(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 414 149 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **90115808.9**

(22) Date of filing: **17.08.90**

(51) Int. Cl.5: **B28B 23/00**, B44C 1/26, B28B 3/00

(30) Priority: **19.08.89 JP 213919/89**

(43) Date of publication of application: **27.02.91 Bulletin 91/09**

(84) Designated Contracting States: **DE ES FR GB IT**

(71) Applicant: **INAX CORPORATION**
6 Koiehonmachi 3-chome
Tokoname-Shi Aichi(JP)

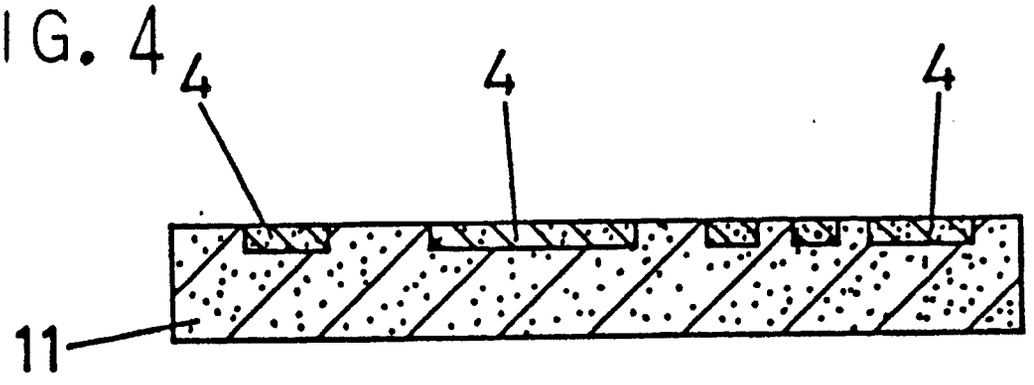
(72) Inventor: **Morishita, Mitsuo**
c/o Inax Corporation, No. 6, Koiehonmachi 3-chome
Tokoname-shi, Aichi(JP)
Inventor: **Kamiya, Shogo**
c/o Inax Corporation, No. 6, Koiehonmachi 3-chome
Tokoname-shi, Aichi(JP)

(74) Representative: **Vossius & Partner**
Siebertstrasse 4 P.O. Box 86 07 67
D-8000 München 86(DE)

(54) Pattern-inlaid ceramic tile and method for production thereof.

(57) A method for producing a pattern-inlaid ceramic tile 11 with less manual operation and with reproducible fine precise pattterns. The method comprises the steps of preparing an inlaying pattern sheet 12 by depositing a paste mixture 3 of a colored sintering powder on a substrate sheet 1, press-molding a tile body material 8 and the Inlaying pattern 4 into a pattern-embedded tile body 10, and firing the green embedded body 10 to a sintering temperature. A multicolored inlaying pattern sheet 12 is prepared by depositing two or more different-color paste mixtures 3 in turn on the substrate sheet 1. A pattern-inlaid tile 11 having natural stone tones can be obtained by using a substantially homogeneous mixture of two or more kinds of different-color particles for the tile body material.

FIG. 4



EP 0 414 149 A2

PATTERN-INLAID CERAMIC TILE AND METHOD FOR PRODUCTION THEREOF

This invention relates to a method for producing a pattern-inlaid ceramic tile and to the resulting pattern-inlaid tile. The inlaid tile can maintain the inlaid pattern semi-permanently even when the tile surfaces are worn out, and is useful for decorative tiles such as floor tile and wall tile.

Such a pattern-inlaid tile has been conventionally produced with handwork, for example, by (a) press-molding a colored tile body material at a lower pressure into small pieces for inlaying, (b) placing a tile body material in a press mold and then the colored pieces thereon in a desired pattern with manual operation, and press-molding them at a higher pressure into a pattern-embedded green tile body, and (c) firing the green body. Such a conventional method needs several pressmolds for desired inlaying patterns, and manual operation for arranging the pattern on the tile body material.

Moreover, it is difficult to produce fine precise patterns and also to reproduce the same inlaying patterns.

