July 6, 1965 R. P. HEUER 3,192,672

BRICK WITH COMOLDED INTERNAL PLATES

Filed March 20, 1961

Fig. 1.

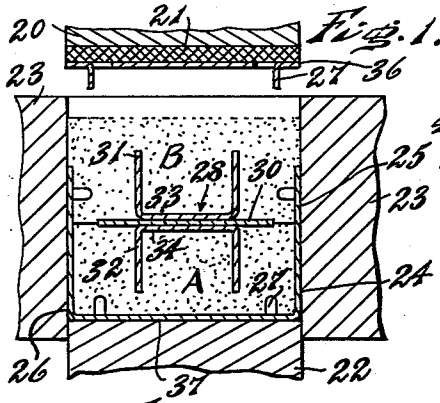


Fig. 2.

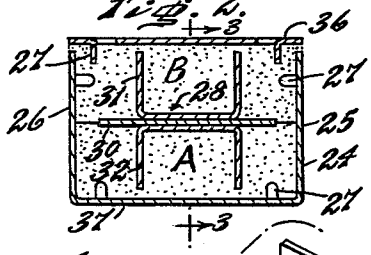


Fig. 3.

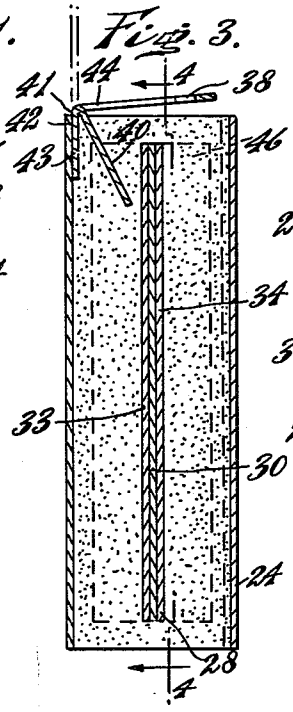


Fig. 4.

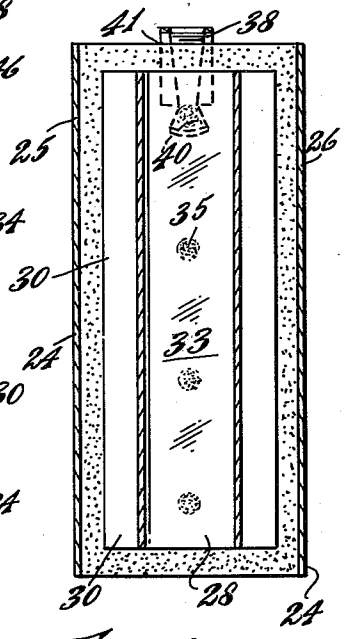


Fig. 5.

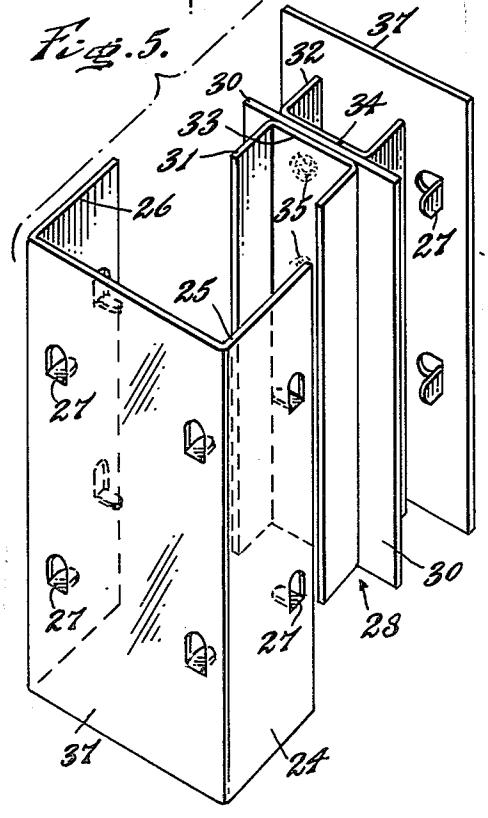
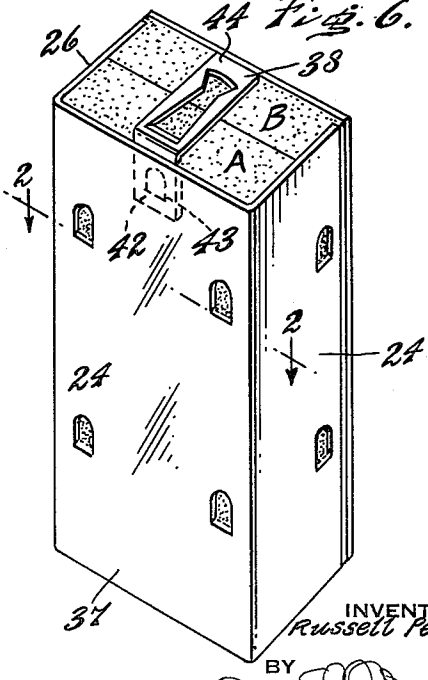


