Oct. 31, 1967 R. E. OVER 3,350,085

REFRACTORY LINING FOR CONICAL PORTION OF A FURNACE AND BRICK THEREFOR

Filed Oct. 28, 1963 3 Sheets-Sheet 1

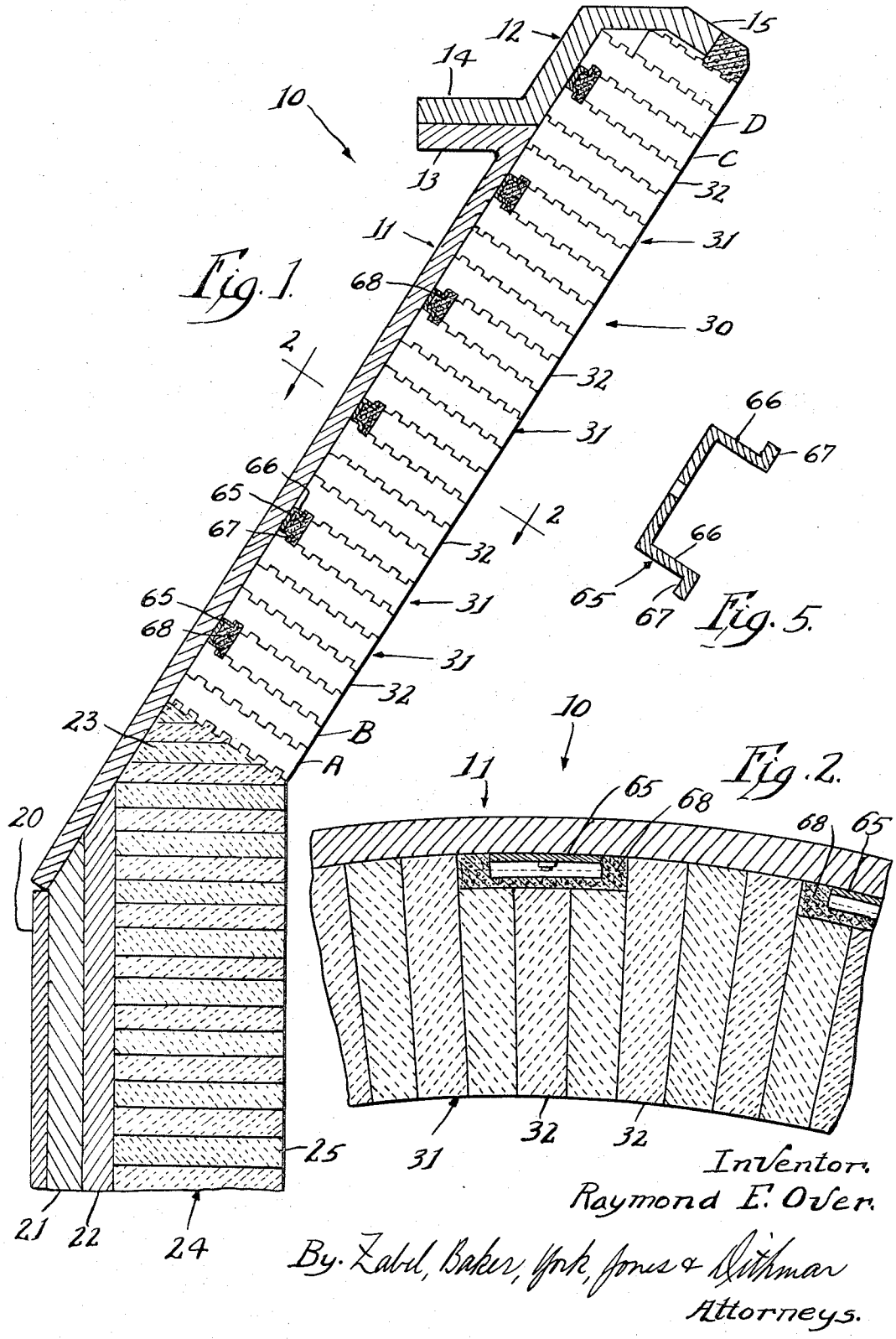

Fig. 1.

Fig. 5.

Fig. 2.

Inventor.
Raymond E. Over.

By. Zabel, Baker, York, Jones & Dithmar
Attorneys.

