ABSTRACT OF THE DISCLOSURE

An insulating construction system for high temperature applications comprising a structural supporting member and insulating body superposed over the structural supporting member and secured thereto by means of ceramic pins, and the ceramic securing pins therefor.

BACKGROUND OF THE INVENTION

This invention is directed to means of constructing and supporting composite walls, ceilings, or panels comprising thermal insulations of assorted insulating compositions resistant to very high temperatures up to a range of about 2,500 to 3,000° F. and suitable for direct exposure to the source of heat as in enclosing structures for furnaces, soaking pits, annealing furnaces, thermal stress relief chambers, and the like high temperature equipment. The invention is particularly concerned with practical and effective means of uniting and securing non- or weak structural insulations, such as bodies of refractory fiber, and of high thermal tolerances with structural or supporting members such as steel or other appropriate metal plates or sheets, etc., to produce composite sections of integrated insulation and supporting or carrying structure, providing complete units suitable by themselves for use as walls, ceilings, or panel components for furnaces and the like foregoing high temperature chambers.

Conventional high temperature installations such as furnaces, soaking pits, thermal stress relieving units, annealing furnaces, etc., are constructed with walls and/or tops of refractory brick or block, such as insulating fire brick, normally braced or even supported with metal structures, and of compositions which typically range in densities of from about 25 pounds per cubic foot for maximum exposure temperatures of approximately 1,600° F. up to about 65 pounds per cubic foot for a maximum exposure temperature of approximately 3,000° F. Of paramount significance in the use of such conventional construction means and material is the high cost of installation comprising the relatively slow assembly of the structure with brick or the like block units with refractory mortar and the requirement therefor of skilled masons. Moreover, these brick-type constructions, aside from high initial construction cost and high weight, are by nature quite rigid and, therefore, prone to cracking and breakage, or spalling, etc., due to thermal expansion, present extensive joint exposure, and are costly to repair, among other significant disadvantages.

SUMMARY OF THE INVENTION

This invention comprises a high temperature insulating construction system and means therefor enabling more economical assembly of furnaces and the like high temperature chambers with wall and/or top sections of panels of a more adaptable and versatile application and improved thermal insulating efficiency over prior conventional brick-type systems. Basically, this invention comprises high temperature insulation construction system for walls, ceilings, panels, or the like sections, comprising an insulating material suitable for direct exposure to the given conditions of heat, superimposed upon a supporting or bracing structural member of lesser thermal resistance and insulating efficiency, and in particular means for effectively uniting and securing the insulation to the supporting or bracing structure consisting of unique pin-like units which are easy to install with many types of common high temperature insulations, securely hold the insulating components and resist the temperature conditions of direct exposure to the source of heat. The pin-like units of this invention are secured by any one of several various means to the supporting structure and impale or pass completely through the body of insulating material or materials whereby at least the exposed end and securing means thereon are composed of a refractory material which will endure the temperature environment.

It is a primary objective and advantage of this invention to provide means of uniting and securing conventional insulating materials resistant to very high temperatures to a structural supporting member wherein the uniting and securing means is easily applied and installed, more firmly and effectively affixes and secures the unit, and itself resists very high temperatures equally as well as insulating material whereby its exposure in extending through and beyond the surface of the insulation in the area of high heat to secure the insulation is not detrimental, thereby providing a complete unit of integrated insulation and structural support as panel-like product or construction suitable by itself to form a furnace or similar high-temperature chamber wall, or top, or section therefor.

