrical form, so that the oxidizable casing only exerts a comparatively small effect in sealing the inter-brick joints, the efficacy of such seal being primarily dependent on the more or less satisfactory way in which the binder material clings to the adjacent elements.

Inasmuch as the bricks in a wall or vault are juxtaposed, it is not necessary that all the sides of each brick be metal-lined for the purpose of providing each inter-brick joint with an oxidized metal seal. In actual practice, the end faces at the internal and external sides are left unlined, while three of four of the remaining (side) faces are metal-lined.

A brick encased in a U-shaped sheet metal casing was described in U. S. patent specification 1,672,524. This brick unit consists of a casing and an agglomerated body of refractory material separately formed and subsequently interfitted with each other. A result of this construction is that relative slippage between the two constituent elements of the brick unit always remains possible and in such case the clearance which arises between the elements impairs the efficiency of the joint, since the expansion resulting from oxidization of the steel liner may not be sufficient to compensate for such clearance and seal the joint.

To improve the adhesion between the refractory filling and the steel casing or liner, in the case of bricks pre-encased over three useful faces thereof, the simplest method would apparently consist of providing a channel-shaped casing by any conventional cutting and pressing methods, placing this channel into the mould of the agglomerating press and then filling it with the refractory brick material, and finally compressing said material directly within the casing. However, when this procedure is applied to a casing produced from a sheet element simply formed to channel section so as to provide a casing having dimensions corresponding with the external dimensions of the brick, it is found that upon compression of the brick material in the casing retained in the press mould or die, the flanges of the channel casing will tend to buckle or distort to such an extent that the bricks thus produced have to be scrapped.

To overcome this difficulty, various means have been conceived, such as reducing the length of the channel flanges. When this is done however two of the three lined sides of the resulting bricks are not metal-lined throughout their full height. Such bricks will therefore present areas possessing lesser resistance to mechanical impacts and to disaggregation caused by temperature variations, and the masonry joints in such areas are less tightly sealed because of the absence of the oxidizable metal. It has also been suggested to use pairs of oppositely-arranged channel sections for lining the bricks, but this method of brick construction is expensive, time-consuming and difficult to carry into practice.

In U. S. patent specifications 2,247,376 and 2,289,911, it has been suggested with the object of preventing distortion of the casing during the moulding process, to weaken the base or web of the channel along a longitudinal line by the provision of slots along this line over a greater part of the length of the web. This of course weakens the structural strength of the resulting brick and moreover requires the exertion of great care in handling the casings if distortion along the weakened line is to be avoided.

I have now found that it is possible to prevent distortion or buckling of the flanges of a channel-casing for a brick unit of the type described provided with a lining over three or four of its sides, while at the same time using a casing in which the flanges extend substantially throughout the full extent of the related brick surfaces, provided the free ends of the casing flanges are conformed to a suitable configuration hereinafter specified, rather than being flat.

Thus the invention provides a method of producing composite bricks fully lined over three (or four) of their faces, which comprises providing a metal casing having an equal number of sides to the number of sides of the brick which are to be lined and corresponding in dimensions to the outer dimensions of the brick, the said casing including a base web and perpendicularly upstanding flanges along the side edges of the brick, the free

end of each flange terminating in a cylindrical surface having its convexity directed towards the inside of the casing, placing said casing into a mould cavity, in such a way that the flanges respectively bear along at least one generatrix thereof against a corresponding side wall of said cavity, and directly compressing the brick material in said casing.

The cylindrical section terminating each flange may be formed by bending the appropriate edge of each flange, or in any other suitable manner, e. g. by grinding.

One important effect of the provision of such a cylindrical surface is that it presents an incline or taper to the material to be bricked of such configuration that the material will not tend to be retained on the terminal edges of the casing flanges and will be directed or guided towards the inside of the casing. The radius of curvature of a cross-section of this surface may be provided as small as will be consistent with the friction coefficient of the sheet metal, which in turn depends on the nature of said metal and the surface condition thereof. The subtended angle of the cylindrical cross-section assumed to be circular will also depend on the same factors.

The invention further comprises a sheet metal brick casing for practicing the method above defined, as well as the resulting lined bricks produced by such method.

Claws punched out of the casing inwardly thereof may be provided in conventional manner to bond the metal lining to the brick material. A cover plate may be secured in a similar way and at the same time over the fourth side of the brick.

The invention will be clearly understood from the ensuing description of some exemplary embodiments of the invention illustrated in the accompanying drawings, wherein:

Fig. 1 is an isometric view of a finished brick according to the invention;

Fig. 2 is a similar view of the channel shaped casing or liner used in the construction of the brick shown in Fig. 1;

Fig. 3 is a diagrammatical vertical section of a mould having a casing as in Fig. 2 placed in it with the flange ends thereof bent to provide the cylindrical surface according to a feature of the invention;

Fig. 4 is a similar view similar to Fig. 3 but showing a liner of somewhat different shape;

Fig. 5 is a diagrammatical vertical section of a mould having a sheet steel liner inserted into it prior the moulding, the flange edges of the liner being ground along the inner arrises thereof to provide the said cylindrical surfaces;

Fig. 6 shows one advantageous arrangement of brick according to the invention in the construction of a wall, wherein the bricks are provided with a sheet metal liner anchored upon the fourth side thereof; and

Fig. 7 is an isometric view of a brick lined on four sides and one end thereof adapted to be suspended from a T-shaped hanger tenon.

