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(54) **DEVICE FOR APPLYING POWDERY GLAZE FOR DECORATING CERAMIC TILES OR SLABS**

(57) The applicator device (1) is suitable for transferring a predetermined design or decoration (D) to a ceramic tile or slab (PL), moved by a conveyor line (T) by means of powder glaze (S).

The applicator device (1) comprises: dispensing means (2), from which the above powder enamel (S) falls by gravity; a metering unit (3), arranged under the dispensing means (2), in which a mobile resting surface (31), consisting of a plurality of conveyor elements (30) mutually placed side by side, receives the fallen enamel powder (S) and arranges it to form a continuous layer (H); a power element (32) for each conveyor element (30), which can be activated selectively to impart a pre-

determined incremental advance to it, such that a metered quantity of the respective powder glaze (S) falls, by gravity, onto the underlying tile or slab ceramic (PL) in transit; an electronic processing unit (4), in which a matrix of cells (C) with the instructions for reproducing the aforementioned predetermined design or decoration (D) is stored; a control and command unit (5), enslaved to the electronic processing unit (4), provided to operate each conveyor element (30) in phase relation with the advancement of the aforementioned ceramic tile or plate (PL), so that in each cell (C) is deposited the quantity of powder glaze (S) foreseen in the mentioned matrix.

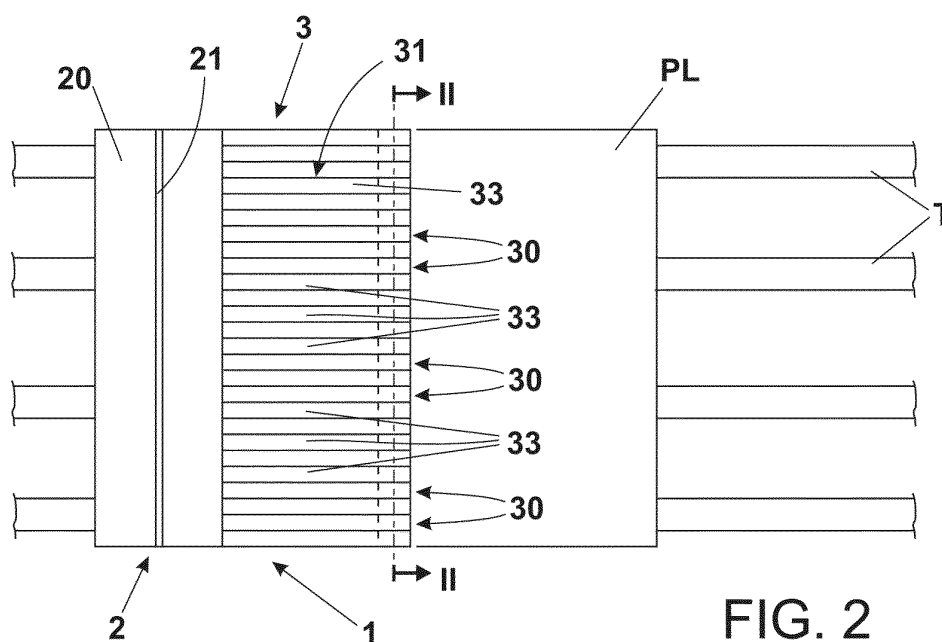


FIG. 2

Description

DESCRIPTION OF THE INVENTION

[0001] The present invention is part of the technical sector concerning the machinery used in the ceramic industry for the decoration of ceramic tiles or slabs.

[0002] In particular, machines that apply decorations with powder glaze are taken into consideration; said powder glaze is subsequently fired to join indissolubly with the relative ceramic tile or slab.

PRIOR ART OF THE INVENTION

[0003] According to a known technique, the powder glaze is introduced into a hopper arranged above the conveyor line with which the ceramic tiles or slabs are advanced.

[0004] The hopper is extended transversely to the direction of feed, for example with a width equal to that of said tiles or ceramic slabs, and is inferiorly affected by a blade slit, suitably calibrated, from which emerges a so-called "dust curtain" which deposits on the underlying tile or ceramic slab in transit.

[0005] With this technique a homogeneous layer of constant thickness is deposited which will give rise to a substantially uniform and monochromatic decoration.

[0006] For the realization of more complex decorations, hoppers are known which provide, in correspondence with the blade slit, a battery of shutters intended to be selectively controlled by an electronic control unit, on the basis of a memorized mapping, to dispense dosed quantities of enamel having unit width equal to that of the shutter, or to prevent its exit.

[0007] The main drawback of this technical solution, as easily understood, lies in the frequent maintenance required by the shutters, which must be small enough to offer a sufficient definition of the decoration and therefore are subject to clogging and considerable wear, as the enamel powder used in the ceramic industry it has a glassy nature and is therefore highly abrasive.

[0008] A variant embodiment of the described solutions provides that the hopper deposits the powdered enamel on a mobile belt placed between the hopper itself and the underlying ceramic tile or slab; the same carpet then deposits on the latter, in a more downstream position.

[0009] With this measure it is possible to intervene on the speed of the moving belt, together with that of the advancement of the transport line of the tiles or ceramic slabs, to modify the decoration parameters, including the thickness of the enamel powder, along the longitudinal development of the same tiles or ceramic slabs.

[0010] However, a very binding limitation remains to the realization of decorations or designs in which many differentiations of the thickness of the enamel are foreseen in the various areas of the tile or ceramic slab, necessary to create not only different chromatic shades, but

also particular effects in relief on the surface of the same ceramic tiles or slabs.

