United States Patent

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[54] **PREASSEMBLY OF REFRACTORY BRICK AND LINING FURNACES THEREWITH**

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[52] **U.S. Cl.** **52/745,** 52/749, 52/DIG. 4, 110/99

[51] **Int. Cl.**.....**E04g 21/14,** E04g 23/02

[58] **Field of Search**.....52/745, 741, 747, 749, 750, 52/249, 122, DIG. 4, 227, 598, 591; 110/99

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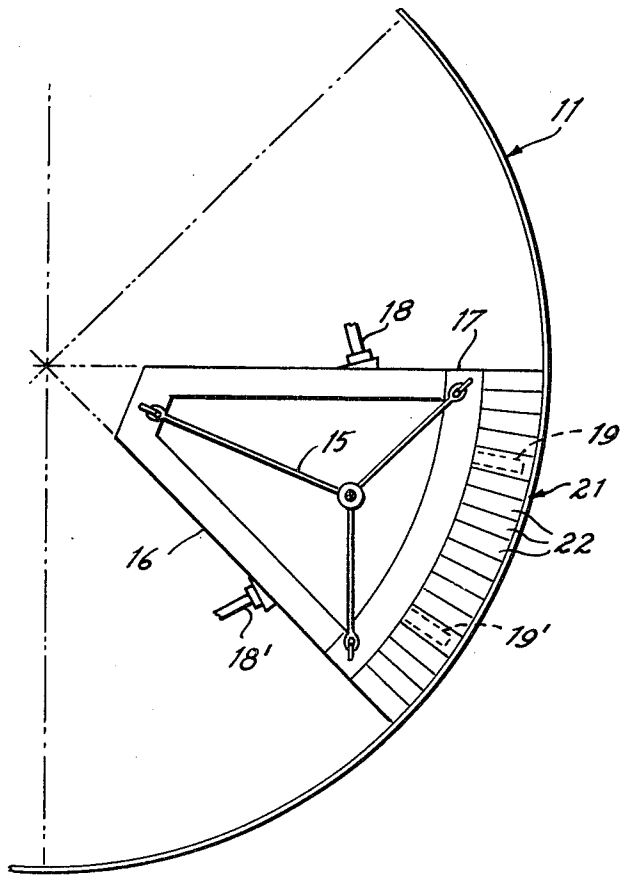
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[57] **ABSTRACT**

Refractory brick are preassembled into configuration matching a furnace to be lined and are retained together for transporting into place in the furnace. The resulting assembly is releasably secured mechanically or magnetically to suitable transporting means.

9 Claims, 7 Drawing Figures



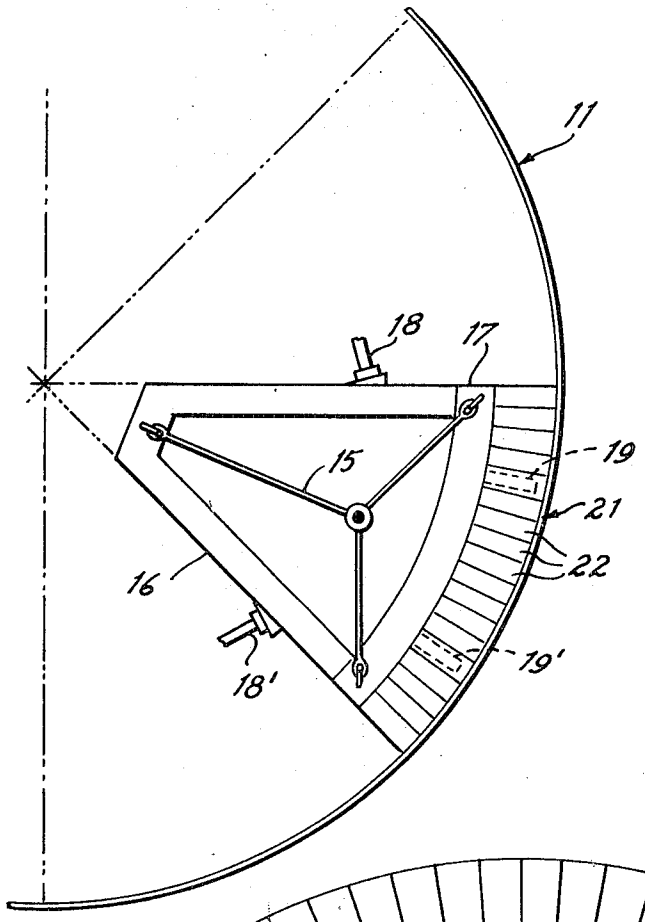
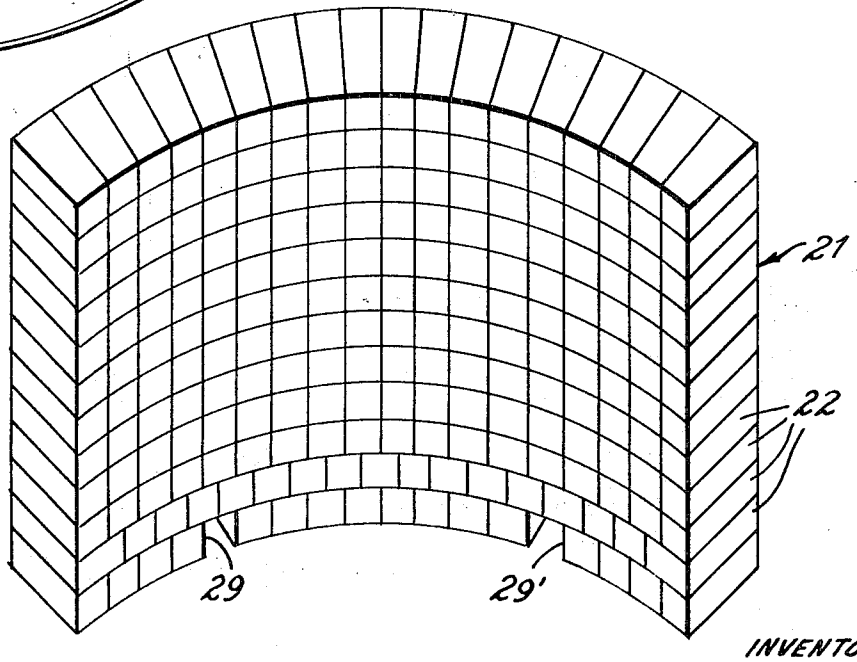


