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(54) Method and means for transfer of granular materials

(57) Transfer means of granular material (15) includes a permeable baffle (33) through which a fluid acts on said granular material; it further comprises a thin belt (31) on which the said granular material lies, said thin belt being unwound from a coil (39) arranged upstream the pressing station and being rewound in coil (39) downstream the said pressing station; a method to prepare a layer of powders designed to be pressed in form of ceramic tile comprises the following steps: arranging on a support surface superimposed layers (310,312) of different powders; acting with a fluid on said superimposed layers of different powders to mix them with each other along a vertical direction.

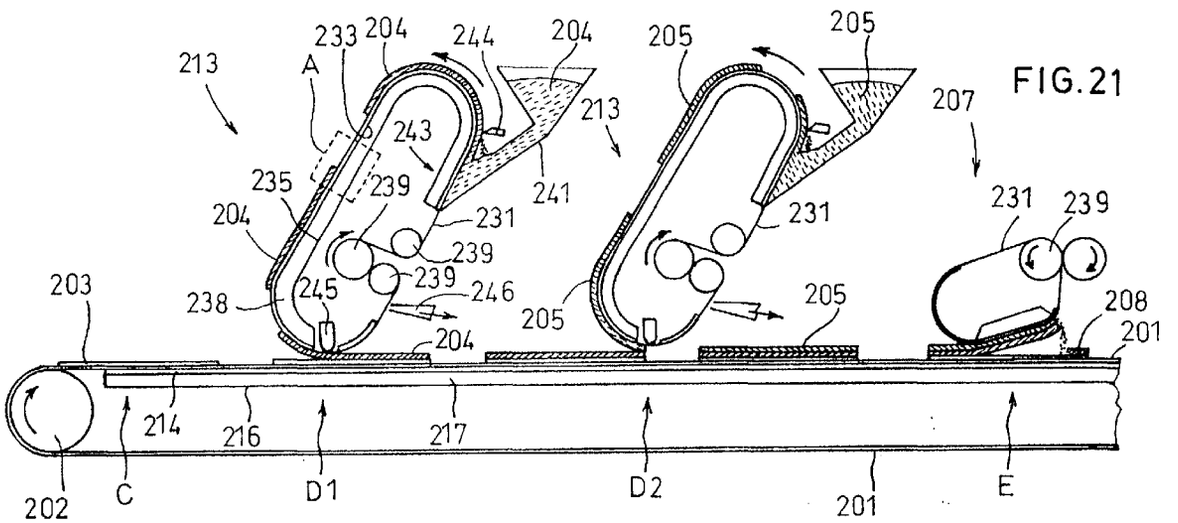

FIG.21

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Description

[0001] The invention relates to a method and relative apparatus for transferring in a controlled manner granular material on a support; in particular, the invention can be applied to the manufacturing of ceramic tiles to add on or take from them granular material.

[0002] In the context of the present description granular material means a loose product capable of flowing, constituted by powders, granules of any form and dimension, scales, small tesserae or any mixture of said pieces.

[0003] IT-B-1268908 discloses a system for decorating objects with a powdery decorating product, in which the decorating product is made to pass through the meshes of a silk-screen and is deposited on predetermined areas of a surface to be decorated.

[0004] PCT/EP94/04291 discloses a system in which a decorating product, in a powdery state, is incorporated in shaped cavities of a transport belt and is projected from the belt onto a surface to be decorated. These systems provide for the decorating product being incorporated in a suitable transfer means, i.e. a silk-screen or a belt, and then ejected from said transfer means; so wear of the silk-screen and changes in the granulometry of the decorating product have been found due to the sliding of the product on the transfer means; furthermore these systems are not suitable for treating granules having large dimensions. A problem occurring, when a layer of powders to be pressed is decorated, is the change of the layer thickness, which leads to a non-uniform pressing; the same problem occurs when the tile is to be shaped with a relief structured surface. Therefore there is a need to change the thickness of a layer of powders to be pressed in order to obtain a uniform pressing.

[0005] A purpose of the present invention is to improve the known decorating machines, particularly to make possible to reduce the strengths on the particles of decorating product, to change and control the thickness of decorating product to be applied, and to reduce wear of the silk-screens and/or the dies used, all that causing variability of the results.

[0006] An other purpose of the present invention is to make possible to decorate a support even with rough granular materials, preserving a good definition and without the need to recover the material distributed in excess.

[0007] A further purpose of the present invention is to make possible to change the thickness of a granular material layer in an easy and controllable way in order to obtain decorating effects on it.

[0008] Furthermore there is the problem of transferring the granular material to the mould for pressing ceramic tiles in a controllable way, i.e. by arranging in any way in the thickness and in the surface regions different granular materials even according to well defined patterns.

[0009] This requirement is particularly felt mainly after the recent sales-success of the so-called products of "porcelain gres", requiring the whole aesthetic effect of the surface is obtained during pressing without the aid of a coating applied later by glazing.

[0010] Therefore there is a problem in reproducing well defined and controllable decorations with granular material, complying with a high productivity, and without generating differences in the thickness of the layer to be pressed.

[0011] Different technologies have been taken into account to solve the above problem but all with remarkable difficulties of application.

[0012] A first technique described in IT-B-890769 was to use multiple loading carriages, but, said technique did not allow to obtain the required aesthetic effects and, in addition, extended substantially the pressing cycles.

[0013] IT-B-1146358 discloses a rotating die multiple mould press; in this case, even if there is the possibility of obtaining fair aesthetic results, remarkable financial commitments are required, special presses being required to be used. Furthermore the moulds are very bulky, expensive, complicated and it is almost impossible to use multiple parallel imprints.

[0014] A further system consists in the use of a double pressing: in the first pressing a semi-finished piece is obtained on which the decorating granules are to be spread and then the whole is subjected to a definitive final pressing; this technique, besides some restrictions in the aesthetic result, involves the use of a second press, that is somewhat onerous, complicated and not always possible due to space reasons.

[0015] Furthermore belt loading systems are known; these ones however do not ensure a controlled distribution of the granules because the filling of the mould space takes place with a certain displacement due to uncontrolled fall of the granules themselves, or, in other cases, there is an excess of granules around the mould that need to be collected and recycled.

[0016] Among the different technologies aimed to solve the said technical problem, a technology uses a decorating image under the form of decalcomania which is included directly into the tile pressing mould: this technology is described for example in the Italian patent 1287519 for industrial invention.

[0017] This method allows to have a good definition of the decoration but involves a considerable increase of the costs because, first of all, the insertion of the decalcomania into the mould has to be done before or after the insertion of the powder constituting the tile body; more operations are therefore needed to load the mould which increase greatly the duration of the working cycle.

[0018] On the other hand, the cost is further increased because said decalcomanias have to be previously prepared by specialised external companies with all the consequent problems for supplying, transporting, storing, etc.

[0019] It is an object of the present invention to overcome and solve the problems just described, i.e. to per-

mit the insertion of a decorating layer, for example a decalcomania, into a pressing mould at the same time as the powder constituting the tile body is inserted, with working cycles substantially equal to the cycles for a normal tile without decorations.

[0020] An other object of the present invention is to allow said decalcomania to be obtained directly during the production cycle related to the pressing.

[0021] A further object of the present invention is to obtain an apparatus, which may be applied to the more widely used presses for forming ceramic tiles, i.e. presses having moulds with lower die, side die and punch always in axis, said apparatus allowing, during a production cycle with single pressing, a filling of the mould space without relative displacements among the granules, i.e. allowing different granular materials to be introduced into the mould in a single filling operation, even according to patterns well defined in the stratification and at the surface, without the presence of excess of powder to be recycled and without loss of productivity.