[0011] These technical limits are very penalizing from a commercial point of view, because they prevent us from adequately exploiting the creative imagination of the designers, especially in the high range of ceramic products, which are nowadays those with the highest profit margins.

OBJECTS OF THE INVENTION

[0012] An object of the present invention is therefore to propose a powder glaze applicator device for the decoration of ceramic tiles or slabs which allows to overcome the technical limits of the known solutions and consequently increases the possibility of realizing designs or decorations of high complexity, with qualitatively optimal results.

[0013] Another object of the invention is to provide an applicator device with high reliability and operating precision, without requiring too frequent maintenance interventions.

[0014] Another object of the invention is to propose an applicator device in which there are no organs subject to the abrasive action of the enamel powder, so as to guarantee constant operating results over time and avoid expensive replacement of parts.

[0015] A further object of the invention provides that the applicator device is made with relatively simple technical solutions, which can be easily integrated into normal production lines both as regards assembly and operation.

SUMMARY OF THE INVENTION

[0016] These and other purposes are fully achieved by means of a powder glaze applicator device for the decoration of ceramic tiles or slabs, with said powder glaze provided to reproduce a predetermined design or decoration, a variable quantity of the same powder glaze being intended to be deposited at selected portions of the surface of said ceramic tile or plate, with the latter moved horizontally along a conveyor line below said applicator device, which comprises:

- dispensing means, provided with a tray for the containment of said powder glaze, in said tray being provided at least a lower blade opening, extended transversely to the aforementioned tile or ceramic plate, for the gravity release of the aforementioned glaze in powder;
- a metering unit, arranged below said dispensing means and in which there are provided: a plurality of conveyor elements, arranged side by side and oriented according to the direction of transport of said tile or ceramic plate, to define a surface in their upper part mobile support of predetermined width, intended to receive the powder glaze released by said dispensing means to continuously form a layer of said

powder glaze; power members, associated with each of said conveyor elements, which can be activated selectively to impart a predetermined incremental advance to the relative conveyor element, such that a metered quantity of powdered enamel is induced to fall, by gravity, onto the underlying ceramic tile or plate in transit with properly synchronized motion;

- an electronic processing unit, in which a matrix is stored in digital form in which the entire surface of the aforementioned ceramic tile or slab is divided into cells with a predetermined unit surface, in each of which the instructions for the reproduction of the aforesaid predetermined design or decoration;
- a control and command unit, associated with said electronic processing unit, provided to operate each conveyor element, present in said dosing unit, in phase relation with the advancement of the aforementioned ceramic tile or plate, so that in each of the aforementioned cells the unit quantity of the same is deposited with the required quantity of enamel powder, with the necessary thickness, in accordance with what is provided for the corresponding cell, in the aforementioned matrix.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] The characteristics of the invention will be evident from the following description of preferred embodiments of the powder glaze applicator device for the decoration of ceramic tiles or slabs, according to the object, in accordance with what is proposed in the claims and with the aid of the attached drawings, in which:

- Fig. 1 is a schematic side view of a first embodiment of the powder glaze applicator device;
- Fig. 2 shows a plan view of Fig. 1, without the powder glaze, to highlight some construction features;
- Fig. 2A shows a partial section view according to the plane II-II of Fig. 2;
- Fig. 3 illustrates, in a schematic side view similar to Fig. 1, a second embodiment of the applicator device;
- Fig. 4 illustrates a plan view of Fig. 3 without the hopper of the enamel powder, to highlight the organ below;
- Figs. 5A and 5B show as many schematic side views of a third embodiment of the applicator device, in two different operating steps;
- Fig. 6 illustrates, in a side view on an enlarged scale, an optional partitioning device applied to the applicator device;
- Fig. 7 schematically illustrates a ceramic tile or plate with a decoration applied by the device;
- Fig. 8 illustrates a detail on an enlarged scale of the ceramic tile or plate of Fig. 7 with highlighted areas in which the powdered enamel applied has different thicknesses from area to area.

DETAILED DESCRIPTION OF THE INVENTION

[0018] In the above figures, reference number 1 indicates, as a whole, a powder glaze applicator device S for the decoration of ceramic tiles or slabs PL.

[0019] The latter are moved horizontally along a conveyor line T, extended below said applicator device 1 and provided with its own motor members, the structure of which will not be further detailed as known.

[0020] The powder glaze S must be suitably distributed, according to variable quantities, in correspondence with selected portions of the surface of said tile or ceramic plate PL, to reproduce a predetermined design or decoration D.

[0021] The ceramic tile or plate PL with the design or decoration D still in the powder state will be introduced, according to the known technique, into a baking oven (not shown), in which the powder glaze S will be melted and incorporated permanently in the material of the tile or PL ceramic plate, becoming a single body with it.

[0022] According to the invention, the applicator device 1 comprises dispensing means 2, which comprise a tray 20 for containing the powder enamel S.

[0023] The tray 20 is advantageously shaped like a hopper and is provided with a lower blade opening 21, extended transversely to the ceramic tile or plate PL, for the gravity release of the aforementioned powder enamel S.

[0024] The tray 20, and the relative lower blade opening 21, have a width preferably equal to that of the ceramic tile or plate PL (Fig. 2).

[0025] Below the tray 20 there is a metering unit 3, in which a plurality of conveyor elements 30 are arranged, arranged side by side and oriented according to the transport direction F of said tile or ceramic plate PL, and able to define in their part above a mobile resting surface 31 of predefined width, preferably equal to or greater than those of the tray 20 as well as of the ceramic tile or plate PL.