Fig. 1.

Fig. 3.



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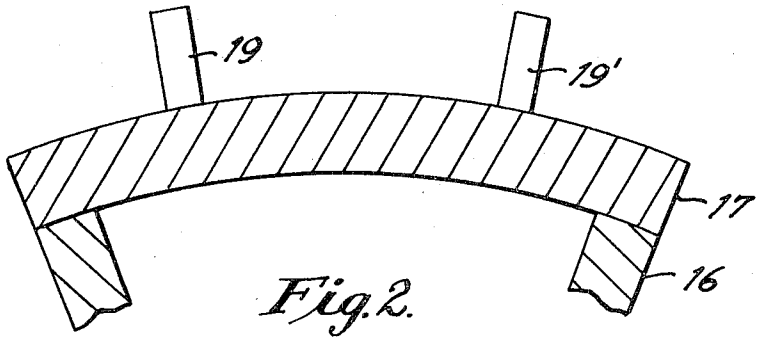


Fig. 2.

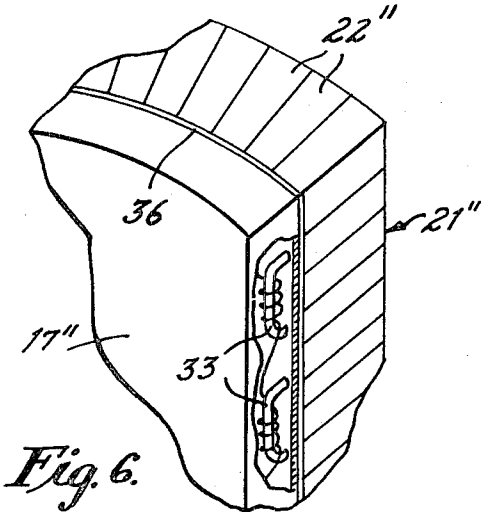


Fig. 6.

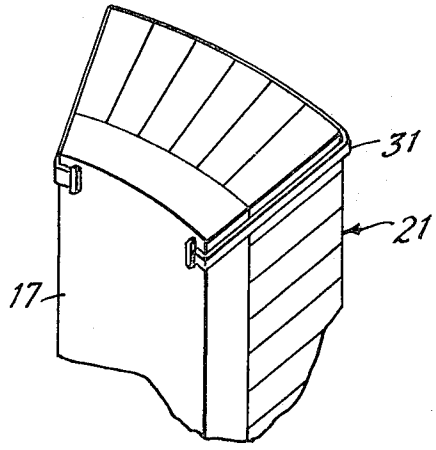


Fig. 4.

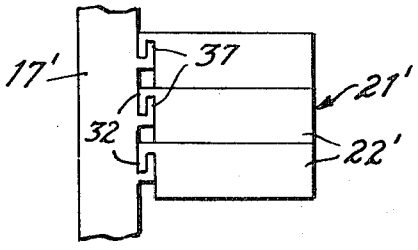


Fig. 5.

