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E. W. VIALL

3,109,259

REFRACTORY

Filed July 2, 1957

Fig. 1

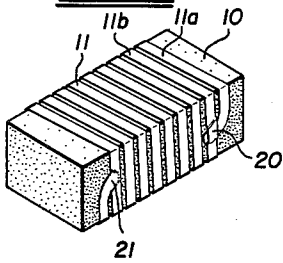


Fig. 2

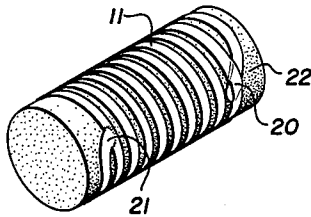


Fig. 3

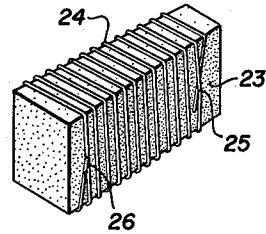


Fig. 4

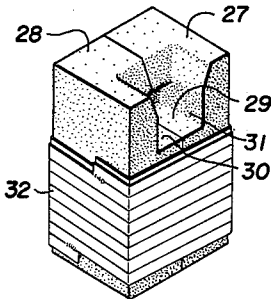


Fig. 5

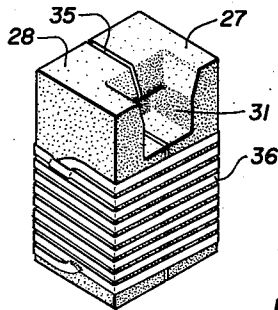


Fig. 6

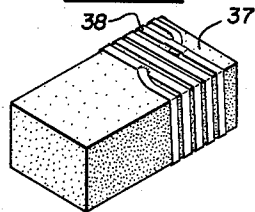


Fig. 7

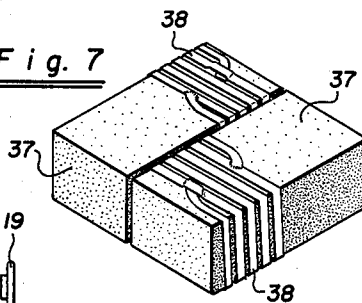


Fig. 8

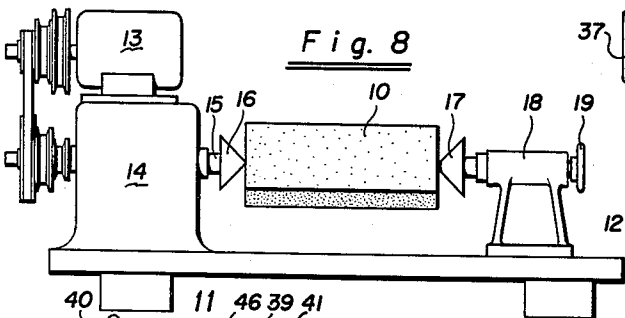
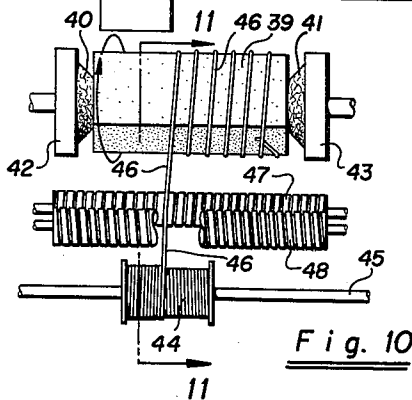


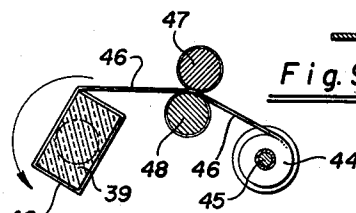
Fig. 9a

Fig. 9b

Fig. 9c

Fig. 9d

Fig. 11



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3,109,259

REFRACTORY

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9 Claims. (Cl. 50—128)

This invention relates to metal encased nonacid refractory brick for industrial furnace linings and to a method of preparing the same; and it particularly pertains to a composite article wherein the metal covering for such refractory component tightly engages the face thereof but may be discontinuous with respect to the longitudinal dimension of such component.