[0026] The mobile resting surface 31 is intended to receive the powder glaze S released by the blade opening 21 of the tray 20, so that a layer H of said powder glaze S continuously forms.

[0027] Said layer H of powdered enamel S preferably, although not necessarily, has a uniform thickness.

[0028] The blade opening 21 is advantageously arranged a few millimeters above the mobile resting surface 31, so as to limit the outflow of the powder enamel S.

[0029] To each of said conveyor elements 30 there are associated respective power members 32 (Fig. 2A), consisting for example of known electric stepper motors or the like, optionally provided with encoders, electronically controlled and capable of accurately performing rotations of amplitude predetermined angle, also very small.

[0030] The applicator device 1 also comprises an electronic processing unit 4, in which a drawing or decoration scheme D provided for the ceramic tile or plate PL is stored in digital form.

[0031] According to an exemplary and non-limiting embodiment of the invention, this drawing or decoration scheme D comprises a two-dimensional matrix, the entire surface of the aforementioned ceramic tile or plate PL is divided into cells C with a predetermined unit surface, and to each cell C is associated with an element of this matrix. In each of the aforementioned matrix elements, instructions relating to the presence or absence of enamel in the corresponding cell C, and possibly the quantity of enamel to be applied to the same, are recorded with appropriate coding. The entire matrix therefore contains sufficient information to reproduce the predetermined design or decoration D on the entire PL tile or slab.

[0032] The applicator device 1 further comprises an actuation unit 5, electrically connected to the electronic processing unit 4 and controlled by it according to actuation sequences defined by a program residing therein, according to the aforementioned drawing or decoration scheme D. The unit drive 5 is provided to operate, in a suitable phase relationship with the advancement of the conveyor line T, the power members 32 of each conveyor element 30 present in said metering unit 3, as better specified below.

[0033] The power members 32 can be activated simultaneously, to move all the conveyor elements 30 in a direction concordant with that of advancement of the same ceramic tile or plate PL, in a phase of formation of said layer H of enamel powder S, or selectively for imparting at least one conveyor element 30 a predetermined incremental advance, such that a metered quantity of powder glaze S is induced to fall, by gravity, onto the underlying ceramic tile or plate PL, in the underlying transit.

[0034] In practice, depending on the decoration to be made, one or more longitudinal strips of said continuous layer H, each having a width corresponding to that of the respective driven conveyor element 30, are made to advance more, by a predetermined quota, with respect to the front of the continuous layer H, until it exceeds the front limit of the mobile resting surface 31, so that predetermined quantities of glaze fall onto the ceramic tile or plate PL and, at the end of the phase, in each of the aforementioned cells C of the same, the quantity of glaze is deposited in powder S, with the necessary thickness, in accordance with the provisions of the aforementioned cell matrix for the realization of the predetermined design or decoration D (Fig. 8).

[0035] According to a feature of the invention, each conveyor element 30 can be operated with adjustable speed, so as to deposit, in the unit of time, different quantities of enamel in powder form on the cell C of tile or slab PL.

[0036] In a first embodiment of the applicator device 1, illustrated in Figs. 1, 2 and 2A, the said plurality of conveyor elements 30 is constituted by a series of belts 33, wound in a closed loop on a respective pair of pulleys 34, 35.

[0037] Each belt 33 has a section such that its external

side 33E is flat and of a width not exceeding that of one of the aforementioned cells C of the matrix (Fig. 2A).

[0038] The belts 33 are mutually close to each other in sufficient numbers to cover at least the width of said ceramic tile or plate PL, and their upper horizontal branches are adapted to define said mobile resting surface 31.

[0039] In order for the upper horizontal branch of each belt 33 to be taut, the relative electric motors 32 are associated with the downstream pulleys 35, and are preferably contained within them, without protruding laterally (see again Fig. 2A).

[0040] In a construction variant of said first embodiment, a collection plate 36 is provided, positioned immediately below said upper horizontal branches of the belts 33, intended to retain any powder enamel S drawn between one belt 33 and the other avoiding the fall on the underlying PL ceramic tile or plate (Fig. 1).

[0041] In a second embodiment of the applicator device 1, illustrated in Figs. 3 and 4, the said plurality of conveyor elements 30 is constituted by a drum 37 with a horizontal axis formed by disks 38 side by side and mutually close together, in sufficient number to cover at least the width of said ceramic tile or plate PL (Fig. 4).

[0042] The thickness of each disk 38 is not greater than the width of one of the aforementioned cells C of the matrix, while the mobile resting surface 31 is constituted by an upper portion of the circumference of said drum 37.

[0043] The electric motor 32 of each disk 38 (not shown in the figures) is preferably contained within it, without protruding laterally.

[0044] In a third embodiment of the applicator device 1, illustrated in Figs. 5A and 5B, an intermediate horizontal belt 6 is provided between the aforesaid metering unit 3 and the underlying ceramic tile or plate PL.

[0045] The intermediate belt 6 extends longitudinally for a length greater than or equal to that of the ceramic tile or slab PL, is provided with actuator means - not shown as having a known structure - independent of those which actuate the conveyor elements 30 and the conveyor line T, and is intended to be operated in advance in phase relation with the metering unit 3, to receive the entire design or decoration D constituted by the enamel powder S supplied by the same metering unit 3 on its upper branch 6S (Fig. 5A), then in phase relation with the transport line T of the ceramic tile or plate PL, to transfer said design or decoration D to the latter (Fig. 5B).

