Sept. 26, 1967 M. GOOZNER 3,344,011

TERRAZZO TILE

Filed Nov. 2, 1964

Fig. 1.

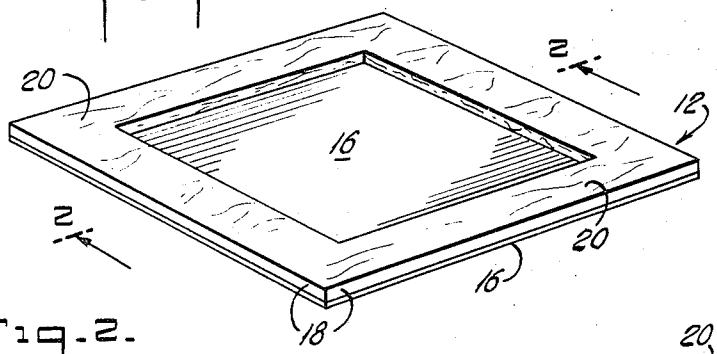


Fig. 2.

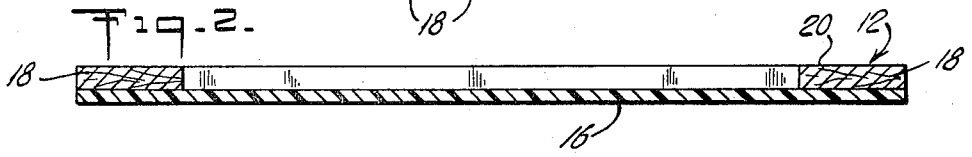


Fig. 3.

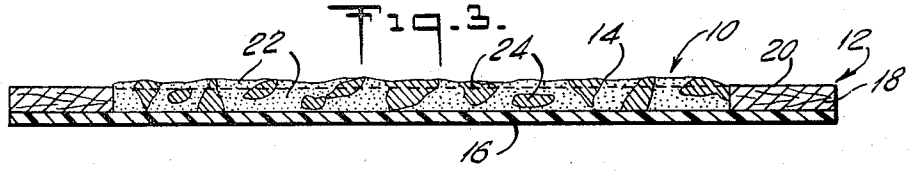


Fig. 4.

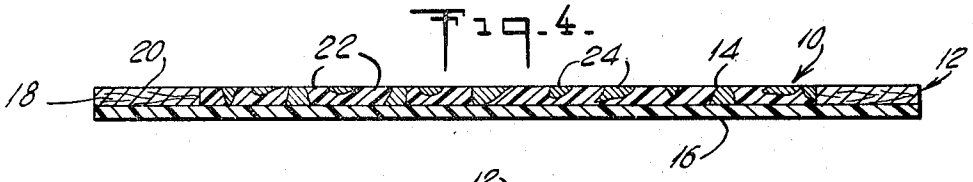


Fig. 5.

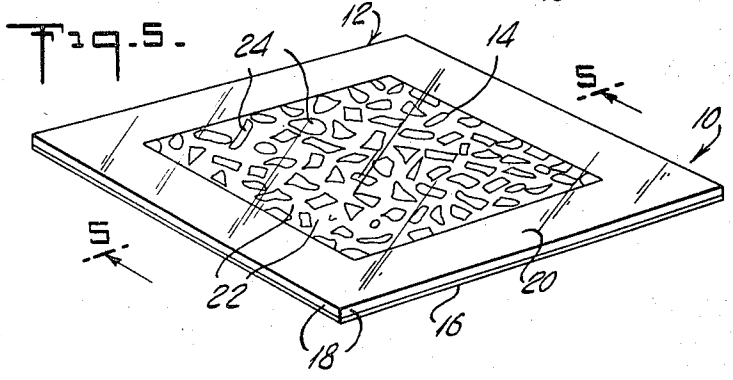
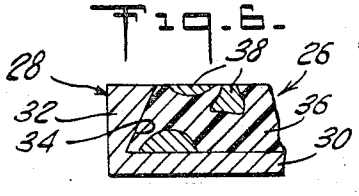


Fig. 6.



