March 5, 1940. D. D. WHITACRE 2,192,723

INSULATING BLOCK

Filed July 11, 1936

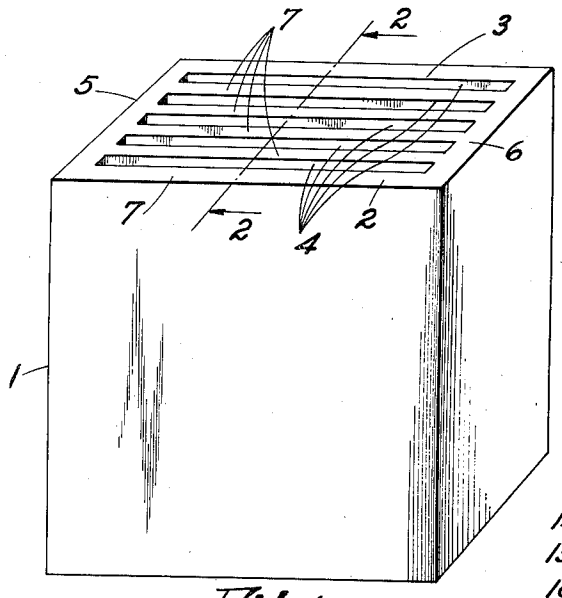


Fig. 1

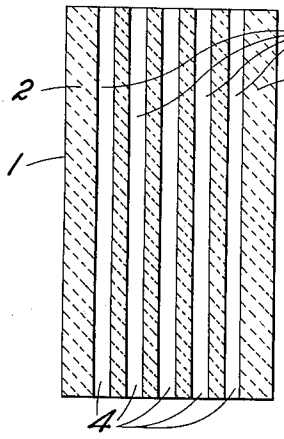


Fig. 2

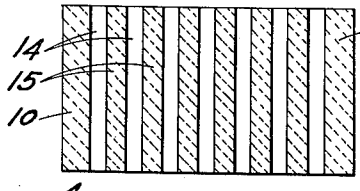


Fig. 4

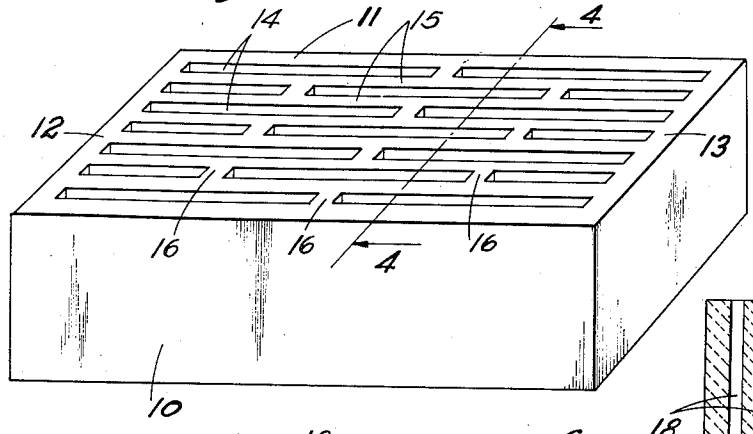


Fig. 3

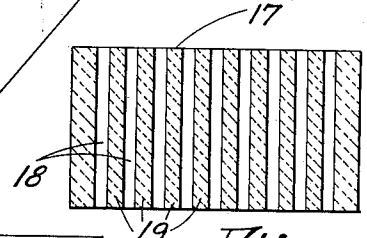


Fig. 6

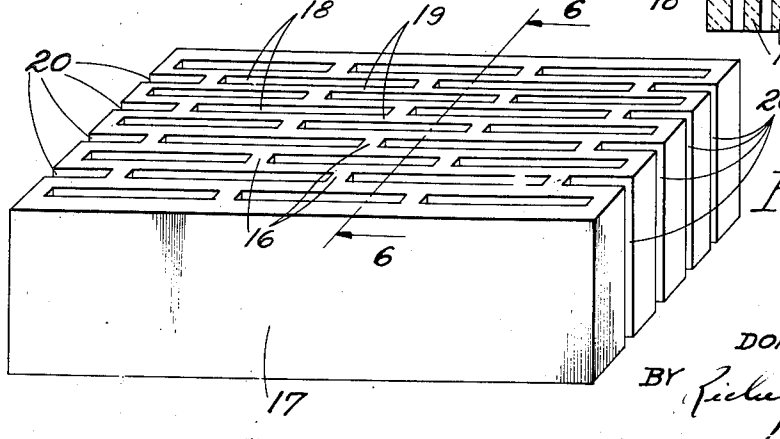


Fig. 5

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INSULATING BLOCK

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7 Claims. (Cl. 72—41)

This invention relates to insulating blocks or bricks, sometimes called insulating refractories as well as to a method or process of making the same or similar products, and more particularly relates to such blocks having light weight, high insulating value and high structural strength and stability particularly at high temperatures.

Heretofore insulating bricks or blocks, including among others those made in whole or in part from clay or clay products, have generally achieved a desirable insulating value only at a sacrifice of their structural strength, resistance to spalling, crumbling, shrinkage and other attributes of structural stability and durability.

Heretofore insulating bricks intended for use at relatively high temperatures have in many instances been made light and heat insulating by greatly adding to the porosity of the bricks either by "bloating" or otherwise to provide a great number of relatively small voids or interstices to supply or increase the porosity of the finished article at the expense of its strength and structural stability. Such bricks which primarily depend upon porosity for their insulating value, not only lack structural strength, but are also subject to structural instability including spalling, shrinkage and crumbling under at least a combination of heat and load, and are therefore grossly unsuitable for such duties as are desired to be placed upon them in furnace walls and arches.

Insulating bricks which heretofore depended upon porosity for their insulating value and/or lightness in weight also have the disadvantage of being permeable to gases, which on the one hand may permit leakage of noxious gases from the furnace, and may on the other hand cause the deterioration of the brick by its acquisition of or inclusion of gases deleterious to itself.