[0046] In the aforementioned Figs. 5A, 5B, by way of non-limiting example, the metering unit 3 with the belts 33 already illustrated in Fig. 1 has been shown, but obviously it is possible to provide, alternatively, the metering unit 3 with the drum 37 of the described second form of realization.

[0047] Fig. 6 schematically illustrates an optional divider unit 7, associated with the metering unit 3, with the latter indifferently of the type with belts 33 (as illustrated by way of example) or drum 37.

[0048] The partitioning device 7 is positioned in the area of the conveyor elements 30 where the aforementioned gravity fall of the powder enamel S takes place, and comprises at least one nozzle 70 for ejection of compressed air for each of said conveyor elements 30, which can be operated in relation to phase with the activation of the latter to reduce the amount of falling enamel powder S, directing an excess part Se towards a recovery tile 71 suitably arranged nearby.

[0049] In the construction example shown in Fig. 6, the battery of nozzles 70 is arranged under the conveyor elements 30, in the space between these and the transiting tile or ceramic slab PL; the ejection of compressed air occurs towards the front with respect to the motion of the latter, and slightly upwards, so that said excess part of enamel powder S can be directed and collected by the aforementioned recovery tile 71.

[0050] From the previous description it is clear that the proposed applicator device has the necessary prerogatives to obtain the predetermined functional results.

[0051] In particular, the technical limits of the known solutions are exceeded as regards the possibility of creating complex decorations, with differentiations both in the longitudinal and transversal direction of the local thickness of the enamel powder, which is carefully dosed according to what is provided in a stored cell matrix, which divides the surface to be decorated as if it were the pixels of an electronic image.

[0052] Within a certain limit, even with the aid of the described optional partitioning device, it is possible to obtain a high definition of the decoration, certainly higher than that allowed by the prior art solutions.

[0053] A very advantageous aspect lies in the fact that the powdered enamel is not induced to pass through metering elements such as shutters and the like, necessarily of small if not very small dimensions, and therefore subject to clogging and wear, consequently high reliability and precision of operation, without requiring frequent maintenance.

[0054] Less frequent maintenance and the absence of expensive replacement of parts mean a more economical management of the decoration plant and a lower number of downtime, therefore higher productivity with less chance of waste.

[0055] The embodiments of the powder glaze applicator device, although illustrated and described in an essential way, are relatively simple for those skilled in the art, easy to construct and can be easily integrated into normal production lines, both as regards assembly and operation.

[0056] However, it is understood that what described above has an exemplifying and non-limiting value; therefore any detail variations that may become necessary for technical and/or functional reasons, both in the method and in the device, are considered as of now falling within the same protective sphere defined by the below claims.

Claims

1. Powder glaze applicator device (S) for the decoration of ceramic tiles or slabs (PL), with said powder glaze (S) designed to reproduce a predetermined design or decoration (D), a variable quantity of the same glaze in powder (S) being destined to be deposited at selected portions of the surface of said ceramic tile or plate (PL), with the latter moved horizontally along a conveyor line (T) below said applicator device (1), which is **characterized in that** it includes:

- dispensing means (2), provided with a tray (20) for containing said powder enamel (S), in said tray (20) being provided at least one lower blade opening (21), extended transversely to the aforementioned tile or ceramic plate (PL), for gravity release of the aforementioned powder glaze (S);

- a metering unit (3), arranged below said dispensing means (2) and in which are provided: a plurality of conveyor elements (30), arranged side by side and oriented according to the direction of transport of said ceramic tile or plate (PL), to define in their upper part a mobile resting surface (31) of predetermined width, intended to receive the powdered enamel (S) released by said dispensing means (2) to form continuously a layer (H) of said enamel powder (S); power members (32), associated with each of said conveyor elements (30), which can be selectively activated to impart a predetermined incremental advance to the relative conveyor element (30), such that a dosed quantity of enamel powder (S) is induced to falling, by gravity, onto the underlying ceramic tile or slab (PL) in transit with suitably synchronized motion;

- an electronic processing unit (4), in which a scheme corresponding to said drawing or decoration (D) for said tile or ceramic plate (PL) is stored in digital form;

- an actuation unit (5), controlled by said electronic processing unit (4), provided for stepping each conveyor element (30) present in said metering unit (3), in phase relation with the advance of the mentioned ceramic tile or plate (PL), to deposit on the surface of said ceramic tile or plate (PL) dosed quantities of powder glaze (S), with the necessary thickness, in accordance with the aforementioned drawing or decoration scheme (D).

2. Applicator device according to the rev. 1, **characterized in that** in said electronic processing unit (4) said drawing or decoration scheme (D) is represented in the form of a matrix, in which the entire surface of the aforementioned ceramic tile or plate (PL) is divided into cells (C) of predetermined unit surface, in

each of which the instructions for reproducing the aforesaid predetermined drawing or decoration (D) are recorded; the advancement speed of each aforementioned conveyor element (30) being defined so that in each of the aforementioned unit surface cells (C) the expected quantity of enamel powder (S) is deposited.

3. Applicator device according to the rev. 1, **characterized in that** said plurality of conveyor elements (30) is constituted by a series of belts (33), wound in a closed loop on a respective pair of pulleys (34, 35), mutually approached in sufficient numbers to cover at least the width of said tile or ceramic slab (PL), and by the fact that said mobile resting surface (31) is constituted by the upper horizontal branches of the aforementioned belts (33).

4. Applicator device according to the rev. 3, **characterized in that** said power members (32) are associated with the pulley (35) downstream of each mentioned pair, so that the upper horizontal branch of the respective belt (33) is taut.

