

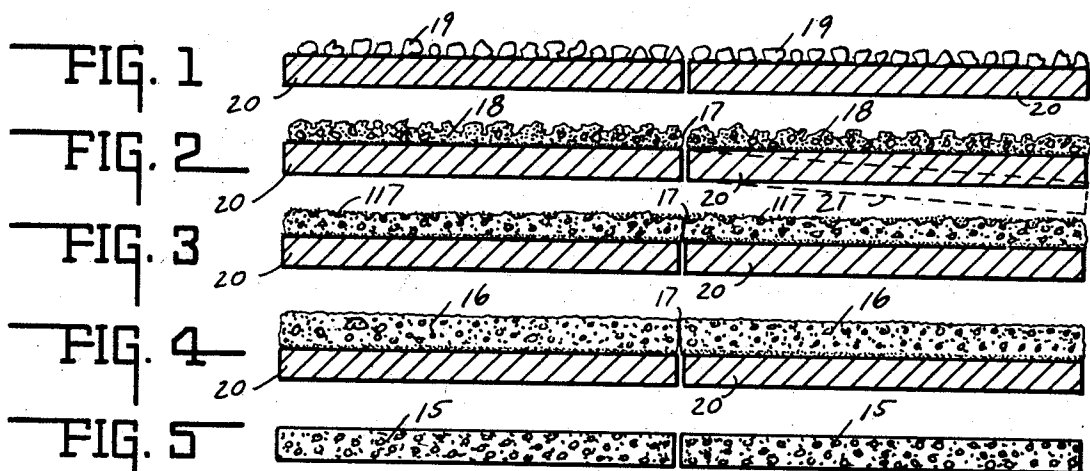
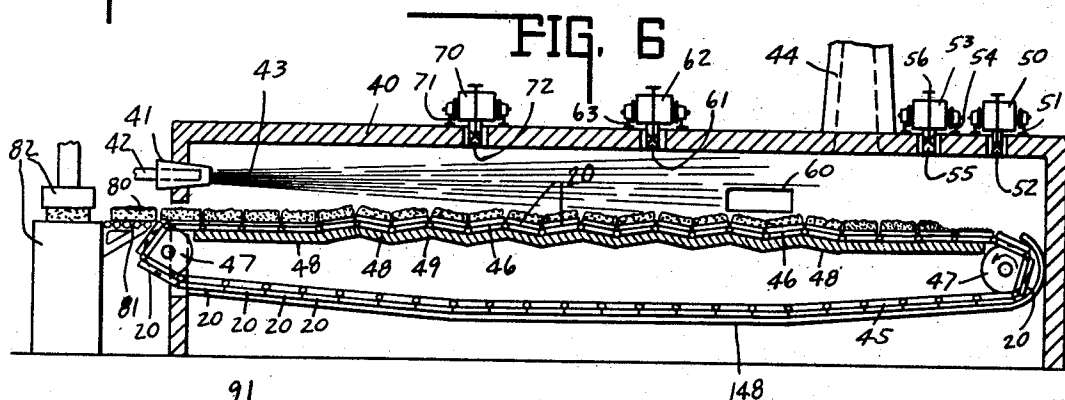
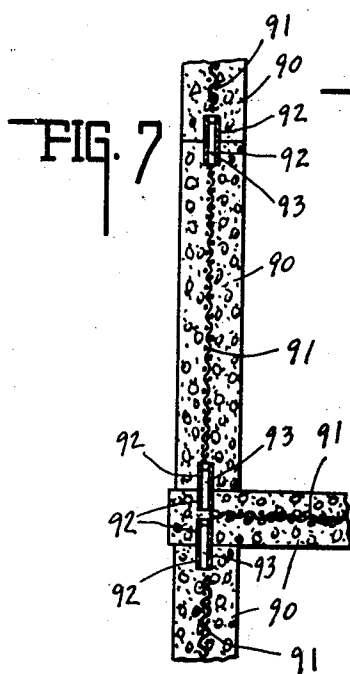
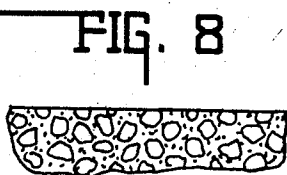
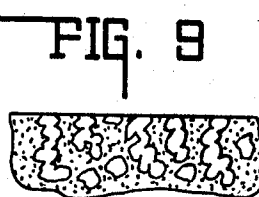
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CERAMIC SLAB FORMING PROCESS AND APPARATUS

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CERAMIC SLAB FORMING PROCESS AND APPARATUS

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12 Claims. (Cl. 25—142)

This invention relates to the manufacture of ceramic slabs of considerable size so that they are suitable for structural purposes.