[0022] Being the decorations constituted by a number of layers of powdery decorating materials overlapping one another, a further drawback is that, due to the wear caused by the trampling on the tiles of the floor, the materials that form the upper layers are removed in a more extensive manner than the lower layers, the appearance of the decoration being so changed.

[0023] This drawback is still more serious when, as a result of polishing (as it occurs often), a large quantity of the surface layers is removed, which involves an unacceptable change of the aesthetic appearance.

[0024] In an attempt to resolve this last problem, the industrial patent application RE96A000004 proposes a method for transferring at the inside of the mould cavity the superimposed layers of the decorating powders, causing them to fall, by gravity, from the end of a conveyor belt and to mix with each other during the fall through sliding over some deviating baffles.

[0025] This method presents a first drawback because this operation may be performed only on the layers of the decorating powders, so that the basic layer has to be previously introduced into the mould. Therefore, with usual fixed presses, two distinct mould loading phases are required, largely extending the working cycles. Furthermore, with such a method, it is not possible to introduce at the same time also the basic layer, because the decorating powders would be mixed through the full thickness of the tile, and widely spread. A second drawback consists in the fact that, however the belt roll is small and the fall distance short, a wide spread of the powders will be present in any way, not permitting an acceptable pattern definition.

[0026] A further purpose of the present invention is to improve the described technology in order to overcome its drawbacks, first of all, to allow a mould to be loaded in only one loading operation, with a well defined and controlled stratigraphical and plan arrangement of different powders and then with the possibility of mutually mixing along a vertical direction the different layers of powder in a controlled and selective way, i.e. just only in a portion of the thickness or in a selected portion of the plan surface.

[0027] In a first aspect of the present invention, there is provided transfer means of granular material, including a permeable baffle through which a fluid acts on said granular material.

[0028] In a second aspect of the present invention, there is provided a method for transferring granular material, comprising acting with a fluid on a granular material through a permeable baffle.

[0029] In a third aspect of the present invention, there is provided transfer means for transferring granular material to a pressing station for ceramic tiles comprising a thin belt where said granular material lays, said thin belt being wound off a spool arranged upstream the pressing station and rewound on a spool downstream the said pressing station.

[0030] In a fourth aspect of the present invention, there is provided a method for preparing a layer of powders designed to be pressed in form of ceramic tile, characterised in that it comprises the following steps:

arranging superimposed layers of different powders on a support surface;
acting with a fluid on said superimposed layers of different powders in order to mix them mutually along a vertical direction.

[0031] The invention would be better understood and carried into effect with reference to the enclosed drawings, which illustrate embodiments of the invention that are exemplifying but not limiting, where:

Figure 1 is a vertical section of a decorating apparatus;
Figure 2 is a side view from the left of figure 1;
Figure 3 is a detail, enlarged, sectioned and broken, of a lower region of a hopper for unloading a powder decorating product with associated ejecting means of a transport fluid;
Figure 4 is a detail, enlarged, sectioned and broken, of a portion of a support on which granules of decorating material are projected;
Figure 5 is a section as in Figure 3, but concerning an embodiment in which particles of decorating product are kept by an air stream hitting the unloading region of the hopper;
Figure 6 is a section as in Figure 5, but during the fall of the product towards the support;
Figure 7 is a section as in Figure 1, but concerning a further embodiment of the decorating apparatus;
Figure 8 is a section as in Figure 1, but concerning a still further embodiment of the apparatus;
Figure 9 is a vertical schematic section of an apparatus for transferring granular material;
Figure 10 is an enlargement of the detail highlighted

in the frame A of Figure 9;
Figure 11 is a vertical schematic section as in Figure 9, but concerning a different embodiment.
Figure 12 is a side schematic view, with sectioned and broken portions of the apparatus according to the invention, used for loading a pressing mould by means of drawer transfer means, at the end of the loading step of the drawer transfer means.
Figure 13 is a partial view of the apparatus as in Figure 12, during a translation step of the drawer transfer means.
Figure 14 is a view of the apparatus as in Figure 13, during a mould loading step.
Figure 15 is a view of the apparatus as in Figure 13, during a return step of the drawer transfer means.
Figure 16 is a view of the apparatus as in Figure 13, during the loading step of the drawer transfer means.
Figure 17 is a view of the apparatus as in Figure 12, but in a different embodiment.
Figure 18 is a partial view of the apparatus as in Figure 17, during the loading step of the drawer transfer means.
Figure 19 is a view of the apparatus as in Figure 17, during a translation step of the drawer transfer means.
Figure 20 is a view of the apparatus as in Figure 17, during a mould loading step.
Figure 21 is a schematic and broken side view of a first portion of the apparatus as in Figure 17, concerning a variation according to the invention.
Figure 22 is a schematic and broken side view of a second portion of the apparatus to completing Figure 21.
Figure 23 is a sectioned side view, very enlarged, of the detail in the frame B of Figure 22.
Figures 24, 25 and 26 are views of the apparatus of Figure 22, however in different operating steps.
Figure 27 is a schematic side view of a variation of the apparatus according to the invention.
Figure 28 is a schematic side view of a further variation of the apparatus according to the invention.
Figure 29 is a schematic side view of an apparatus according to the invention in an application to mutually mix different layers of superimposed powders.
Figures 30, 31 and 32 represent three different variations of the apparatus of Figure 29.

[0032] With reference to Figure 1, a hopper 1 containing a flowable decorating product 2, for example a granular or powdery product, is provided with a lower opening 3 large enough to let the product 2 be discharged, in such a way it can be projected on a support 4, movable along a direction F. Below the opening 3 an obturator element 5 is arranged, capable of partially obstructing the outflow of the product 2 from the hopper 1, leaving a gap 6 of height H in which the product 2 is already outside the hopper 1 and is ready to be projected towards the support 4. Ejecting means 7 are provided at a side of the gap 6, said ejecting means having an ejecting nozzle 8 capable of directing a stream of a transporting fluid, for examples compressed air, towards the gap 6 in such a way as to force the product 2 which is in the gap 6 to be discharged at the opposite side, where a downwardly-bent deflecting baffle 9 directs the product towards the support 4.

[0033] The ejecting nozzle 8 is provided with an end turned towards the gap 6 on which end a selective screen 10 is caused to pass.

[0034] As one can see in Figures 2 and 3, the screen 10 is provided with barrier regions 11, that is regions through which the transport fluid can not pass, and regions 12 permeable to the transport fluid, through which the transport fluid can easily pass and act on the product 2, which is in the gap 6, in order to transport it.

[0035] The screen 10 is flexible, so that it can be wound on roller means 13, supported in a free to rotate manner below the ejecting means 7, and on a motorised roller 14, arranged above the ejecting means 7. The screen 10, for example, can consists of a usual silk-screen with any pattern defined by the permeable regions 12.

[0036] Therefore, the transport fluid ejected by the ejecting nozzle 8, moves from the gap 6 mainly the product 2 facing the permeable regions 12, so defining a corresponding decoration on the support 4.

[0037] As can be seen in Figure 4, the support 4 can be yielding, for example consisting of powders defining a soft layer: in this case the product 2 can hit the upper surface of the support 4 with enough strength to let the particles 15 of the product 2 penetrate into the layer of the support 4.

[0038] As can be seen with reference to Figures 5 and 6, the obturator element 5 may be inclined in such a way as to have a side 16, remote from the nozzle 8, substantially matching the opening 3 to prevent the product 2 from being discharged from that side, and another side 17, near to the nozzle 8, closer to support 4 than the remote side 16.

[0039] In this way, the compressed air ejected from the nozzle 8 stops the fall of the product 2 from the opening 3 onto the permeable regions 12 but do not prevents the product 2 from falling onto the barrier regions 11 of the support 4.