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United States Patent Office 3,344,011 Patented Sept. 26, 1967

3,344,011

TERRAZZO TILE

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Filed Nov. 2, 1964, Ser. No. 408,259
8 Claims. (Cl. 161—44)

The present invention relates generally to improvements in facing material and it relates particularly to an ornamental terrazzo-like tile having a synthetic resin matrix and an improved method of producing the same.

As is well known, terrazzo floors have for many years been made by spreading a mixture of concrete containing marble chip aggregate over the surface to be covered, allowing the concrete to harden in situ, and then grinding the protruding portions of the aggregate down to the level of the hardened concrete and then grinding further to produce a smooth surface. Such floors are very costly to produce, are obviously not suitable for economic mass production, and are exceedingly heavy, necessitating increased costs for structural supports, particularly for upper floors. Recent attempts to substitute synthetic resin for the concrete obviously fall short of constituting a complete solution of the aforementioned problems, and further raise other problems such as the defective installations resulting from the existence of bubbles, voids or air holes below or in the floor surfaces.

It is, therefore, a principal object of the present invention to provide an improved terrazzo simulating tile and a method of producing the same.

Another object of the present invention is to provide an improved terrazzo simulating tile having a synthetic organic polymer matrix.

Still another object of the present invention is to provide a terrazzo simulating tile of a unique and highly ornamental and attractive appearance.

A further object of the present invention is to provide an improved ornamental terrazzo simulating tile which may be easily and rapidly installed.

Still a further object of the present invention is to provide an improved tile of the above nature characterized by its versatility, adaptability and low cost.

The above and other objects of the present invention will become apparent from a reading of the following description taken in conjunction with the accompanying drawing, wherein;

FIGURE 1 is a top perspective view of a shell section of a tile in accordance with the present invention;

FIGURE 2 is a sectional view taken along line 2—2 in FIGURE 1;

FIGURE 3 is a view similar to FIGURE 2 with the shell cavity filled with the terrazzo forming mass;

FIGURE 4 is a top perspective view of the finished tile;

FIGURE 5 is a sectional view taken along line 5—5 in FIGURE 4; and

FIGURE 6 is an enlarged detailed transverse sectional view of another embodiment of the present invention.

In a sense the present invention contemplates the provision of an ornamental tile comprising a shallow open-topped shell member including a bottom wall and an upwardly directed peripheral wall, a matrix of a solid synthetic organic polymer disposed in an substantially filling said shell and adhering to the walls thereof and having an upper face, and an aggregate material distributed throughout said matrix and exposed at said matrix upper face. The terrazzo tiles so provided have been found to be extremely durable, strong, light in weight, dimensionally stable, resistant to acid, alkali, solvents, fats and oils, steam, microorganisms, etc. economical to manufacture and install, non-porous, resilient, flexible, and having a highly ornamental surface and which may assume various shapes, configurations and appearances.

Referring now to the drawings and particularly FIGURES 1 to 5 thereof which illustrate a preferred embodiment of the present invention, the reference numeral **10** generally designates the improved tile member which comprises a shallow open-topped shell member **12** and a terrazzo simulating filler **14** adherent to the walls thereof. While the tile member **10** may be of any desired configuration it is advantageously square and may have dimensions which are conventionally employed in floor tile, for example 9" x 9", 12" x 12", 24" x 24", and of any desired height, for example about ⅛" to ½ inch or more. The shell member **12** comprises a flat bottom wall **16** and a peripheral wall **18** which may be integrally formed with the bottom wall **16** or may be separate and cemented or otherwise adhered thereto. The upper face **20** of the peripheral wall **18** is exposed when the tile is used and the wall **18** may thus be formed of any attractive material and the face **20** may be suitably decorated. A highly attractive tile may be produced by forming the wall **18** of flat wooden strips having abutting bevelled end edges, the width of the wooden strips depending on the desired appearance. The wall **16** may be formed of any suitable preferably flexible material and may be a thermoplastic resin or an elastomeric material.