It is among the objects of my invention to provide an insulating brick or refractory in which a high insulating value and lightness in weight may be achieved, and in which also a high structural strength and stability is maintained throughout the range of temperatures to which the bricks are subjected in use. Further and more particularly, it is an object of my invention to provide a relatively light weight brick having a high insulating value in which the structural strength, at least per unit of net area, is substantially the same as a solid brick made of good quality fire clay according to present practice. A further object of my invention is to provide an insulating brick, the resistance of which to spalling, shrinkage, crumbling and the like, is substantially the same as a solid fire clay brick as above described. A further object is to provide a brick of high insulating value of substantially less permeability than insulating brick, which are available on the market today of comparable insulating value. A further object of my invention is to provide an insulating brick of the burned clay type of light weight as well as great structural strength. A further object of my invention is to provide an insulating brick that has all of the necessary desirable physical characteristics of solid fire clay blocks, but with a substantially higher insulating value than has heretofore been obtained in such blocks. A further and more specific object is to provide an insulating brick capable of withstanding the standard test load of twenty-five pounds per square inch of gross area without any substantial shrinkage, or spalling or the like, up to a temperature, as for example, between 2000° and 3000° F., or at least up to the temperature under which a similar refractory material in a dense solid brick will withstand the same load. A further object of my invention is to produce an insulating brick capable of carrying out the foregoing objects which may be economically manufactured and readily transported and laid up in a wall or other structure.

A further object is to provide a method for making particularly the insulating blocks hereinbefore referred to, and more generally to provide a method of making extrudable hollow tile products of shapes difficult to extrude, such for example as the insulating blocks herein described, having relatively long and slender web portions supported only at relatively distant points.