5. Applicator device according to the rev. 1, **characterized in that** said plurality of conveyor elements (30) is constituted by a drum (37) with a horizontal axis formed by discs (38) side by side and mutually close together, in a number sufficient to cover at least the width of said tile or ceramic slab (PL), from the fact that said mobile resting surface (31) is constituted by an upper portion of the circumference of said drum (37) and from the fact that said power members (32) are associated with each of the same disks (38).

6. Applicator device according to the rev. 1, **characterized in that** between the aforementioned metering unit (3) and the underlying ceramic tile or slab (PL) there is an intermediate carpet (6) arranged horizontally, equipped with actuating members independent from those which actuate said conveyor elements (30) and said conveyor line (T), said intermediate belt (6) extending longitudinally for a length greater than or equal to that of said ceramic tile or slab (PL), intended to be operated in advance first in phase relation with said group dispenser (3) to receive the entire design or decoration (D) made up of the enamel powder (S) supplied by the same dispensing means (2) on its upper branch (6S), and subsequently in phase relation with the aforementioned transport line (T) of the ceramic tile or plate (PL), to transfer said design or decoration (D) to the latter.

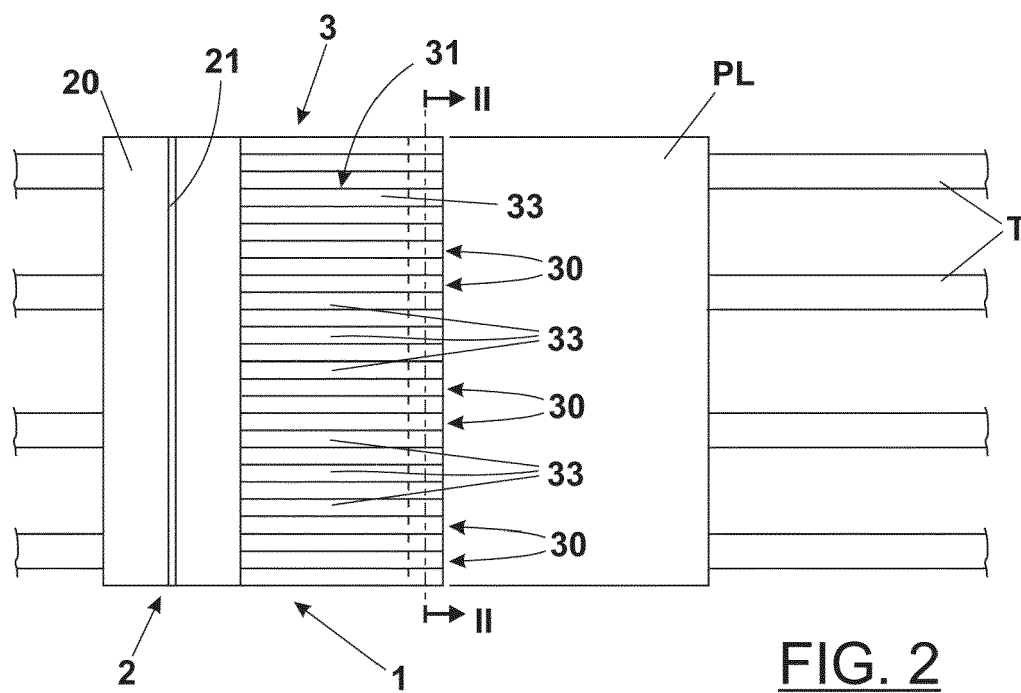
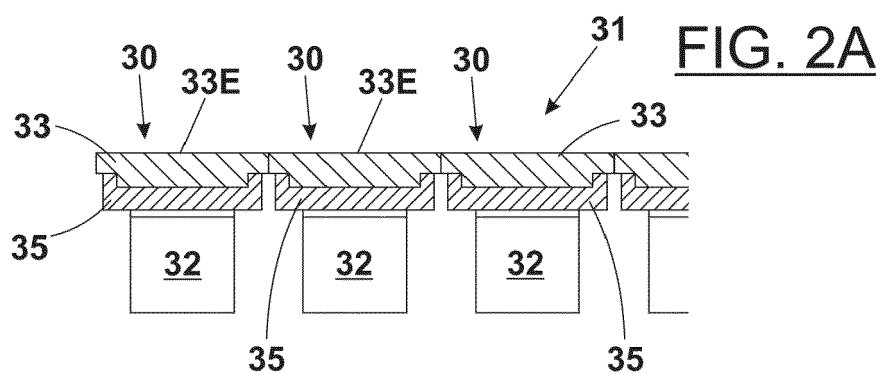
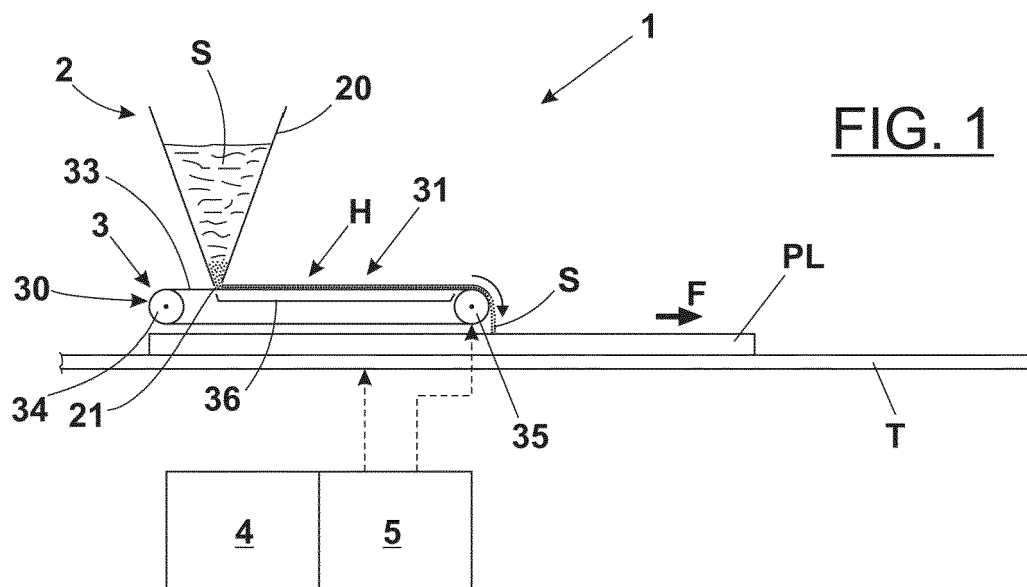
7. Applicator device according to the rev. 3, **characterized in that** it provides a collection plate (36), positioned immediately below said upper horizontal branches of the belts (33) defining the aforementioned mobile support surface (31), intended to retain

