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(11) **EP 1 101 584 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
23.05.2001 Bulletin 2001/21

(51) Int Cl.7: **B28B 3/02**, B28B 11/04,
B28B 7/00, B28B 11/00

(21) Application number: **00203852.9**

(22) Date of filing: **03.11.2000**

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE TR**
Designated Extension States:
AL LT LV MK RO SI

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(30) Priority: **15.11.1999 IT RE990116**

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(54) **Method for manufacturing tiles having their exposed side provided with depressions and reliefs to reproduce the appearance of split quarystone**

(57) The method comprises the following operations:

- in a usual mould, forming a crude tile from an atomized powder mix, that mould punch intended to create the exposed face of the tile reproducing the appearance of split quarystone or of a non-flat surface;
- drying the thus formed tile in a continuous dryer in accordance with a usual drying cycle;
- applying on the exposed side of the dried tile at least one layer of coloured atomized clay or of pigment in powder form, to at least partly cover said side of the tile;
- subjecting the exposed side of the tile to the action of an air stream at an incidence angle tending towards zero;
- kiln-firing the tile treated in this manner in accordance with a usual firing cycle.

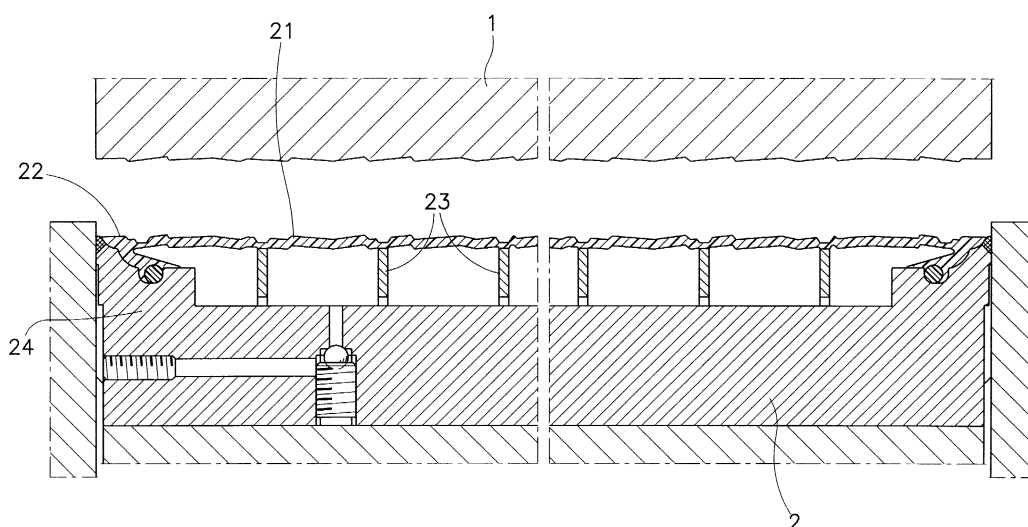


FIG. 4

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Description

[0001] This invention relates to the manufacture of paving or facing tiles with particular aesthetic characteristics.

[0002] The search for increasingly new and innovative ornamental motifs for ceramic tiles has always aimed at reproducing the appearance of natural stone, such as marble.

[0003] Reproduction of the ornamental motifs of stone subjected to precise cutting, and hence presenting a smooth and often dressed surface, has been achieved by methods which have recently become part of ceramic technology.

[0004] This stone, such as natural marble provided with irregular multi-colour veining, has been produced practically perfectly, by a method known as bulk coloration which enables tiles to be formed composed of at least two powders forming an agglomerate of partly mixed masses emerging at the tile surface, in the manner of natural marble veining.

[0005] It has however not as yet been possible to form a tile having a surface which reproduces the appearance of split quarystone, ie having crests and reliefs spaced apart by depressions and presenting colours or colour tones variously shaded in accordance with the arrangement of said crests, reliefs and depressions.

[0006] The object of this patent is to provide a method enabling ceramic tiles to be manufactured having the aforesaid appearance, either formal or chromatic, of split quarystone, or of natural stone of non-flat surface.

