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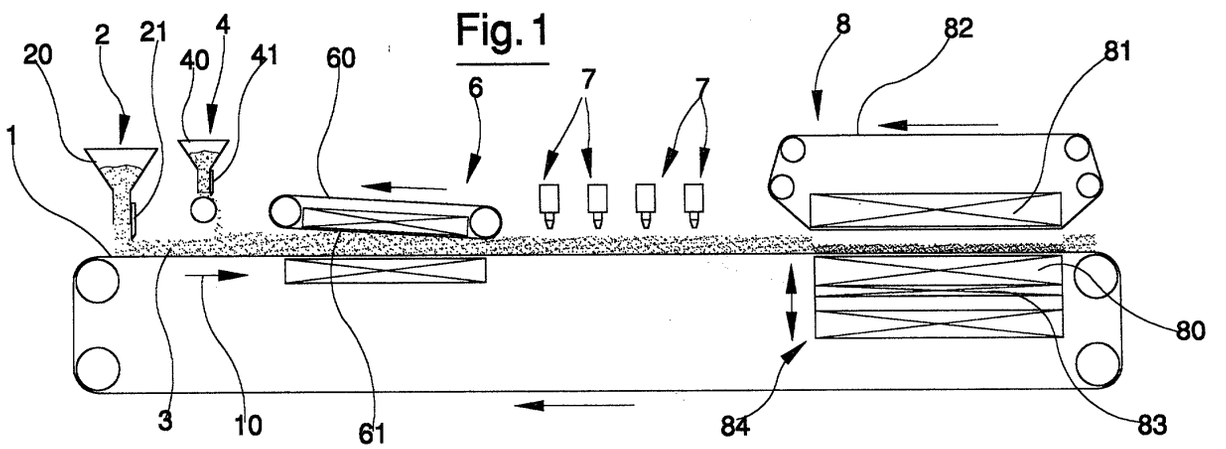
(54) A process and apparatus for decorating ceramic slabs or tiles

(57) The process for decorating ceramic slabs or tiles comprises: application of a first layer of powders (3) on a mobile conveyor plane (1); the powders (3) being raw materials destined for press-forming and firing to produce a ceramic slab or a tile; possible application of a second layer of powders (5) on the first layer of powders (3). During firing the second layer of powders (5) reacts with subsequently-applied colouring substances applied according to predetermined patterns. A slight compacting of the powders is performed by pressing, if considered necessary, before application, in predetermined patterns, and by means of ink-jet systems, of colouring liquids which will react, during firing, with at least the powders of the second layer of powders (5) in order to colour the second layer of powders (5). A final pressing is then performed.

Fig. 1



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Description

[0001] In products which are intended to imitate natural stone and marble, an important technology is the development of decorations which involve a considerable part of the depth of the tile or slab and which therefore do not involve only a thin layer of glaze on the surface of a base biscuit. These indepth decorations are also advantageous in other ways, for example in that they can be sanded, an unimaginable operation for glazed tiles.

[0002] In the traditional art relating to single-pressing techniques (vitrified stoneware), the chances of obtaining wide ranges of decorations with brilliant colours are small and very limited.

[0003] The prior art teaches a way of obtaining decorations on blanks by applying soluble salts on the previously-formed tile. Though this leads to appreciable aesthetic results, it is not possible to obtain very precise designs with sufficiently brilliant coloration. Further, the level of penetration into the product is not very deep. The production process also involves the use of traditional silk-screening machines, and therefore leads to considerable pollution.

[0004] Another prior art teaching is the "double loading" process, where there is a single pressing operation in a die into which two layers have been previously and discretely laid; a bottom layer of homogeneous powders and an upper layer of granulated materials in which decorations have been made at the dry powder stage. There is a greater richness of decoration here, but the designs are still not very precise; a further consequence is the considerable reduction in line productivity, as the forming operation is slower. A rapid change of decorations is also problematic.

[0005] In a recently-developed process a production line is characterised by a double-pressing which comprises a compacting (low pressure) of the base powders, and a depositing on the compacted base of coloured granulated powders arranged in predetermined patterns (obtained by means of special holed matrices). The final pressing operation results in the formed product which will then be fired. Even using this technique the level of final precision of the pattern is somewhat approximative and not exact enough to satisfy some requirements.

[0006] Other processes involve supplying the powders on a belt, with a single or double pressing, and the application of the coloured powders in predetermined patterns using traditional processes. The results obtained, in terms of the pattern, the brilliancy of the colours etc. are about the same as the above-described processes.

[0007] The main aim of the present invention is to obviate the limitations and drawbacks in the prior art by providing a process for decoration ceramic slabs or tiles, through which very precise decoration can be obtained, characterised by tones and shades controlled point-by-point and by intense and brilliant colours (where so desired, obviously).