BRIEF DESCRIPTION OF THE DRAWING

The invention will be more fully understood and further objects and advantages thereof will be apparent when reference is made to the following detailed description of a preferred embodiment of the invention and the accompanying drawings, in which:

FIG. 1a is a side elevation view, partly in section, of a preferred insulation construction of a high temperature insulation system of this invention;

FIG. 1b is a view of the washer component and pin shown in FIG. 1a, taken on a plane and viewed in a direction of the arrows 1B—1B;

FIG. 2 is a perspective view of the ceramic portion of the pin of FIG. 1a, and the washer therefor;

FIG. 3 is a side elevation view, partly in section, illustrating still a further alternative of pin; and,

FIG. 4 is an additional side elevation view, partly in section, illustrating another alternative type of pin; and,

FIG. 5 is also a side elevation view, partly in section, illustrating still a further alternative of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

This invention essentially comprises a uniting and securing means to join a body of high temperature resistant insulation of little or no structural integrity to a supporting structure member, which consists of pin-like members of ceramic material, enabling the integration of a complete unit assembly of insulation and structural supporting member, which unit itself, or multiples thereof, can effectively serve as a furnace, or the like high temperature chamber, wall or top. The pin-like members of ceramic material, or the ceramic securing pins, enables the positioning and effective fixing of the insulating material, whether of low density, soft and flexible fibrous felts or blankets or of rigid semi-structural bodies, to the structural support member such as metal sheet, by permitting the pin-like members to extend completely through the insulation and project out from the surface exposed to the high temperature conditions without any detrimental effects wherein the complete
transverse of the body of insulation by the pin-like member provides for positive securing and fixing of the insulation regardless of its consistency or density to the structural member and greatly facilitates assembling the composite unit and the fabrication of furnace and like high temperature chamber structures.

Referring to the drawings, FIGS. 1a and 1b illustrate a furnace construction system comprising an integrated unit of insulation and supporting structure joined and secured by means of a composite pin 12 of a preferred member and means of construction of the invention. In the figure the structural member comprises a sheet of steel 10, or other appropriate metal, with the body of thermal insulation 11 superimposed thereon and each of said components is effectively united and secured together by means of pins 12 of a composite of a metal section 13, and a ceramic section 14. The metal section 13 of the pin 12 is secured to the structural support member 10 and is adjacent to the exterior or cool face of the unit, and the ceramic section 14 extends through and beyond the insulation surface in the direction of the interior or hot face and is provided with a positive stop thereon and thus of necessity is exposed to maximum temperature conditions. The metal section 13 of composite pin 12 may be secured to the structural support member 10 by any appropriate means, such as by welding 15. And in the preferred embodiment, metal section 13 is joined to the ceramic section 14 by means of a threaded joint 16. As illustrated, the metal section 13 comprises the male component of the threaded joint which is preferred in that it enables the use of ordinary flat-head bolts, and additionally facilitates mounting of the insulation thereon by impalement. However, the ceramic section 14 can be constructed with external threads and function as the male component whereby the cooperating metal female section, by surrounding the more fragile ceramic material, provides a stronger junction. To facilitate the mounting and positioning of the insulating body by means of impalement upon the composite pin 12, the terminal end of the ceramic section opposite to the metal section 13 secured to structural support 10, is preferably formed in a point 17. Also in the preferred embodiment, adjacent to the said terminal end of the ceramic section 14, and opposite to the metal section 13 secured to the supporting structure 10, there is provided a pair of two or more lugs, such as illustrated lug 18 and 18', positioned thereon at a point just beyond the designed thickness of the body of thermal insulation 11 mounted on the pins, which cooperate with ceramic washer 19, provided with a center hole 20 and extending to the insulation in a pair of slots 21 and 21', each sized and positioned to cooperate with ceramic section 14 of pin 12 and lugs 18 and 18' thereof, whereby the washer may be slipped over the end of the ceramic section 14, past lugs 18 and 18', and then turned approximately 90°, forming a bayonet coupling to provide a shoulder means forming a positive stop to retain the insulation 11 securely in position. Details of the bayonet coupling and components forming the same are more fully illustrated in the perspective view of FIG. 2.