Fig. 6.



INVENTOR
Russell Pearce Heuer
BY
ATTORNEYS

United States Patent Office 3,192,672 Patented July 6, 1965

3,192,672

BRICK WITH COMOLDED INTERNAL PLATES

Russell Pearce Heuer, Villanova, Pa., assignor to General Refractories Company, a corporation of Pennsylvania

Filed Mar. 20, 1961, Ser. No. 96,884
2 Claims. (Cl. 50—416)

The present invention relates to refractory brick having high resistance to spalling and particularly to such brick intended for use in suspended roofs or supported walls of furnaces, and methods of making the same.

A purpose of the invention is to increase the resistance of refractory brick against spalling at the hot face due to repeated changes in temperature by creating a plurality of individual refractory cells defined by internal oxidizable metallic plates.

A further purpose is to provide a floating internal plate structure which extends substantially from the hot end to the cold end and in any case more than 80% of the distance, which extends from a position adjacent each of two opposed lateral faces of the brick to a position adjacent the other of said opposed lateral faces and which extends from a position adjacent each of two second opposed lateral faces at right angles to the first to a position adjacent the other of said second opposed lateral faces, but not clear to the outside of the brick, the internal plate in both transverse directions extending at least 80% of the distance across the brick, but leaving refractory between the edge of the plate and the outside so that the internal plate is not in direct metal-to-metal heat transfer contact with the outside of the brick or any outside plate thereon, and any tendency for too rapid heating of the outside of the brick or the plate on the outside of the brick will not communicate to the interior, giving the inside plate ample time to oxidize and to react slowly with the refractory after installation. In the preferred form, the internal plate assembly will have two extensions toward said second opposed faces of the brick in both directions.

A further purpose is to create six individual cells with three internal comolded oxidizable metallic plates.

A further purpose is to place an oxidizable metallic plate at the center of a refractory brick with plates radiating from the center plate in directions normal to the lateral faces of the brick.

A further purpose is to comold a separator plate in the brick which can be inserted during the molding process after a portion of the refractory has been placed in the mold.

A further purpose is to prefabricate the internal oxidizable plates into a unitary structure prior to inserting the plates into the mold.

A further purpose is to use a floating internal plate having projections extending substantially the full length and down into a first refractory mixture and up into a second refractory mixture as a dam for separating the two refractory mixtures, placing a charge of the first refractory mixture in the mold, then inserting the internal plate and finally inserting the second refractory mixture, the downward projections from the internal plate being anchored in the first refractory mixture and the upward projections from the internal plate being anchored in the second refractory mixture.

Further purposes appear in the specification and in the claims.

In the drawings I have chosen to illustrate a few only of the numerous embodiments in which my invention appears, choosing the forms shown from the standpoints of convenience in illustration, satisfactory operation and clear demonstration of the principles involved.