In a simple embodiment of the invention illustrated in Figs. 1 and 2, the brick **10** according to the invention is lined throughout the full extent of three of its four sides with a metal liner or casing **11**. This casing consists of a channel including two flanges **12** upstanding perpendicularly from the web **13** of the channel. The casing corresponds in its dimensions with the external dimensions of the brick to be produced, allowance being made for the necessary clearance required for its insertion into the mould. As is clearly shown in the drawings, the edges of the casing flanges **12** remote from the web are slightly bent outwards to provide outward cylindrical surfaces **12***a* having small radii of curvature.

The casing **11** may be placed in the moulding cavity before or after the brick material has been charged into it, as desired, and the material then compressed in the casing by any appropriate means; or alternatively, the material may be tamped into the cavity during the compression step by means of a piston **14** and suitable guide means. In either case, the casing may be so placed that its web **13** is directed upwards (Figs. 3 and 4) or downwards (Fig. 5) or indeed at any desired angle. Yet a further procedure would be to combine the displacements of both the casing and brick material, said casing and material being moved towards each other. In all cases the cylindrical surfaces **12***a* terminating the flanges of the casing are made to bear against the walls **16** of the moulding cavity along a generatrix **15** of each cylindrical surface.

In practice, in order to impart to the resulting bricks as accurate a box-like shape as possible, it is desirable, in the event the cylindrical surfaces **12***a* are formed by bending the free edges of the flanges, to keep the extent of said cylindrical surface as small as possible, and accordingly use the smallest radius of curvature consistent with the thickness of the sheet metal used.

It may be stated by way of indication that good results have been obtained with a metal sheet 1 mm. thick formed to radii of curvature of 1 mm. and 2 mm. respectively for both sides, the subtended angle of the cylindrical cross-section being about 60°. In this case, the sheet metal was cut at right angles prior to the cambering of its edges, so that the external arrises of the lips formed abutted against the opposite parallel sides **16** of the moulding cavity along two generatrices **15** of the outer cylindrical surface, the end surface of each flange being directed along a diammetric plane of the cylinder.

If desired, and especially in order to make the casing edges less sharp, any other equivalent form may be imparted to such edges, and things so arranged for example that the end of flange **12** will bear against the mould cavity wall over the whole area of the end surface **18—19** of the sheet, as in Fig. 4, rather than by only one edge or arris **15** thereof as in Fig. 3.

To improve the bond between the brick material and its casing, claws **22** are preferably punched inwards from the flanges to be embedded in the body of the brick on moulding.

Fig. 5 illustrates another form of embodiment of a casing according to the invention arranged in a moulding cavity prior to being charged with brick material. As shown in this figure, the cylindrical surface **12***a* is provided by removing metal adjacent to the inner arris of the flange **12**, for example by grinding, so that the cylindrical surface is intersected by the outer surface of flange **12** along a generatrix **15**.

Where the bricks are of the type shown in Fig. 1, and more especially in the case of bricks provided with a cover plate anchored to their fourth side, it becomes desirable, owing to the flare provided along the arrises **12***a* which slightly increases the width of one side of the brick to set the bricks in alternating relationship when erecting a wall with one brick with the liner web downwards and the next with the web upwards (see Fig. 6) so that the lateral projections will interfit with the fillets provided at the junction of the casing web with the casing flanges.

Steel-lined bricks of the kind contemplated herein are frequently used in suspended vaults and in such cases special precautions have to be taken in order to provide for the engagement of the hanger means.

In U. S. Patents 2,125,193, 2,247,376 and 2,289,911, steel-cased bricks are disclosed wherein one side of the casing or the cover which in many cases is adapted to the fourth side of the brick, is widely cut out to clear the recess into which the hanger engages and allows its being inserted into said recess, with the end of the encased brick still being free from a metal lining.

Obviously the method described makes it possible to construct a brick lined over three sides and one end thereof, with the use of a casing consisting of a web and three flanges upstanding therefrom. Such an arrangement is especially desirable where the brick is to be suspended or hooked. Fig. 7 shows such a brick which is designed for being suspended from a T-shaped hanger or

hook. In this case, the casing would comprise, in addition to the web 13 and the side flanges 12, a third flange 23 also formed with a cylindrical surface 23*a* along its free edge. A cutout 24 is formed in the flange 23 for insertion of the hanger shank, and a T-shaped cutout 25 is formed in the web 13, both cutouts 24 and 25 being formed in corresponding positions, for example by means of a common punch in a single punching step prior to bending the flange 24 along the edge 26. Two claws 22*a* are preferably punched inwards from the flange 23 in a manner similar to the claws 22 of flanges 12. Inasmuch as the suspension of a brick of this kind is assured only by the odd square inch or so of brick material engaging the cross-arm of the T-hanger, a metal lining over the end of the brick on the suspended side thereof will provide a considerable reinforcement, and will make it possible moreover to form the notch or cutout at a point closer to the end of the brick, whereby the brick is utilized more fully and will have a longer service life.

It will be understood that many alterations may be made in the details of the brick and channel casing or liner described and illustrated without exceeding the scope of invention as defined by the ensuing claim.

What I claim is:

A metal lined refractory brick for metallurgical purposes comprising an outer oxidizable elongated channel shaped sheet steel casing including a web, at least two upstanding flat flange portions extending at right angles from the web along the two longer edges thereof, refractory brick material compressed in the casing and having

an outer elongated exposed face extending between the flange portions, said web and flange portions completely covering the respective sides of the brick material, said flange portions having a height just equal to the height of the brick material, each of said flange portions terminating in an outwardly turned free edge portion, said free edge portion of each flange portion extending over an angle of not more than 90° and extending parallel with its respective longer edge of the web and forming a cylindrical surface whose convexity is directed towards the brick material, the free edge portions being flush with the elongated exposed face of the brick material.

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