A further object is to provide an insulating brick which not only has desirable insulating and other qualities for high temperature insulation, but which is also adapted for practical use with a high insulating value for lower temperatures, such as in or about room or refrigerating temperatures.

Other objects and advantages of my invention will appear from the following description herein contained, reference being made of the drawing; the essential characteristics are summarized in the claims.

In the drawing,

Figure 1 is a perspective view of a block or unit showing one desirable form of my invention;

Figure 2 is a vertical section taken along the line 2—2 of Figure 1;

Figure 3 is a perspective view of another form

of my invention embodied in a block of the external dimensions of standard fire brick size;

Figure 4 is a vertical section taken along the line 4—4 of Figure 3;

Figure 5 is another form of my invention embodying a block of standard fire brick size having its ends indented; and

Figure 6 is a vertical section taken along the line 6—6 of Figure 5.

In carrying out the objects of my invention I have found that great insulating value combined with great structural strength may be obtained in an extruded and burned clay block in which continuous long and narrow voids are formed transversely of the body of the block. For example, I have found that by providing a block with a plurality of voids about ¼" wide, and preferably from about 4 to 6 inches long, which are spaced from each other by parallel webs in the block of about the same cross sectional area, that the resulting product will so resist the transmission of heat in a direction transversely of the voids that the load bearing part of the block may be formed of relatively dense refractory material.

Further in carrying out the objects of my invention I have found that the insulating or heat transmission resisting qualities of the block may be greatly increased by providing relatively large and numerous and relatively flat surfaces extending transversely of the path of the flow of heat, which are light in color (being or approaching buff or white), each of which actively reflects particularly radiant heat which would otherwise tend to be transmitted across any voided portions of the block.

In carrying out the objects of my invention I have further found that the greater the number of such exposed heat reflecting surfaces that I can interpose in the path of movement of heat across the block, the more effectively and conclusively can I reduce the transmission of particularly radiant heat through the voided block.

Further in carrying out the objects of my invention, the arrangement of the voids disclosed in the drawing, each containing a relatively small amount of air, particularly where each void is closed off at its ends either by a mortor bed or its equivalent, effectively reduces the movement of air in the restricted area to reduce or substantially eliminate the transmission of heat across the voided spaces by convection. The transmission of heat by conduction through the air in the voids is, as is well known, a determinable factor, but is maintained in a small amount even where the voids are as narrow as I prefer to make them, because particularly the resistance to transmission of heat by conduction from a gas to a solid, and vice versa, is a factor which is multiplied many times by interposing a plurality of webs and air or gas filled voids in parallel relationship transversely of the path of transmission or heat. Having in mind that the transmission of heat from one exterior surface of the block to the other also involves the conduction of heat through the solid material of the blocks, I have illustrated particularly in the forms of my invention shown in Figures 3 and 5, an arrangement whereby the voids are staggered relative to each other, so that at least in the body of the block a very tortuous path of solid material of small cross sectional area, as measured across the direction of flow of heat by conduction in the webs, is provided whereby to increase greatly the resistance of such paths to the conduction of heat transversely of the block.

The arrangement and shape of the voided portions of the block and the character and disposition of the surfaces of the voids in their relation to the solid portions of the block, is such in its efficacy toward resisting the transmission of heat therethrough, that I am able to form the solid portions of the block of relatively small insulating value as such without materially detracting from the whole insulating value of the complete block, and that by so doing I may form the solid portions of the block of such dense and/or strong and durable refractory material, such as a highly refractory fire clay, that I can preserve in my complete block the advantages of lightness of weight, strength and durability, absence of permeability, and freedom from spalling and shrinking and crumbling, while preserving and obtaining a high insulating value for the complete block or unit.