The filler or core member **14** includes a matrix **22** formed of synthetic organic polymeric resin, advantageously an epoxy resin, as will be hereinafter set forth, and a relatively coarse aggregate **24** distributed therethrough, particularly adjacent the upper surface of the core member **22** and may also include a relatively fine aggregate concentrated primarily at the lower section of the core member **14**. The coarse aggregate **24** is advantageously marble chips having flat exposed upper faces substantially coplanar with the upper face of the matrix **14** and the peripheral wall upper face **20**. It is important to note that the inner face of the shell **12** adherent to the matrix **14** and forms a unit therewith and the shell **12** and the matrix **14** are formed of materials wherein the matrix, particularly the alkyd resins which when set or polymerized in the shell **12**, firmly adheres to the inner face of the shell **12**. The walls **16** and **18** of the shell **10** may be formed of wood, metal, synthetic organic resins, for example polyvinyl chloride, saran, polyethylene, polypropylene, polystyrene, preferably of the high impact type, nylon, polyesters, etc. The inner faces of the shell wall should be clean of any material which would function as a parting agent such as oils, greases, soft waxes and the like.

The epoxy resins employed as the matrix herein are well-known in the art and no claim is made thereto per se except in combination with the other materials and procedures here disclosed and claimed for the production of a novel terrazzo tile. In general, these epoxy resins may be described as complex polymeric reaction products of the reaction of a mole of a polyhydric phenol with one to two or more moles of a polyfunctional halohydrin in the presence of an amount of an alkaline material at least sufficient, and usually up to 30% in excess, to combine with or neutralize the halide liberated from the halohydrin. Such products contain terminal epoxy groups and, in some instances, lower amounts of terminal hydroxy groups. The term "epoxy group" refers to a triatomic heterocycle composed of one oxygen atom and two saturated carbon atoms. These epoxy resins operative herein, their compositions and methods for their production are disclosed in numerous prior publications including for example U.S. Patents Nos. 2,585,115, 2,602,785, etc. The most typical and preferred epoxy resin is produced by

the reaction of 2,2-bis(4-hydroxyphenyl)propane, commonly known as bis-phenol, with epichlorhydrin in the presence of an alkali such as caustic soda.

Instead of or in addition to bis-phenol, other polyhydric phenols may be employed, particularly dihydric mononuclear phenols such as resorcinol, catechol, hydroquinone, etc., and polynuclear phenols such as 4,4'-dihydroxybenzophenone, 1,1 - bis(4 - hydroxyphenyl)ethane, 1,1-bil(4 - hydroxyphenyl)isobutane, 2,2 - bis(4 - hydroxyphenyl)butane, 2,2 - bis(4 - hydroxy - 2 - methylphenyl) propane, 2,2 - bis(4 - hydroxynaphthyl)methane, 1,5 - dihydroxynaphthalene, etc. Instead of or in addition to epichlorhydrin, there may be employed epibromhydrin, epiiodohydrin, beta - methyl epichlorhydrin, gamma - methyl epichlorhydrin, glycerol dichlorhydrin, etc.

These epoxy resins are marketed by a number of different companies under such trademarks as ERL, Epi-Rez, Hysol, Epon, Araldite, Bakelite, etc., and are available in a number of grades, viscosities, and other variable properties depending upon the particular end use. For use in the present invention, the epoxy resin should be sufficiently fluid to fill and level off in the shell with a minimum of bubble entrapment, while yet being sufficiently viscous to prevent settlings of the aggregate to the bottom of the shell prior to hardening of the resin. The viscosity may range, for example, from that of a syrup to that of a thick paint or pourable wet concrete mix, depending upon the size and amount of aggregate and the speed of hardening, it being necessary that at least some of the marble chips aggregate protrude above the surface level of the hardened resin matrix for the attainment of the desired effect. Any necessary thinning of fluidization may be accomplished in known manner by addition to the epoxy resin composition of a fluidizing amount of a normally liquid mono-epoxy reactive diluent or a cyano-substituted hydrocarbon. As examples of such mono-epoxy diluents, there may be mentioned as preferred those which boil above 100 °C. and are therefore substantially non-volatile, such as the monoglycidyl ethers including methyl, ethyl, butyl, isopropyl, allyl, crotyl, isoamyl, phenyl, o-tolyl, p-tolyl, thymyl, and naphthyl glycidyl ethers, or the less preferred propylene oxide, isobutylene oxide, butadiene monoxide, 1,2-pentylene oxide, octylene oxide, styrene oxide, glycidol, decylene oxide and the like. Preferred cyano-substituted hydrocarbons art those containing 2 to 8 carbon atoms and normally liquid, particularly acetonitrile and methyl cyanide. It will be understood that as employed herein, the term "epoxy resin" is inclusive of the resin composition with or without such fluidizing additives, and that the term "liquid epoxy resin" refers to a resin having the required viscosity characteristics described above which can be achieved in known manner by workers skilled in the art.