The chief object of this invention is to produce by expansive burning, a structural unit or slab which has considerable thickness or depth, whereby the unit has sufficient body to resist crushing when incorporated in a structure such as a side wall, which is relatively light, which may have a glazed surface for outside exposure, which has a porous or expanded body for strength and insulation and acoustical properties, and which may be strengthened when and where desired by the addition of suitable reinforcement.

The chief feature of this invention consists in supplying, ordinarily, crushed and sized material capable of expansive burning to a support and subjecting the material to the necessary temperature to secure such so-called expansive burning, then supplying particularly to the low places of the resultant rough and uneven slab finer material in an amount at least sufficient to form when similarly burned a substantially level surface. Since the expansion occurs in a spheroidal manner, and since the finer material subsequently applied to the initial material fails to completely fill all voids therein, a light weight ceramic slab is finally obtained. However, due to the expansive burning the successive layer is not only formed as such, but is likewise simultaneously fusibly secured to the previous layer.

Another feature of the process consists in its ready adaptation to the production of a metallic reinforced slab. This is accomplished by first supplying a layer of material capable of expansive burning, then laying thereon the metallic reinforcement, such as expanded metal, wire fencing, wire mesh or heavy screening, completely covering same to protect it, and with additional material, and then leveling as previously indicated.

Fence wire of No. 12 or 14 gage has been found suitable. When single stage formation is desired, the reinforcement may be coated with clay slip or embedded in a clay core which protects the reinforcement during the burning.

In certain instances, the clay protected reinforcement may be provided with an easily fusible clay slip. This fusible slip will materially increase the bond between the reinforcement and the expansive burnable material. The fusible slip will likewise prevent flaking of the initial slip. This latter is usually partially dried, before the fusible slip is applied thereto, which application may be by dipping or the like.

Another feature of the invention consists in the formation of successive layers of expanded material which may be of like density or different densities. It has been determined that if the material capable of expansive burning is moister than other like material, the moister material will have larger cells therein than the other.

Another feature of the invention consists in the formation of a layer of ceramic material from a plurality of spaced or slightly isolated portions of material, capable of expansive burning, then expanding with heat the particles into bonded contact with adjacent particles to form a single layer of ceramic material.

Whenever the local clay utilized does not have naturally the expansive burning property, there may be added to it a small portion of gas forming material, such as dolomite.

By judicious grading of material, judicious positioning of the same, or both, undue irregularity or roughness of surface in the formation of the slab may be materially reduced or substantially prevented.

Likewise, the completed slab—while hot or warm—may be pressed flat and even by a press or rolls.

When the ware is desired for interior surfacing, such as acoustical work, the reinforcement may be omitted, and preferably the natural surface is dressed off to expose the porous interior. Dressing the slab can be accomplished by a carborundum saw, and the trim if sized properly can be used as aggregate.

The respective slabs may be tongue and grooved for interlocking association when laid up and the edges, when slab is used for acoustical purposes, may be beveled for neatness of appearance.

The slabs may be made in large sizes and then reduced, for example, slabs may be two feet by three feet in area and from two and one-half to four or so inches in depth. These slabs then may be reduced to brick or block size if desired, and by saws or the like. The slab size mentioned is one that lends itself readily to reduction but more especially lends itself to initial production as hereinafter set forth.

When interlocking is desired, each slab may be provided with sockets in the form of embedded pipe, sockets of adjacent slabs registering to receive connecting dowels, as illustrated in Fig. 7. The sockets may be a part of or attached to the reinforcement.

When the slab or portions thereof are to be used for certain types of interiors and in general for all exterior work, glaze forming material is

applied to the upper surface of the slab in its formation. The material itself or the finer particles, or the glaze forming material may include any of the usual ceramic coloring materials, such as oxides.

When laying up the units, the rough edges and the like expose porosities which easily are bonded together by most mortars, although preferably a waterproof mortar should be employed.

For acoustical purposes, the more porous the exposed surface is, the greater the acoustical value. To increase the acoustical effects over the usual surface value, it has been found desirable to modify the surface from a vesicular condition—see Fig. 8—to a reentrant form—see Fig. 9. The vesicular form is more acceptable for use in general insulation and particularly cold storage installation.

To form a certain percentage of reentrant openings in the slab, a preexpanded raw material may be used. This may be made by mixing a mineral yeast (acid and dolomite) with the clay and drying the slurry rapidly in a rotary drier. The aggregate thus formed should be over expanded. That is, most of the bubbles should break, leaving an intercommunicating system of voids—see Fig. 9. This aggregate in nearly-dry condition is further expanded in the reverberatory furnace and built up into expansively burned slabs. When such a material is to be used for acoustical work, the outer glaze should be dressed off to expose the porous interior. If any glaze is used, it must be "spattered" and being careful not to cover more than about 60-70% of the surface, and the 30-40% should provide passage ways for the sound.

