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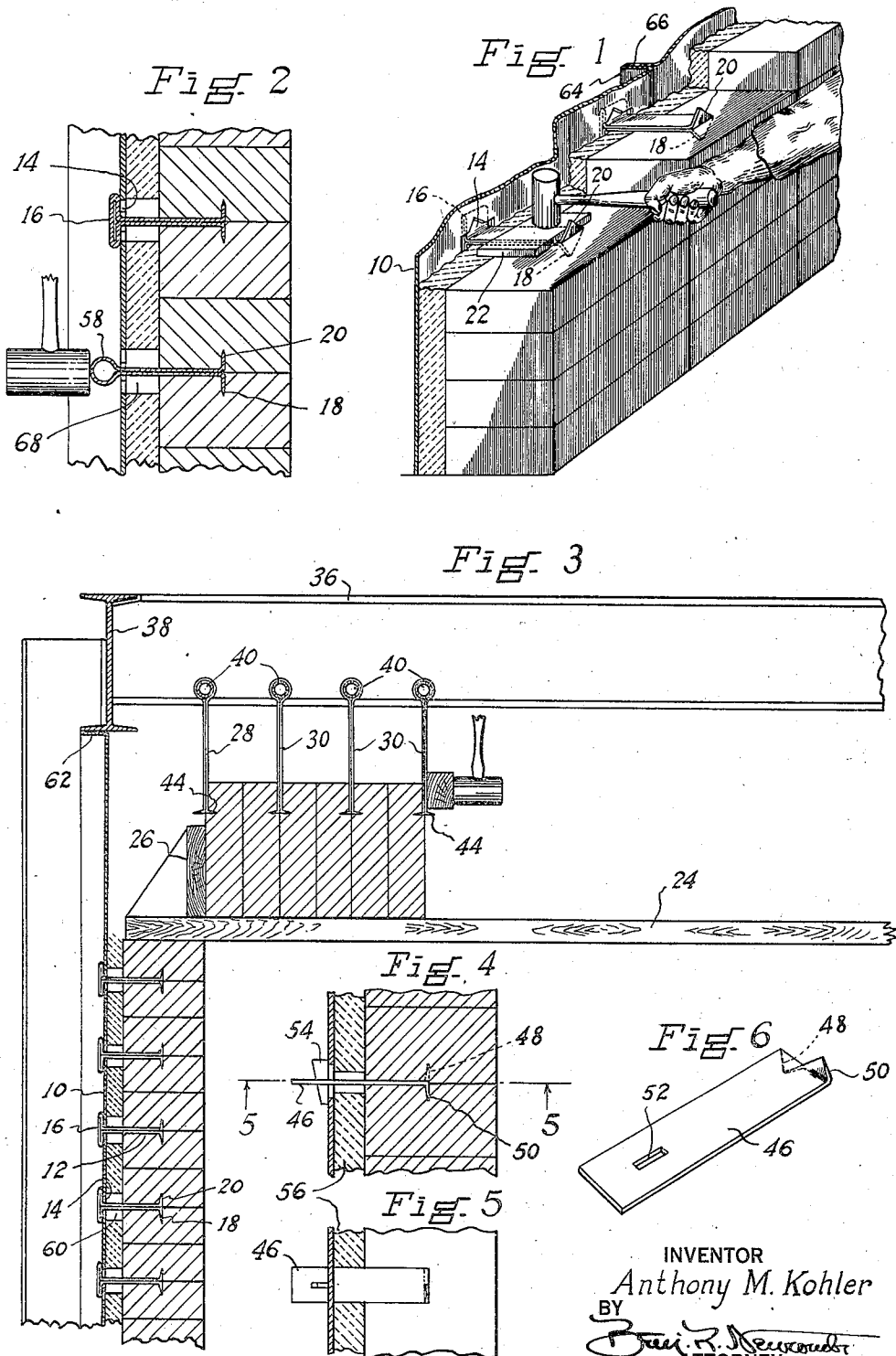
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WALL AND ARCH CONSTRUCTION