[0008] A further aim of the present invention is to provide, by a simple process, a considerable depth of penetration of the decoration into the tile body mass.

[0009] A further aim is to eliminate the need to arrange printing matrices for making dry-stage decoration - and with it to eliminate the paraphernalia involved it the use of the matrices, in relation to storage space and the transport of the objects themselves so that they can be changed each time the decoration to be effected is changed.

[0010] An advantage of the present invention is the fact that no contact occurs between the matrix and the piece to be decorated during the decorating process.

[0011] A further advantage is that the process can advantageously be applied also to small production batches.

[0012] A further advantage is the reduction (in relation to the prior art) in the space occupied by the production line, as well as the space needed for materials, i.e. colorants and clay.

[0013] A still further advantage, of no small importance, is the drastic reduction in the consumption of raw materials and in the generation of pollution.

[0014] These aims and advantages and others besides are all attained by the present invention, as it is characterised in the claims that follow.

[0015] Further characteristics and advantages of the present invention will better emerge from the detailed description that follows of a preferred but non-exclusive embodiment of the invention, illustrated purely by way of a nonlimiting example in the accompanying figures of the drawings, in which:

figure 1 is a schematic side view in vertical elevation of the invention;
figure 2 is a schematic plan view from above of figure 1.

[0016] The process for decorating ceramic slabs and tiles comprises the following stages:

application of a first layer of powders 3 on a mobile conveyor plane or belt 1; the powders being the raw material for press-forming and subsequent firing to produce a finished product, being a ceramic slab or a tile;
application, if necessary, of a second layer of powders 5, known as a primer, on the first layer of powders 3; the second layer of powders 5 will react, during firing, with subsequently-applied colouring substances according to predetermined patterns;
if necessary, a slight compacting by pressing;
application, in accordance with predetermined patterns, and by means of ink-jet systems, of colouring liquids which will react, during a subsequent firing, with at least the powders of the second layer of pow-

ders 5 in order to colour the second layer of powders 5;
a final pressing.

[0017] Compaction is normally carried out using a pressure which varies from 5 to 10 kg/cm^2, and which in any case does not exceed 15 kg/cm^2.

[0018] After final pressing the pressed product can be cut to size to produce a slab or tile of the desired size, whence it can be sent for firing.

[0019] The above-described process can be realised by an apparatus for ceramic slab or tile decoration which, with reference to the figures, comprises a mobile conveyor plane or belt 1 superiorly to which the following are positioned, in order:

a first feeder 2 for applying or depositing on the conveyor plane 1 a first layer of powders 3 constituting the raw material to be formed by pressing and to be subsequently subjected to firing to produce the finished product, i.e. a ceramic slab or tile;
a second feeder 4 for applying or depositing on the first layer of powders 3 a second layer of powders 5, or "primer", which during the firing process will react with colouring substances, subsequently to be applied according to predetermined patterns;
a compacting device 6 of the material deposited on the conveyor plane 1;
at least one decorating machine 7 which is able to apply, using an ink-jet system, liquid colouring substances which during the firing process will react with at least the powders of the second layer of powders 5 and colour the powders 5;
a press 8 for carrying out the final pressing operation, forming the slabs or tiles before firing.

[0020] The first feeder 2 comprises a first hopper 20 equipped with a valve batcher 21 for regulating the thickness of the first layer of powders 3 deposited on the mobile conveyor plane 1.

[0021] The second feeder 2 comprises a second hopper 40 equipped with a valve batcher 41 for regulating the thickness of the second layer of powders 5, also known as a "primer" deposited on the first layer 3.

[0022] The compacting device 6 comprises a compacting belt 60, ring-wound and stretched between two rollers 61 having parallel axes and arranged perpendicularly to the advancement direction of the mobile conveyor plane 1.

[0023] The lower branch 61 of the compacting belt 60 faces the underlying mobile conveyor plane 1, and is arranged at an inclination thereto with, the angle of inclination such that the distance between the lower branch 61 and the mobile conveyor plane 1 decreases gradually in the advancement direction of the conveyor plane 1.

[0024] The press 8, which has the task of carrying out the final pressing operation, comprises:

a lower body 80 having an upper surface which is predisposed so that the mobile conveyor plane 1 can rest and run on an upper surface thereof;
an upper body 81 having a lower surface which is predisposed so that a ring-wound belt 82 can rest and run thereon.

[0025] At least the lower body 80 (but possibly the upper body 81) is solidly connected to the piston 83 of a hydraulic power organ 84.

