Dec. 8, 1959 E. D. WILKINS 2,915,893

METAL CLAD REFRACTORY BRICK

Filed March 27, 1953

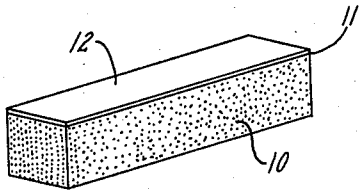


FIG. 1.

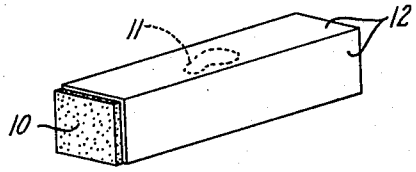


FIG. 2.

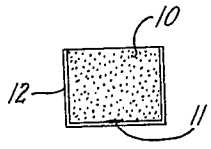


FIG. 3.

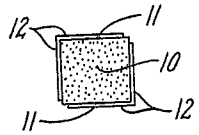


FIG. 4.

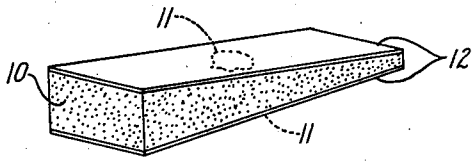


FIG. 5.

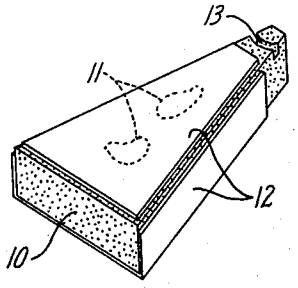


FIG. 6.

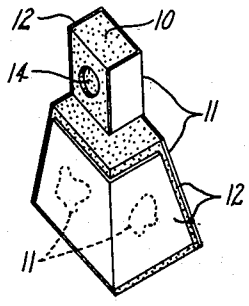


FIG. 7.

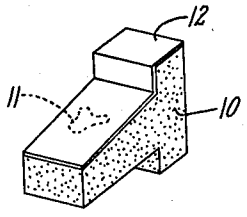


FIG. 8.

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United States Patent Office 2,915,893 Patented Dec. 8, 1959

2,915,893

METAL CLAD REFRACTORY BRICK

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Application March 27, 1953, Serial No. 345,219

6 Claims. (Cl. 72—35)

This invention relates to the production of metal-clad or metal-plated refractory bricks or shaped pieces especially suitable for use in furnace linings; and also to the refractory pieces produced.

It has been known in the past to provide refractory brick or other pieces for use in furnace linings, wherein the refractory material bears a metallic coating on two or more sides of the piece. Many various means for holding the metal onto the refractory have been devised. For instance, it has been known to place the metal casing or lining in the brick mold and then to fill the mold, fitted with the casing, with the brick mix, and press. The metal lining is made with tabs or ears which are bent inwardly and engage the brick mix, or, alternatively or in addition, can contain apertures through or into which the brick mix extrudes, thereby fixedly engaging the casing when the mix hardens. This mode of procedure involves the operations of providing the metal casing with the ears, or apertures, and the disadvantages attendant upon placing the lining in the brick press or mold, then filling with brick mix and pressing. Furthermore, in this procedure, the metal ears or tabs tend to swell from oxidation upon heating or firing and thereby disrupt the refractory structure. It has also been proposed to make the green or unfired brick in the usual way, and then to press metal casings on to the green brick, the metal casings being fitted with ears or tabs to engage the brick. However, this method is not suited to the applications of casings to some kinds of brick, especially, for instance, to bricks composed substantially of non-plastic materials, such as highly refractory magnesia or periclase, or periclase-chrome bricks, because cracks tend to develop in the bricks upon later firing. Still another means of applying the casings to brick, especially when a three-sided or U-shaped casing is employed, is to merely spring the casing onto the brick and depend upon frictional engagement to retain the casing on the brick. This also has not been satisfactory beacuse it has been found that the casings tend to slip off the brick in handling or during placing in the furnaces where it is desired to employ them, and constitute a hazard to the workmen. It has also been proposed to cement the casings to the brick with a refractory cement such as a refractory or inorganic bonding material but this has proved quite unsatisfactory in practice.

It is an object of the present invention, therefore, to provide a simple, inexpensive and effective means for attaching metal casings to bricks of all types. It is a further object to provide such means for applying metal casings of various types to many varieties of bricks. It is a still further object to provide metal-cased bricks, whereof the casings are fixedly attached and will more certainly remain so during handling, shipping, placing and heating.