[0040] As shown in Figure 7, the ejecting means 7 may be substantially placed over the opening 3 in order to reduce the fall distance K of the product 2 to a minimum. In that event, it is necessary to provide a further deflecting baffle 18, associated with the deflecting baffle 9 and able to direct the transport fluid towards the opening 3 and to define, together with the wall 9, a S-shaped duct originating from the nozzle 8 and through which the product 2 dragged by the transport fluid flows. In this embodiment, when the action of the transport fluid is interrupted, the product 2 has to stop its fall motion

through the hopper 1, due to its own friction angle.

[0041] The ejecting means 7 are provided with holes 23 in order to support the rollers 13 on an air cushion .

[0042] In the embodiment of Figure 8, the opening 3 is kept adherent to a side of the screen 10 and, at the opposite side, suction means maintain, in a chamber 19, an enough pressure drop p- to assure the adherence between the particles 15 of the product 2 and the screen 10 at the permeable regions 12 thereof. The screen 10 is wound on a pair of rollers 20, through which the air can be sucked, and on a roller 21, external to the chamber 19, defining, together with one of the rollers 2, a horizontal path stroke for the screen 10. When moving along the direction Q, the screen 10 passes under a wall 22, surrounding the chamber 19 under pressure drop, and beyond which the product 2 is no more kept adherent to the screen 10 by the pressure drop p- and falls on the support 4, decorating it.

[0043] With reference to the Figures 9 and 10 a screen 31, constituted by a weft of wires 32 forming a endless belt, leans, in a portion of its route, against a permeable wall 33, consisting of a wall provided with a number of through holes 34; the screen 31 having permeable regions 36 and non-permeable regions 37.

[0044] The permeable wall 33, together with other non-permeable walls 35, surrounds a chamber 38 into which a pressure drop P- is kept by known means, not shown.

[0045] In the portion of the route not in contact with the permeable wall 33, the screen 31 is wound on rollers 39 capable of moving the screen 31 sliding on the permeable wall 33, in a controlled and synchronised manner with an underlying support 40.

[0046] In the upper side there is a container 41 having inside the granular material 42; at the bottom, said container is provided with a opening leading near to the screen 31 in the route portion where the chamber 38 is present: in this portion therefore, the granular material will be attracted by the permeable regions 36 of the screen 31 and here will stay adherent for a certain thickness S. In order to avoid an undesired dragging of granules 42 over the not permeable regions 37 of the screen, it is advantageously provided that, near the collecting region 43 from the container 41, the active side of the screen 31, designed to adhere to the granular material 42, is turned downwards.

[0047] The collected granular material that rises adherent to the screen 31 will be automatically and continuously replaced by natural sliding fall from the container 41. Over the collecting region 43, can be advantageously placed a scraping blade 44 in order to level the layer of granular material 42. Along the whole downward route of the screen the granular material 42 is kept adherent due to the presence of the chamber 38 in pressure drop, while, downwards, near the support 40, the granular material remains n on the support 40 due to lack of pressure drop and gravity effect; the transfer can be aided through the action of other means as for example a body 45, having a suitable vibration and in contact to the screen 31.

[0048] Before the rollers 39 a cleaning system of the screen 31 can be advantageously placed, for example a sucking mouth 46.

[0049] The screen 31 can work away from the support 40 but may also work in contact with it. This second possibility is very advantageous when said support 40 is constituted by a layer of another granular material; in this case the granular material 42 will penetrate into the support 40, keeping it levelled and furthermore the pattern will result better defined due to the absence of falling and sliding of said granular material 42. Said penetration can be achieved by forcing said material 42 into the levelled support 40, in such a case the granular material 42, displacing automatically the other granular material of the support 40, replaces it and keep it levelled, or said penetration can be achieved introducing said granular material 42 into cavities 49 already provided in the support 40.

[0050] As represented in Figure 11, the invention is used to take in a selective manner granular material from an underlying support 40; in such a case the taken granular material 47 can be easily recycled causing it to fall into an upstream distributing device 48; this use is particularly useful to modify in a controlled manner the thickness of a layer of granular material, or to obtain said cavities 49, in which a different material may be introduced.

[0051] It is pointed out that the invention allows an effective control of the dosing of the granular material simply regulating the pressure drop level in the chamber 38; for example, using:

- a screen 31 with 1296 meshes per cm2 consisting of wires having a diameter of 0.12 mm;
- a granular material 42 having a specific weight of 1.8 g/cm^3 and a dimension of the granules between 0.6 and 1 mm;
- a pressure drop of 500 Pa (about 51 mm H_2O) in the chamber 38;
- a layer of granular material 42 having thickness S of about 1.5 mm may be transferred; the thickness S may be reduced or increased by increasing or reducing the pressure drop.

[0052] The invention can be carried out in different forms, for example: with movable or stationary planar screens, with drum-shaped screens, for applications on the movable support 40 (as in the explained examples) or stationary. In this last event, since the support 40 is stationary, the apparatus will be caused to translate.

[0053] The invention is also suitable for transferring material in form of great scales or tesserae without real limits of dimension, particularly valuable aesthetic effects being obtainable using these materials, as for example mosaic surfaces or imitations of natural stones.

[0054] The apparatus 101 (Figure 12) includes a belt

102 of permeable to air material, for example of thin metal mesh or texture material, said belt, having on its external surface some separating walls 103 forming compartments of dimensions corresponding to the dimensions of the tile 104, is moved in a controlled way by rollers 105.

[0055] Starting from the initial portion of said belt, are present:

- a feeder 107 of granules 108 forming a base layer;
- an apparatus 109 for transferring granules, that takes a surface portion of the granules 108 in a selective manner bringing the granules again into the feeder 107, forming some cavities 110;
- an apparatus 111 for transferring granules, capable to deposit on the basic layer 108 a different granular material 112;

a terminal portion 113 of said belt 102 co-operating with feeding drawer transfer means 114.

[0056] On the said terminal portion 113 of said belt 102 is therefore formed a bulk of granules 114a having a plurality of components arranged in different layers.

[0057] Said drawer transfer means 114 includes a porous diaphragm 115 overhung by a chamber 116 suitable for being depressurised by well known means, not shown, and enclosed by side walls forming a frame 117 axially movable with reference to said porous screen 115.

[0058] The drawer transfer means 114 is horizontally movable from a position overhanging the terminal portion 113 of the belt 102 (as in the Figures 12, 16, 17 and 18) to a position at the inside of the mould 118 in its open configuration (as in the Figures 14 and 20).

[0059] Said mould 118 is constituted by a lateral frame die 119, a lower punch 120 and an upper punch 121; obviously a mould of the type known as "double mirror" may also be used, that is a mould with two axially movable side matrices or also any other suitable mould.

[0060] In each drawing and translating cycle of the drawer transfer means 114, the belt 102 advances one step, discharging the exceeding granular material 108 and bringing a new portion of the granules bulk 114a in a suitable position for drawing.

[0061] In the Figures from 17 to 20 a variation of the apparatus without dividing walls 103 is shown, so that on the belt 102 a continuous layer of granules 108 is formed, while different granules 112 and 112a are placed only in the regions designed to be taken by the drawer transfer means 114; in this event the lateral walls 122 of the drawer transfer means 114 are relatively thin, that is capable of penetrating into a bulk of granules 108 without throwing it appreciably into disorder, or are shaped so has to have a wedge-shaped transversal section, having a tip facing downwards.

[0062] In this version some excesses of granules 123 are produced that may be directly recycled in to the feeder 107, the said excesses 123 not being polluted by the different granules 112 and 112a; A possible inconvenience due to the installation of a transfer means for said excesses of granules 123 is completely counterbalanced if the apparatus is designed to the production of different tile formats. In this event the mechanical operations to change the format are actually simple and fast, because only the frames 122 are to be replaced and the granule transfer means 109, 111 are to be adjusted, if the case may be; to that purpose, there is provided fixing said lateral walls 122 to the structure of said permeable wall 115 in a removable manner in such a way as to allow an easy substitution.