Referring more particularly to the drawing of the several illustrative forms of blocks in which my invention is shown to be embodied, I have illustrated in Figure 1 a block which in commercial form I prefer to form with its front face 1 and its opposite rear face substantially square, whereby the block may be set in the wall with its voids extending vertically, as shown in Figure 1, or may be set in alternate courses with its voids extending horizontally, whereby to close off the voids in adjacent blocks. In practice I have found it advantageous to make such block with dimensions about 6" x 6" x 3¼" to 4½", whereby alternate rows in a wall, such as in a furnace wall, may be end set and side set respectively to accomplish the result of sealing off the air spaces in each void in each block.

As will be seen in Figures 1 and 2 the block therein disclosed has a front face 1 on the outer side of a front wall 2, which is disposed opposite and parallel to a similarly formed rear wall 3. Between the front and rear walls I provide a plurality of voids 4, each of which extends throughout the whole height of the block, and preferably extends substantially the whole length of the block, terminating adjacent the end walls 5 and 6. For convenient strength in handling and shipping I prefer that the front and back walls 2 and 3 and the end walls 5 and 6 be about ½" in thickness in this form of my invention. Spacing each of the voids 4 from the other and preferably extending parallel to each other, and joining the end walls 5 and 6, are webs 7. In this form I prefer that the voids 4 and the webs 7 each be about ¼" in thickness, whereby to provide a great many narrow voids whose major faces lie transversely of the direction of flow of heat from the front wall to the rear wall of the block, it being understood that my blocks are intended to be disposed with what I have termed the front wall or the rear wall lying substantially normal to the heat source.

Particularly in the form of my invention shown in Figures 1 and 2, I prefer that the faces of the block, which are intended to lie adjacent to or abut upon adjacent blocks in a wall structure be ground off smoothly, as with a grinding wheel, and ground to accurate dimensions, so that each of the blocks may have a close abutting contact with its neighbor, whereby a dry joint or a very light mortar or mixture of water and clay may be used to bond the bricks or blocks together in a furnace wall. It may be appropriately noted that the admixture of a small amount of pow-

dered coal with powdered clay in the plastic mix prior to the extrusion and burning of the blocks will facilitate the grinding as more fully described in my Patent No. 2,102,447, issued December 14, 1937, and as more fully described hereinafter in connection with the appended description of the method by which I prefer to make the blocks of the instant invention.

Referring more particularly to Figures 3 and 4 I have illustrated a block in a form having conventional fire brick dimensions, being about 9" x 4½" x 2½", having front and rear walls 10 and 11 respectively, end walls 12 and 13, and a plurality of voids 14, each being long and narrow and extending the whole height of the block, as shown also in Figure 4. The voids 14 are spaced from each other by interposed webs 15. In the form shown in Figure 3 I prefer, for the reasons above given and for the sake of strength, particularly in handling the block before it is burned, that the voids be staggered as shown, whereby the relatively narrow webs therebetween be interconnected only as at the points 16 in the mid-portions of the block. The long and narrow voids, however, interrupt any continuous solid portion of the block, at least in the mid-portion of the block, in a direction transverse to the front and rear faces, whereby only a long and tortuous path of small cross sectional area is afforded for the conduction of heat from the front to the rear face of the block through the solid web portions thereof.

In the form of my invention illustrated in Figures 3 and 4 I prefer that the voids 14 be about seven in number, and be only about ¼" wide in the direction transversely of the block, as measured from the front to the rear face thereof, and that the major voids preferably be only a little less in length than about one-half the length of the whole block. In this embodiment I prefer that the webs 15 be about $\frac{5}{16}$" in thickness, and be disposed as shown in the perspective view in Figure 3. The end walls 12 and 13 and front and rear walls 10 and 11 may preferably be a little thicker than the webs, as for example about ½" in thickness, whereby to more effectively resist the shocks and strains of handling and shipping.