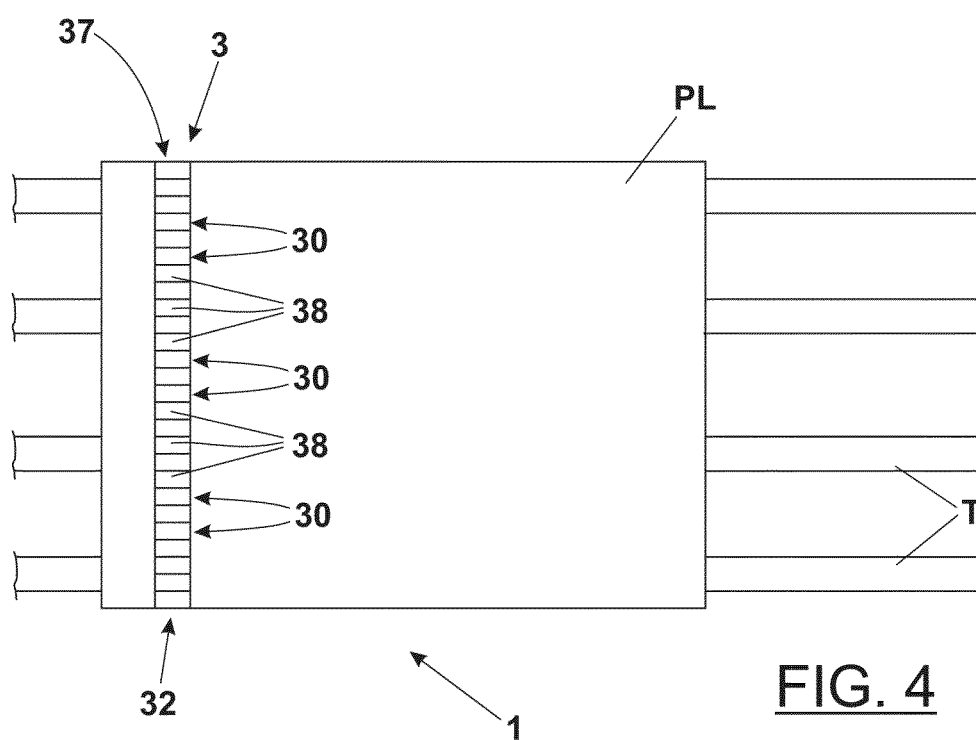
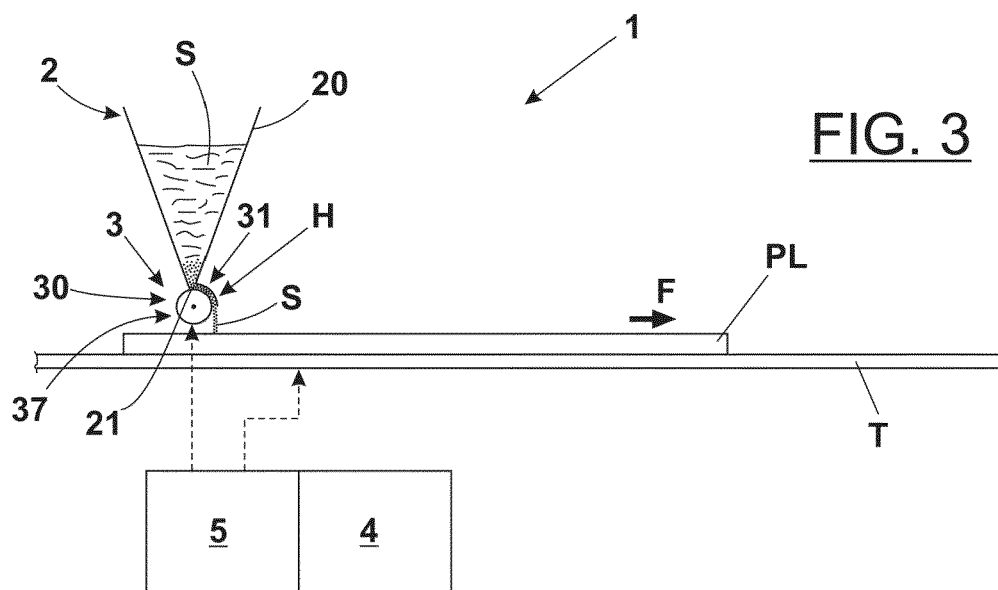
any powder enamel (S) drawn between one belt and the other, avoiding their deposit on the underlying ceramic tile or plate (PL).