[0063] As can be seen in Figure 19, during the translation of the drawer transfer means 114 a lower trimming on the granules 108 may be performed, to remove a possible excess of granules or to level the surface through a scraper 124, such material automatically mixing with the other excesses of granules 123.

[0064] With reference to the Figures 21, 22, 23, 24, 25 and 26 the apparatus includes an endless belt 201 in a material permeable to the air wound on rollers 202, at least one of them being provided with members for the rotation, not shown.

[0065] Starting from the left side there are:

a station C where a low permeability layer formed by a support sheet 203 is deposited on the belt 201,
a decorating station D1, suitable for applying on said support sheet 203 the layer of decorating granular material 204,
a decorating station D2 suitable for applying the layer of decorating granular material 205,
a station E, provided with a device 207 for mixing said decorating layers 204, 205 with each other to transform them in a bulk 208 having a modified stratification; such a bulk 208 together with the support sheet 203 constitutes a so-called decalcomania 209,
a station F1, provided with means 206 capable of covering the said decalcomania 209 with a layer of powders 210 constituting the base layer of the tile 211,
a terminal station G of the belt 201, co-operating with drawer transfer means 212.

[0066] The upper branch of the said belt 201 may be advanced step by step to the right with a step width equal to the distance between each station and next one. Of course there may be present a plurality of decorating stations D1, D2 each provided with decorating means 213 capable to apply further decorating materials 204, 205. Such a decoration can be obtained from powdery or granular material at a dry state, as in the example, or from powdery or granular material kneaded with a liquid mean according to well known technologies; in the first case there will be preferably a subsequent station (not shown) to fix the said decorating materials, for example by applying a fixing agent, in the sec-

ond case there will be preferably a subsequent dry station (not shown).

[0067] As pointed out in the Figures 21, 22 and 23 the whole portion of the belt 201 from the station C to the station F1 lays on a permeable support 214, for example due to presence of the small holes 215; the said support 214 together with a sealing wall 216 bounds a chamber 217, in which a light pressure drop is maintained through well known means, not shown. Such a pressure drop has the function to maintain steadily in its position on the belt 201, the sheet 203 and the respective decalcomania 209.

[0068] The transfer means 212 is constituted by a permeable wall 218, overhung by a chamber 219 suitable for being depressurised through well known means, not shown, and by lateral walls projecting downwards and forming a relatively thin, or "wedge" shaped, frame 220, that is walls capable to penetrate into the powder layer 210 without appreciably throwing it into disorder.

[0069] Said drawer transfer means 212 may be translated from a position overhanging the terminal station G of the belt 201 (as in the Figures 22 and 24) to a position at the inside of the open mould 221 (as in the Figures 25 and 26) Said mould 221 is constituted by a side frame-shaped die 222, a lower punch 223 and an upper punch 224; obviously a mould of the type known as "double mirror" may be used, that is a mould with two movable side dies or any other suitable mould.

[0070] At each cycle of drawing and translation of the drawer transfer mean 212, the belt 201 advances one step unloading the excess 224 of powders 210 and bringing a new decalcomania 209 with respective layer of powders 210 to a drawing position.

[0071] The pressure drop in the chamber 219 is activated during the drawing step (Figure 24), is maintained during the translation step (Figure 25) and is deactivated during the unloading phase in the mould 221 (Figure 26).

[0072] The combination just described, that is the transfer of the powder layer 210 and the low permeability layer by means of said pressure drop apparatus 212, is particularly effective and congenial, because, forming said low permeability layer a substantially impermeable wall, the powders 210 may be supported at the inside of the apparatus by a "static pressure drop" of minimum value. In absence of the said low permeability layer it would be necessary a higher pressure drop and of dynamic type for supporting the powders 210, that is a pressure drop with a continuous air flow through the powders 210, which could produce separations between the different granular components of the powders 210 and decomposition of the aesthetic aspect of the decoration.

[0073] It may be also advantageous to replace the decalcomania 209 with a thin sheet of paper or plastic material, or a low permeability layer, designed to form said substantially impermeable wall to support the powders 210, while the decorating materials may be arranged in different position, for example on the powders 210 and directly in contact with the permeable wall 218.

[0074] Obviously a number of modifications of practical application nature may be applied to the present invention, without departing from the limits of the inventive idea as claimed. For example:

[0075] The decalcomanias 209 may be prepared in advance so that the stations D and E may be omitted.

[0076] The transfer equipments may be of any known type, for example capable to move the terminal portion of the belt 201 from an external position to an internal position in the mould 221, the mould being opened so that the decalcomania 209 with its layer of powders 210 may be arranged in it.

[0077] The pressing may be made directly on the belt 201, in this case the transfer apparatus being constituted by the belt 201 itself.

[0078] The sheets 203 may have a peripheral plan dimension like that of the tile 211, but may be constituted also by a thin continuous belt, for example of heat-fusible plastic material that, in such a case, may be automatically cut to a given dimension by the same frame 220 heated to a suitable temperature.

[0079] In a further variation shown in Figure 27, said thin continuous belt 225, lying on the belt 201 during the passage under the various stations D, E, F1, is dragged into the open mould 226 together with the decorating material 204, 205 and the powders 210; in such a case said thin continuous belt 225 is not cut and can therefore be detached and wound as a coil 227 downstream the mould after pressing has occurred. Said thin continuous belt 225 may have a thickness of some hundredths of millimetre or a fraction of hundredth of millimetre, such a configuration beyond the advantage of a low cost (mainly if it consists of material recoverable by recycling) allows the tile surface to be obtained having a shape exactly matching the profile of the underlying die 228 as in a usual mould, without being even necessary cleaning operations of the die 228 itself. Said mould 226 is provided with a side frame 229 able to penetrate into the powder 210 without substantially throwing it into disorder.

[0080] Since this particular type of mould 226 forms the tiles with a downward extraction, it is possible to obtain the spacer of the tile only in the lower side of the edge, so that the visible side of the tile 211 will be preferably the upper side. Therefore, with reference to the Figure 27, it may be advantageous to arrange the decorating layers 204, 205 on the base layer 210. As shown in Figure 28, the low permeability layer may be achieved distributing on the belt 201 a first layer 253 of powdery material 254, preferably on isolated regions with a peripheral extension corresponding to about the peripheral dimension of the tile 211.

[0081] Said powder material 254 will not necessarily be constituted by decorating materials but may be the same material 210 suitable to form the body of the tile 211, or may be an other material with characteristics

particularly suitable to the treatment to which it has to be submitted and to the function it has to carry out.

[0082] The layer 253, submitted to a compacting action by being caused to pass between the rollers 255 in order to form the low permeability layer 256, is then covered by the powder 10 and by decorating layers 257, if any. The packet of layers so arranged is then drawn by the drawer transfer means 212 and transferred to the mould 221, as already described.

[0083] The advantage of such a version consists in the fact that, even if the transfer means 212 works with a "static pressure drop", there is no foreign material that has to be detached and removed from the pressed tile 211, because said layer 253 constitutes an integral portion of the tile 211; furthermore, the compacting of said layer 253 is particularly easy because said layer has a small thickness so that rollers of great diameter are not necessary; considerable pressing forces are not necessary because the area subjected to pressing is somewhat limited.

[0084] Furthermore, the small thickness of the layer 253 allows a good compacting to be obtained in the peripheral regions of the said layer even without lateral containing walls for the powder.

[0085] The belt 201, in this version, can be also advantageously split into two portions, a first portion having a non-permeable surface where the compacting takes place and a second portion having a permeable surface, in order to make easier the working of the transfer means 212.

[0086] The low permeability layer may be obtained by treating the layer 253 with appropriate impermeabilizing substances.