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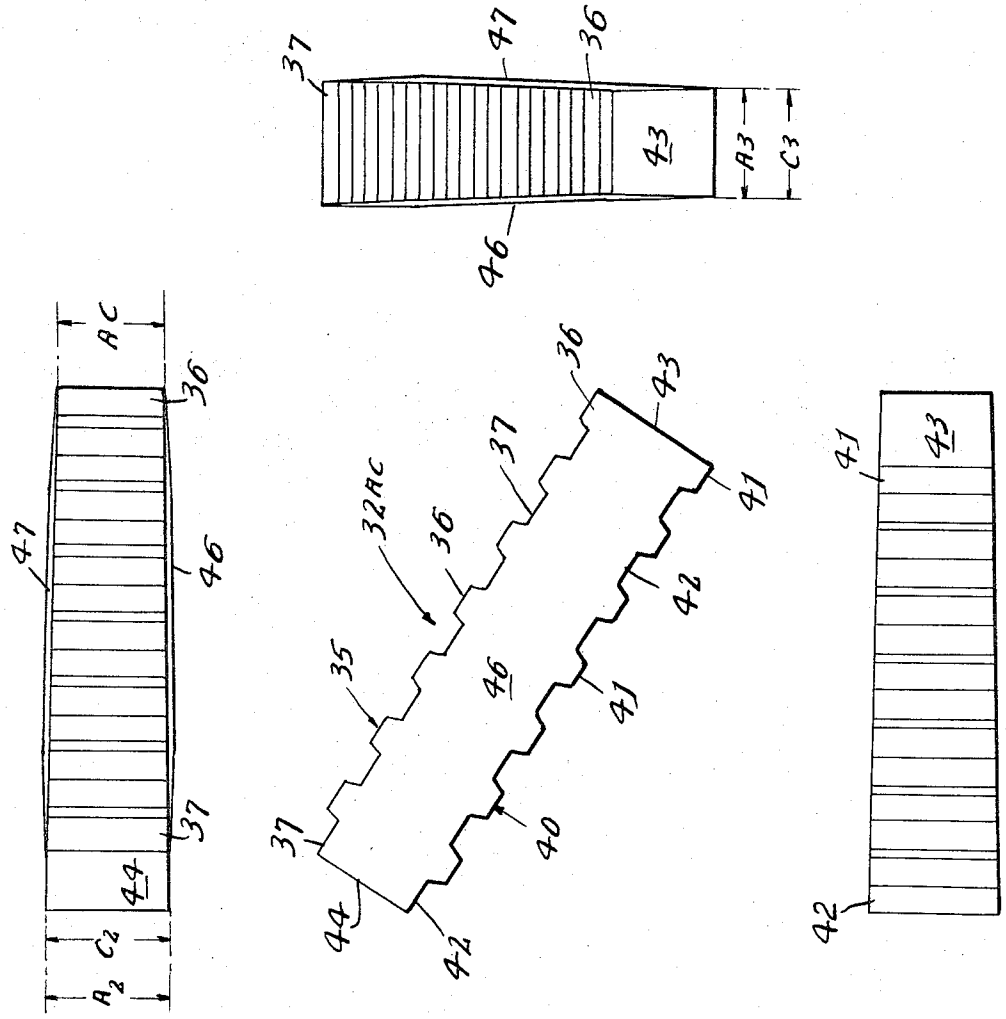
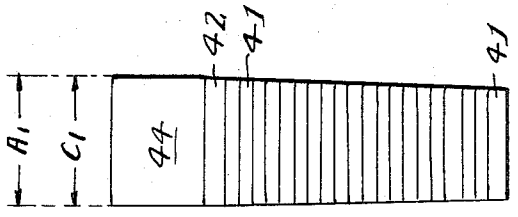


Fig. 3.



Inventor.
Raymond E. Over.

By. Zabel, Baker, York, Jones & Dithmar
Attorneys.

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Filed Oct. 28, 1963 3 Sheets-Sheet 3