[0007] This object is attained according to the invention by a method comprising the following operations.

[0008] A ceramic mix is fed into the forming cavity of a mould, and then pressed with an upper punch which reproduces the form of the stone to be reproduced, with the purpose of creating the exposed upper surface of the tile.

[0009] A layer of atomized clay covered by a second layer of multi-colour glazes variously mixed and distributed can also be used.

[0010] The punch is constructed of steel, and can be covered by rubber or equivalent materials.

[0011] It is preferably used together with a lower punch known as a reverse face punch the purpose of which is to create the tile rear side, and is of steel or of steel covered by a rubber layer intended to form the rear face of the tile.

[0012] The surface representing the stone often presents reliefs and depressions of the order of several millimetres, therefore to prevent substantial thickness non-uniformity causing difficulties during firing, the invention provides for the rubber covering layer of the lower punch to reproduce in negative, on that side intended to come into contact with the material to be pressed, the shape of the upper punch to hence obtain substantially uniform tile thicknesses.

[0013] The lower punch, known as the reverse face

punch, is preferably an isostatic punch, hence in this case the profiled layer of rubber or equivalent material being the membrane of the said isostatic punch.

[0014] In this respect, an isostatic punch is known to comprise a rubber membrane which on one side is in contact with the material to be compressed and on the other side floats on an oil film.

[0015] In order not to compromise uniform distribution of the isostatic thrust action of the oil through the membrane, this latter is preferably made with as uniform a thickness as possible, in order to maintain uniform deformability under the pressing action of the material.

[0016] In other words, the membrane rear surface, which comes into contact with the oil, presents unevenness corresponding to that of the upper surface which comes into contact with the material.

[0017] The crude tile formed in this manner is subjected to normal drying by known means.

[0018] In a variant of the invention, the tile is subjected immediately after drying to an operation known as flashing, consisting of spray-applying an aqueous suspension of neutral or coloured glaze.

[0019] Said glaze is applied by sprays directed tangentially to the tile surface, and preferably in a direction perpendicular to the reliefs or crests.

[0020] After the flashing operation the tile is preferably subjected to a brushing operation effected by slightly abrasive soft pads.

[0021] Said flashing and brushing operations, which may also be omitted, are followed by decoration with a layer of coloured glaze powder distributed over all or part of the surface either by a usual silk screen or by equivalent known means.

[0022] The application of coloured glaze is followed, according to the invention, by a blowing operation consisting of subjecting the tile surface to an air stream in a substantially tangential direction, the purpose of which is to accumulate the glaze behind and in front of crests and in the surface cavities, and to at least partially remove it from those regions mostly subjected to the action of the stream.

[0023] The orientation of the air stream is chosen, according to the invention, on the basis of the chromatic effect to be obtained, and is preferably perpendicular to direction of the crests and depressions, in one or in the opposite direction.

[0024] It should be noted, for clarity, that the crests on the irregular surface of split stone are the results of natural separation of strata in the stone, and hence generally lie parallel one to another.

[0025] After the blowing operation the tile can be conveniently subjected to a brushing operation effected by a soft blade, or by a brush acting in the same direction as the blow.

[0026] In certain cases it can be preferable to effect this brushing operation immediately prior to blowing, to favour accumulation of powder in the regions adjacent to the crests and in the depressions.

[0027] After subjection to the air stream, known for simplicity hereinafter as the blowing operation, the tile is subjected to firing by known methods using known cycles.

[0028] In a variant of the aforescribed method, instead of being a single-colour mix the base mix can be obtained by partially mixing together at least two atomized powder masses coloured differently so that the tile mass obtained is characterised by veining or staining reproducing the appearance of natural marble.

[0029] In a further possible embodiment of the invention, the mould cavity is filled by one of the known double loading systems, ie with a first layer of single-colour material, and a second thin layer of coloured material, which can be single- or multi-colour depending on the required appearance of the finished product.

[0030] Likewise, if the layer of coloured glaze is applied after drying and before the blowing operation, different coloured powders can be used in adjacent or totally or partly superposed layers.