The main object of the present invention is to provide a method for producing a pattern-inlaid ceramic tile with less manual operation and with reproducible fine precise patterns.

Other objects and features of the invention will become clear in the following description.

According to the present invention, there is provided a method for producing a pattern-inlaid ceramic tile, which comprises the steps of:

preparing a paste mixture consisting essentially of a sintering inorganic powder, a pigment, a binder and a solvent, and depositing the paste mixture onto a substrate sheet in a predetermined pattern and drying the deposited mixture to form an inlaying pattern sheet;

placing in a mold the inlaying sheet and a body material for ceramic tile in such a fashion that the inlaying pattern contacts the body material, and press-molding them into a green tile body having the inlaying pattern embedded on the surface of the tile body; and then

firing the resulting green embedded body to a sintering temperature.

The pattern-inlaid tile having natural stone tones can be obtained by combining the inlaying pattern with a tile body having colored dots. Such a color-dotted tile body is produced from a substantially homogeneous mixture of two or more kinds of different-color particles for the tile body material.

When a multicolored pattern is to be inlaid, two or more different-color paste mixtures are deposited in turn on the substrate sheet twice or more times through predetermined pattern openings to obtain a multicolored inlaying pattern sheet.

The present invention is further described with reference to the drawings, wherein FIG.1 is a schematic cross-sectional view showing deposition, of an inlaying paste mixture onto a substrate sheet through a mask plate; FIG.2 is a schematic cross-sectional view of press-molding in a mold; FIG.3 is a schematic cross-sectional view of a green pattern-embedded tile body; and FIG. 4 is a schematic cross-sectional view of a pattern-inlaid ceramic tile.

(1) Materials for Inlaying Pattern Sheets

A sintering inorganic powder having a sintering temperature similar to that of a tile body material is used for the inlaying pattern sheet. The sintering powder is selected to have a sintering shrinkage coefficient and a thermal expansion coefficient similar to those of the tile body material to be used, for example, within 5% in difference between those coefficients. It is generally convenient to use for the inlaying pattern a sintering inorganic powder similar to or identical with the tile body material, in view of the coefficients and good bonding properties between them.

As the pigment for the inlaying pattern can be used those pigments conventionally, used for coloring ceramics. The pigment is generally used in an amount of 0.5 to 30% by weight of the sintering inorganic powder.

The binder contained in the inlaying mixture is preferably those which can be burnt away at a sintering temperature of the ceramic tile body material and/or inlaying material, and is exemplified by carboxymethyl cellulose, methyl cellulose, starch paste, oil and the lake. Such binder is generally used in the paste mixture in an amount of 0.5~10% by weight of the inlaying mixture.

The solvent used to prepare the paste mixture includes, for example, water and aqueous solutions of lower alcohols. The amount of the solvent is such that makes a paste mixture for screen-printing or depositing the paste onto the substrate (e.g. 3 to 20% by weight), as known by those skilled in the art.

As necessary, additives conventionally used for ceramic tile materials may also be incorporated into the inlaying mixture.

(2) Inlaying Pattern Sheets

The inlaying sheet 12 can be prepared by applying the paste mixture 3 onto a substrate sheet

1 in a desired pattern and thickness, for example, through a mask plate 2 having pattern openings or by means of screen printing to deposit the mixture, followed by drying. The masking deposition can be effected by spraying or brush-coating.

The substrate sheet 1 is generally of flexible permeable materials such as pulp paper, paper board, woven or non-woven fabrics, etc. When a combustible substrate sheet is used, the sheet 1 is not always peeled off before firing. When incombustible substrate sheets are used, the sheet is normally peeled off prior to firing.

(3) Materials for Tile Bodies

The ceramic tile body material 8 used herein consists essentially of sintering inorganic materials such, as pottery materials (e.g. a mixture of clay, agalmatolite and lime) or stoneware/porcelain materials (e.g. a mixture of talc, feldspar and clay). The material 8 may contain a binder (e.g. C.M.C.) and 0.1 to 10% by weight of pigments as necessary.