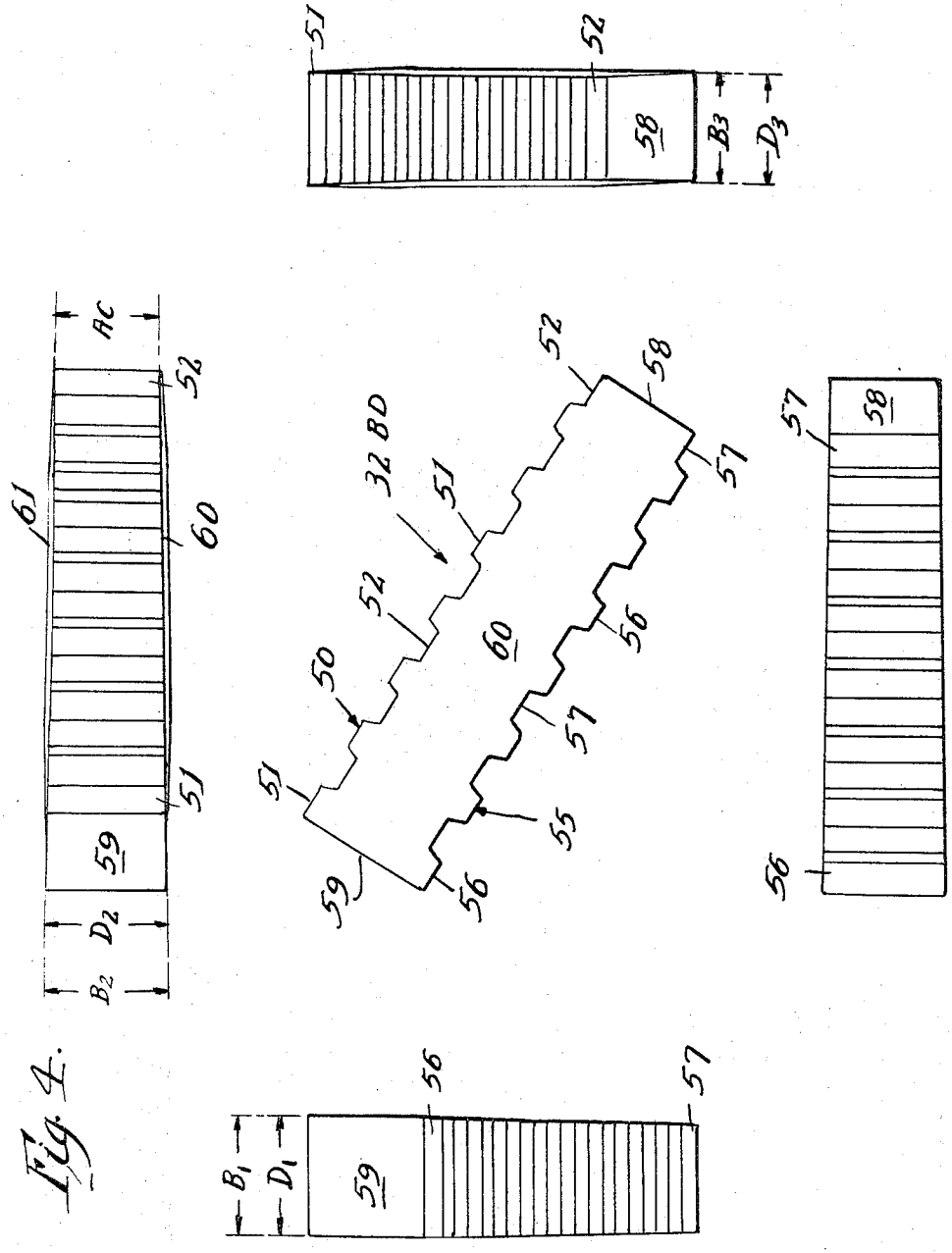

Fig. 4.

Inventor.
Raymond E. Over.

By. Zabel, Baker, York, Jones & Gilchrist
Attorneys.

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REFRACTORY LINING FOR CONICAL PORTION OF A FURNACE AND BRICK THEREFOR

Raymond E. Over, Mokena, Ill., assignor to M. H. Detrick Company, Chicago, Ill., a corporation of Delaware

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This invention relates to a refractory lining for the conical portion of a high temperature furnace, such as a basic oxygen furnace, and to the brick used in such lining.

The upper portion of a basic oxygen furnace is conical in shape and open at the upper end. The furnace is charged through the open end, and, after a predetermined heat period, tilted, causing the molten metal to flow out through the open end.

The refractory lining of the conical portion is subjected to extreme thermal and mechanical conditions. It therefore is important that this lining be capable of withstanding severe conditions of high temperature, thermal change and mechanical shock and abrasion.

One object of the invention is to provide an improved refractory lining for the conical portion of a high temperature furnace, the lining made up of superimposed annular layers or rows of refractory brick.