The full nature of the invention will be understood from the accompanying drawing and the following description and claims:—

In the drawing, Fig. 1 is a diagrammatic side elevational view of the first step of the process, showing the arrangement provided for sectional formation.

Fig. 2 is a similar view of the same material after having been expansively burned and illustrates the result after the second step of the process has been performed.

Fig. 3 is a similar view illustrating the third step of the process.

Fig. 4 is a similar view showing the fourth step of the process.

Fig. 5 is a sectional view of the slab sections in substantially completed form.

Fig. 6 is a longitudinal sectional view through one form of the reverberatory furnace suitable for performing the process and producing a ceramic slab.

Fig. 7 is a central sectional view through a reinforced and socketed type of ceramic slab, embodying the invention.

Fig. 8 is an enlarged sectional view through a vesicular form of slab.

Fig. 9 is a similar view of a reentrant form of slab.

In Figs. 1 to 5 inclusive, of the drawing, there is illustrated the successive steps of the process hereinbefore set forth in considerable detail.

In Fig. 1, 20 indicates the successive conveyor flights which, during the formation of the slab, are positioned in substantially abutting relation. 19 indicates the particles of material positioned thereon and which, when expansively burned, form the slab 18. The dotted line indicated at 21 shows the oscillatory extent of travel to which the flights are subjected for parting the slabs as

at 17—see Fig. 3—and thereby forming by a substantially continuous process ceramic units. After the initial material 19 has been expansively burned to form the slab, or layer 18, additional finer material 117 is applied thereto in leveled relation and the material again expansively burned to produce the substantially level ceramic slab 16—see Fig. 4.

Following this formation of the substantially level units, there is produced the finally finished product as indicated at 15 in Fig. 5.

In Fig. 6 there is illustrated diagrammatically, a suitable form of apparatus for carrying out the process and producing the product of this invention. In said figure, 40 indicates an upper wall of a reverberatory furnace having an air inlet 41 at one end in which is mounted a flame jet nozzle 42, which may be of the oil or gas or powdered fuel type. The flame 43 therefrom discharges longitudinally into the furnace and the products of combustion pass out at the opposite end through the stack 44. An endless conveyor 45 in the furnace includes a plurality of refractory flights 20 suitably mounted on spaced chain links 46. The chains thereof are associated with sprocket wheels 47 at opposite ends of the elongated horizontal reverberatory furnace. The upper run of the conveyor is supported upon supporting guide rails 48, which, as indicated at 49, are offset so that the conveyor has an up and down movement at the portion of its travel corresponding to the saw-tooth or equivalent arrangement 49 of the supporting rail or track-way 48. This movement is shown exaggerated in Fig. 6 for the sake of clearness. Power is preferably applied to the sprocket wheel 47 at the product inlet end of the furnace so that the conveyor links 46 will actually conform to the offset portions of the track-way 48, so that in the passage of the upper run of the conveyor, each flight will oscillate as shown by the dotted line indicated at 21 in Fig. 2.

There is conventionally illustrated at 50, a reciprocating carriage which reciprocates on the transverse track-ways 51 and said carriage 50 is adapted to discharge sand or the like through the nozzle 52 to the upper surface of the upper run of the conveyor. This sand, or the like, protects the conveyor flights from oxidation and the intense heat of the furnace. It also prevents sticking of the ware to the upper surface of the flights.

A similarly transversely reciprocating carriage is indicated at 53 and is transversely movable on the track-ways 54 and the spout 55 is adapted to discharge large particles of considerable size and suitably graded, if desired, on to the upper surface of the upper run of the conveyor flights and to the desired depth, said spout having a suitable control valve 56 for regulating the amount of discharge. The rate of travel of the conveyor is determined by the rate of burning, which is determined by the character and depth of the material handled. The rate of reciprocation of the carriages 50 and 53 and any other dispensing carriages, as well, are, of course, regulated to that just sufficient to deposit the necessary amount of material and to the desired depth upon the upper run of the conveyor.

After the initial deposition of the material, capable of expansion when burnt, is deposited upon the upper run of the conveyor, the conveyor arrives at the station, indicated by the numeral 60, and at this station a suitable reinforcement may be inserted in the opening 60 through the side

wall of the furnace and positioned upon the expansively burned material prior to its burning, or just as it is beginning to burn, and then the reinforced ware immediately thereafter passes beneath another outlet 61 communicating with carriage 62, transversely movable on tracks 63, whereby additional material is supplied to the upper surface of the slab, or material, thus theretofore deposited. This material thereupon is burned and the slag is formed with the reinforcement therein.

When no reinforcement is to be inserted, the opening 60 is held closed at all times. Carriages 53 and 62 may also be adapted to discharge respectively coarse and fine particles capable of expansive burning, e.g. Agitation, or rather oscillation, of the flights beneath the discharge outlet 61 also will cause the finer material to settle automatically in the lower portions of the upper surface of the slab previously formed and thus automatic leveling of the second layer of material is obtained so that upon subsequent burning, the slab surface is leveled.