According to the present invention, the bricks are molded or formed as desired, and there is applied between the brick and the metal casing an amount of a sticky, rubbery organic adhesive which adheres to both the brick and the metal, and the metal casing is then applied to the brick over the applied adhesive. The adhesives useful herein do not dry to a hard, brittle state under the conditions of use but remain sticky or "tacky," and adherent. They are water-insoluble and are employed in the form of emulsions in water. When the adhesive comes into contact with the brick, the emulsion appears to break and the rubbery constituents are believed to coagulate or condense. The adhesives useful herein are rubbery materials, or polymeric organic materials, such as natural rubber latex, synthetic rubber latex or synthetic polymerizable elastomers such as isoprene, butadiene-styrene copolymer, butadiene-acrylonitrile copolymer or other substances polymerizable to form synthetic rubber, polyethylene, and vinyl resin latex, for example, of polyvinyl acetate and polyvinyl chloride. Mixtures of these adhesives can be employed. If desired, an admixture of rubbery material or a rubber latex or polymeric organic material, as described, and a resin or resins can be employed. The adhesives useful herein adhere well to the brick and metal surfaces in the cold, i.e. at ordinary atmospheric temperatures, and also remain adhesive at the temperatures encountered in furnace rooms. These latter temperatures are, in general, higher than ordinary air temperatures but the adhesives disclosed above do not lose their strength of bond or stickiness when the cased bricks are held for some time under such conditions. In this manner, the adhesives herein employed behave well, in contrast to sodium silicate which tends to become hard and brittle, and to asphalt which softens, under these conditions.

Figures 1 to 8 are illustrative of some embodiments of the present invention wherein there are shown metal casings applied to one or more sides of a refractory brick or block adapted for use in a furnace. In Figure 1, a single metal plate is shown, applied to one side of a brick, and in this embodiment the adhesive is shown as distributed fairly evenly over the metal and brick surfaces, whereas in each of the other figures there is shown a partial distribution of the adhesive, i.e., over only a part of the surface to which applied. Such partial distribution of adhesive can be employed in any desired embodiment of the invention, and, in general, adhesive is required between only one surface of the brick and a continuous metal piece. Figure 2 shows a brick encased by an L-shaped plate; Figure 3, plated on three sides by a U-shaped plate; Figure 4, plated on four sides by two L-shaped plates; Figure 5, single plates applied on opposite faces of a brick; Figure 6, a brick adapted to be suspended, as by means of recessed portion **13**, and encased or plated over a major portion of four sides by means of a U-shaped plate and a single plate, as shown, adhesive being applied between brick and bottom of the U and between brick and the top plate; Figure 7, a refractory block adapted to be suspended from one end, the lower portion being plated or encased on four sides, by means of two L-shaped plates, and the upper portion being plated or encased on three sides by a U-shaped plate and having recessed portion **14** on the unplated side adapted to engage a supporting element; and Figure 8, an irregular block having offset portions on opposite faces, in effect, substantially a T-shaped block, at least one face of the leg and offset or shoulder of the T being covered by a continuous metal plate of conforming configuration. In each Figure, 10 represents a refractory brick; **11**, adhesive as herein defined; and **12**, metal plate or casing.

The brick to be encased in metal, or to which a spacer plate is to be applied, can be any type of refractory brick. The term "metal case" in the specification and claims is intended to include a metal plate applied to one side of the brick, or a case applied to more than one side, and to the whole or a portion of the side. Prefer-

ably, there can be employed periclase brick, magnesite brick, chromite brick, periclase-chrome or chrome-periclase brick. The types enumerated are those very commonly employed but the method of this invention is useful with other types of refractory brick as well. Most usually iron or steel plates are employed with nonacid bricks. Any desired metal can be employed. Steel is a preferred metal, but other metals can be used.

In practicing the present invention, the refractory batch, prepared as desired (various methods being well-known in this art) is shaped into brick in the known manner, for instance by pressing. The brick can be cased directly, or it can be first dried or fired. An amount of adhesive is dropped or placed on the brick surface or surfaces and the metal casing laid on. Alternatively, the adhesive can be applied to the metal and the so-treated metal then applied to the brick. The bricks are allowed to stand until the adhesive has set, which usually requires only about one-half hour, and are then ready for shipment, handling, or use.

In one embodiment of this invention, a brick batch is prepared which contains high purity periclase grain in graded sizes according to good commercial practice in this art, and a bonding material which comprises finely divided magnesia of high purity, volatilized silica and a water solution of magnesium chloride. Bricks are pressed from this batch and are dried. Upon one surface is dropped an amount, or "gob," of a water emulsion of a synthetic rubbery material. The emulsion has a solids content of 42%, a pH of 8 to 9, viscosity 850 to 1000 cps. at 25° C. and a unit weight of 8.45 lbs. per gallon. It is a synthetic rubber-resin emulsion. Films formed from this emulsion are clear, substantially colorless, odorless, and unaffected by the temperatures encountered in practice, before firing. The adhesive film is extremely water-resistant. An L-shaped steel casing is laid on the brick to which the adhesive emulsion has been applied, and the whole is allowed to set, to form a strongly bonded masonry unit as shown in Figure 2. Apparently the adhesive-water emulsion breaks when it comes into contact with the brick surface, and the moisture or water is absorbed into the brick or evaporates, and the adhesive component deposits. It is believed that, when such emulsion is applied to the surface of a nonacid or a basic brick containing a salt or electrolyte in its composition, for example, in the bond, the salt or electrolyte aids in or effects the breaking of the emulsion.