[0087] With reference to the Figure 29 the invention can be used as mixing apparatus 313 of layered powders, such an apparatus, placed closely above the layer to be modified, during the motion of relative translation, raises the surface layers and leaves them fall subsequently in a downstream position. The particular substantially vertical orientation of the layers when they detach from the screen 331, favours an optimal mixing of the layers during the fall; furthermore, since the fall may be very limited, the plan disposition of the decoration will be thrown into disorder only to a minimum extent. By using the screen 331 with both permeable regions and non-permeable, the mixing may be obtained only on a selected portion of the layers and/or at different depths, so obtaining special aesthetic effects.

[0088] In Figure 31 a mixing device is shown constituted by an ejector 350 provided with an opening shaped as a thin slot 351 arranged transversally with respect to the direction of movement of the underlying layers; if a suitable air is caused to flow through the said slot 351, a mixing of the surface layers will be produced; some of the surface particles will be deeply throw, while some of the deeply placed particles will raise at the surface.

[0089] As shown in Figure 30, a permeable screen 331 is associated to said ejector 350, said screen running on a sliding wall 352 and passing under the said ejector 350, such a configuration offering a first advantage consisting in that a selective mixing can be made even in this case, using the screen 331 provided with both permeable and impermeable regions; furthermore, in this case, the ejector slot 351 may be also disposed in a lower position interfering with the layers 310, 312, without producing accumulations of powder because the screen 331 will drag the powder forward; in addition, said arrangement is particularly advantageous because an excessive volatility of the surface powders is avoided.

[0090] In Figure 32 a mixing device is shown consisting of a fluid bed route portion on the belt 302. From below the belt 302, constituted by permeable material, as already explained, air is blown, keeping a certain amount of pressure inside a chamber 353. The belt 302 slides over the said chamber 353, that is stationary; the air causes a mixing of the layer of powders while goes up, passing through the whole layer; obviously, in this case, also the most deep particles of the layer will be involved in the mixing and sometimes that can be advantageous, if, for example, the decorating powders are applied directly on the belt 302 or are arranged in a middle layer and covered by a base powder layer 305; with the treatment of fluid bed mixing the decorating powders will be distributed at the inside of the whole overhanging bulk and at the surface, with shades of agreeable effects.

[0091] The mixing devices 313 can be used also in conditions different from those up to now described, for example they can be used for applications on an already pressed or fired material or to form decalcomanias or again a layers of powders already loaded in a mould can be mixed. Furthermore, the layer to be mixed can be kept stationary while the mixing device 313 translates.

[0092] The apparatus according to the invention makes possible therefore to obtain an optimal and uniform loading of the mould in a single step, making possible, in addition, to apply an unlimited number of different decorating layers with well defined patterns and to mix them with each other in a controllable and selective manner, which is particularly productive and advantageous.

[0093] The apparatuses and means, described above according to specific configurations and combinations, may be an object of protection individually, or in any combination with parts or equipments in any way included in the present description.

Claims

1. Transfer means arranged for transferring a granular material, including screen means through which an operating fluid acts on said granular material.

2. Transfer means according to claim 1, wherein said

screen means includes regions non-permeable to said operating fluid.

3. Transfer means according to claim 1, or 2, wherein said screen means is surrounded by frame means suitable for containing said granular material.

4. Transfer means according to any of preceding claims, wherein said screen means is arranged in the form of a endless belt.

5. Transfer means according to any of preceding claims, wherein said screen means communicates with chamber means in which said operating fluid is contained.

6. Transfer means according to claim 5, wherein said chamber means are provided with at least one opening through which said operating fluid flows out said chamber means to act on said granular material.

7. Transfer means according to claim 5, wherein said chamber means are provided with at least one opening through which said operating fluid is drawn back into the said chamber means in order to withdraw said granular material.

8. Transfer means according to claim 6, or 7, wherein said at least one opening is arranged adjacent to an efflux opening of container means in which said granular material is contained.

9. Transfer means according to claim 8, wherein said efflux opening is turned towards said screen means in a region of said screen means having an outer face facing downwards.

10. Transfer means according to any of preceding claims and further comprising support belt means arranged to support said granular material.

11. Transfer means according to claim 10, wherein said belt means includes projections suitable to define compartments for containing said granular material.

12. Transfer means according to claim 10, or 11, wherein said supporting belt means defines said screen means.

13. Transfer means according to any of claims 10 to 12, wherein at least two initially distinct layers of said granular material are arranged on said belt means.

14. Transfer means according to any of claims 10 or 11, or 13 when depending on claims 10 or 11, wherein said screen means is arranged above said granular material.

15. Transfer means according to any of preceding claims, wherein said screen means are movable in order to be introduced in a mould suitable for forming ceramic tiles.

16. Transfer means according to any of preceding claims, wherein said granular material include one layer substantially non-permeable to said operating fluid.

17. Transfer means according to claim 16, wherein said substantially non-permeable layer includes ceramic material.

18. Transfer means according to claim 17, and further comprising means for forming said substantially non-permeable layer.

19. Transfer means according to claim 18, wherein said means for forming said substantially non-permeable layer comprises means for distributing decorating means on a sheet support.

20. Method for transferring granular material comprising acting with an operating fluid on a granular material causing said operating fluid to pass through permeable regions of screen means.

21. Method according to claim 20, wherein said granular material is peripherally contained by frame means.

22. Method according to any of claims 20 or 21 wherein the said acting comprises blowing said operating fluid through said screen means.

23. Method according to any of claims 20 to 22, wherein said acting comprises sucking said operating fluid-through said screen means.

24. Method according to claim 22, or 23, wherein said acting takes place near an efflux opening of container means in which said granular material is contained.

25. Method according to claim 24, wherein said acting takes place while said screen means have one of their outer faces interacting with said granular material and facing downwards.

26. Method according to any of claims 20 to 25, wherein said acting takes place while said screen means supports said granular material.

27. Method according to any of claims 20 to 25, wherein said acting takes place while said screen means lies above said granular material.

28. Method according to any of claims 20 to 27, wherein said granular material is distributed in at least two layers.

29. Method according to claim 28, wherein said granular material is submitted to the action of said operating fluid in such a manner that said at least two layers are at least partially mixed with each other.

30. Method according to any of claims 20 to 29, wherein said acting comprises transferring said granular material into a mould for forming ceramic tiles.

31. Method according to any of claims 20 to 30, and further comprising providing said granular material with a substantially non-permeable layer.

32. Method for transferring granular material to a pressing station for ceramic tiles, comprising arranging said granular material on thin belt means, unwinding said belt means from a coil arranged upstream the pressing station and rewinding said belt means in form of a coil downstream the said pressing station.

33. Method to prepare a layer of powders designed to be pressed in the form of ceramic tile, characterised in that it comprises the following steps: arranging on a support surface superimposed layers of different powders; acting with a fluid on said superimposed layers of different powders in order to mix them with each other.

34. Method to prepare powders suitable for forming ceramic products comprising arranging at least one layer of powders on supporting means, selectively removing upper regions of said at least one layer to obtain cavities in said at least one layer, then filling said cavities with further powders.

35. Method according to claim 34, or 33, or 32, and comprising the use of means according to one or more of preceding claims.