Another object is to provide a lining for the conical portion of a furnace wherein the lining is constructed with bricks of no more than four different shapes. When four shapes are used, the bricks comprise two series of two bricks each, the bricks in one series having a male characteristic and the bricks in the other series having a female characteristic. The two bricks in each series differ from each other in amount of taper on the edges of the top and bottom faces, referring to the installed position, whereby bricks of the two taper characteristics may be used alone and in appropriate combination to produce annular layer or rows of brick having all the diameters required by the conical portion of the furnace.

Another object is to provide a lining for the conical portion of a furnace wherein each component brick, apart from those at the upper and lower ends, is interlocked with at least two other component bricks. This feature, of course, lends stability to the entire lining, and provides desirable intimacy between the respective bricks.

Another object is to provide a lining for the conical portion of a furnace made up of superimposed annular layers of refractory brick wherein the longitudinal axis of each brick is perpendicular to the plane tangent to the conical portion at the intersection of the axis with the conical portion.

Still another object is to provide a lining for the conical portion of a furnace wherein means are provided whereby some of the brick is anchored positively to the conical portion of the furnace both during and after installation. Thus, the use of internal forms during installation of the lining is avoided, and some of the brick weight of the finished lining is carried by the conical portion of the furnace.

Another object is to provide a lining for the conical portion of a furnace wherein the inner surface of the lining is substantially conical in shape, thus avoiding a corbelled inner surface. The latter appears to have inferior resistance to the extreme thermal and mechanical conditions encountered in furnaces of this type.

Another object is to provide a lining of the character described that is comparatively inexpensive and easy to install, compared with prior art conical linings.

Still another object is to provide a refractory brick for use in the lining of a conical portion of a furnace. In one form, the brick of the invention contemplates four

different specific shapes, these shapes being all that are required to construct a conical lining in the range of sizes commonly employed.

Other objects, advantages and details of the invention will be apparent as the description proceeds, reference being had to the accompanying drawings wherein one form of the invention is shown. It is to be understood that the description and drawings are illustrative only and that the scope of the invention is to be measured by the appended claims.

In the drawings:

FIG. 1 is a fragmentary longitudinal sectional view through a portion of a furnace, including the conical portion, the view showing a refractory lining embodying the invention.

FIG. 2 is an enlarged fragmentary sectional view on line 2—2 of FIG. 1.

FIG. 3 in the center is an enlarged side elevational view of a brick used in the lining, the inclination of the brick corresponding to the brick inclination of FIG. 1. Quadrature projections of the central brick also from part of FIG. 3, the illustrated brick being representative of one of the two brick series of the invention, namely the male series.

FIG. 4 in the center is an enlarged side elevational view of a brick used in the lining, the inclination of the brick corresponding to the brick inclination of FIG. 1. Quadrature projections of the central brick also from part of FIG. 4, the illustrated brick being representative of the other of the two brick series of the invention, namely the female series.

FIG. 5 is an enlarged sectional view of an anchor means used in the invention.

Referring first to FIGS. 1 and 2 of the drawings, a fragmentary part of the conical furnace portion with the refractory lining of the invention is designated **10**. The conical portion comprises a lower conical part **11** and an upper cap part **12**, both of suitable metal. As illustrated, the two parts have flanges **13** and **14** that cooperate to hold the two parts together. Part **12** also has an inwardly extending flange **15** that defines the upper open end of the furnace.

Other parts of the furnace illustrated in FIG. 1 include lower cylindrical casing **20**, layers of insulation **21** and **22**, insulation **23** and lower refractory lining **24** made up of horizontally disposed brick **25**. These parts are not involved in the invention, as will be seen.

The invention, as mentioned, concerns itself with refractory lining **30** for conical portion **10** of the furnace. Lining **30** comprises superimposed annular rows or layers **31** of refractory brick **32**.

The longitudinal axis of each brick **32** is perpendicular to the plane tangent to conical portion **10** at the intersection point of the axis with the conical portion. Thus, the inner surface of lining **30** has the same conical shape as conical portion **10**. This smooth surface is an improvement over the corbelled or stepped inner surface found in many prior art linings.

Brick **32** used in illustrated lining **30** fall in two series, one series having a male characteristic and the other a female characteristic. In addition, each brick series includes two members, the members in each series differing slightly from each other in shape. Thus, in the form of the invention shown, the entire lining is constructed with brick of only four different shapes.

In another and related form of the invention, as will be seen, the entire lining may be constructed with brick of only two different shapes.