Another adhesive material useful in this invention is a water emulsion of polyvinyl acetate (50% solids), containing about 20% of ortho-nitrobiphenyl. For instance, there can be employed a mixture of 100 parts by weight of polyvinyl acetate-water emulsion, containing 50% solids, by weight of the emulsion, and from 20 to 25 parts by weight of ortho-nitrobiphenyl, the admixture being applied in the manner described above. There can also be employed in this invention natural rubber latex, that is, Hevea latex.

Bricks which have been metal cased in this manner have been installed in steel furnaces and have proved exceptionally satisfactory. Bricks or blocks, each having a metal plate on one or more faces or sides, prepared according to the invention, are particularly useful in lining rotary kilns, e.g. for cement-burning operations. Organic fibrous spacers, e.g. of paper or wood, can also be applied in the same manner. The bond formed is so strong that pieces of the refractory are pulled away when the case is pried off, after the adhesive bond has set. The bricks metal-cased in this manner can be handled, shipped, held for a time in the furnace room, if desired, and then installed in a steel-making furnace, and exhibit great strength and stability of adhesive bond during these operations. It is desirable that the bonding adhesive be elastic and it is preferred that it exhibit sufficient resilience to withstand the shocks and strains incidental to handling and installation. The rubbery base adhesives useful in this invention have good initial tackiness and set to a strong, resilient bond which retains its desired qualities during long storage and under varying temperature conditions. It is advantageous also that these water emulsions avoid the circumstance of using toxic or noxious solvents or vehicles; that the emulsions are easy to apply and produce cased bricks of neat appearance. It is sometimes desirable to employ in the emulsion one or more plasticizers or tackiness-promoters, such as ortho-nitrobiphenyl, dibutyl phthalate, tricresyl phosphate or others as known to this art. As indicated in the above example, a resin or resins can also be admixed in the emulsion.

It is an advantage of the present invention that metal cases or plates can be securely affixed in a simple and efficient manner to any desired type of brick. With respect to metal cases which previously have been fixed to brick by springing, it has been necessary that the size of the case be controlled with extreme care in order to ensure proper contact. The present invention enables strong bonding of the case to the brick even though there may be such variation in size as would have precluded good springing contact. It is also an advantage that plates can be separately affixed to sides, e.g. opposite or other, sides of the brick; and also, that to brick of unusual or irregular configuration there can be affixed a metal plate or plates of conforming configuration. It is a further advantage that the organic adhesives of this invention are destroyed when the brick is fired, yielding volatile products, predominantly carbon dioxide and water, which go off with the furnace gases and which do not combine with or deleteriously affect the refractory bricks. It is also advantageous that handling and costs can be substantially reduced by applying the adhesive and metal case to the brick directly after the pressing or forming step. Alternatively, it is very advantageous in some instances to apply the metal case to an already burned brick, whereas this operation would not be possible if eared cases were to be pressed onto the brick.

In this specification, percentages are by weight unless otherwise specified, if desired, the metal plate can cover less than the whole of a brick surface, e.g., side, to which it is applied. It is to be understood that variations and modifications can be made in the invention without departing from the scope of the appended claims, the above specific description and the drawings having been given for purposes of illustration only. This application is a continuation-in-part of my copending application, Ser. No. 345,181, filed March 27, 1953, and now abandoned, pertaining to metal-cased bricks.

Having now described the invention, what is claimed is:

1. A composite refractory furnace lining article comprising a nonacid refractory block having side faces and end faces, a metal plate covering at least the major portion of at least one of said side faces, and a combustible organic adhesive interposed between said plate and said block and affixing said plate to said side face, said adhesive being sticky at ordinary atmospheric temperatures.

2. A composite refractory furnace lining article comprising a substantially wedge-shaped, nonacid refractory block having side faces and end faces, two of said side faces being in opposed diverging relation, one of said end faces being smaller than the other end face, a metal plate covering at least a major portion of one of said divergent side faces, and a combustible, organic rubbery adhesive disposed between said plate and said side face and affixing said plate to said side face of said refractory block, said adhesive being sticky at ordinary atmospheric temperatures.

3. An article as in claim 2 wherein said metal plate is a steel plate.

4. A composite refractory furnace lining article comprising a nonacid refractory block having side faces and

end faces, a metal plate covering at least the major portion of one of said side faces, and a combustible adhesive interposed between said plate and said block and affixing said plate to said side face, said adhesive being sticky at ordinary atmospheric temperatures.

5. A composite refractory furnace lining article comprising a substantially wedge-shaped, nonacid refractory block having side faces and end faces, at least the major portion of two of said side faces being in opposed diverging relation, one of said end faces being smaller than the other end face, a metal plate covering at least a major portion of one of said divergent side faces, and a combustible adhesive disposed between said plate and said side face and affixing said plate to said side face of said refractory block, said adhesive being sticky at ordinary atmospheric temperatures.

6. A composite refractory furnace lining article composed of a nonacid refractory brick having four side faces and two end faces, a U-shaped steel plate covering three side faces of said brick, and a combustible, organic adhesive interposed between said brick and said steel plate and resiliently affixing said plate to said brick, said adhesive being sticky at ordinary atmospheric temperatures.

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