There is illustrated a carriage 70 transversely movable upon track 71 and having a spout 72. This carriage is adapted to supply to the slab theretofore formed, a surface or coating material for applying a colored or uncolored glaze or merely a color coating.

In certain forms of the invention, the material supplied by one or more of the carriages, forms a vesicular structure when burned and one or more of the other carriages may supply material which is capable of reentrant formation when burned. The amount supplied by each carriage, of course, may be regulated by controlling the discharge therefrom. The means for replenishing the supply in the carriage is not illustrated, since such apparatus may be of many different characters.

After the ware has been expansively burned and formed in separated unit formation upon the upper run of the conveyor, one slab to each flight, the conveyor discharges the slab, which is herein indicated by the numeral 80, and to a suitable transfer mechanism 81 in the form of supporting rolls, or the like, and the same discharges the slab to a suitable pressing or forming means 82, the aforesaid being merely a conventional illustration of this station in the operation that occurs there.

In Fig. 7 of the drawing there is illustrated reinforced interlocking ware and herein 90 indicates the slab, 91 the reinforcement and mounted in the slab and suitably secured to the reinforcement is a pipe portion 92 forming a socket. Sockets in adjacent members 90 register with each other and a dowel 93 may be mounted in one socket and thus receivable by the other socket for anchoring the two adjacent slabs together.

The physical finishing of the surface of the slabs formed, as hereinbefore specified, may be by any one of the methods as set forth more specifically in the first portion of the description.

The invention claimed is:—

1. The process of forming a light weight ceramic slab comprising supplying material capable of expansive burning to a supporting surface, expansively burning same, supplying additional material to the lower portions of the upper uneven surface thereof, and expansively burning same to even up the upper surface of the resultant slab.

2. The process of forming a light weight ceramic slab of appreciable depth comprising sup-

plying to a supporting surface large particles of material capable of expansively burning, then burning same, then applying smaller particles of similar material to the lower portions of the upper surface of the heat expanded material, and then burning said smaller particles to even up the upper surface of the slab.

3. The process of forming a reinforced light weight ceramic slab comprising coating with a protective clay slip metallic reinforcement, associating the same with material capable of expansive burning in the desired relation, and then burning the material for forming the reinforced ceramic slab with the reinforcement included therein.

4. The process of forming a light-weight ceramic slab having high acoustical and insulating properties comprising supplying to a supporting surface material capable of expansive burning and other material having reentrant porosity when burned, burning said materials to form a slab and removing a surface layer to expose the resulting porous interior as a porous surface.

5. The process of forming a light weight ceramic slab having high acoustical and insulating properties comprising supplying to a supporting surface particles of material capable of expansive burning and when burned forming a vesicular construction, burning same, then applying thereto similar material but capable when burned of forming a reentrant construction, burning same, and then forming the outer surface by removal of all or the major portions of exposed surface area of the upper surface for exposing the reentrant formation for acoustical purposes.

6. A furnace of the character described, including in combination an endless articulated conveyor having a plurality of substantially abutting plates for supporting expansively burning material thereon, means for supplying material to the upper run and surface of said plates, means for causing the burning in the furnace, and means associated with the upper run of said conveyor for causing each plate during the burning to tilt relative to the next adjacent plate.

7. The process of forming a light ceramic slab having acoustical and heat insulating properties comprising forming a vesicular ceramic mass with an included aggregate having reentrant cavities, and then dressing one surface of the slab to expose the cavities.

8. A process for forming an expanded slab having insulating and acoustical properties comprising supplying to a supporting surface material capable of expansive burning and other material having reentrant porosity when burned, burning said material to form a slab and dressing to desired size and shape.

9. A process for forming insulating and acoustical slabs comprising cementing by fusion a combination of expanded aggregate having reentrant cavities and other material capable of expansive burning, the cementing occurring during aggregate travel accompanied by a separation into units during the travel.

10. Apparatus for forming expanded slabs including in combination a heating compartment, relatively rigid abutting conveyor elements adapted to pass through a heating compartment, and feeding means adapted to deposit raw material onto said elements while in the heating compartment, the motion of said elements being governed to secure a separation of material on each element from that on adjacent elements.

11. A process for forming an expanded slab having insulating and acoustical properties comprising cementing by fusion a combination of material which is capable of expansive burning and material which has been expanded in wet plastic condition. 80
12. A process for forming an expanded slab having insulating and acoustical properties comprising combining two materials, one capable of expansive burning and the other which has been expanded in a wet plastic condition embedding therein a metal reinforcement and then cementing the materials, and the reinforcement together into slab formation by fusion of the more fusible material. 85

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