Metal-cased refractory articles have long been known in the construction of industrial furnaces; and many methods have been proposed and used for making these articles. However, the prior art methods have had real disadvantages because the refractory brick or block has not been safely held by the known metal cases in all or in many instances. That is to say, sometimes the bricks fall out of the cases, especially during handling and installation in the place of use, and are broken or cause serious injuries to the workers. It is especially important and desired to encase the refractory brick or block in a tight and secure manner to avoid such disadvantages, and at the same time to avoid injury to the formed refractory shape itself. It is desired also to apply a metal covering securely to a masonry unit comprising more than one refractory brick or block, e.g. consisting of two refractory bricks or blocks having a hanger-receiving recess at or adjacent one end and, if desired, an internal metal reinforcing plate.

It is, therefore, an object of this invention to provide a metal-cased refractory article wherein the metal case tightly and securely engages the refractory component. It is a further object of the present invention to provide a method of applying a metal casing or encasement to a preformed refractory block or blocks which ensures secure and tight fitting of the casing regardless of size or shape to the refractory article. It is a further particular object to provide such secure and tight-fitting casing while incorporating a minimal amount of metal into or about the masonry unit and without embedding projecting anchors of the metal within the refractory. It is a further particular object to reduce heat losses in a furnace. Other objects and advantages will become apparent from the description below.

According to this invention, there is provided a composite refractory article comprising a preformed, nonacid refractory block component and a metal casing disposed about four sides or lateral faces of such block component, the casing being composed of a winding of an elongated metal strip, for example metal wire or strapping. Preferably, for most industrial furnace installations the winding is of ferrous metal, i.e., iron or steel. The article is produced by winding metal wire or thin, preferably relatively narrow, metal strip spirally about the preformed refractory block. For example, the block is placed in a lathe and turned while metal wire is fed onto the block by hand; but, alternatively, automatic feeding and winding devices are employed.

The invention and its mode of operation are further illustrated by the accompanying drawings, wherein:

FIGURE 1 is a perspective view of a masonry unit comprising a basic refractory component having a metal strip spiral winding over substantially the length of its four lateral faces.

FIGURE 2 is a perspective view of a masonry unit comprising a cylindrical refractory block and a spiral metal strip winding over substantially its length.

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FIGURE 3 is a perspective view of a wedge-shaped refractory block spirally longitudinally wound with metal wire.

FIGURE 4 is a perspective view of a hanger unit comprising a pair of refractory blocks having apertures forming a common hanger-receiving socket or recess, the unit being spirally wound with metal strip.

FIGURE 5 is a perspective view of another embodiment of a masonry suspension or hanger unit spirally wound with metal.

FIGURE 6 is a perspective view of a brick spirally wound with metal over about one-half of its length.

FIGURE 7 is a view of two juxtaposed bricks spirally wound with metal over about one-half the length of each.

FIGURE 8 shows in schematic form one embodiment of a means for carrying out the process, and making the product, of this invention.

FIGURES 9a, b, c and d are sectional views of some embodiments of the elongated metal strip, such as wires and straps, useful in forming the masonry unit of this invention.

FIGURE 10 is a schematic view of one embodiment of a means for mechanically winding a brick with wire.

FIGURE 11 is a view along line 11—11 of FIGURE 10, partly in section and showing an end elevation of the wire feed elements.

In many embodiments of this invention, the metal winding extends over substantially the entire length of the refractory component, or over a predominant portion of the longitudinal surface thereof. If desired, the winding extends over less than the entire length. For example, the winding is placed over one-half the length of the refractory block or component; and in this latter embodiment, in installing a furnace wall or roof, the units are so placed that a spirally wound half of the refractory is juxtaposed to the half of the next refractory which is not wound or covered with metal, and in this manner the blocks in a furnace lining or roof are separated in effect by one thickness of metal. The bricks or blocks of the present invention can be installed in a furnace wall or roof adjacent unplated bricks or adjacent bricks coated or plated in any other suitable manner.