Original Filed Jan. 22, 1935

2 Sheets-Sheet 1



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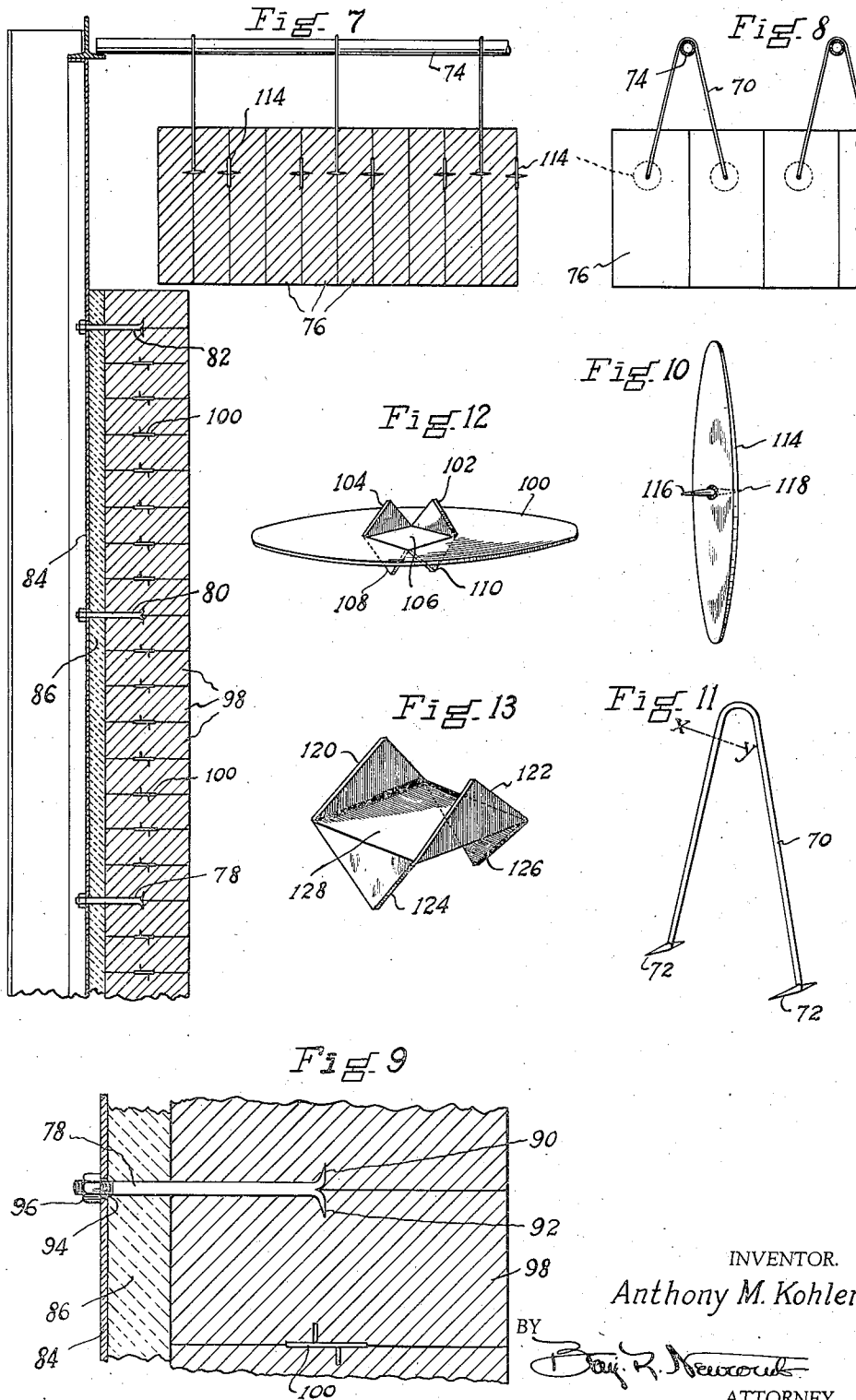
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WALL AND ARCH CONSTRUCTION

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This invention relates to furnaces. It comprehends furnace erection which eliminates a costly operation in the manufacture of the refractory elements for a furnace and provides for the building of a furnace with preformed refractory elements mechanically bonded without the necessity of supplying especially formed elements to receive bonding members in interlocking relationship. In other words, the invention enables the furnace builder to erect a bonded wall furnace of high efficiency with bricks of but one size and shape. It results in a marked decrease in erection costs and provides a novel method of building furnace walls and arches.

A further object of the invention is to improve furnace building methods in such a way that a complete furnace including bonded arches and walls may be built with plain rectangular shapes of bricks of high refractory and insulating properties which are all identical in shape, design or manufacture. By the use of the invention the furnace erector need not be supplied with refractories of various kinds and shapes for different parts of the furnace.

It is also an object of the invention to provide a method of building refractory walls wherein the pierceable bricks of an inner wall are bonded to each other and to an outer insulating and supporting wall by impaling individual bricks of the inner wall on pointed metallic tie members during the erection of the inner wall.