[0031] A further variant of the invention enables the split surface of the tile to be provided with shallow, more or less extensive craters of opaque neutral colour, or glossy, or coloured.

[0032] These craters are obtained by feeding volatile material bodies directly into the mould cavity.

[0033] The means for feeding said bodies, constituting substantially a third loading, are totally similar to the known means for effecting the second loading.

[0034] The term "volatile material" means a material which burns away or sublimates completely at a temperature less than or equal to 600°C, so that it disappears completely at the latest during the initial stage of the kiln firing process to create more or less extensive craters.

[0035] Materials can also be used which burn away or sublime at lower temperature, typically the temperature attained by the tile during the drying stage.

[0036] A particularly suitable flake forming material is an easily combustible fibrous material, such as sawdust.

[0037] Best results are however obtained with a material comprising starch or other volatile substances which facilitate aggregation with colouring substances or pigments, and could be for example a ground cereal or cereal bran.

[0038] The material resulting from the crushing or grinding of maize grains has proved particularly convenient.

[0039] Other convenient materials are, according to the invention, wheat grains, barley, oats or rice, including unground.

[0040] Cereal flakes have also proved convenient, as have oven-baked cereals such as popcorn, or even straw fragments.

[0041] If the volatile material is required to disappear as early as the drying stage, it is convenient to use a wax or an equivalent synthetic material.

[0042] If the base of the craters obtained in this manner is to have a bright or coloured surface, the material

before being reduced to flakes is mixed with powdered coloured atomized clay, or with pigments or powdered vitreous glaze.

[0043] The merits and characteristics of the invention will be apparent from the ensuing example and from the accompanying Figure 1, Figure 2 and Figure 3, showing three tiles obtained by the method which differ from each other by the different shape of the punches.

[0044] Figure 4 is a section through an isostatic lower punch of the invention, associated with the respective steel upper punch.

EXAMPLE

[0045] The base ceramic mix is prepared by wet grinding a mixture composed of high quality, high plasticity clays of very low iron and titanium content, fluxes and feldspathic sands also of very low iron and titanium content. Subsequent drying of the liquid mixture is achieved by an atomizer which produces a powder of controlled moisture content and particle size.

[0046] The powder mix obtained in this manner passes through a continuous colouring device in which the powder is pigmented by feeding colouring oxides together with the powder in predetermined proportions, and is fed into the feed hopper of the press.

[0047] The press is fed using a machine which distributes several atomized layers in different successive loadings.

[0048] By means of this machine, the mould forming cavities are filled with a first layer of coloured base mix to the extent of about 90% of the total tile thickness.

[0049] In an immediately following step, a second layer is applied composed of a mixture of four atomized ceramic glazes differing in colour and fusibility.

[0050] This mixture is obtained by withdrawing from four different containers, one per component, cyclically variable quantities of the components and distributing them with a variable repetitive cycle within the forming cavity.

[0051] On this second layer there is distributed a third layer composed of small flakes of ceramic glaze of relatively regular geometry which fire glossy.

[0052] Because of the particular surface structure, which is extremely irregular and exacerbated in the reliefs, physical tensions which would compromise the compactness and consistency of the tile were eliminated by using a special punch which, in addition to the normal isostatic compensation normally used, presents a further compensation for thicknesses.

[0053] In this respect, as shown in Figure 4 the surface structure of the upper punch (1) is reproduced in negative on the upper face (21) of the membrane constituting the deformable part of the lower isostatic punch (2), such as to maintain as far as possible in every section of the tile an equal distance between the two punches.

[0054] The planarity of the lower resting surface nec-

essary for subsequent operations on the tile and for its laying is ensured by a flat wide-mesh grating (23) on which the membrane (22) rests.

[0055] Between the edges of the grating (23) it can be seen that the membrane lower face in contact with the oil is shaped to match the pattern of the upper face.

[0056] In correspondence with the top of the grating, the membrane carries incised grooves intended to form the coplanar feet of the tile.