The refractory block component is a formed shape composed of nonacid, that is, neutral or basic, refractory material. It is, for example, made of deadburned magnesite, alumina, periclase, chromite, magnesia-chrome or chrome-magnesia mixes, or of any other desired neutral or basic refractory; and the mixes are made up, bonded and formed into shape in the manner known to the art. If desired, the formed shapes are burned, baked or fired prior to application of the metal encasement. The refractory batches are formed into any desired shape, including the ordinary rectangular parallelopipeds or prisms, or wedges or keys, or any irregular shapes, such as rounds, T-shapes, or other shapes; and when desired to form a refractory article to be suspended, as in a furnace roof, a hanger-receiving or socket recess is formed in the refractory shape or shapes. The ordinary "straight" brick or rectangular parallelopiped is shown, for instance, in FIGURE 1, but a wedge or key form well known in this art can alternatively be employed. Also, a composite article is made up, in one embodiment, comprising two refractory blocks, disposed on end and side by side and encased in one spiral winding, and, if desired, a metal spacer or divider plate is disposed between the facing surfaces of the two blocks. This spacer or divider plate is made of any desired metal, but most usually iron or steel is employed; and the divider is of any desired shape, the divider plates being also known to this art.

The encasement is, as stated, formed of metal wire of

any desired type, e.g. round, FIG. 9a, or half-round wire, FIG. 9b, or of metal strip or strapping. For instance, in one embodiment there is employed a steel strap of 18 gauge (U.S. Standard) or about 0.05 inch in thickness, and of about three-fourths inch width, such as is illustrated at FIGURE 9c. Alternatively, there can be employed a stepped strap as illustrated at FIGURE 9d. The wrappings or spiral windings are applied in any desired relationship. The stepped strap of FIGURE 9d is useful in applying a winding in overlapping relationship as shown on FIGURE 4, for instance, which results in a complete coverage of the refractory surface in the area to which the winding is applied. In this embodiment, the strip or strapping is provided with an upper extension or flange 34 and an oppositely disposed lower extension or flange 33, and in winding such a strapping lower flange 33 underlies upper extension or flange 34 of an adjacent turn or coil, or vice versa. Alternatively, plain strip such as shown in FIGURE 9c, or wire, can be applied so that the coils or turns of the winding abut and effect like complete coverage. However, it is quite an advantage in many embodiments to wind the metal about the refractory so as to provide spaces between adjacent coils, as shown for example in FIGURES 1, 2, 3, 5, 6 and 7. In this latter manner of winding, the conduction of heat from the end or face of the refractory which is exposed to the interior of the furnace (the hot face, as it is known) to the end or face thereof exposed to the shell (known as the cold face) is greatly diminished, and this decreases heat losses from the furnace. The metal strap employed is of any desired width; and as the width increases, the number of turns or coils required decreases. If desired, the metal can be preheated to facilitate winding, especially where an automatic winding machine is employed. Preferably, the wire is applied under tension to ensure close fitting to the brick or block. In applying the spiral windings, it is suitable to overlap the second coil over the end of the first coil of the winding to secure the latter, then winding is continued as far as desired. The end of the last coil is affixed conveniently by spot welding or otherwise welding to the next adjacent coil, to fasten the entire winding securely to the brick.

The metal encasement is made of any desired metal. For example, nickel or copper is employed, if desired. Preferably, the encasement is made of ferrous metal, such as iron or steel.

It is an advantage of the present invention that the metal encasement tightly engages the refractory component. In pressing refractory bricks, for example, considerable wear or erosion occurs in the die box which results in small but troublesome variations in the sizes of bricks as pressed. In applying to preformed bricks conventional sheet metal cases of the prior art, the cases are uniformly sized and do not accommodate themselves to the changing dimensions of the bricks as they come from the brick presses. As a result, it is difficult to secure a good fit or permanent attachment of case to brick, and the cases have become detached from the bricks or have loosened so that the bricks have fallen out and caused injury to workers during handling or installation. The present invention avoids the difficulty of loose fitting of the metal encasement due to change in dimension of the brick as pressed because the encasement is necessarily fitted closely to the brick as an essential step of its application. The wire or strip is applied under tension or is drawn against the brick face as tightly as desired, as it is wound thereon. Tight fitting of the encasement is of great importance because in this event the brick cannot fall out of the case during handling; and this avoids a great source of injuries to workmen in the plant during handling or installation of the brick.