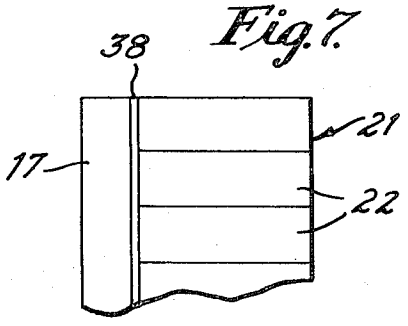


Fig. 7.

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PREASSEMBLY OF REFRACTORY BRICK AND LINING FURNACES THEREWITH

This invention relates to the lining of furnaces or similar enclosures with refractory brick or the like and concerns especially techniques for reducing the time required for relining.

Current practice in relining the sidewalls of an electric arc furnace, for example, from the slag line to the top involves stocking pallets of brick in the furnace interior and then laying the brick in place to make up the desired refractory wall. This requires considerable manpower within the furnace, assistance from bricklayer helpers to load pallets with brick outside the furnace, and crane service to transport loaded pallets into the interior and to remove the empty pallets. Furthermore, time often is lost because of lack of coordination between the respective craftsmen. Residual heat in the furnace renders working conditions unpleasant or even hazardous and is conducive to hurried work and resulting misplacement, discarding or other waste of new brick.

A primary object of the present invention is reduction in the time required to line or reline a furnace with refractory brick.

Another object is reduction in the number of times that an individual brick is handled in the relining of a furnace.

A further object is improvement in techniques for transporting brick into a furnace to be relined.

Other objects of this invention, together with means and methods for attaining the various objects, will be apparent from the following description and the accompanying diagrams, in which the parts are designated by corresponding reference numerals throughout (sometimes with primes added to indicate modified forms).

FIG. 1 is a plan of apparatus according to this invention shown in use in a cylindrical furnace shown fragmentarily;

FIG. 2 is a sectional plan through part of the apparatus of the preceding view; shown on an enlarged scale;

FIG. 3 is a perspective view of an assembly of refractory brick for use according to this invention;

FIG. 4 is a fragmentary perspective view of an embodiment of brick assembly according to the invention;

FIG. 5 is a fragmentary side elevation, partly in section, of another embodiment of brick assembly useful according to the invention;

FIG. 6 is a fragmentary perspective view, partially schematic, of a further embodiment of brick assembly according to the invention; and

FIG. 7 is yet another fragmentary side elevation of a brick assembly according to this invention.

In general, the objects of the present invention are accomplished, in the lining of furnaces or similar enclosures with refractory material, by preassembling a plurality of refractory brick in configuration matching a certain part of the enclosure, and retaining the resulting assembly together while transporting the assembly into place in that part of the enclosure. The assembly of brick is retained together by mechanical means along an end face or on lateral faces. It also is secured mechanically or magnetically along an end face of the assembly to transporting means for transport into the furnace enclosure. The invention is applicable to refractory brick generally and to furnaces generally without regard to composition, shape, size, etc.

FIG. 1 shows from the top, by way of example rather than limitation, furnace shell **11** enclosing a partial wall of brick, together with other elements useful in putting the wall in place. The partial wall is made up of arcuate assembly **21** of individual refractory brick **22** and has a convex rear or "cold" face juxtaposed to the concave interior wall of the shell. Sling **15**, adjusted for proper balance, carries generally trapezoidal transporting frame **16**, which has convex end plate **17** bounding the longer of its two ends and juxtaposed to the concave or "hot" face of the brick assembly. The sides of the frame flare outward from the short to the long end at an indicated angle of 45°. Pair of legs **19**, **19'** of the transporting frame extend forward from the plate and can be seen in broken lines as underlying the brick assembly. Pair of jacks **18**, **18'** shown fragmentarily at the sides of the frame facilitate placement of the assembly at the desired location in the shell.

FIG. 2 represents a section taken through transporting frame **16**, apart from the brick assembly and sectioned above the legs. The narrow end and most of the sidewall portions are cut away to conserve space of illustration.

FIG. 3 shows in perspective the "hot" face of assembly **21** of brick **22**. Visible in the lowest course are openings **29**, **29'** to receive legs **19**, **19'** of the transporting frame. If desired, recesses could be left in the next lower course (not shown) for a like purpose. As shown the two lowest courses are shaped or laid (or both) somewhat differently than the overlying courses and preferably are bonded together, as by epoxy cement or by spot-welding of metal cladding, to assure that the lifting force applied by the transporting frame through the legs is transmitted to the entire assembly. The rest of the brick may be retained together likewise or in other suitable manner, interconnected either laterally or along an end face.