The invention will be described with reference to the accompanying drawings, in which:

Fig. 1 is an isometric view illustrating the manner in which the furnace wall is constructed.

Fig. 2 is a partial sectional view through the wall indicating the manner in which the elements of the wall are bonded.

Fig. 3 is a vertical section through a part of the wall and the arch, showing the manner in which the arch is constructed.

Fig. 4 is a detailed view of a modification of the bonding members.

Fig. 5 is a detailed view showing the Fig. 4 structure in plan.

Fig. 6 is a perspective view of the metallic bonding member of the Fig. 4 and the Fig. 5 construction.

Fig. 7 is a view in the nature of a vertical section through a furnace representing another embodiment of the invention.

Fig. 8 is a view in the nature of an end elevation of the Fig. 7 arch when the last row (shown) of refractory elements is removed.

Fig. 9 is a partial section, showing on a larger

scale, the wall bonding elements of the Fig. 7 embodiment.

Fig. 10 is a perspective view of brick bonding element.

Fig. 11 is a perspective view of the arch impaler or suspending and bonding element.

Fig. 12 shows a sheet metal brick bonding member in perspective, and

Fig. 13 is a perspective view of an additional embodiment of the sheet metal brick bonding member.

The refractory elements of the arch and the inner wall of the illustrative furnace are of light weight. They are porous to a certain extent, and their thermal conductivity is of such an order that there may be a temperature in excess of 2000° F. at their furnace ends while the temperature at their opposite ends is such that it is not above normal room temperature. The weight of the elements is from one-half to one-sixth the weight of firebrick which have been used in the prior art. They can be pierced or impaled to a limited extent without breaking.

In building the illustrative furnace wall in the manner indicated in Fig. 1 of the drawings, a course of the insulating firebrick is laid upon a suitable base and is positioned as a row spaced from an outer wall indicated at 10. The tops of these bricks are preferably about level with the mid-parts of the openings 14 formed in the outer wall. Metallic bonding members are then inserted through these openings. The movement of these members through the wall 10 is limited by the heads 16 in such a way that the upwardly and downwardly extended prongs 20 and 18 are situated over the upper surfaces of the brick and at a sufficient distance from their outer edges to provide adequate bonding supports. Furthermore, the location of these prongs is such that they are protected by a considerable portion of the brick between them and the furnace face of the wall. By reason of the insulating properties of the brick the bonding members will be protected to such an extent that there will be no failure of furnace operation due to the melting of the metal of those members. This quality of the brick together with their properties whereby they can be pierced to a limited extent permits the use of bonding members which are constructed of relatively light material. Economy of insulation is thereby promoted.

After each bonding member is in the position indicated a block 22 may be positioned above it to cushion the blow of a hammer which forces the lower prong down into the insulating fire-

brick. This operation may be continued along the entire extent of the wall, with each brick having a bonding member holding it to the outer wall 10.

5 The second course of brick is then brought into position above, and in alignment with the lower course. Each individual brick of this second course is then subjected to a separate blow to impale it upon one of the upwardly extending
10 prongs of a bonding member. This operation is then continued until the bricks of the second course are entirely bonded to the bricks below them and to the outer wall 10.

It will be observed from the Fig. 1 disclosure
15 that the block 22 covers the portion of the bonding members which extends parallel to the contacting surfaces of the superposed brick. Adequate seating of these portions within the brick material by the blows is promoted by constructing the bonding elements of narrower strips.
20 They may be made of wire or small diameter half round bars to foster the necessary limited pressing of the bricks to seat these portions of the bonding members and permit successive bricks
25 to be in contact.

The above described operations are continued until the wall has reached such a height as that indicated in Fig. 3 of the drawings. Thereupon a temporary support 24 may be positioned on
30 top of the wall, for use in the construction of the arch.

In the illustrative method of constructing the arch a temporary stop 26 is provided at the ends of the support 24. Thereafter the end bonding members or hangers 28 are strung upon rods
35 40 in the position indicated. The rods 40 may be mounted upon transverse members 36 supported at their ends by I beams 38, and the hangers 28 may be abutted against any suitable stop. The bricks of the first course of the arch are then placed upon the support 24 and are
40 brought into contact with the prongs 44 of the bonding members 28. These bricks are then struck blows to impale them upon the prongs 44 and a succeeding course of bricks is laid in place.
45 Another row of bonding members 30 is placed in position and they are treated in a similar manner to cause them to pierce the brick and be thereby maintained in position. These operations
50 are continued until the entire arch is formed and then the temporary support 24 is withdrawn and the walls of the furnace are completed.