[0057] The three superposed layers are then pressed with a specific pressure of 400 kg/cm² using a hydraulic press.

[0058] The tiles are removed from the mould and then dried in a normal vertical dryer with boat-shaped containers, using a 60 minute cycle at 250°C.

[0059] The dried but hot tiles (at this stage the tile is still at 70°C) are sprayed tangentially, using a spray gun, with a film of liquid ceramic glaze which, after its rapid drying, is removed from the more projecting parts of the tile structure with a rotary disc brush.

[0060] At this point, a layer composed of a mixture of three powdered ceramic glazes, differing in colour and fusibility, is applied to the tile.

[0061] The mixture is distributed by known means.

[0062] A soft rubber blade is used to facilitate deposition and accumulation of the powder in the bas-relief regions adjacent to the crests and in the surface depressions.

[0063] Using a known tangential blowing machine, the tile is blown tangentially to partly remove the previously applied powdered glaze mixture and partly force it into the specific recesses in the tile structure.

[0064] At this point a fixer is applied to the glaze remaining on the tile, in this case it being a 5-10% polymer solution in polyvinyl alcohol.

[0065] The tile is then fired in a ceramic roller kiln at a temperature of 1200°C using a residence cycle of 60 minutes, to assume the appearance shown in the figures.

Claims

1. A method for manufacturing tiles the surface of which reproduces the appearance of split quarystone, or which have a non-flat exposed face, characterised by comprising the following operations:
 - in a usual mould, forming a crude tile from an atomized powder mix, that mould punch intended to create the exposed face of the tile reproducing the appearance of split quarystone or of a non-flat surface;
 - drying the thus formed tile in a continuous dryer in accordance with a usual drying cycle;
 - applying on the exposed side of the dried tile at least one layer of coloured atomized clay or of pigment in powder form, to at least partly cover

- said side of the tile;
- subjecting the exposed side of the tile to the action of an air stream at an incidence angle tending towards zero;
- kiln-firing the tile treated in this manner in accordance with a usual firing cycle.

2. A method as claimed in claim 1, characterised in that before subjecting the exposed side of the tile to the air jet, it is subjected to light brushing, the purpose of which is to accumulate glaze in powder form against the edges of the crests or in the depressions of that side.
3. A method as claimed in claim 1, characterised in that after subjecting the exposed side of the tile to the air jet, it is subjected to light brushing, the purpose of which is to accumulate glaze in powder form against the edges of the crests or in the depressions of that side.
4. A method as claimed in claim 1, characterised in that the mould upper punch intended to create the exposed face of the tile is of steel and reproduces the appearance of split quarystone or of a non-flat surface, whereas the mould lower punch intended to form the reverse face comprises a rubber or equivalent sheet reproducing in negative the pattern of the upper punch.
5. A method as claimed in claim 4, characterised in that the mould upper punch intended to create the exposed face of the tile is of steel covered with a layer of rubber or equivalent material which reproduces the appearance of split stone or of a non-flat surface.
6. A method as claimed in claims 4 and 5, characterised in that the the rubber or equivalent sheet covering the lower punch intended to create the tile reverse face reproducing in negative the pattern of the upper punch is the membrane of an isostatic punch.
7. A method as claimed in claim 6, characterised in that said membrane reproducing the pattern of the upper punch is of substantially constant thickness in all those portions which undergo deformation.
8. A method as claimed in claim 1, characterised in that the atomized clay mix comprises at least two materials of different colour partly mixed together.
9. A method as claimed in claim 1, characterised in that the atomized clay mix is disposed in the mould in at least two layers.
10. A method as claimed in claim 1, characterised in that the atomized coloured clay or pigment powder

is applied as adjacent or totally or partly superposed layers of different colour.