[0026] The two layers of powders, arranged one on top of the other, laid by the first feeder 2 and the second feeder 4, while being transported by the mobile conveyor plane 1 in the direction indicated by the arrow 10, are compacted as they cross the compacting device 6, the lower branch of which moves at a same speed as the mobile conveyor plane 1.

[0027] Four inkjet decorating machines operate on the compacted materials, each of which inkjets, according to its design, applies a colouring liquid which penetrates deeply at least into the second layer of powders 5.

[0028] The colouring substance reacts during subsequent firing with the powders of the second layer, colouring them according to the pattern desired.

[0029] After application of the colouring substances by the inkjet decorating machines, the material is subjected to final pressing by the press 8.

[0030] The pressed product can be cut down to produce shaped slabs or tiles ready for firing.

Claims

1. A process and apparatus for decorating ceramic slabs or tiles, comprising:

application of a first layer of powders (3) on a mobile conveyor plane (1); the powders (3) being raw materials destined for press-forming and firing to produce a ceramic slab or a tile;
possible application of a second layer of powders (5) on the first layer of powders (3); the second layer of powders (5) reacting during a subsequent firing with subsequently-applied colouring substances according to predetermined patterns;
a slight compacting by pressing, if considered necessary;
application, in accordance with predetermined patterns, and by means of ink-jet systems, of colouring liquids which will react, during firing, with at least the powders of the second layer of powders (5) in order to colour the second layer of powders (5);
a final pressing;
cutting the pressed product to size to produce a slab or tile of the desired size before being sent for firing.

2. The process of claim 1, **characterised in that** the final pressing stage comprises a cutting down of the pressed product to achieve a formed tile or slab to be sent on for firing.

3. The process of claim 1 or 2, **characterised in that** the slight compacting is carried out by applying a pressure of not more than 15 kg/cm^2.

4. An apparatus for decorating ceramic slabs or tiles, comprising a mobile conveyor plane or belt (1) superiorly to which are positioned, in order:

a first feeder (2) for applying or depositing on the conveyor plane (1) a first layer of powders (3) constituting the raw material to be formed by pressing and to be subsequently subjected to firing to produce a finished product, i.e. a ceramic slab or tile;
a second feeder (4) for applying or depositing on the first layer of powders (3) a second layer of powders (5), or "primer", which during the firing process will react with colouring substances, subsequently to be applied according to predetermined patterns;
a compacting device (6) of the material deposited on the conveyor plane (1);
at least one decorating machine (7) which is able to apply, using an ink-jet system, liquid colouring substances which during the firing process will react with at least the powders of the second layer of powders (5) and colour the powders (5);
a press (8) for carrying out the final pressing operation, forming the slabs or tiles before firing.

5. The apparatus of claim 4, **characterised in that** the first feeder (2) comprises a first hopper (20) equipped with a valve batcher (21) for regulating the thickness of the first layer of powders (3) deposited on the mobile conveyor plane (1).

6. The apparatus of claim 5, **characterised in that** the second feeder (4) comprises a second hopper (40) equipped with a valve batcher (41) for regulating the thickness of the second layer of powders (5) deposited on the first layer (3).

7. The apparatus of claim 6, **characterised in that** the compacting device (6) comprises a compacting belt (60), ring-wound and stretched between two rollers (61) having parallel axes and arranged perpendicularly to the advancement direction of the mobile conveyor plane (1); the lower branch (61) of the compacting belt (60) faces the underlying mobile conveyor plane (1), and is arranged at an inclination thereto with, the angle of inclination such that the distance between the lower branch (61) and the mobile conveyor plane (1) decreases gradually in the advancement direction of the conveyor plane (1).

8. The apparatus of claim 7, **characterised in that** the press (8), which carries out the final pressing operation, comprises:

a lower body (80) having an upper surface which is predisposed so that the mobile conveyor plane (1) can rest and run on an upper surface thereof;
an upper body (81) having a lower surface which is predisposed so that a ring-wound belt (82) can rest and run thereon;
at least the lower body (80) or at least the upper body (81) being solidly connected to a piston (83) of a hydraulic power organ (84).