It is also a great advantage of the embodiments of the present invention wherein the coils of wire or strip are spaced apart, that there is presented a rough or corrugated surface which enables the worker to get and maintain

a firm hold on the brick and there is much less danger of dropping the article. It is a further advantage, when the metal coils are spaced from each other, that the conduction of heat from the hot face of the brick, or from the interior of the furnace to the shell, is decreased and heat losses from the furnace are correspondingly decreased or reduced. Other advantages are that the metal encasement can be applied to blocks of irregular shape or to a unit comprising a plurality of blocks; and that it can be applied according to this invention to fired or unfired shapes. Also, with spaced apart coils the bricks tend to interlock with each other when installed. Furthermore, by this method of applying metal encasement, there is avoided the necessity for changing the presses and the shapes of metal casings of the prior art; and application of the metal is much more rapid than by prior art methods. In stacking, the cased brick surface in many embodiments of this invention is so rugose that slipping of the masonry units upon each other is prevented. More efficient use is also made of the casing metal and the wastage in cutting cases from sheets is avoided.

The invention will now be described by way of an example and also with particular reference to the accompanying drawings.

In FIGURE 1 there is shown a masonry unit according to the invention which comprises an unfired refractory block 10 of rectangular cross-section, composed, in accordance with this example, of periclase-chrome refractory, cold-bonded or chemically bonded and prepared according to the method described and claimed in Austin et al., U.S. 2,537,013, dated January 9, 1951, this block being in the form and shape of the ordinary wall brick for furnace linings; and a spiral metal winding 11 of steel strapping which is about one-half inch in width and 14 gauge or 0.078 inch in thickness. The strapping is applied by placing the brick in the device shown in FIGURE 8.

In the device of FIGURE 8, shown schematically, there is provided a bench 12 supported from the floor in any desired manner and disposed thereon a simple lathe arrangement comprising motor 13, gear reduction box 14 and drill chuck 15 on spindle 15. Opposite chuck 16 and substantially in the same horizontal plane is disposed drill chuck 17 supported in sleeve or housing 18 and horizontally, axially adjustable by wheel 19 in the usual manner. A brick 10 is placed between drill chucks 16 and 17 and chuck 17 is adjusted by means of wheel 19 until the brick is securely engaged. The operator then places on the brick, end 20 of the first coil, 11a, of metal winding 11, and forms coil 11a by starting motor 13 and thereby actuating the rotation of the spindles, chucks and brick 10. As the brick turns, coil 11b is formed and disposed over end 20 of coil 11a, thereby securing the winding to the brick at the starting end. Coil 11b is slightly spaced from coil 11a and each succeeding coil is slightly spaced from the adjacent coil, in this example the spaces being about one-half inch. The end of the last coil is brought over the adjacent coil and spot-welded thereto at 21. During the winding the metal strap is maintained under tension so that the coils fit tightly against the brick. The spacing of the adjacent coils from each other results in reduced or decreased conduction of heat from the hot to the cold face of the brick when installed in a furnace, as compared with heat conduction of a continuous metal sheet casing. The metal winding or encasement securely engages the brick and is not dislodged in handling, shipping or installation. The metal of the winding oxidizes and combines with the brick material and provides a good bond between adjacent bricks or blocks upon firing in a furnace.

In FIGURE 2, the nonacid refractory shape 22 is cylindrical and metal strapping 11 is applied and is affixed, at 20 and 21, in the same manner as the winding in FIGURE 1. If desired, the strap can also be wound around the shoulder extensions of this block, transverse to the shoulder axis. In FIGURE 3, a wedge-shaped nonacid

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refractory block 23 is similarly wound with steel wire 24, starting end 25 of the wire being caught under one or more coils thereof, and the other end being welded to the adjacent or next-to-last coil at 26.