FIGURE 1 is a diagrammatic vertical section at one end of a mold transverse to the major axis of the brick, showing a mold in open position preparatory to molding according to the invention with oxidizable metallic plates in position on the top, bottom and sides of the mold, and with plates in the interior of the refractory.

FIGURE 2 is a transverse section through the brick of FIGURE 6 on the line 2—2.

FIGURE 3 is a section of the brick of the invention taken on the line 3—3 of FIGURE 2.

FIGURE 4 is a section of the brick of the invention taken on the line 4—4 of FIGURE 3.

FIGURE 5 is an exploded fragmentary perspective showing the plates of the brick of the invention.

FIGURE 6 is a perspective showing the finished brick of the invention.

Describing in illustration but not in limitation and referring to the drawings:

Extensive use has been made in prior practice of basic refractory brick having oxidizable metallic plates applied on all faces and oxidizable metallic internal plates in the interior of the brick. The refractories used in these bricks consist of the various basic refractories of which the most widely used are magnesia, chrome-magnesia and magnesia-chrome.

The oxidizable metallic plates are usually of steel, preferably plain carbon steel such as AISI 1010 or 1035 or suitably low alloy steel such as AISI 8630. The plates are normally in the range of thickness between 1/64 inch and 1/4 inch and are suitably affixed to the refractory of the brick. In furnace use, the plates oxidize and react with the refractory to improve the behavior of the refractory.

One method of making such brick includes affixing internal oxidizable metallic plates to the external oxidizable metallic plates prior to placing the plates in a mold, and then introducing the refractory into the mold, as shown in Heuer et al. U.S. Patent 2,791,116. The internal plates form cells which have their openings through which the refractory is introduced in a direction vertically up- and supported by the external plate at the bottom of the mold. The refractory, upon being introduced into a cell, is isolated in that cell and is not free to travel into an adjacent cell during the molding process to equalize the levels in the various cells. Furthermore, no vertical separation of the refractory can be attained since the cells must always be unobstructed vertically for the entire height of the brick in cross section in order to allow the cells to be filled.

In the present invention, internal cells are created in the brick which divide the brick not only horizontally in cross section but also vertically in cross section. In addition, the internal plates may be introduced after a portion of the refractory has been introduced into the mold so that the mold can be filled to a given height with a refractory of one composition, the internal oxidizable metallic plates introduced, and then the mold may be filled completely with a refractory of another composition. Furthermore, in the brick of the present invention the internal oxidizable metallic plates are not fixed or attached to the external oxidizable metallic plates, but rather are comolded in a position at which they are suspended in the refractory. This allows the refractory to seek its own level during the molding process while the refractory is in a fluid condition.

Another advantage of the invention is that whereas in the prior art the practice was to affix the internal plates to the external plates prior to molding, in the present invention the internal plates are prefabricated together and then inserted into the refractory without the necessary step of attaching them to the exernal plates. Although the partition walls formed by the internal plates extend across the major portion of the cross section, it will be understood that there may be some remaining cross connections between the refractories where the plates ap-

proach the external walls. These open areas allow free flow of the refractory during molding and provide a rigid anchor completely around the internal plates.

A further advantage of the invention is that the internal plates are structurally unconnected with the external plates so that stresses cannot be set up in an over-all plate structure including internal and external plates which could damage the brick in service. Furthermore, although the internal plates at the lateral faces are so close to the exterior that heating can occur and chemical reaction with the refractory can take place, there is not metal-to-metal contact between the external and internal plates which might heat the internal plates more rapidly than would be desirable to cause reaction with the refractory under most favorable conditions.

The brick mix employed may, for example, be magnesia or refractory material high in magnesia, such as dead-burned magnesite or electrically fused magnesia. Chromite may be used instead of part of the material high in magnesia. For example, mixtures of chromite with magnesia containing for instance 75% of chomite and 25% of dead-burned magnesite may be used. The amount of chromite present may be decreased, for example to a composition containing 25% chormite and 75% of dead-burned magnesite. Any other suitable basic refractory composition may be employed, provided there is at least 10% by weight of magnesia.