It is possible to use a homogeneous mixture of two or more kinds of different-color sintering inorganic particles prepared by coloring a sintering inorganic powder with a pigment, spray-drying the powder to give colored particles of approximately 0.1 to 0.8mm in mean particle sizes, and mixing them. By using such a mixture, a uniformly dotted pattern can be obtained in the tile body 10. When such dotted patterns are to be formed in the tile body 10, it is preferred to place in a mold a tile body material (i.e. a mixture of such colored particles), and then an inlaying sheet thereon with the inlaying pattern facing the mixture. Incidentally, colored finer particles contained in the tile body material 8 are apt to sink with non-uniform distribution in the mold, and may form a nonuniformly dotted pattern at the bottom of the tile body but a uniformly dotted pattern on the embedded top surface.

For example, a tile body having granite tones can be obtained by using a homogeneous mixture of a particulate tile material containing black pigment and a white particulate material containing no pigment. A tile body having semiprecious stone tones can be obtained by using a homogeneous mixture of two or more kinds of different-color particles for the tile body material.

(4) Press-molding and Firing

The tile body material 8 and inlaying pattern sheet 12 are placed in a mold with either the inlaying pattern 4 on the tile body material 8 or the inlaying pattern 4 under the body material 8. The materials in the mold 7 are press-molded usually under a pressure of 200 to 400 kgf/sq.cm to form a green tile body having the inlaying pattern 4 embedded on the surface of the tile body. The resulting embedded tile body is then fired in a kiln or oven to a sintering temperature, usually 1000 to 1400 °C.

As necessary, the resulting pattern-embedded tile body 10 may be coated with a substantially transparent glaze agent after biscuit-firing to a temperature of usually from 1000 to 1300 °C. The glaze-coated tile body is then fired to a glazing or sintering temperature of usually about 1000~1400 °C, to produce a glazed pattern-inlayed ceramic tile.

(5) Pattern-inlaid Ceramic Tile

The size of the pattern-inlaid ceramic tile 11 is usually in a range of 50mm × 50mm to 1000mm × 1000mm. The thickness thereof is usually 5 to 35mm. The thickness of the inlaid pattern layer is usually 0.3 to 5mm and generally about 1/10 to 1/4 of the whole thickness of the inlaid ceramic tile 11. The total surface area of the inlaid pattern layer is usually 1 to 80% of the top surface area of the inlaid ceramic tile. Incidentally, the level of the inlaid pattern 4 is substantially identical with or slightly lower than uninlaid top surfaces of the tile body. The inlaid patterns are thus durable against wearing and exhibit sharp pattern lines, even when glazed.

(6) Features

According to the present invention, the inlaid patterns having desired designs and thickness can be readily formed on a ceramic tile simply by changing the pattern of the mask 3 or screen for the deposition and the thickness of the inlaying material on the sheet. Moreover, the shape of the pattern can be retained by the binder contained in the inlaying material and the binder can be burnt away after firing of the embedded ceramic tile. Since inlaying patterns 4 are formed by depositing the inlaying material 3 through a mask plate 3 or screen onto a substrate sheet 12, the same patterns can be readily reproduced with fine precise tones.

(7) Examples

The present invention is further explained by way of working examples with reference to the

drawings. In the following examples, percentages and parts are by weight unless otherwise specified.

Example 1

An inlaying material was prepared by mixing 100 parts of an inorganic sintering powder comprising 60% of talc, 30% of feldspar and 10% of clay, with 15 parts of a purple pigment, 6 parts of starch paste (a binder) and water to give a paste mixture 3. The binder serves to bond these materials to one another and to maintain the shape of the resulting inlaying pattern.

A masking plate 2 having openings of curved line patterns was placed on a non-woven fabric substrate sheet 1 as shown in FIG. 1. The inlaying material 3 was applied by spraying it onto the substrate sheet 1. The inlaying material 3 was then dried to such a water content (e.g. 4%) as low as that of a tile body material, to obtain an inlaying pattern sheet 12.