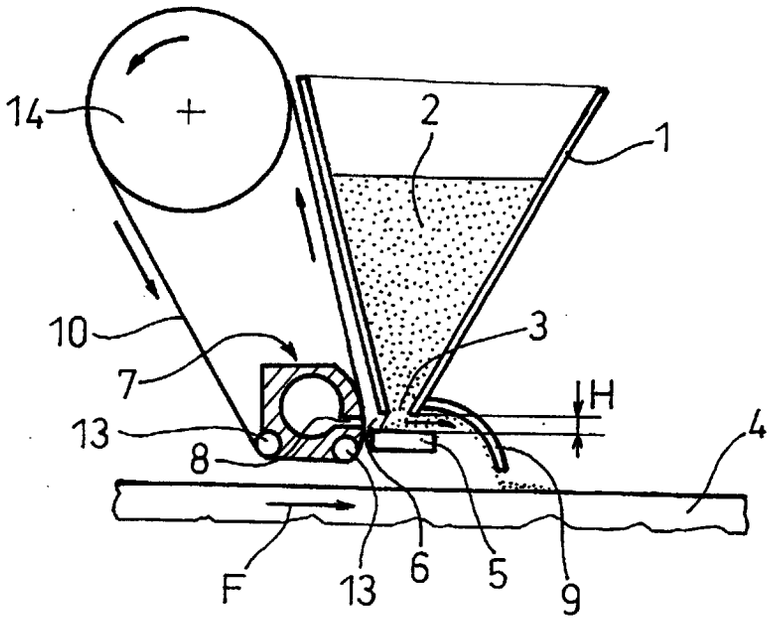

FIG.1

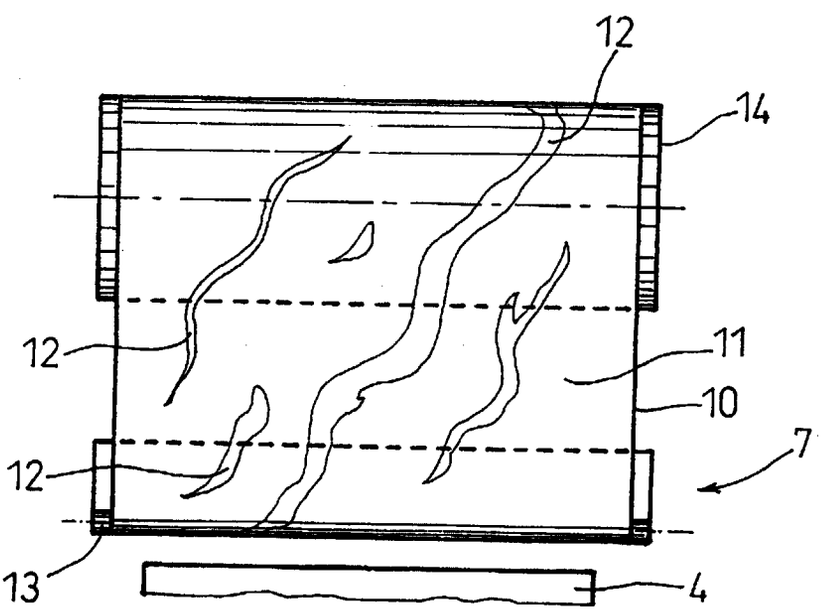

FIG.2

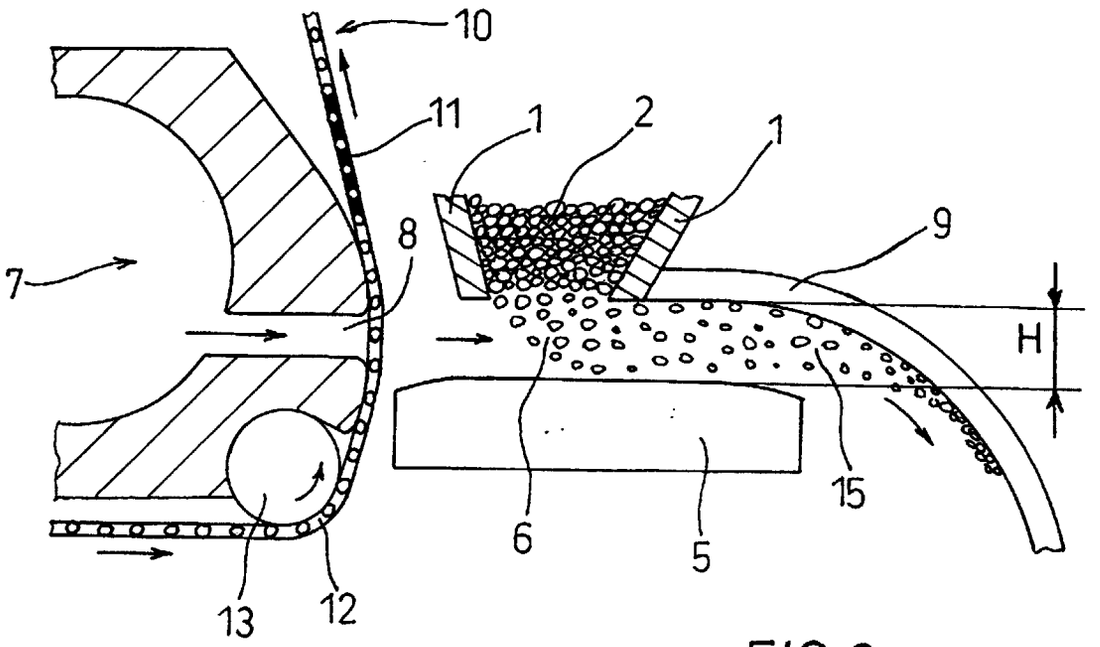

FIG.3

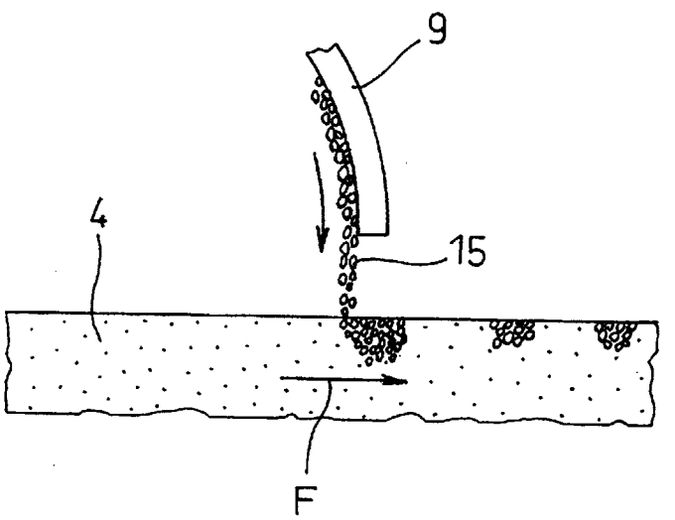

FIG.4

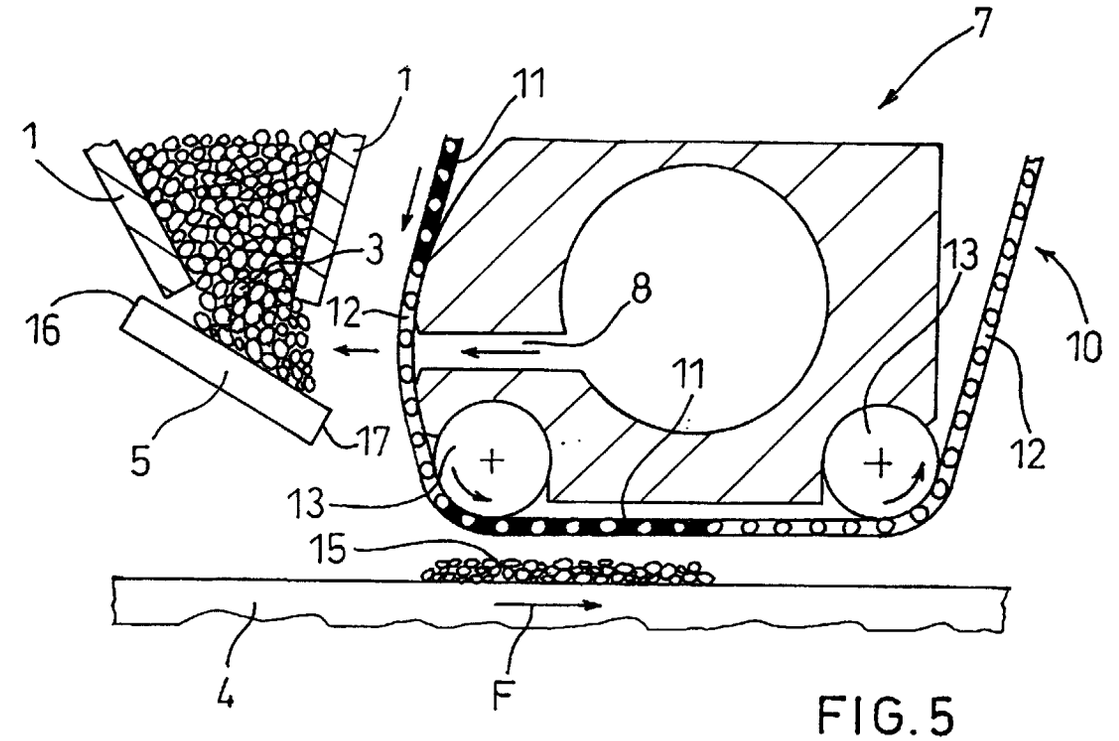
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FIG.5