It will be understood that the brick are preassembled outside the furnace in a configuration to match the inside of the furnace shell (or part of it if the furnace should be asymmetrical). The transporting frame is juxtaposed to the assembly and is lifted, as by the illustrated sling and a suitable crane (not shown) to transport the assembly, as through the open top of the furnace, to the interior where it is deposited to make up the desired part of the refractory wall, whereupon the frame is removed to the outside to repeat the process. One or two men inside the furnace will suffice to guide the placement of the assembly and the disengagement of the transporting frame.

The assembly of refractory brick may be secured to transporting frame **16** mechanically, as in FIG. **4** by one or more clamps **31** fitting snugly about the opposite or convex face of the assembly and along the sides thereof and of plate **17** of the transporting frame; or as in FIG. **5** by an interlocking modification (designated by priming of the reference numerals) wherein projections **32** outward and downward from bricks **22'** of assembly **21'** engage with projections **37** upward and outward from modified end plate **17'** of the transporting frame.

Alternatively, the assembly may be secured magnetically to transporting frame **16** as shown in FIG. **6**. Plurality of electromagnets **33** embedded in further modified end plate **17'**, preferably with their pole pieces flush with the convex surface thereof, are suitably energized by a source of electrical energy (not shown) to secure assembly **21''** of modified brick **22''** with the "hot" face thereof juxtaposed to the face of end plate **17''**. Coating **36** of magnetically permeable metal (e.g., steel) on that "hot" face provides a flux path for magnetic gripping of the assembly. The showing of electromagnets **33** is largely schematic, and it will be understood that armatures, pole pieces, and suitable winding, may be incorporated into the structure of plate **17''** rather than being embedded therein as suggested in FIG. **6**. The plate structure may be modified variously by exercise of ordinary skill so that in effect it constitutes one big electromagnet for optimum gripping of the brick assembly, as this invention is not limited to any specific structure thereof.

If desired, expendable membranous plate **38** made of magnetically permeable metal or the like may be bonded by any suitable means (epoxy cement, spot welding, etc.) to the end face of some or all of bricks **22** in assembly **21**, thereby both retaining the assembly together and facilitating securing it for transporting. Then the actual transporting may be accomplished as previously indicated. Use of this expendable membrane is especially suitable for magnetic securing of the assembly. However, with installation of appropriate projections thereon, or with provision of suitable apertures therein, it may be adapted to securing the assembly mechanically also as by cooperation with projections from modified end plate **17'** or equivalent of the transporting frame.

By practice of this invention the time required to reline a furnace may be cut to a minor fraction of the time required by conventional techniques, such as from 5 or 6 hours to 1 or 2 hours for a cylindrical electric arc furnace. Advantages and benefits of doing so have been mentioned above and are apparent.

Various embodiments of the methods and means for practicing this invention have been illustrated or described herein. Other modifications may be made, as by adding, combining, or subdividing parts or steps, while retaining at least some of the advantages and benefits of the present invention. The invention itself is defined in the following claims.

I claim:

1. The method of lining an enclosure with refractory material comprising preassembling into an assembly having a desired configuration, a plurality of refractory brick each provided with at least one magnetically permeable end face, magnetically gripping the assembled permeable end faces to a carrier means for transporting, and transporting the assembly of bricks so gripped as a unit into place in the enclosure.

2. Method according to claim 1, wherein an expendable magnetically permeable membrane is bonded to an end face of the assembly.

3. Method according to claim 1, wherein the assembly has the configuration of a sector and is transported into place at a part of the enclosure having a correspondingly arcuate shape.

4. Method according to claim 3, wherein the sector subtends an angle of from about 30° to about 45°.

5. Apparatus comprising, in combination, refractory brick preassembled into a configuration having an end face matching the shape of a furnace into which the resulting assembly is to be installed and having retaining means to retain

the assembly together in such configuration, transporting means having an end plate configured to abut the end face of the assembly, and means for securing the assembly to the end plate of the transporting means, the securing means being magnetically permeable, and the transporting means comprising means for setting up a magnetic field to grip the magnetically permeable securing means to the end plate for transporting of the assembly.

6. Apparatus according to claim 5, wherein the securing means comprises a metallic coating on the end face of the component brick.

7. Apparatus according to claim 5, wherein the securing means comprises a metallic membranous plate affixed to the assembly.

8. The method of lining an enclosure with brick-shaped elements comprising erecting outside said enclosure an assembly of said brick-shaped elements having end faces configured to conform to a portion of said enclosure, juxtaposing to said assembly a supporting surface also conforming to said enclosure portion, and transporting said assembly into said enclosure while juxtaposed to said supporting surface, said assembly being retained magnetically against said juxtaposed supporting surface during transportation.

9. The method of claim 8 characterized that said end faces and supporting surface are all curved.

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