As shown in FIG.2 was placed a porcelain tile body material 8 in a mold cavity 7 formed by a lower mold portion 5 and side mold portions 6. The body material 8 was prepared by mixing 60% of talc, 30% of feldspar, 9% of clay, 1% of CMC and water, and spray-drying the mixture to give particles (mean particle size: 0. 4mm). The inlaying pattern sheet 12 was placed on the tile body material 8 in the mold with the pattern layer 4 downwards. An upper mold portion 9 was applied onto the substrate sheet. The materials in the mold were press-molded with a pressure of 320 kgf/sq.cm to give a molded tile body 10 wherein the inlaying patterns 4 were embedded as shown in FIG.3.

The molded tile body 10 was dried and then fired to a maximum temperature of 1250 ° C in a roller hearth kiln. During firing, the substrate sheet 1 and binder were burnt away. Thus, there was obtained an inlaid tile 11 of 300 × 300 × 8mm (thickness) having purple curved line patterns 4 of about 2mm thick inlaid onto the surface of the tile 11. The area of the pattern layer 4 was about 2% of the top tile surface area. Cracks and deformation such as warping were not observed in the resulting inlaid tile.

Example 2

The processes of Example 1 were repeated except the following steps to obtain a glazed multi-color pattern inlaid tile.

Three inlaying paste materials were prepared, which contained 10 parts by weight of green, purple and yellowish green pigments to 100 parts of the sintering powder, respectively. Flower petal patterns were screen-printed through three different screens in turn on a pulp paper substrate with the green, purple and yellowish green paste materials, wherein each printed layer was 0.3mm thick and overprinted layers were 0.9mm thick, followed by drying to obtain an inlaying pattern sheet.

Three colored porcelain materials were prepared by mixing 0.5 part of yellow pigment, 5 parts of red pigment and 5 parts of black pigment, respectively with 100 parts of the porcelain material powder. Each colored material was spray-dried into particles of 0.4mm in mean size. A tile body material was then prepared by homogeneously mixing 25% of the yellow particles, 50% of the red particles and 25% of the black particles.

The resulting mixed tile body material was placed in the mold, and the resulting inlaying sheet was placed on the tile body material with the inlaying pattern downwards. The materials in the mold were press-molded as in Example 1. The pulp paper substrate sheet was peeled off from the green molded article.

The green pattern-embedded tile was fired to 1100 ° C. The top surface of the biscuit-fired tile was coated with a substantially transparent glaze agent and then fired to a maximum temperature of 1250 ° C in a roller hearth kiln. A glazed multi-color pattern inlaid tile 300 × 300 × 8mm (thickness) was obtained, which had petal patterns of green, purple and yellowish green colors of about 0.3 to 0.9mm thick inlaid onto a tile body having semi-precious stone tones composed of yellow, red and black dots. The area of the inlaid patterns was about 30% of the top tile surface area. Cracks and deformation such as warping were not observed in the resulting inlaid tile.

Claims

1. A method for producing a pattern-inlaid ceramic tile (11), which comprises the steps of:
preparing a paste mixture (3) consisting essentially of a sintering inorganic powder, a pigment, a binder and a solvent, and depositing the paste mixture (3) onto a substrate sheet (1) through a predetermined pattern opening and drying the deposited mixture to form an inlaying patttern sheet (12);
placing in a mold (7) the inlaying sheet (12) and a body material (8) for ceramic tile in such a fashion that the inlaying pattern (4) contacts the body material (8), and press-molding them into a green tile body (10) having the inlaying pattern (4) embedded on the surface of the tile body; and then
firing the resulting green embedded body (10) to a sintering temperature.

2. The method according to Claim 1, in which a substantially homogeneous mixture of two or more

kinds of different-color particulate tile body materials is used as the body material for ceramic tile.

3. The method according to Claim 1 or 2, in which the body material for ceramic tile is placed in the mold and then the inlaying pattern sheet is placed thereon in such a fashion that the inlaying pattern contacts the body material.

4. The method according to Claim 1, 2 or 3, in which the paste mixture is deposited on the substrate sheet by using a pattern mask plate.