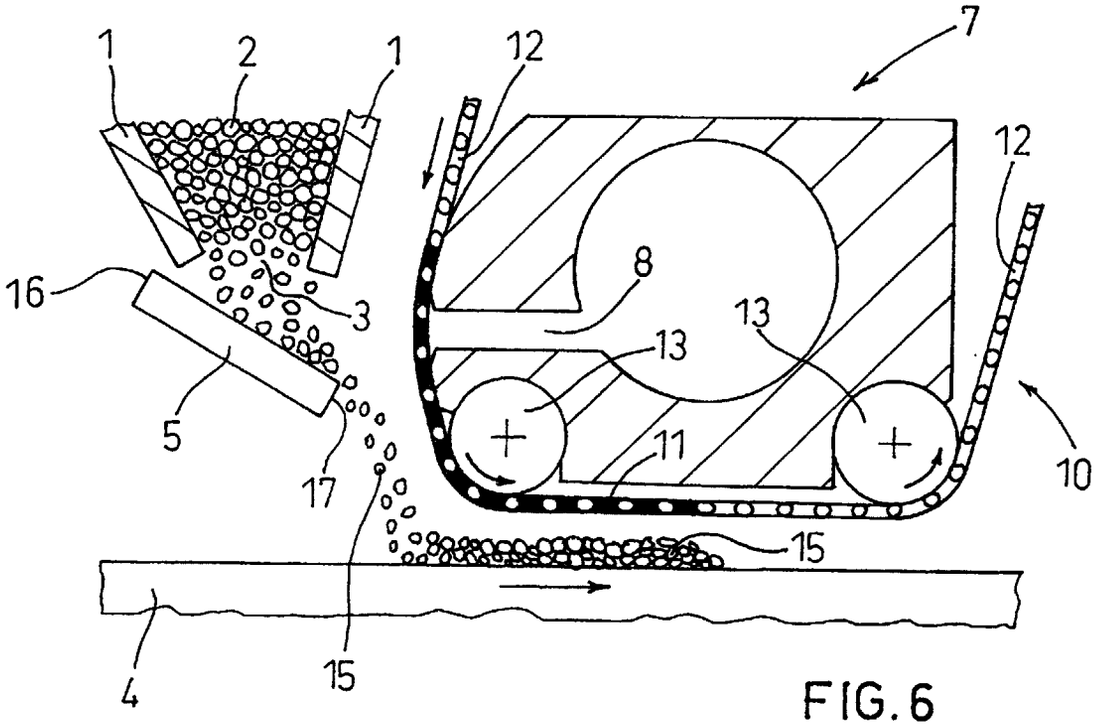
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FIG.6

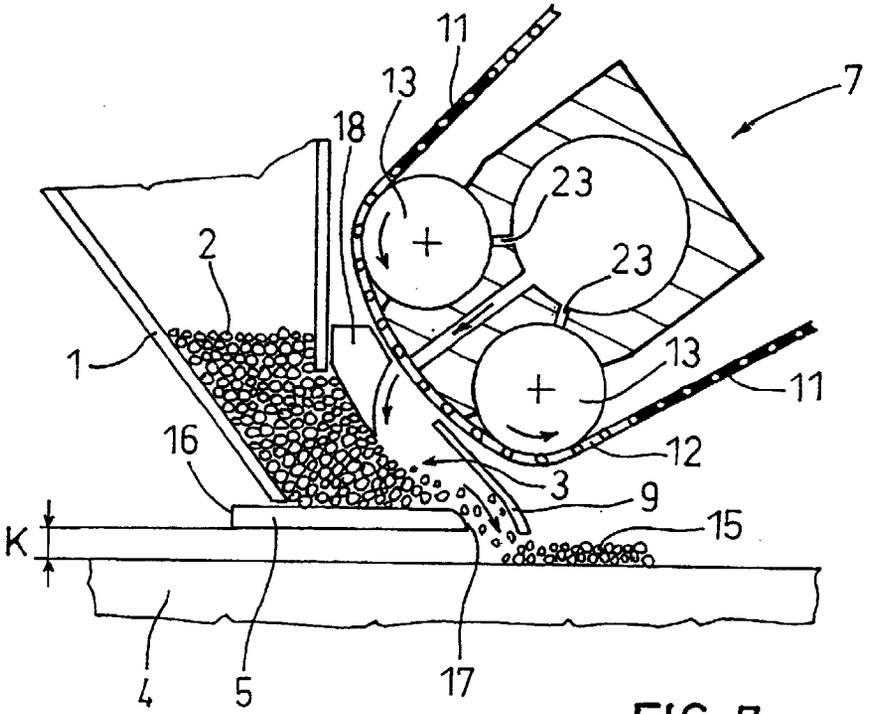
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FIG. 7

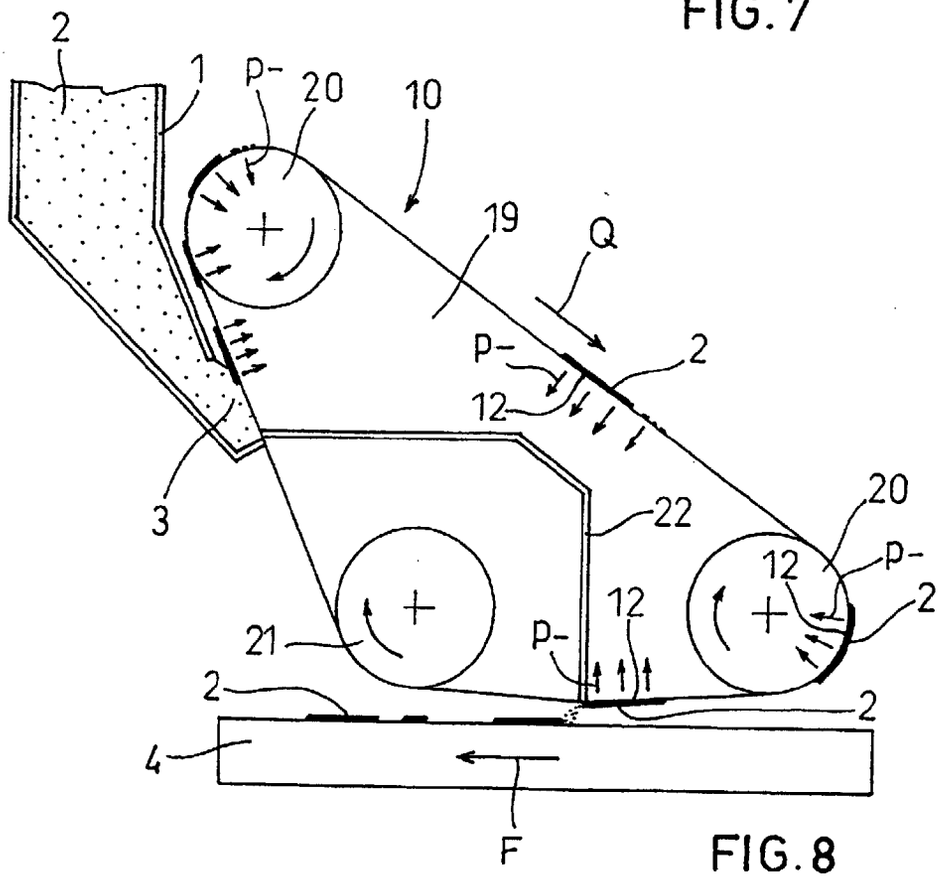
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FIG. 8