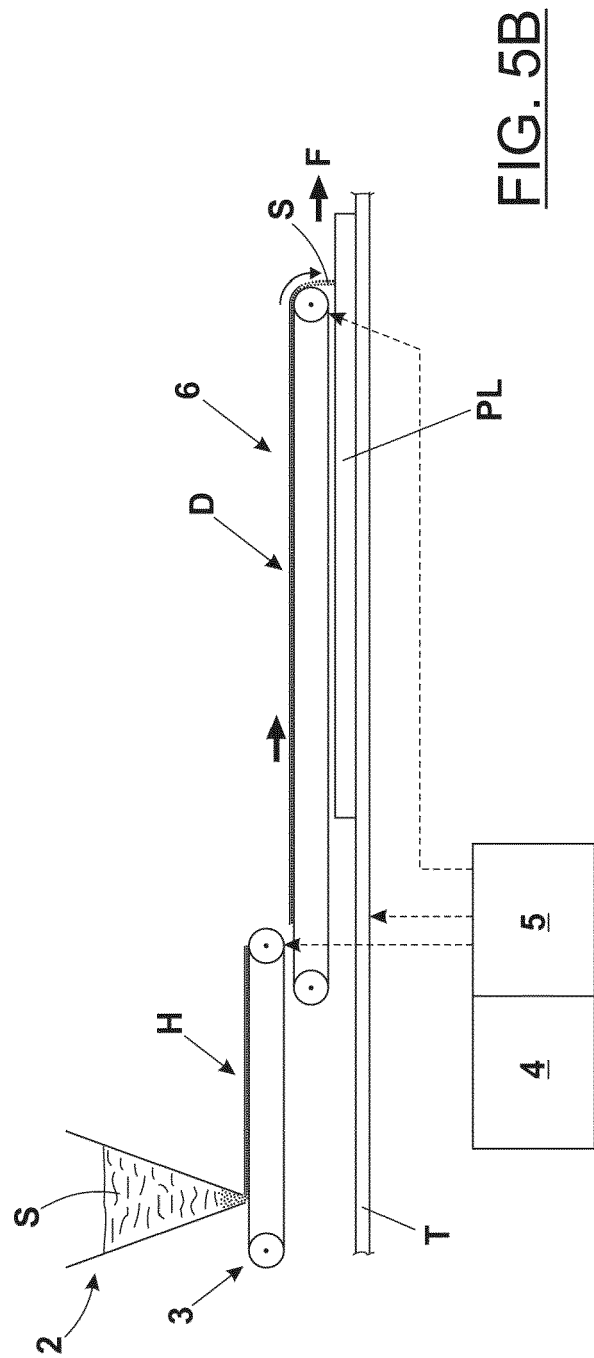
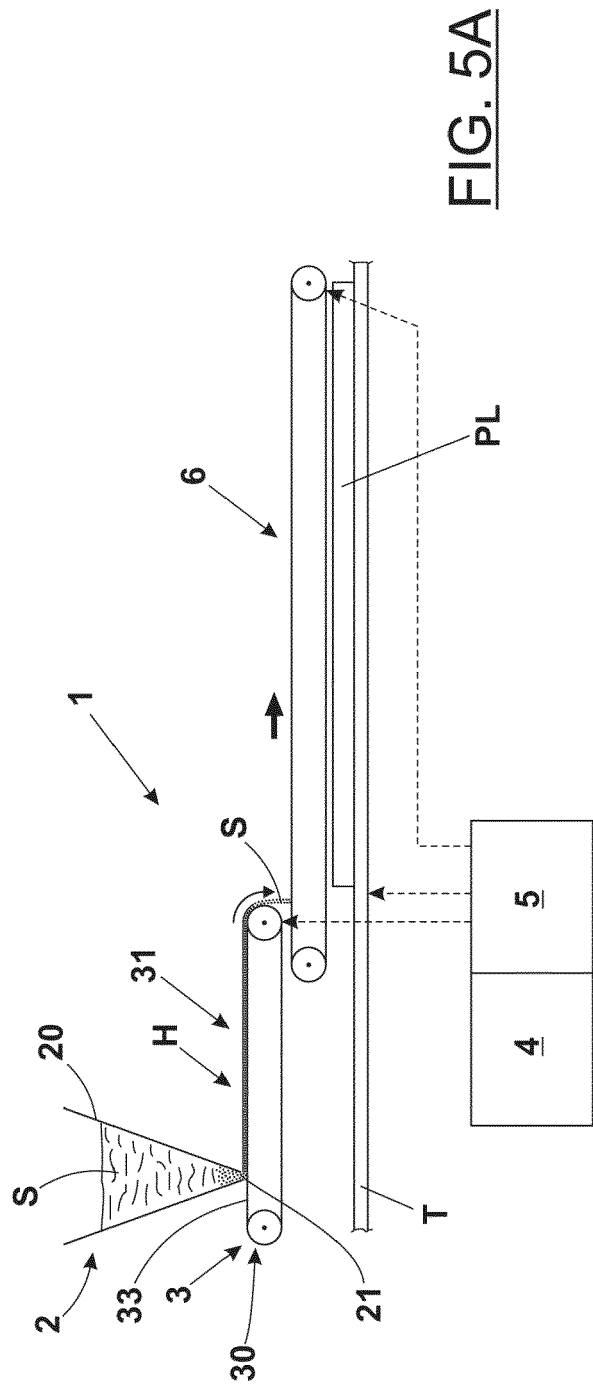
8. Applicator device according to the rev. 1, **characterized in that** in said metering unit (3) there is a partitioning device (7), associated with said plurality of conveyor elements (30), in the zone of these where the mentioned gravity drop of the dosed quantity of enamel takes place powder (S), with said partitioning device (7) equipped with at least one nozzle (70) for ejection of compressed air for each of said conveyor elements (30), which can be activated in phase relation with the activation of the latter for reduce the amount of falling enamel powder (S), directing an excess part (Se) to a recovery tile (71) suitably placed nearby.