In the embodiment shown in Figures 5 and 6 I prefer that the block 17 be similar to the block 10 of Figure 3 as to external dimensions, and the staggered relation of the voids. In this modification I have shown the ends of the blocks to be indented as at 20, preferably for about one inch in the form therein shown, whereby when adjacent blocks are laid end to end no direct and continuous path is afforded for the conduction of heat along the end walls of the block from front to rear thereof. I have illustrated the voids 18 about $\frac{3}{16}$" in thickness and the webs 19 about ¼" in thickness with the exterior walls a little thinner than in the preceding figures; the ratio of voided to solid area being a little less than shown in Figures 3 and 4.

In these forms of construction I also contemplate that while the blocks may be simply extruded and wire cut and burned in the usual way, and laid upon appropriate mortar beds as fire brick have been commonly laid in the past, it may be advantageous to grind the exterior surfaces of the blocks whereby to bring these surfaces into more intimate contact with adjacent blocks and reduce the thickness of or eliminate mortar beds or partitions between the blocks.

In forming the blocks hereinbefore illustrated and described, I prefer to use fire clay and extrude the same. It will be appreciated, however, that the extrusion of blocks with the numerous narrow parallel webs and voids is a thing which has been regarded at least as being very difficult if not impossible under such practices as have heretofore been known.

I have found that blocks having the structural characteristics of my invention may be made successfully with the long narrow webs and voids herein illustrated and described by extruding a mixture of water and clay and deaerating the mix before it is forced through the extruding die by extruding and deaerating means or mechanism which are available on the open market today. The blocks so extruded are preferably dried and burned in the manner hereinafter described. When extruding with the aid of deaeration the density of the finished product is increased somewhat, and I have observed the increase in density to be between about 5% and 8% when extruding blocks made of fire clay having the characteristics of my invention. In an insulating block so made I obtain blocks with a little less than 50% voided cross sectional area which, with the added density due to deaerating, gives a resulting block of standard fire or refractory clay having a weight of about 70 pounds per cubic foot.

While blocks, so made and the above method of making them, have many of the advantages of my invention I have found it substantially more advantageous to form the blocks from a mixture of powdered coal and powdered clay in which a portion of coal (I have successfully employed coal and clay found in the neighborhood of Waynesburg, Ohio) as, for example, 40% coal to 60% clay by weight are mixed together and ground together to substantially the same fineness, preferably fine enough to pass through a fifty mesh screen, and then mixed together with water and extruded, preferably with the aid of deaeration, and thereafter dried and burned in the manner hereinafter described. The admixture of the finely divided coal to the finely divided clay in the above method is advantageous in that the powdered coal content in the clay stream helps the extrusion and coacts with the step of deaeration seemingly by tending to lubricate the die through which the plastic stream is extruded, and by coacting with the deaeration in preventing laminations in the plastic stream, and preventing cracks, or other faults in the finished product. Extruding with the aid of deaeration is known to have reduced the effect of laminations in difficult cross sectional shapes, but I have found that by employing both deaeration and admixture of powdered coal with clay that the extrusion of the blocks having long and slender webs in the body thereof is very greatly facilitated.

The blocks to which the finely divided coal has been added are dried, and burned in kilns, care being taken to control the temperature of the kilns as by throttling the oxygen supply thereto, particularly when the coal content of the blocks undergoes combustion in the kiln. I have found this can be successfully accomplished by controlling the dampers leading from the kilns, or by banking the kiln fires when the kiln temperature approaches the upper limit of effective burning during the period when the coal content of the blocks is undergoing combustion. The result of burning out the coal from the blocks serves to reduce their weight in substantially the proportion of the proportion of coal to clay in

the original mix, less of course the ash content which remains in the blocks. With the coal which I have successfully used, the ash content may run from about 5% to 8% with the result that in a block according to my invention in which the voided cross sectional area is a little less than 50% of the whole area, and where I have added as much as 40% coal to the original mix of coal and fire clay, I obtain a finished block which weighs from about 40 to 48 pounds per cubic foot, depending on the precise relation of voided area to solid area, the ash content of the coal, and the extent to which the density is increased by reason of the deaeration. The resulting block even with the relatively great addition of coal retains a surprising amount of strength as compared to a pure clay block. I have found, for example, that the addition of up to as much as about 20% coal to the clay appears in some instances to add strength to the finished blocks and apparently does not substantially detract from the strength thereof.