5. The method according to Claim 1, 2 or 3, in which the paste mixture is deposited on the substrate sheet by screen printing.

6. The method according to any one of Claims 1 through 5, in which two or more different-color paste mixtures are deposited in turn on the substrate sheet twice or more times to obtain a multicolored inlaying pattern sheet.

7. The method according to any one of Claims 1 through 6, in which the pattern-embedded green tile body is biscuit-fired, coated with a substantially transparent glaze agent, and then fired.

8. The pattern-inlaid ceramic tile producible according to any one of Claims 1 to 7

9, The ceramic tile according to Claim 8, in which the pattern-inlaid ceramic tile has a substantially transparent glaze layer on the top surface thereof.

FIG. 1

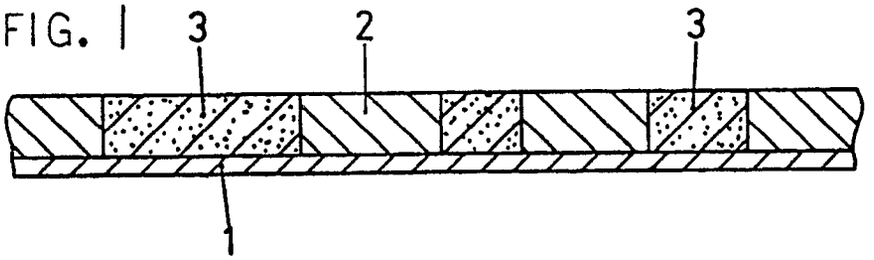


FIG. 2

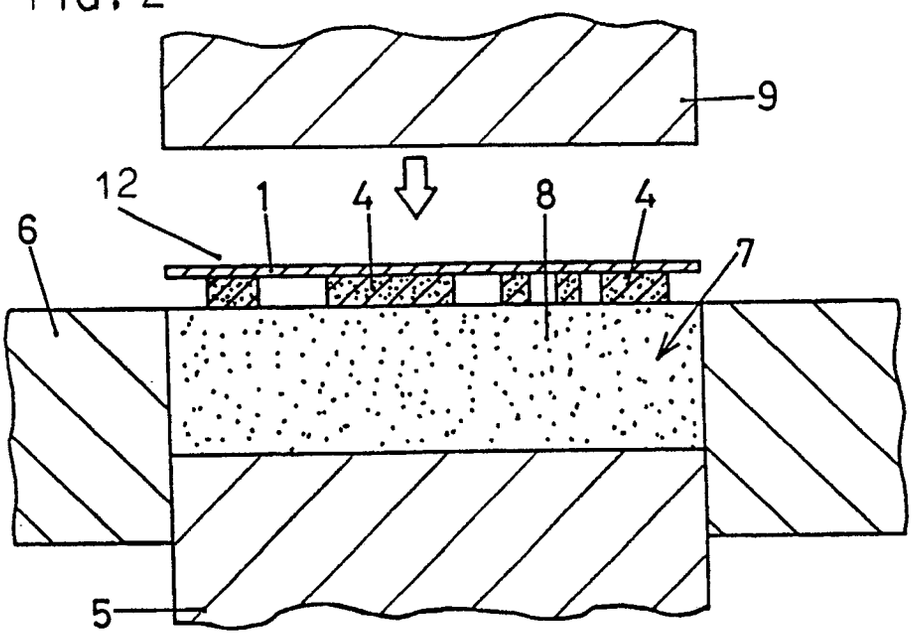


FIG. 3

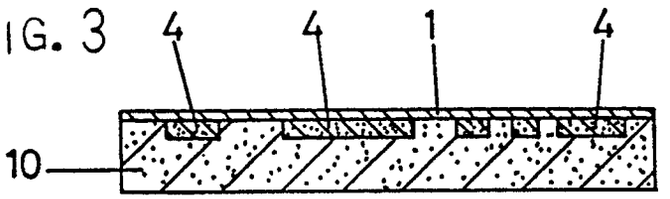


FIG. 4