Referring to FIG. 3, the central drawing is a side elevational view of a brick designated **32AC**, the brick having the shape of the brick falling in one of the two series (the AC or male series).

Upper face 35 of brick 32AC, referring to the installed position, has alternate ribs 36 and recesses 37 which, as will be seen, interlock with the ribs and recesses of adjacent brick. Lower face 40 of brick 32AC likewise has alternate ribs 41 and recesses 42.

Brick 32AC has an inner face 43, referring to the installed position, that is one element of the inner surface of the lining and an outer face 44 that lies adjacent conical portion 10 of the furnace. Faces 43 and 44 are parallel to each other and perpendicular to the top and bottom faces 35 and 40.

Brick 32AC also has side faces 46 and 47, the two surfaces being planar, but tapering in small degree inwardly toward each other from outer face 44 and upwardly toward each other from bottom face 40.

The inner end portions of top and bottom faces 35 and 40 of brick 32AC terminate in ribs 36 and 41, thus giving this brick series the previously mentioned male characteristic. Conversely, the outer end portions of top and bottom faces 35 and 40 terminate in recesses 37 and 42.

Referring to FIG. 4, the central illustration is a side elevational view of a brick designated 32BD, this brick representing the shape of the brick falling in the other of the two series.

As in the case of brick 32AC, brick 32BD has an upper face 50, referring to the installed position, having alternate ribs 51 and recesses 52, and a lower face 55 having alternate ribs 56 and recesses 57. Brick 32BD also has an inner face 58 and an outer face 59, the latter two faces being parallel to each other and perpendicular to the top and bottom faces 50 and 55.

Brick 32BD also has side faces 60 and 61, the two surfaces being planar and tapering in small degree inwardly toward each other from outer end face 59 and upwardly toward each other from bottom face 55.

The inner end portions of top and bottom faces 50 and 55 of brick 32BD terminate in recesses 52 and 57, thus giving this brick series the previously mentioned female charactertistic. Conversely, the outer end portions of top and bottom faces 50 and 55 terminate in ribs 51 and 56.

Each annular row or layer 31 of refractory brick 32 is made up exclusively of brick of one or the other of the aforesaid two series, i.e. either the male series or the female series. As shown in FIG. 1, the annular layers of female brick alternate with annular layers of male brick, thereby providing an interlocking relationship that gives a substantially unbroken conical shape to the inner surface of the lining.

In preferred form, the invention contemplates that some of the lining brick is anchored positively to conical portion 10 of the furnace. Since each lining brick has interlocking relationship with at least two other bricks, and some of the bricks are fastened to the wall, it will be seen that the entire lining is attached securely to conical portion 10 and that at least some of the brick weight is carried by the conical portion.

Referring to FIGS. 1, 2 and 5, vertically and circumferentially spaced means 65 serve to anchor certain of the lining brick to conical portion 10. In the illustrated form of the invention, means 65 comprise short lengths of channel, bolted or otherwise secured to conical portion 10. The channel legs 66 have outwardly extending flanges 67 that are received within recesses 52 and 57 of female brick 32BD, the flanges engaging ribs 51 and 56 to retain the bricks in place.

As shown in FIG. 1, anchor channels 65 are spaced vertically so that some brick in each alternate row or layer of female brick 32BD engage a channel flange 67. Male brick 32AC adjacent anchor channels 65 are reduced in length by breaking away the outer ends, and the space thereby left may be filled with castable insulating material 68.

The channels for each annular layer are spaced circumferentially, the circumferential spacing in FIG. 2 being the width of six brick, although this spacing may vary with the circumference of the layer.

The length of each anchor channel shown in FIG. 2 is such as to engage three brick. Thus, in the annular layer shown, alternate groups of three brick are anchored, and intermediate groups of three brick are not anchored by a channel, but all individual brick are interlocked with adjacent brick.

This anchoring arrangement facilitates erection of the conical lining by eliminating the need for interior forms to hold the partially installed annular layers in place pending completion of the layer.

Referring both to male brick 32AC and female brick 32BD, the top face at the outer end of each brick is narrower in width than the bottom face at the outer end. This width difference reflects the dimensional characteristics of a cone. These top and bottom faces taper substantially uniformly in width toward the inner brick end, thereby giving the brick a modified pie shape. Thus, when the bricks are assembled in a conical lining, the planar side faces of each brick are parallel to the adjacent side faces of laterally adjacent brick.