While the practice of deaeration of the plastic stream does, as I have mentioned above, facilitate extrusion of the plastic mix even without the addition of any coal to the original mix, I have found that the addition of as little as of about 3% to 5% of finely divided coal to the finely divided clay, as above described, with or without deaeration, has a very helpful effect in facilitating extrusion, both as to the speed with which the plastic stream may be forced through the die and as to the evenness of texture and freedom from flaws or defects in the finished product.

Whether coal is added to the clay content of the original mix or not, I prefer that in the burning of the ware and near the end of the run (when coal has been added, after the coal content has been substantially consumed in the kiln) that an excess of oxygen be supplied to the ware in the kilns, while the temperature is maintained at substantially the maximum effective burning temperature for the reason that "topping off" the run with an excess of oxygen lightens the color of the ware giving light buff color and approaching a whiteness which I desire. I believe that the light color of the ware, particularly on the surfaces of the webs and shells of the block which lie transversely of the path of flow of heat therethrough, materially adds to the insulating value of the block by the virtue which the light colored surfaces have in reflecting radiant heat, particularly across the voided portions of the block.

It will be seen therefore that the process which I prefer for making the blocks of my invention includes both the deaeration by the plastic stream just prior to extrusion, and also includes the admixture of the finely divided coal with the finely divided clay in the original mix preparatory to the extrusion thereof. By the use of both of these steps in the manufacture of my blocks, I facilitate the extrusion thereof and compensate for the additional density resulting from the deaeration, and, when desired, substantially reduce the density without materially impairing the structural strength of the blocks. Moreover the finished block is of such texture and consistency that its exterior surfaces may easily be ground off smooth as upon an abrasive grinding wheel, and the heat conductivity of the solid portions of the block is reduced in about the same proportion as their density is reduced.

It has been known to be desirable in this art to make insulating refractory blocks of light weight to reduce the heat storage capacity in the furnace walls and to make possible the use of lighter furnaces and lighter furnace structure and generally to reduce the time for heating a furnace, which is particularly advantageous where furnaces are intermittently operated. These advantages are obtained by my blocks, and particularly so when made according to my preferred process.

It will further be understood that the blocks made according to my invention and according to my preferred process of manufacture may be made to have a rather wide range of densities to meet such varying demands as may arise for specific problems of furnace construction and operation, and this variation in density may be accomplished by the varying proportions of coal and clay in the original mix while maintaining the same or substantially the same arrangements of webs and voids in the body of the block without reducing the structural strength or stability to any point dangerously near that of only 25#/sq. ft. which has heretofore been accepted as a desirable standard in this art.

While I have illustrated in the drawing and described three desirable forms of blocks embodying my invention, and have shown in one instance a block with five ¼" voids spaced by parallel ¼" webs, and have shown in the other instances blocks with different numbers of $\frac{3}{16}$" and ¼" parallel voids spaced by ¼" and $\frac{5}{16}$" parallel webs respectively, it will be understood that reasonable deviations from those particular dimensions and relationships may be made without substantial loss of the advantages of my invention, particularly as long as the following factors are kept in mind. I have found it feasible and desirable in some instances to reduce the widths of the voids as, for example, from ¼" or $\frac{3}{16}$" down to ⅛", while maintaining the webs at about ¼" or $\frac{5}{16}$" in thickness, and while this tends to reduce the flow of radiant heat because of the greater number of reflecting surfaces, and tends to reduce the flow of heat by conduction across the voids, by virtue of the increased number of surfaces at which the conduction loss from the gaseous content of the void to the solid content of the web, and vice versa, remains substantially constant, still by so doing the proportion of voided cross sectional area to solid cross sectional area is reduced, and the gross density or weight of the whole block is relatively increased. Where the use to which the block is subjected as, for example, where the furnace temperature is not extremely high, I believe it practicable to compensate for such an increase in gross weight by the admixture of more coal in the mix, thereby increasing the porosity of the solid structure of the block to compensate for the reduction in proportion to the voided area. On the other hand, where a furnace is intended to be used in continuous operation, and where the gross density or weight of the block with its resulting heat content is not of such controlling importance, the reduction in proportion of voided area may not be disadvantageous, and circumstances may well exist where the extra strength resulting from the relative increase in the proportion of solid cross sectional area will be found to be desirable.