The marble chip aggregate employed in the present invention may have any desired particle configuration and size, usually ranging for example from ⅛" to 1" in diameter or thickness and being of irregular shapes. Similarly, this aggregate may be used in any desired proportions in the resin, as for example from about 0.2 to 10 parts per part of epoxy resin. The size distribution and the proportion of aggregate will of course depend upon the effects desired, the size and thickness of the tile, etc. Generally, higher proportions are more economical in view of the relatively high cost of the epoxy resin.

In producing the tiles of the present invention, a hardening agent (otherwise referred to as a curing agent, cross-linking agent, or catalyst) must be mixed with the epoxy resin and marble chip aggregate to effect hardening of the resin in the shell. A great variety of such hardening agents are known, such as alkalies like sodium or potassium hydroxide; alkali phenoxides like sodium phenoxides; carboxylic acids or anhydrides such as formic acid, oxalic acid or phthalic anhydride; Friedel-Crafts metal halides like aluminum chloride, zinc chloride, ferric chloride or boron trifluoride as well as complexes thereof with ethers, acid anhydrides, ketones, diazonium salts, etc.; phosphoric acid and partial esters thereof including n-butyl orthophosphate, diethyl orthophosphate and hexaethyl tetraphosphate; and, preferably, amino compounds such as triethyl amine, ethylene diamine, diethyl amine, di-n-butylamine, diethylene triamine, triethylene tetramine, pyridine, piperidine, dicyandiamide, melamine, and the like. The amounts vary with the particular agent. For the alkalies or phenoxides, 2% to 4% is suitable. With phosphoric acid and esters thereof, good results are obtained with 1% to 10% added. The amino compounds are used in amounts of about 5% to 15%, and the others involve addition of about 1% to 20%.

Since flexibility, resilience and toughness are desired, and brittleness or extreme hardness is a disadvantage in handling, installation and use, particularly for floor tiles, the epoxy resin should be selected for such desired properties, being available by reason of proper control of the proportions of reactants, reaction conditions, inclusion of known plasticizers, etc. Such desirable properties can additionally be achieved by use of a hardening agent which also yields these desirable properties. As such hardening agents with plural functions, there may be mentioned the polymeric polyamide reaction products of polymeric fat acids containing at least 2 carboxyl groups with an aliphatic polyamine such as ethylene diamine or diethylene triamine, as discussed in U.S. Patent Nos. 2,450,940 and 2,705,223, and available on the market as, for example, Versamid 125, etc. Alternatively or in addition, epoxidized cashew nut oil (available as Cardolite NC513–3MCo) may be employed as a component of the epoxy resin, functioning both as a plasticizer and as a fluidizer or viscosity reducer.