Figs. 4, 5, and 6 of the drawings illustrate a modification in which the metallic bonding members are single flat metallic pieces 46. They are
55 provided at their ends with upwardly and downwardly struck prongs 48 and 50 and at their other end they are provided with cam slots 52. The operative position of these members with respect
60 to the wall is shown in Fig. 4. This figure indicates cam wedges or keys 54 which may be driven through the slots 52 to bind the outer wall and the inner wall against the intermediate insulation 56.

65 Fig. 1 indicates a procedure with the use of which all of the metallic bonding members of the furnace may be of the same type. They may all have the circular heads 58 in order that some of them may be used for supporting the arch. After
70 these bonding members are used in the construction of the wall they may be struck blows as indicated in Fig. 1 to form the flat heads 16.

The light weight of the bricks and their high thermal conductivity permits the use of thin
75 metal panels in the outer wall. These panels are

flanged as indicated at 64 and 66 in Fig. 1 and these flanges may be secured to any suitable supporting members such as I beams when used as columns. Fig. 6 indicates the flange 62 on one of these panels as secured to the I beam 38.

5 When the insulation 56 is in the form of insulating boards the openings 68 formed therein will conform to the shape of the openings 14 in the outer wall 10. It will be noted that these openings are shaped to allow the prongs 18 and 20
10 of the bonding members to pass therethrough while preventing the heads of the bonding members from such movement.

The manufacture of the illustrative brick and the material from which they are made are such
15 that these bricks constitute a building structure in which there are small uniformly distributed voids of the same order of magnitude. Their extent is indicated by the fact that they may constitute up to 80% of the volume of the individual
20 bricks.

When brick impalers such as those shown in Figs. 10, 12 and 13 are positioned between adjacent bricks a slight pressure manually exerted will
25 impale the bricks. They may be then transferred as a unit to their wall, or arch forming position. In forming the Fig. 7 arch two of such units may be contiguously arranged and a similar assembly spaced from the first. The impaler
30 70 (Fig. 11) may then be positioned between these assemblies and pressure exerted on the latter to impale them on the double-pointed spikes 72. When the impaler 70 is then positioned with a
35 beam such as the rod or pipe 74 within the loop of the former, a composite arch unit is in arch forming position with eight bricks, having a total mass of the order of 16 pounds suspended by a
40 metallic impaler the mass of which is of the order of two ounces.

When a temporary arch support (like 24, Fig. 3)
45 is used in the erection of the Fig. 7 arch, the individual bricks 76 may be successively impaled, several brick impalers being used between the successive suspension impalers 70 as illustrated. In either case, the total weight of the arch is of
50 such an order that the beams 74 may be of low cost and small weight.

Fig. 7 shows a wall having widely spaced bonding impalers 78, 80, and 82 uniting the outer wall
55 84 with the inner wall and the insulator 86. In this modification the bonding impalers are screw threaded shanks split at their inner ends to form the spikes 90 and 92. Their outer ends extend through outer wall openings 94 which are preferably larger in diameter than the shank. The
60 parts of the wall may be tightly bonded by turning up the nuts 96 on the screw threaded ends of the shanks after all of the bricks 98 are impaled in the positions shown in Fig. 7. There are here eight bricks between successively superposed
65 bonding impalers, these intermediate bricks being manually impaled in succession with the brick impalers 100 manually seated between them. One of these elements is shown in Fig. 12. It is a thin metal disk with two upstanding prongs 102 and
70 104 struck up from the metal at its center. Along the two other sides of the square hole 106 at the center of the disk two similar prongs 108 and 110 are bent downwardly. When this disk is inserted between two of the bricks 98 and the
75 upper brick is manually pressed toward the lower one the two bricks are formed into a bonded unit in which the bricks are locked against relative turning movements as well as against relative shifting movements be they longitudinal or trans-

verse. An apertured block may be used for pressing a similar disk into the top brick of this unit, and these operations repeated until the wall is complete.

5 The brick impaler shown in Fig. 10 consists of a thin metal disk 114 with spikes 116 and 118 normal thereto and welded in position. Alternatively, a double ended spike may be inserted through a hole in the disk and secured by welding.

10 In the formation of an impaler like that shown in Fig. 13 a single square piece of thin sheet metal may be used. Opposite corners are then bent to form prongs. When they are bent in the same direction the prongs 120 and 122 are formed and oppositely directed prongs 124 and 126 are formed by similarly bending the remaining corner portions. Thus, in effect, two mutually-reinforcing channels are formed, with the main body portion 128 constituting the base or web of each channel.