It will also be understood that the thicknesses of the webs may be varied somewhat. Where their thickness is reduced a lighter weight block for a given clay or clay and coal mix will result with the accompanying reduction in net cross sectional area of the block, which may be ad-

vantageous, where higher insulation and less relative strength are desirable, up to the point where the webs are reduced in columnar strength, both in handling before burning and under load bearing conditions after having been burned, to the point where the strength of the whole block is jeopardized. In blocks where the webs are long, as in Figure 1, this limitation is perhaps more acute than where the webs are relatively short in vertical dimension as in Figures 3 and 5. For most practical purposes within my present experience, I have found that the dimensions between webs and voids which I have given as preferable are very satisfactory for a wide range of uses.

Those skilled in the art will appreciate that blocks embodying my invention may be used as furnace liners as well as insulating back-ups for solid fire brick lining, and while I am aware that the more arduous conditions of service in some types of furnaces, as for example where molten metal is brought into contact with the inner surface of the furnace walls, that blocks according to the preferred forms of my invention, which I have illustrated herein, might not have the physical strength to resist either the weight of molten metal or its abrasive or eroding effect on the relatively thin exterior walls of the blocks, still it will be understood that my blocks, having the same or substantially the same exterior durability and refractory quality as solid blocks made of the same fire or refractory clay or material, may be subjected to much more arduous service as furnace liners than other blocks of comparable insulating value, which are known today, and which depend upon porosity or other factors which lead to their inherent structural weakness or instability, particularly at high temperature.

Within the range of variation of the contents and design of the blocks which I have particularly referred to herein, it will be appreciated, for example, that a furnace wall may advantageously be built of blocks embodying my invention in which that portion of the wall, which is exposed directly to the furnace heat or contents, may be made from the original clay mix only, and that portion of the wall may be "backed up" with a layer of blocks having a lesser density, as by a relatively high admixture of coal with the original clay mix.

The insulating quality of various blocks embodying the essential characteristics of my invention may be judged at least in part from the results of certain tests which I have observed, in which, for example, a block similar to that shown in Figures 1 and 2, being 6" x 6" x 3" in external over-all dimensions, and having five ¼" voids each about 5¼" as therein shown, and being made from an original mix of about 60% clay to 40% coal made substantially according to my preferred method of manufacture herein described, was found to maintain a static temperature differential such that when one face of the block was maintained at 1900° F. the other face of the block remained at or slightly below 550° F. In a similarly formed block having seven such voids, and being 4¼" in overall thickness, a temperature differential from 1900° F. on one face down to a little less than 500° F. on the other face was maintained after a static condition had been established. In a similarly formed block with nine ¼" voids and with the same proportion of coal and clay content in the original mix in which the over-all thickness of the block was 4½" (one of the outside walls being a little thinner than those herein shown) a static temperature differential was maintained as between 1900° F. on the hot side down to a little less than 350° F. on the cold side. A block of similar shape with the same number of voids, but made with the admixture of only 10% of coal to 90% of clay in the original mix, maintained a temperature differential from about 1900° F. on the hot side down to about 400° on the cold side.