The method for producing the novel tiles of the present invention involves filling a shell **12** with liquid epoxy resin containing epoxy hardener and marble chip aggregate protruding above the surface of said liquid, allowing the epoxy resin to harden, and then grinding the protruding portions of the marble chip aggregate down to the level of the hardened epoxy resin. The shell may have any desired size and shape, as aforesaid, depending upon the product desired. Prior to filling, it is important that the inner surfaces of the shell should be clean of any parting agents. The epoxy resin, hardening agent therefor, and marble chip aggregate are simply mixed in conventional equipment such as a screw type mixer, and deposited in the shell **12** in an amount so that the resin is at substantially the level of the shell upper edge. As previously explained, the resin mix must have the proper viscosity to minimize entrapment of bubbles, without permitting settling of suspended aggregate to the bottom of the shell. The viscosity is of course not so important when sufficient particles of aggregate are large enough to rest on the bottom of the shell and protrude above the surface level of the resin. Conversely, if relatively small size aggregate is used, the viscosity of the resin mix must be high enough, or the rate of hardening increased enough as by increasing the amount of hardening agent, or both, to maintain the desired proportion of aggregate protruding above the resin level during hardening, which may not be completed for ½ to 4 or more hours.

As a further feature of the invention, the mixture in the mold is subjected to a de-aerating treatment to eliminate or minimize entrapment of voids or bubbles therein. Preferably, this is accomplished by mechanical vibration, as by vibrating the resin filled shell on a vibrating table for 10–15 minutes following the shell-filling operation. Other de-aerating means may be applied simultaneously, consecutively, or alternatively, such as vacuum, heat, and/or ultrasonic vibrations, etc. A low porosity tile is thus obtained with increased strength and diminished tendencies toward failure in use.

After the resin has hardened sufficiently to bond firmly with the aggregate and the shell, conventional grinding means are employed to grind the protruding portions of

the aggregate down to the surface level of the hardened resin. Little or no resin need be ground to yield a highly pleasing and effective smooth, polished terrazzo surface. Any surface bubbles remaining can be broken by application of a spray of low boiling volatile solvent such as acetone or methyl ethyl ketone, or by ultrasonic vibrations or the like.

The foregoing method results in a tile which usually has some small holes or voids in the bottom surface facing the mold bottom. When a less porous tile is desired, the following method may be employed.

A resin-rich mixture of epoxy resin, hardener, and fine particle size aggregate is first deposited into the shell. This fine size aggregate is preferably sand, although marble dust, silica, barytes, mica, silicates, calcium sulfate, alumina, emery, corundum, diatomaceous earth, burned clays, ground slag, etc. may be employed. The shell is then vibrated for 5 to 10 minutes to settle this fine size aggregate to and adjacent the shell bottom, after which the desired amount of marble chip aggregate is sprinkled or spread over the surface of the partially hardened epoxy resin in the shell and the shell again vibrated for about 5 to 10 minutes. This second vibrating treatment serves to embed the marble chip aggregate in the upper portion of the tile with many of the particles protruding above the surface level of the resin. After the resin has hardened sufficiently, a grinding treatment and, if necessary, treatment of the surface to break air bubbles is applied as described above. This method yields a tile of lower porosity and with little or no entrapment of bubbles or voids as compared with tiles produced by the previously described method due to the dual vibrating treatment and the use of the fine particle size aggregate for filling the voids adjacent the lower surface of the tile. In this method, since most of the marble chip aggregate is concentrated in the upper portion of the tile where maximum use is made of its ornamental and wear-resisting properties, lower proportions of such aggregate can be employed, as for example about 25 to 75% of the amounts used in the previously described method. The fine particle size aggregate can be employed in even lower proportions ranging for example from about 0.1 to 0.5 parts per part of epoxy resin.

As a further feature of this invention, it has been found that even further improvements can be obtained with respect to appearance, anti-skid and wear-resisting properties by including in the tile a predetermined amount of hardened phenolic resin aggregate, the particles of which are irregularly shaped and of a size similar to the marble chip aggregate, or smaller if so desired. Any desired amount of hardened phenolic resin aggregate may be employed although the desired effect can generally be obtained by substitution of about 10 to 50% of the marble chip aggregate otherwise used, with the hardened phenolic resin aggregate.