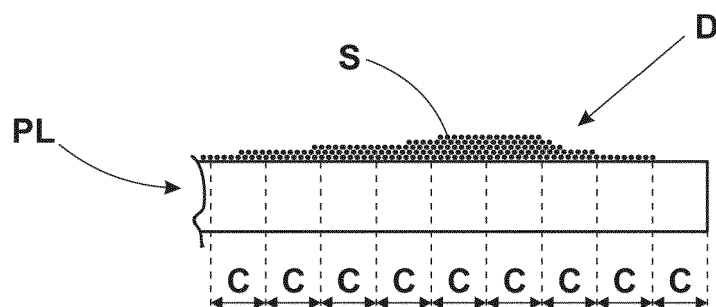
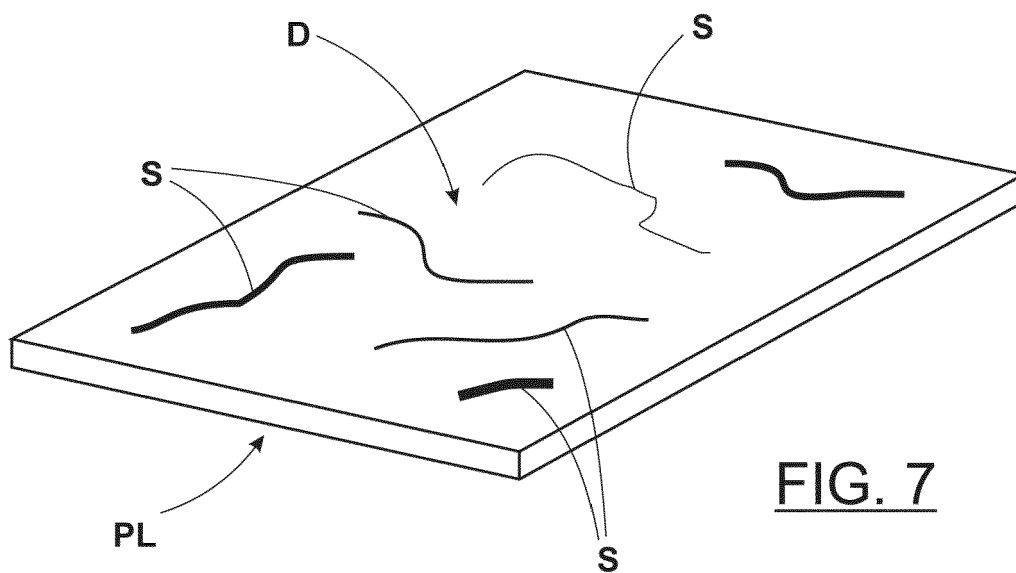
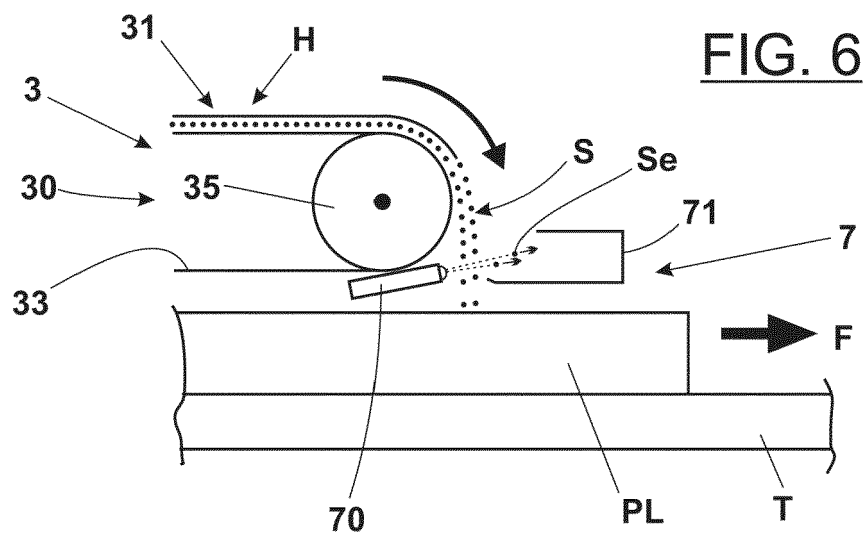
9. Applicator device according to any one of the preceding claims, **characterized in that** said mobile resting surface (31) has a width equal to or greater than that of said ceramic tile or plate (PL).

10. Applicator device according to any one of the preceding claims, **characterized in that** said layer (H) of powdered enamel (S), formed on the aforementioned mobile resting surface (31), has uniform thickness.











EUROPEAN SEARCH REPORT

Application Number
EP 19 20 2323

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 20 April 2020	Examiner Voltz, Eric
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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