20 Starting with a square sheet of metal two opposite corners may be reversely bent to opposite positions in which they are normal to the main body portion. When, thereafter, the remaining corner portions are similarly treated, there is produced a brick impaler which has some of the results secured by the embodiment shown in Fig. 12.

Referring again to Fig. 11, hooked suspension impalers are formed when the wire forming the main body of the impaler (and leading from the right hand spike 72) is terminated at a position indicated by the line $x-y$. The arch units are preferably smaller in this case, and the wire may more effectively take tension stresses, but there must be a separate beam (such as beam 74) for each row of units.

What is claimed is:

1. In a method of building a refractory furnace arch of light weight insulating firebrick having entirely plane surfaces, disposing an initial row of firebrick on a base which determines the ultimate fire face of the arch, impaling the initial firebrick on metallic hangers or bonding members which ultimately will support the arch, impaling the bricks of the next row on the same bonding members by forcing them toward the initial firebrick, continuing the same steps with succeeding rows until the entire surface of the arch is formed and then removing the base.

2. In a method of building a furnace wall of porous insulating firebrick which can be pierced without fracture, bonding the bricks in successive courses to each other and to an external support by impaling the bricks on metallic bonding members which are forced completely into the plane faced sides of the bricks.

3. In a method of building a refractory furnace arch of porous insulating firebrick which can be pierced without fracture, impaling successive firebrick on projections of metallic hangers, and assembling the hangers on arch supports so that a complete arch is formed.

4. In a furnace, an outer wall provided with small openings, headed metallic bonding members having transverse impaler portions at their ends opposite their heads, the openings permitting the impalers to pass therethrough but being too small to allow the heads to pass, pierceable insulating firebricks impaled on the bonding members and forming an inner wall spaced from the outer wall and held in position by the latter, said firebricks being pierceable without fracture and having such insulating properties that there may be a temperature differential in excess of 2000° F. between

their opposite ends during the operation of a furnace.

5. The method of building furnaces which includes the use of porous light weight firebrick elements assembled to bound the furnace space and the impaling of those elements on bonding members during the erection of the furnace to maintain them in alignment and to tie them to external supports.

6. In a furnace, an outer wall which is substantially gas tight, an inner wall spaced from the outer wall and consisting of porous light weight bricks which are capable of being impaled without fracture, and metallic impalers partially inserted through openings in the outer wall and having their impaling parts between successive bricks which are forcibly impaled to bond the inner wall to the outer wall.

7. In the art of building furnaces capable of withstanding flames or gases at temperatures greater than 2000° F., laying a course of porous lightweight refractory firebrick of plain rectangular shape, disposing oppositely pointed metallic bonding members with some of their pointed portions directed transversely to the bonding sides of said firebrick, forcing some of said pointed portions into said sides so that the firebrick are impaled, disposing a succeeding course of said firebrick in alignment with the first course and adjacent the remaining pointed portions of said bonding members, impaling the firebrick of the last course upon said remaining pointed portions and forcing them into substantial contact with the firebrick of the first course, and continuing these operations until the furnace is completed.

8. The method of building a furnace wall of porous insulating firebrick which can be pierced without fracture, comprising, bonding the bricks in successive superposed courses to each other and to a spaced external support by impaling the brick on metallic bonding members which are forced into the plane faced sides of the brick, disposing compressible insulating material in the space between the external support and the brick, and exerting force upon the bonding members to press the brick and the insulating material against the external supports.

9. In a wall, spaced wall bonding impalers, a plurality of bricks between successive impalers, and a plurality of brick impalers between successive wall bonding impalers.

10. In a furnace arch, spaced arch suspending impalers constructed of small gauge wires bent to receive arch supporting beams, a plurality of brick impalers, between successive suspending impalers, and bricks separating the impalers and combining therewith to form separate arch units.

11. A furnace construction including cellular insulating firebrick which can be pierced without fracture, external holding means, and lightweight metallic tying members having their outer ends anchored to the holding means, said members having at their opposite ends transverse brick impaling projections which are forced into the brick during the building of the furnace.

12. A furnace construction including lightweight insulating firebrick which can be pierced at its face without fracture, external holding means, and tying members extending from said holding means to the firebrick and having their outer ends anchored to the holding means, said members having at their inner ends brick impaling projections which are forced into the brick during assembly.

13. A furnace construction including lightweight insulating firebrick which can be pierced at its face without fracture, external holding means, and lightweight metallic tying members having their outer ends movably connected to the holding means for permitting relative expansion of the bricks and said means, said members having at their inner ends brick impaling projections which are forced into the brick during assembly. 5
- 10 14. A furnace wall constructor including

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