Thus, the preferred furnace construction of this invention may be conveniently assembled simply by welding standard bolts 13 to a common metal supporting plate member 10, threading thereon ceramic pin sections 14, and impaling insulating material 11, such as a plurality of fibrous blankets 22, 23, 24, and 25, as shown in FIG. 1a, upon the ends of the composite pin 12. Washers 19 are then positioned over the end of the pin just past lugs 18 and 18' and turned approximately 90°, whereupon a unit suitable for furnace construction embodying both the structural support and insulating means is provided and the hot face surface of the unit comprising the exposed insulation and pin like members with securing components will withstand the high temperature environ-
ment of the furnace or the like high temperature chamber.

FIGS. 3 and 4 illustrate variations of this invention comprising the use of ceramic pin-like members formed in the general configurations of common bolts. In FIG. 3, the body of insulation 11 is secured to structural member 10, by providing member 10 with plurality of holes 26 to receive ceramic bolt 27 having a large head 28, to provide shoulder means for positively retaining the insulation. Bolt 27 is preferably constructed with a large diameter shank 29, approximately the length of the depth of insulation installed therewith, forming shoulder 30 of a diameter greater than hole 26 in structural support member 10, thereby functioning as a stop and fixing the positioning of the bolt. Terminal end of ceramic bolt 27 is provided with threads 31 on which nut 32 is applied to positively hold and fix ceramic bolt 27. Since nut 32 is positioned on the cold face of the unit it can be composed of metal or the like low temperature resistant metal or material. With this arrangement a low density insulating material which is highly compressible or resilient can be fixed into position and positively held without undue compression thereof, and in turn reduction in its insulating efficiency.

FIG. 4 illustrates a similar bolt-type shaft member comprising ceramic bolt 33 of generally conventional construction passing through a hole 26 in structural support 10, and having a head 34 with diameter greater than hole 26 functioning as the stop. The opposite terminal end of bolt 33 is provided with threads 35, a ceramic washer 36, and a ceramic nut 37 to hold washer 36 in place. In the embodiment of FIG. 4, as in the embodiment of FIG. 3, the insulation 11 and structural support member, are assembled in juxta-position and the bolts pass through the insulating body 11 simply by force if the insulation is of sufficiently low density or through drilled holes if necessary in alignment with the holes 26 of structural support member, and washers which are desired and nuts applied to the threaded ceramic bolts 27 or 33.

In the embodiment in FIG. 5, threaded stud 38 is welded to structural support plate 10 and a ceramic shaft 39 threaded thereon with the stud forming the male member and shaft 39 the female member of the threaded connection. The terminal end of ceramic shaft 39 opposite threaded stud 38 can be provided with a pair of generally opposing lugs 40 and 40' to cooperate with a slotted washer 41 providing a bayonet-type coupling to form a shoulder stop to positively fix and secure the body of insulation 11, comprising for example a rigid material 42 which has been drilled forming holes 43 to permit it to be slipped over ceramic shaft 39 which joins and secures it to structural support member 10 to provide the furnace construction unit.

In the preferred composite ceramic-metal pin embodiment of this invention, the pin should be proportioned so that the ceramic section extends from the hot face or exposed surface back into the insulation to a point where the temperature is reduced sufficiently that the metal portion of the pin is not adversely affected by the heat. For a high temperature resistant metal such as stainless steel a maximum safe temperature may be where the temperature does not exceed about 1,500°F, while for common steel it might be as little as 500°F. In order to insure prolonged effective operation of the furnace structure or similar high temperature chamber.

Thus, with the means and construction of this invention, furnaces or other high temperature chambers can be assembled from units comprising a metal plate with conventional bolts welded therein with holes 26 which are fitted with the ceramic portion forming the composite pin, having impaled thereon a conventional insulation of the desired thickness and secured with a washer which is applied simply by inserting it over the pin and applying an approximate 90° turn. Or, as is evident from the foregoing,
the metal plate may be drilled and ceramic bolts passed through the holes and the insulation, and fixed into place with either metal or ceramic nuts, depending on the direction of the bolt. When appropriate, such as with a rigid insulating material, the insulation may be drilled to accommodate the pins or bolts.