While I have emphasized the utility of blocks embodying my invention, particularly as refractory insulators for relatively high temperature work, I have found that a block similar to that illustrated in Figure 3, having eight rows of $\frac{3}{16}$" voids, being about 4½" in over-all thickness, and being made from a mix including 40 parts of coal to 60 parts of clay, was the equivalent in insulating value to about 2½" of thickness of cork in the temperature ranges at and below about 200° F. A similar block made without the admixture of any coal insulated as effectively as about 2.1" of cork within the same temperature ranges.

The blocks described and referred to herein have the long narrow parallel voids, which with the front and back faces thereof provide from about 3½ to 4½ reflecting surfaces per inch of block thickness all of substantially the same area as the front face of the block and all lying transversely of the flow of heat. Where the voided area is a little less than about half the whole area of the block, as I prefer, the densities can be readily varied from about 40 or less to about 70 pounds per cubic foot while maintaining a structural strength far in excess of that commonly required in this art. Such blocks in thicknesses from about 3 to 4½" maintain temperature gradients from about 300 to 450° F. per inch at about 1900° F. on the hot side and at lower temperatures insulate about half as effectively as cork per inch of thickness, the cost of my blocks being less than cork for the same insulating value.

From the foregoing it will be seen that I have discovered a highly useful and novel insulating brick or insulating refractory and a useful and novel method of making the same, and while I have illustrated and described a limited number of forms of my inventions or improvements which I have found preferable and desirable, modifications and changes will readily occur to those skilled in the art without departing from the teaching of this specification, and I do not care to be limited to the preferred forms of my inventions herein illustrated and described, or in any manner other than by the claims appended hereto when construed with the range of equivalents to which they are entitled in this art.

I claim:

1. An insulating load bearing structural unit comprising a burned clay block having front and back faces adapted to be disposed transversely to the direction of flow of heat, and having a plurality of narrow webs spaced by a plurality of voids formed in said block, all of said voids being parallel to said front and back faces and providing, with the front and back faces of the block, from about three to five surfaces per inch of block thickness substantially equal in area to the front face of the block and lying parallel thereto, said webs being supported only at points disaligned on opposite faces thereof whereby to provide only a tortuous path of solid material from the front to the rear of said block at least in the mid-portion thereof.

2. An insulating block according to claim 1

having a density ranging from about forty to seventy pounds per cubic foot.

3. An insulating block according to claim 1 which in about three to four and one-half inch thicknesses maintains a temperature gradient from about 300° F. to about 450° F. at about 1900° F. on the hot side thereof.

4. An insulating block according to claim 1 having a density of about forty pounds per cubic foot and having load bearing strength per unit of net area of a similar order to that of a solid block made of the same kind of clay.

5. An insulating load bearing structural unit comprising a burned clay block having front and back faces adapted to be disposed transversely to the direction of flow of heat and having a plurality of voids formed therein all of which are parallel to said front and back faces and providing, with the front and back faces of the block, from about three to five surfaces per inch of block thickness substantially equal in area to the front face of the block and lying parallel thereto, said block having its end walls indented at least between certain adjacent voids whereby to avoid a direct path of solid material from front to rear of the blocks in the end walls thereof.

6. An insulating load bearing structural unit comprising a burned clay block having front and back faces adapted to be disposed transversely to the direction of flow of heat and having a plurality of relatively thin wide voids formed therein extending from top to bottom of said block, each of said voids being arranged with its width extending substantially parallel to said front and back faces, and said voids being overlapped with their side edges staggered to provide only tortuous paths of solid material from the front to the rear face of said block, at least in the mid-portion thereof.

7. An insulating load bearing structural unit comprising a burned clay block having front and back faces adapted to be disposed transversely to the direction of flow of heat and having a plurality of relatively thin wide voids formed therein extending from top to bottom of said block, each of said voids being arranged with its width extending substantially parallel to said front and back faces, and said voids being overlapped with their side edges staggered and the end walls of said block being indented between certain adjacent voids to provide only tortuous paths of solid material from the front to the rear face of said block.

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