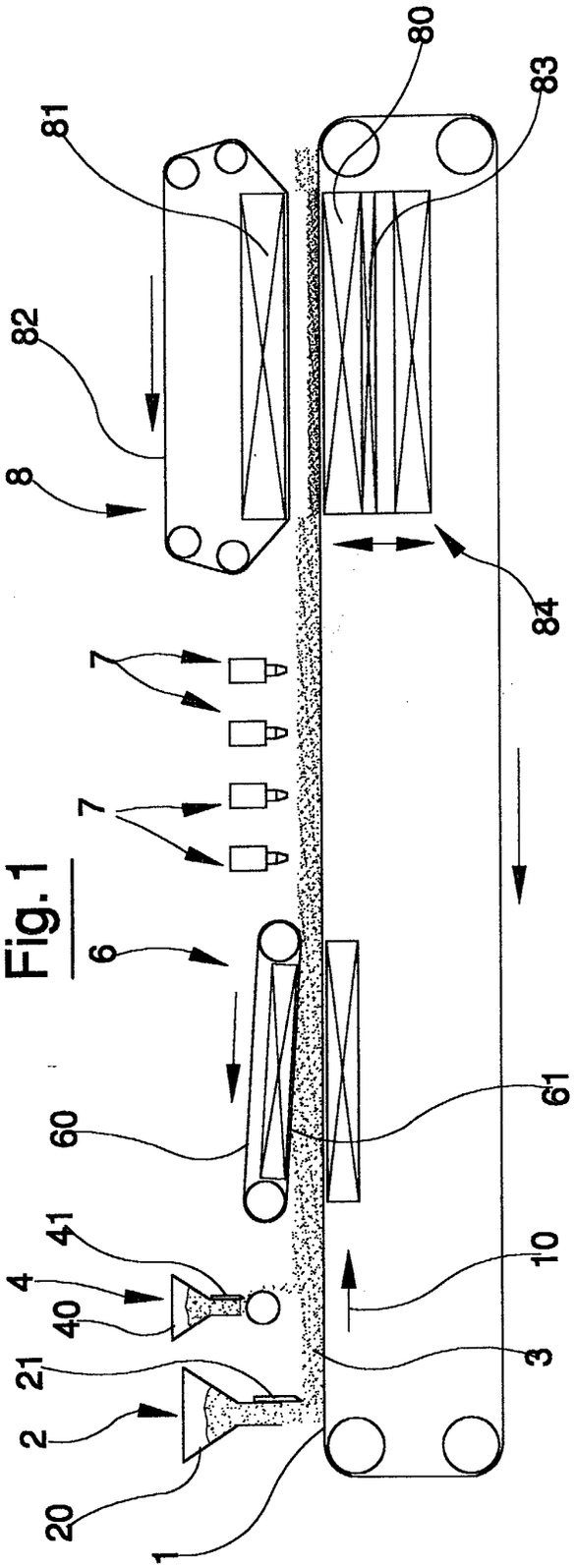

Fig. 1

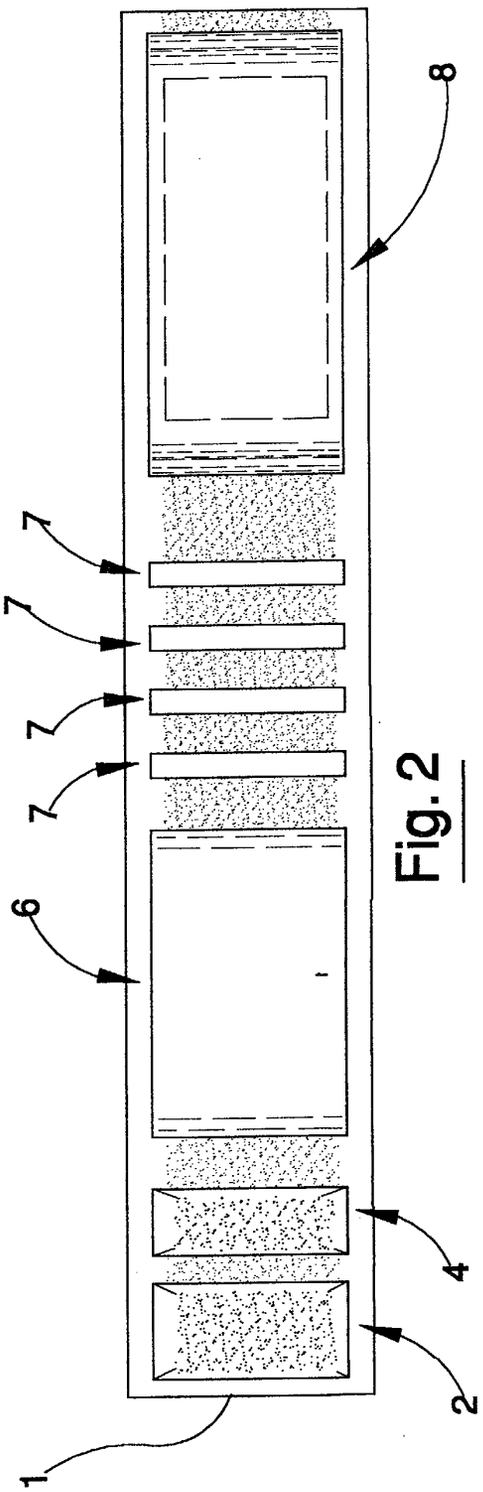

Fig. 2