With this system for furnaces or the like high temperature chamber construction, it will be evident that complete wall sections and tops, or large panels thereof, can be assembled with continuous uninterrupted bodies of insulation eliminating or substantially reducing vulnerable joints, and substantially facilitating assembly and construction time. The use of a ceramic composition for the pin-like members, or for at least the section adjacent to the hot face, permitting the penetration thereof completely through the body of insulation and their exposure, greatly facilitates assembly and enables the application of positive securing means without introducing thermally vulnerable components or areas or reducing the overall temperature limits of the construction since the ceramic component will endure temperatures generally comparable to many high temperature insulations up to and often in excess of 2,500° F.

Additionally, the simplified construction system of this invention enables a convenient and economical application of composite insulations, including a high temperature resistant insulating material such as felts or blocks of highly refractory fibers or alumina and silica, or the like insulating materials on the hot face, with lower cost backup insulations of reduced thermal resistance such as glass or mineral wool, intermediate the high temperature insulation and the structural support.

Insulating materials for use in the construction system of this invention may comprise any conventional or commercial composition which will meet the given temperature requirements including common refractories, magnesia products, hydrated calcium silicates, but preferably fibrous insulations such as those described in pages 96 to 100 of Product Engineering, Aug. 3, 1964 or pages 91 to 95 of Product Engineering, Feb. 14, 1966, and composed predominately of alumina and silica alone, or modified as known in the art. Ceramic compositions for the ceramic section of the pin may comprise any high thermal shock resistant refractory having good strength at elevated temperatures such as high alumina compositions or mullite, bonded fused aluminum oxide, spinels, synthetic sapphire, magnesia, zircon or zirconia, silicon carbide, etc.

What we claim is:

1. A high temperature insulation construction for direct exposure to high temperature environments ranging up to about 2500° F. to 3000° F., comprising:

   (a) a structural supporting member;

   (b) a body of insulating materials superimposed over the structural supporting member;

   (c) said body of insulating material being secured to the structural supporting member by means of a plurality of spaced-apart pins of ceramic composition passing through the body of insulating material with one end secured to the structural supporting member and the opposite end extending through and exposed on the surface of the body of insulating material and having thereon shoulder means for holding

the body of insulating material in position over the structural supporting member.

2. The high temperature insulation construction of claim 1, wherein the pin passing through the body of insulating material and securing the same to the structural supporting member is of a composite structure with the end thereof fixed to the structural supporting member being composed of metal, and the remainder of the pin being of ceramic material.

3. The high temperature insulation construction of claim 2, wherein the shoulder means on the exposed end of the ceramic pin comprises a ceramic washer.

4. The high temperature insulation construction of claim 3, wherein the ceramic washer is held in position on the exposed end of the ceramic pin by means of a bayonet coupling.

5. The high temperature insulation construction of claim 2, wherein the metal section and the section of ceramic material of the pin are united to each other by means of a cooperating threaded joint.

6. The high temperature insulation construction of claim 1, wherein the pin of ceramic composition comprises a bolt passing through both the structural supporting member and the body of insulating material.

7. The high temperature insulation construction of claim 6, wherein the pin of ceramic composition comprises a bolt provided with a shaft having a reduced portion intermediate the ends forming a shoulder to function as a stop fixing its position in relation to the structural supporting member through which it passes.

8. Fastening means for securing an insulating body to a structural supporting member comprising an elongated composite pin having a metal section and a section of ceramic materials, said metal section being adapted to be secured to the structural supporting member and the section of ceramic material being adapted to extend through and beyond the insulating body and having on its terminal end means providing a shoulder to retain the insulating body and on its opposite end, adjacent to the metal section, having means to join with the metal section to form a continuous unit.

9. The elongated composite pin of claim 8, wherein the means on a terminal end adapted to extend beyond the insulating body to provide a shoulder to retain the insulating body, comprises lugs and a washer with cooperating slots to form a bayonet joint.

10. The elongated composite pin of claim 9, wherein the means of joining the metal section with the section of ceramic material comprises a threaded joint.

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PRICE C. FAW, Jr., Primary Examiner

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