To accommodate the variation in diameter between the annular brick layers at the bottom of conical portion 10 and those at the top, each series of brick, male and female, comprises two shapes. The difference in these two shapes is amount of taper. Bricks 32A and 32B used in the largest diameter layers at the lower end of conical portion 10 have comparatively slight taper, while bricks 32C and 32D used at the upper end of the conical portion have a more pronounced taper.

Referring to male brick 32AC in FIG. 3, the dimensions C_1, C_2 and C_3 of brick 32C are slightly larger than the corresponding dimensions A_1, A_2 and A_3 of brick 32A. Thus, since the inner faces of the bricks have the same width, the taper in brick 32C is greater than that in brick 32A, such increased taper being appropriate for the brick used in the smaller diameter layers.

Similarly, referring to female brick 32BD in FIG. 4, the dimensions D_1, D_2 and D_3 of brick 32D are slightly larger than the corresponding dimensions B_1, B_2 and B_3 of brick 32B, so the brick 32D used in the smaller diameter layer has the greater taper.

Referring to FIG. 1, the lower and maximum diameter layers designated A and B will consist exclusively of bricks 32A and 32B, the bricks in each series having the gentler taper. At the other extreme, the minimum diameter layers designated C and D will be made up exclusively of bricks 32C and 32D, the bricks in each series having the greater taper. Each intermediate layer comprises a combination of bricks of the two tapers. In the case of a male layer, the bricks are the proper combination of bricks 32A and 32C, and in case of a female layer, the proper combination of bricks 32B and 32D. Thus, the geometric requirements of any diameter layer may be satisfied.

The previously mentioned modified form of lining and brick therefor contemplates only two brick shapes, the shapes, differing from each other in amount of taper, as is the case with the two brick in each of the series described above. In the modified brick, the upper face has ribs and grooves of male or female characteristic, and the lower face has ribs and grooves of opposite characteristic. The anchor channels used with such brick are provided with legs of unequal length to engage the misaligned ribs on the top and bottom surfaces of the bricks.

From the above description it is thought that the construction and advantages of this invention will be readily apparent to those skilled in the art. Various changes in detail may be made without departing from the spirit or losing the advantages of the invention.

Having thus described the invention, what is claimed as new and desired to secure by Letters Patent is:

1. A refractory lining of uniform thickness for the conical portion of a furnace comprising:

superimposed annular layers of refractory brick, the longitudinal axis of each brick perpendicular to the plane tangent to the conical portion at the intersection point of the axis with said conical portion;

the top and bottom faces of each brick, referring to the installed position of the brick in a conical portion of substantially vertical axis, having alternate ribs and recesses interlocking with the ribs and recesses of adjacent bricks above and below, the side faces of each brick substantially planar;

the top face at the outer end of each brick narrower in width than the bottom face at the outer end, the top and bottom faces tapering substantially uniformly in width toward the inner brick end, whereby the substantially planar side faces of each brick are parallel to the adjacent side faces of laterally adjacent brick;

the top and bottom faces of all brick in one annular layer having ribs at the inner end portions thereof and the top and bottom faces of all brick in the adjacent annular layers having recesses at the inner end portions thereof, whereby the inner brick ends define a substantially conical surface;

the top and bottom faces of some of said brick respectively tapering in width to a greater extent than the taper of the top and bottom faces of the remaining brick, whereby brick shapes employing said two tapers may be used alone and in combination to

produce annular layers of brick having all required diameters.

2. The combination of claim 1 with the addition of means on said conical furnace portion interlocking with the outer end portions of some of said refractory brick, whereby the lining is anchored positively to said conical portion during and after installation and at least some of the brick weight is carried by said conical portion.

References Cited

UNITED STATES PATENTS

891,991	6/1908	Harmansen	263—46 X
1,224,757	5/1917	Lind	52—89 X
2,082,698	6/1937	Karmanocky	263—46 X
2,206,205	7/1940	Selby	52—575
2,304,170	12/1942	Heuer	52—89 X
2,319,065	5/1943	Karmanocky	52—89
2,762,217	9/1956	Barr	52—593 X
2,930,601	3/1960	Heuer	263—46
2,854,842	10/1958	Hosbein	263—46 X
3,088,722	5/1963	Slesaczek	263—46
3,132,447	5/1964	Hosbein	110—99 X
3,183,625	5/1965	Agnew	52—575 X
3,274,742	9/1966	Paul	52—89 X

JOHN F. CAMPBELL, *Primary Examiner.*

R. F. DROPKIN, *Assistant Examiner.*