The hardened phenolic resin aggregate is conveniently and economically obtained as a by-product of the phenolic plastics industry wherein a great variety of objects are made by molding phenol-formaldehyde resin compositions (usually containing a small amount of catalyst and larger proportions of inert filler material) in any desired size and shape configuration to a fully cured, hardened condition with or without application of heat. A great deal of scrap is produced during the molding operation, mainly constituted by the excess resin squeezed out of the molds and known as flashing. Similar amounts of scrap are obtained from broken pieces, rejects, off grade lots, and faulty castings. All this scrap presently poses a disposal problem which is at least partially solved by the use made of such scrap in the production of the terrazzo tiles of the present invention. This freely available scrap is readily adapted for use herein by simply reducing the size of the scrap particles, as by free roller crushing and screening, to approximately the size of the marble chip aggregate or smaller. The resulting particles of hardened phenolic resin are similar to the marble chip aggregate in being irregularly shaped, angular grid particles, and are employed herein by simply adding them together with the marble chip aggregate in the methods described above for producing the tiles of the present invention. As with the marble chip aggregate, portions of hardened phenolic resin aggregate remain protruding above the surface level of the hardened resin matrix in the shell and are ground down to such level together with the marble chip aggregate as described. The resulting surface presents a field of hardened epoxy resin, usually white, ivory or egg-shell in color, interrupted by irregularly shaped insets of marble, of varying color depending upon the source of the marble chips, and of hardened phenolic resin, usually black though of any color depending upon the color of the objects from which the scrap was obtained. It will be understood that the epoxy resin may be colored by addition of any suitable pigment or dye.

The following examples are only illustrative of certain embodiments of this invention and are not to be regarded as limitative. All parts and proportions referred to herein and in the appended claims are by weight unless otherwise indicated.

Example 1

100 parts of liquid epoxy resin containing the reaction product of bis-phenol and epichlorhydrin, 10 parts of diethylene triamine hardener, 40 parts of hardened phenolic resin aggregate ranging from about ⅛ to ½" in size, and 60 parts of marble chip aggregate of similar size is mixed in a screw type mixer and deposited into a 9" x 9" shell, the interior cavity of which has a depth of 3/16". The filled shell is vibrated on a vibrating table for about 10 minutes, and the resin then allowed to harden for a few hours, after which the protruding portions of hardened phenolic resin and marble chip aggregate are ground down and the surface of the tile polished smooth.

Example 2

100 parts of liquid epoxy resin as in Example 1, 15 parts of Versamid 125 polyamide of flexibilizer-hardener, and 20 parts of building sand is mixed in a screw type mixer and deposited into a 12" x 12" shell having clean faces and a depth of ¼". The filled shell is vibrated on a vibrating table for about 5 minutes after which a mixture of 20 parts of hardened phenolic resin aggregate and 30 parts of marble chip aggregate sized as in Example 1 is spread over the surface of the resin. The shell is again vibrated on a vibrating table for about 10 minutes, the surface of the tile sprayed with acetone, and the resin then allowed to harden. The protruding portions of hardened phenolic resin and marble chip aggregate are then ground down and the tile surface polished smooth.

For certain applications, it has been found useful to eliminate the marble chip aggregate entirely and utilize only phenolic resin as the aggregate, since marble chips, which are essentially limestone, are easily attacked by inorganic acids, the production of a terrazzo-like tile composition including a hardened epoxy resin matrix and an aggregate of phenolic resin chips.

By employing a 100% phenolic chip aggregate, there is obtained a terrazzo-like tile which is completely resistant to inorganic acids. Such tile is useful in electroplating plants, breweries, dairies or like places where strong acetic conditions are encountered on floors or walls. Similarly, in laundries, soap manufacturing plants, or other areas where strong alkaline conditions prevail. The use of tiles containing the 100% phenolic chip aggregate would be more desirable than tiles containing a mixture of marble chip and phenolic resin chip aggregate.

In FIGURE 6 of the drawing there is illustrated another embodiment of the present invention, differing from that first described only in the construction of the shell member. The tile member is designated as **26** and includes an open topped shell member **28** which may be of any desired configuration and size and of any suitable

material as above set forth and includes integrally formed base wall **30** and an upstanding peripheral wall **32**. The inner face **34** of the wall **32** is downwardly outwardly inclined to provide an undercut. The shell cavity is filled with a core comprising a synthetic organic polymer resin matrix **36**, advantageously an epoxy resin, having an aggregate **38** distributed therethrough. The upper faces of the matrix **36**, aggregate **38** and peripheral wall **32** are preferably substantially coplanar and the peripheral border of the core **32** mates the undercut inner face of the peripheral wall **32** to thereby effect the interlocking of the core and shell. The tile **26** may be produced in the manner of the tile **10**.