Bond substances should preferably be added to secure bond without kiln firing. Organic binders such as sulphite pitch, dextrine, glue, gum arabic or inorganic binders such as water solutions of magnesium sulphate, magnesium chloride, sodium dichromate, sodium silicate and the like may be used. The amount of binder used should be sufficient to form a brick which is mechanically strong without kiln firing. Normally the binder will be of the order of 1% of the weight of the brick and will seldom exceed 2% and should never exceed 5%.

The pressure of molding the brick will in any case exceed 1,000 pounds per square inch and preferably exceed 5,000 pounds per square inch and will most desirably exceed 10,000 pounds per square inch.

Where reference is made herein to a brick it is intended to include the standard rectangular shapes as well as any suitable block or other shape provided with any suitable contour or attachment to engage a suitable hanger or support.

The two refractory mixtures may, for example, be chrome-magnesia and magnesia, or chrome-magnesia and magnesia-chrome. The bricks can be located so that one composition is in a preferential position in the refractory structure or they can be utilized to give a combination of properties for example in a roof which would not be possible if the bricks were of one composition. Thus the refractory of one composition may primarily impart physical properties such as strength at high temperatures and resistance to spalling, and the refractory of the other composition may, for example, impart resistance to chemical attack. It is well known, for example, that magnesia will be relatively very resistant to chemical attack for example in a basic open hearth furnace, and chrome-magnesia will under such conditions in some cases be of preferable physical properties.

I illustrate in the drawings in FIGURE 1 a refractory mold having a top die **20** equipped with a magnetic clutch **21** on its lower end, a lower die **22** and mold side walls **23**. It will be understood that the side walls extend around all four sides of the mold.

In molding in accordance with the invention starting with an empty mold, a U-shaped metallic external plate **24** is placed on the bottom of the mold with the arms of the U **25** and **26** resting against the side wall. Magnetic clutches may be used to hold the U-shaped plate against the bottom or side walls if desired. Tabs or prongs **27** lanced from the external plate extend inwardly toward the center of the mold. There are desirably four tabs

in the bottom plate and two tabs in each of the arms of the U. Although the tabs are shown lanced in a direction which causes them to rotate about the hinge line toward one of the ends of the U, it should be understood that the prongs may be lanced in any direction. Refractory A is then introduced into the mold to a height of approximately one-half the vertical distance of the mold and the internal plates are then placed into the mold. As seen in the drawings, the internal plates consist of separator plate **30** and two U-shaped internal plates **31** and **32**. The U-shaped internal plates are placed in abutting relationship with the separator plate so that the base **33** of one of the U-shaped plates **31** lies along the separator plate on one side of the separator plate, while the base **34** of the other U **32** lies along the separator plate on the side opposite that of the first U. The separator plate and U-shaped internal plates are joined as by spot welding at **35** prior to being introduced into the mold.

Subsequently a second moist basic refractory composition B is placed in the mold over the internal separator plates and the remainder of the mold is filled. A flat oxidizable metallic plate **36** having tabs **27**, suitably four in number, is attached to the magnetic clutch **21**.

If desired a suitable hanger **38** in the form of an L-shaped member with a lanced tab **40** is inserted into the refractory along the bottom or base of the U-shaped external plate at **41**, with the lanced tab **40** of the hanger extending diagonally into the refractory. A suitable joint as by welding at **42** is made to secure one leg **43** of the hanger to the base of the U-shaped plate before inserting the U-shaped plate in the mold. Prior to placing the brick in use the leg **44** of the L **38** lying along the cold end of the brick is rotated 90° above the bend line as shown in phantom in FIGURE 3 in order to provide a hanger for suspending the brick.

The top die **20** and the lower die **22** are moved together, suitably bringing the top die down, and applying the mold pressure through the bottom flat plate **37** which is the base of the U-shaped external plate, and the top flat plate **36**.