11. A method as claimed in claim 1, characterised in that the orientation of the air stream is substantially perpendicular to the direction of the crests and depressions, in one or in the opposite direction. 5
12. A method as claimed in claim 1, characterised in that flakes of volatile material able to burn completely away at a temperature less than or equal to 600°C are added to the atomized clay fed to the mould cavity. 10
13. A method as claimed in claim 12, characterised in that said volatile material is chosen from the following: cereals, ground cereals, crushed cereals, blown cereals, cooked and ventilated cereals, cereal flakes, sawdust, crushed straw, wax. 15
14. A method as claimed in claim 12, characterised in that said volatile material comprises an agglomerating substance, such as starch. 20
15. A method as claimed in claim 12, characterised in that said material is a ground or crushed cereal. 25
16. A method as claimed in claim 12, characterised in that said volatile material comprises a coloured pigment powder. 30
17. A method as claimed in claim 12, characterised in that said volatile material comprises a vitreous glaze powder. 35
18. An apparatus for manufacturing a tile by the method claimed in claims 1 to 17, characterised by comprising a steel upper punch intended to create the tile exposed face comprising crests and depressions, and a lower punch covered with a layer of rubber or equivalent intended to create the tile rear face, and having a conformation equal or close to the conformation in negative of the upper punch. 40
19. An apparatus as claimed in claim 18, characterised in that the rubber layer covering the lower punch has a conformation equal or close to the conformation in negative of the upper punch. 45
20. An apparatus as claimed in claim 18, characterised in that the upper punch is covered with rubber or equivalent material. 50
21. An apparatus as claimed in claim 20, characterised in that the layer of rubber or equivalent material covering the upper punch comprises crests and depressions. 55
22. An apparatus as claimed in claim 18, characterised in that the rubber layer intended to create the tile rear face is the elastic membrane of an isostatic punch.
23. An apparatus as claimed in claim 22, characterised in that said membrane is of substantially constant thickness.
24. A ceramic flooring or facing tile having its exposed face reproducing the appearance of split stone with crests and depressions or in any event a non-flat profile, characterised by comprising an accumulation of coloured pigment against the crests and in the depressions, whereas the level and relief surfaces present only traces of coloured pigment.
25. A tile as claimed in claim 24, characterised by comprising inserts of coloured glaze on the exposed surfaces.
26. A tile as claimed in claim 25, characterised in that the inserts are multi-coloured.
27. A tile as claimed in claim 24, characterised by presenting, in its surface, cavities and/or microcavities reproducing the appearance of porous stone, and/or the action of woodworm.



FIG. 1



FIG.2

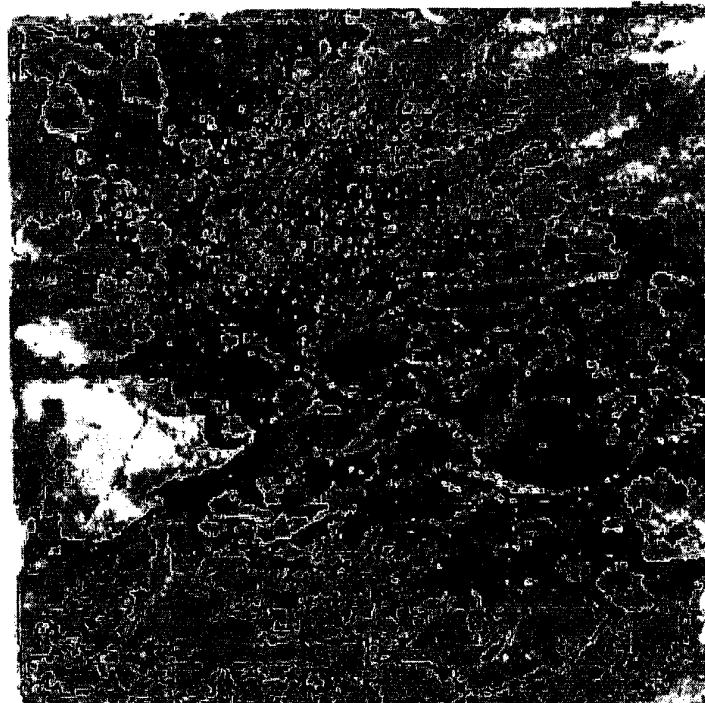


FIG.3