While there have been described and illustrated preferred embodiments of the present invention, it is apparent that numerous alterations, omissions and additions may be made without departing from the spirit thereof.

What is claimed is:

1. An ornamental tile comprising a shallow open topped shell member including a bottom wall and an upwardly directed peripheral wall, a matrix of a solid synthetic organic polymer disposed in and substantially filling said shell and adhering to the walls thereof and having an upper face, and an aggregate material distributed throughout said matrix and exposed at said matrix upper face, said peripheral wall having a width at least several times greater than the height thereof and being made of a material contrasting with said matrix and said aggregate to provide a composite tile having an ornamental upper surface constituting a central body bordered by a wide, contrasting frame.

2. An ornamental tile comprising a shallow open topped shell member including a bottom wall and an upwardly directed peripheral wall, a solid epoxy resin matrix disposed in and substantially filling said shell and adhering to the walls thereof and having a substantially planar upper face, and an aggregate material distributed throughout said matrix and having exposed upper faces substantially coplanar with the upper face of said matrix, said peripheral wall having an upper surface substantially wider than the height thereof and being made of a material contrasting with said matrix and said aggregate, the upper surface of said peripheral wall being substantially coplanar with the upper face of said matrix to provide a unitary tile having an ornamental upper surface constituting a terrazzo-like body bordered by a wide, contrasting frame.

3. The ornamental tile of claim **2** wherein said peripheral wall is made of wood.

4. The ornamental tile of claim **2** wherein said aggregate comprises granules of a solid phenolic resin.

5. An ornamental tile comprising a rectangular shallow open topped shell member having a rectangular bottom wall and a shallow upstanding peripheral wall, a solid epoxy resin matrix filling said shell and adherent to the walls thereof and having a flat upper face substantially coplanar with the upper edge of said peripheral wall, and an aggregate distributed throughout said matrix and having flat upper faces substantially coplanar with the upper face of said matrix, said peripheral wall formed of wooden strips of greater width than height.

6. The ornamental tile of claim **5** wherein the inner face of said peripheral wall is inclined downwardly and outwardly, providing an undercut mating with the margin of said matrix to lock the latter to said shell.

7. The improved method of producing an ornamental tile comprising the steps of providing a shallow shell having a central cavity bordered by a rectangular peripheral wall of substantially greater width than height and having a wide flat upper surface and resin adherent inner faces, filling the central cavity of said shell with a liquid epoxy resin containing an epoxy hardener and an aggregate protruding above the surface of said liquid, allowing the epoxy resin to harden and adhere to the walls of said shell and then grinding the protruding portions of the aggregate and the upper surface of the hardened epoxy resin, down to the level of the upper surface of said peripheral wall, to provide a unitary tile having a flat ornamental upper surface constituting a central body bordered by a wide frame.

8. The improved method of producing an ornamental tile comprising the steps of providing a shallow shell having a central cavity bordered by a rectangular peripheral wall of substantially greater width than height and having a wide flat upper surface and resin adherent inner faces, filling the central cavity of said shell with a liquid epoxy resin containing an epoxy hardener and an aggregate of relatively small particle size, vibrating said shell to settle said aggregate adjacent to the lower surface of the shell, spreading marble chips aggregate of relatively larger particle size in the surface of said liquid, again vibrating the shell to embed said marble chip aggregate partially and completely in the surface of said liquid, allowing the epoxy resin to harden and adhere to the walls of the shell, and then grinding the protruding portion of the marble chip aggregate and the upper surface of the hardened epoxy resin down to the level of the upper surface of said peripheral wall, to provide a unitary tile having a flat ornamental upper surface constituting a central body bordered by a wide frame.

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