In FIGURE 4 there is shown still another embodiment of the invention wherein there is provided a hanger unit. This unit is composed of two basic refractory shapes 27 and 28, having recesses 29 and 30, respectively, so that when the shapes are assembled there is formed a common socket or recess 31 which will receive the foot of a hanger device when installed in a furnace roof. The refractory shapes or blocks are assembled and are wound with steel strapping 32. In this instance, it is of course not suitable to employ drill chucks such as are used in the embodiment of FIGURE 1, but rather it will be understood that universal or box chucks would be employed to hold the two blocks together. The metal strapping in this embodiment is a stepped strip of the type shown at 9d, and it is so wound onto the double block that the coils overlap, a lower flange or shoulder 33 of one coil underlying upper flange or shoulder 34 of an adjacent coil, and in this manner a substantially flat outer metal surface is formed. This enables close fitting of the masonry units in a furnace roof installation. The ends of the strapping are preferably affixed to adjacent coils in this embodiment by spot welding, particularly since the coils overlap; but, alternatively, the starting end can be caught under an adjacent coil in the manner of the previous figures and the terminal end can be affixed by spot welding to the next to the last coil. The winding is so applied that the socket recess is not obscured or entry thereto interfered with by the metal winding.

The embodiment of FIGURE 5 shows another example of a hanger unit composed of similar nonacid refractory blocks 27 and 28 having suitable recesses to form a common hanger-receiving recess 31. In this embodiment there is also provided an internal metal reinforcing plate 35 disposed between the facing surfaces of the two refractory blocks as they are assembled into the completed unit. This block is wound on a lathe in a similar manner to the unit of FIGURE 4 except that in the present example the metal coil 36 is composed of flat steel strapping of the type shown in FIGURE 9c and is so applied to the refractory component as to provide a slight spacing between adjacent coils. In this embodiment it is convenient to catch the starting end of the winding under one or more coils thereof and to affix the terminal end by spot welding to the next to the last coil of the winding. This article as well as the article of FIGURE 4 are suitable for installation in refractory furnace roofs either in combination with other similarly wound masonry units or with masonry units encased in another manner or free of any casings.

In FIGURES 6 and 7 are shown embodiments of the present invention wherein a metal winding is applied to about one-half of the longitudinal surfaces of a refractory block, in this instance a wall brick, although it is to be understood that hanger units or rotary kiln blocks can be similarly wound over about one-half their longitudinal surface. In FIGURE 7 there are shown two of these blocks placed adjacent to each other and demonstrating that, when installed in a furnace lining, there will be provided one thickness of metal between adjacent blocks. The embodiments of FIGURES 6 and 7, wherein like numerals designate like elements, comprise a nonacid or basic refractory block 37 and a metal winding 38. As shown, these windings are suitably applied by catching a starting end under an adjacent coil and welding the terminal ends to the next to the last coil.

FIGURES 10 and 11 illustrate schematically a mechanical means for winding the metal onto refractory-shaped objects according to this invention. In this arrangement or embodiment, a brick 39, for example, is placed in a lathe, which is not shown in detail because any conventional apparatus of this type can be employed. The brick is held between felt cups 40 and 41 which prevent abrasion

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or damage to the refractory material, and head stock 42 and tail stock 43, driven and supported by usual means (not shown). A coil of wire 44 is disposed at the side of the lathe and rotates and moves forwardly along supporting rod or axle 45. Wire 46 is drawn off coil 44, passes between upper screw 47 and lower screw 48 and is laid on brick 39, the starting end being caught under the successive coil as previously described. Screws 47 and 48 also rotate and feed the wire onto the brick in coils in spaced relationship corresponding to the pitch of the screws, both screws being of the same pitch and being threaded in opposite directions. The method of winding by this device is shown more clearly in FIG. 11, which shows the lateral arrangement of the wire coil 44, screws 47 and 48, and brick 39 with wire 46 being wound thereon, the brick being driven in a counter-clockwise rotation as viewed in FIGURE 11 to draw wire off coil 44 and between the screws for placement thereby in the desired spacing on the brick. When the desired amount of brick surface has been wound with the wire, the wire is cut or otherwise severed from the coil source, the end welded to an adjacent turn of wire on the brick, and the coil 44 then returned to its starting position, either manually by the operator or by a suitable mechanism (not shown). Alternatively, the coil 44 does not move in the direction of the winding but wire is freely drawn off therefrom, passing through the screw device and onto the brick.