As seen in FIGURE 2 the finished brick will have the separator plate and the U-shaped internal plate extending in a direction normal to at least some of the external plates and the internal plates will terminate short of actual contact with the external plates. The top external plate **36** will be comolded with the refractory and anchored by tabs **27** which are suitably spaced over the plate in a manner similar to the tabs formed in the base **37** of the U-shaped external plate. By terminating the internal plates short of contact with the external plates, flow of the refractory is allowed horizontally so that a level is secured in each of the cells created by the internal plates. However, the separator plate **30** which lies in a horizontal plane in the mold provides a barrier over substantially all of the interface between the different compositions A and B in the brick while at the same time allowing the unitary internal plate structure **28** to be independent of the external plates. The separator plate is of a width suitable to clear tabs **27** on the arms **25** and **26** of the external U-shaped plate so that the internal plate units may be freely inserted.

The U-shaped internal plates **31** and **32** plus the separator plate **30** join to form an integral unit **28** which in cross section subdivides the molded refractory into six cells. The center cells are desirably slightly larger than the end cells and the U's **31** and **32** are shaped in a manner suitable to so divide the brick. Internal plate structure **28** is placed in the refractory when the mold is approximately half full with the arms of one of the U's **32** extending downwardly while the arms of the other U-shaped internal plate **31** is extending upwardly. The separator plate **30** extends in a horizontal plane. The internal plates extend longitudinally throughout the brick terminating slightly short of the hot end at **45** and slightly short of the cold end at **46**. The separator plate **30** and the U-

shaped internal plates 31 and 32 can be made of the same material as the external plates with a suitable thickness of between 1/64 and 1/4 inch.

It should be understood that instead of different refractory compositions A and B, a single refractory composition may be used.

After the brick is molded, it will be dried in any suitable manner as well known in the art and inserted into a furnace such as an open hearth steel furnace to be subjected to firing temperature for the first time during use.

In view of my invention and disclosure, variations and modifications to meet individual whim or particular need will doubtless become evident to others skilled in the art, to obtain all or part of the benefits of my invention without copying the method and structure shown, and I, therefore, claim all such insofar as they fall within the reasonable spirit and scope of my claims.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. A basic refractory brick comprising a body consisting substantially of basic refractory material containing magnesia, said brick being generally of rectangular form and having four lateral faces and two end faces, oxidizable metallic external plates extending over the bulk of said four lateral faces of the brick, an oxidizable ferrous metallic internal separator plate extending longitudinally of the brick and dividing the brick into separate compartments, oxidizable ferrous metallic U-shaped internal plates in the body of the brick, means securing the bases of the said U-shaped internal plates to the separator plate, wherein said internal plates are disposed so that each lateral face of the brick has at least one internal plate disposed transverse to said lateral face, and each of two opposite lateral faces of the brick have two internal plates disposed transverse to said opposite lateral faces, said

internal separator plate and said U-shaped internal plates being in comolded relationship with said body, there being refractory between said internal plates and said external plates, said internal plates dividing the body into at least six refractory cells, and on oxidation of said internal plates and reaction with said basic refractory, each of said cells near one end of the brick after exposure to elevated temperature having areas of reaction between the metal of the plate and the refractory along at least two adjoining sides of said cells.

2. A refractory brick of claim 1, in which said basic refractory body is of one composition containing magnesia on one side of said separator plate and of another composition containing magnesia on the other side of said separator plate.

References Cited by the Examiner

UNITED STATES PATENTS

1,413,828	4/22	Burns	50—312
1,775,396	9/30	Jackman et al.	50—464
2,247,376	7/41	Heuer	25—156
2,289,911	7/42	Heuer	50—416
2,527,063	10/50	Heuer	25—156
2,791,116	5/57	Heuer	50—416
2,799,233	7/57	Heuer	50—413
2,901,990	9/59	Hutter	110—99
2,960,048	11/60	Garretts	110—99
3,073,264	1/63	Monlux	110—99

FOREIGN PATENTS

844,515	1960	Great Britain.

HENRY C. SUTHERLAND, *Primary Examiner.*

WILLIAM I. MUSHAKE, JACOB L. NACKENOFF, *Examiners.*