It is to be understood that other than steel strap can be applied and that wires of various sizes and cross-sectional configuration can be employed in the winding to provide a protective metal coating or casing for the refractory block or blocks. The gauge units given herein are U.S. Standard, as given in Chemical Engineers' Handbook, John H. Perry, Second Edition, published by McGraw-Hill Book Company, 1941. Also, in any article the coils of the windings can lie closely adjacent or abutting each other or can be spaced as desired, or alternatively, can overlap which latter embodiment for purposes of illustration is shown herein in FIGURE 4. It is usually desired that the winding does not extend quite to the end of the block and conveniently winding usually starts and is completed about from one-eighth to one-fourth of an inch in from the respective ends of the brick or block, except that as noted above, where a hanger unit is wound, care is taken that the winding does not interfere with the introduction of a hanger device into the socket or hanger receiving recess. For convenience the term "refractory block" is used to include bricks or various shapes or kiln blocks, and these components can be of any desired size. In fact, it is an important advantage of the present invention, as indicated above, that the sizes to be metal coated may vary considerably, and it is not necessary to fit a formed casing to a formed brick. It is also to be understood that automatic winding devices can be employed, and may be advantageous, in placing the windings or coils upon the refractory components. It is preferred that a soft material, such as felt, be interposed between the ends of the block and metal parts of the machine in winding, to avoid damage to the refractory.

Having now described the invention, what is claimed is:

1. Process for metal encasing a preformed basic refractory furnace lining block which comprises rotating said block, placing one end of an elongated metal strip on a longitudinal face of said block adjacent one end of said block, feeding said elongated metal strip over said strip end and onto said block while rotation is continued to form a helical winding of successive coils of said strip on said block, and welding the other end of said strip to an adjacent coil thereof, to form a furnace lining article.

2. Process for applying protective metal to the surface of a pair of preformed refractory blocks to form a furnace lining article, which comprises maintaining said blocks in tight juxtaposition as a pair, rotating said pair of blocks, placing an end of an elongated metal strip upon an exterior longitudinal face of said pair of blocks

adjacent one end thereof, feeding strip to form at least one coil over said strip end to prevent unwinding of successive coils, and continuing feeding said strip to form successive coils on said longitudinal exterior surfaces to the other end of said block, and welding the other end of said elongated metal strip to an adjacent coil thereof.

3. A furnace lining article which comprises a preformed nonacid refractory block and fixedly disposed upon said block and tightly engaging the longitudinal surfaces thereof an unembedded spiral winding of elongated ferrous metal strip, each end of said strip being affixed to an adjacent coil of said spiral winding to enable maintaining said spiral winding in close contact with said block.

4. Furnace lining article as in claim 3 wherein one end of said winding is tightly held by at least one superposed coil of said winding and the other end thereof is welded to an adjacent preceding coil.

5. Furnace lining article as in claim 3 wherein said successive coils of said winding are slightly spaced from each other to reduce heat conduction from the hot face to the cold face of said article when installed in the furnace.

6. Furnace lining article which comprises a preformed nonacid refractory block, and fixedly disposed upon said block and tightly engaging the longitudinal surfaces of said block a spiral winding of a metal strip having an upper flange at one side and a lower flange at the opposite side, said upper flange of one coil overlying said lower flange of an adjacent coil to form a continuous metal coating upon said block, each end of said winding being welded to an adjacent coil.

7. Furnace lining unit article for forming a suspended furnace roof which comprises a pair of juxtaposed nonacid refractory blocks having a hanger-receiving recess at

one end of said unit article, and fixedly disposed upon said unit article and tightly engaging the exterior longitudinal surfaces of said unit article an unembedded spiral winding of elongated steel strip, each end of said strip being affixed to an adjacent coil of said winding to maintain said winding in close contact with said surfaces.

8. Furnace lining article as in claim 7 wherein a metal plate is disposed between the interior abutting faces of said pair of blocks.

9. A furnace lining article composed of a rectangular basic refractory block and, fixedly disposed upon said block and tightly engaging the four lateral surfaces thereof, a spiral winding of steel strapping, each coil of said strapping being slightly spaced from adjacent coils thereof to reduce conduction of heat from the hot face to the cold face of said article when installed in a furnace, the ends of said winding being secured to adjacent coils thereof.

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