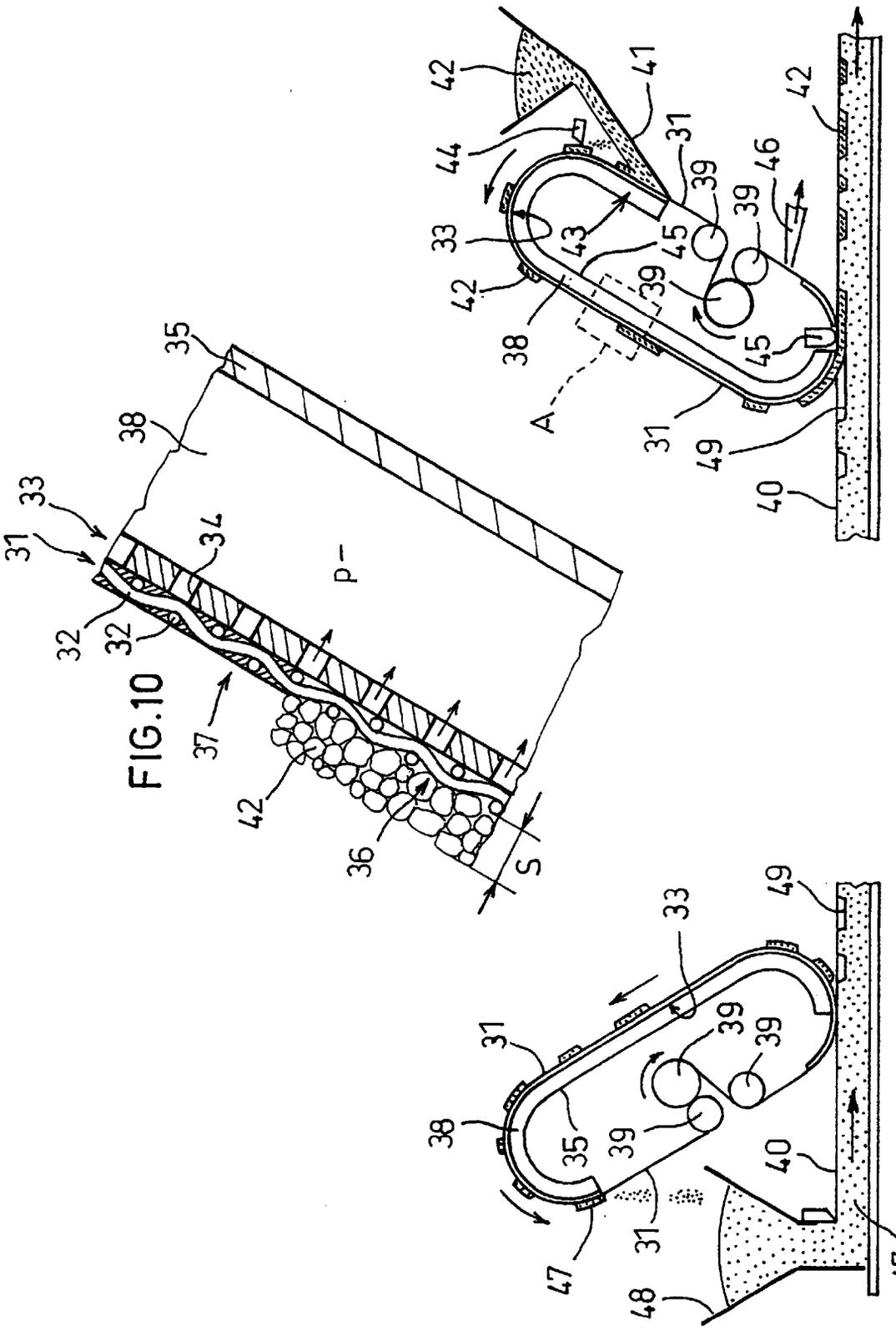

FIG.9

FIG.10

FIG.11

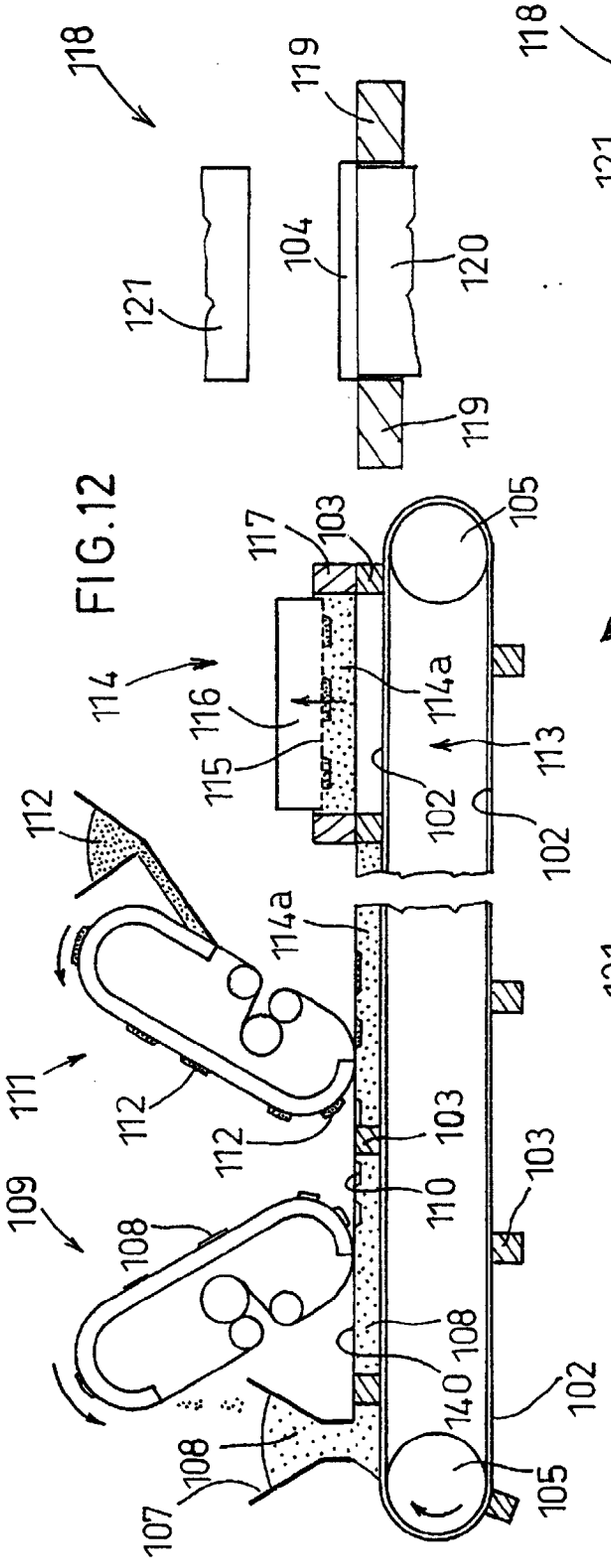
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FIG.12
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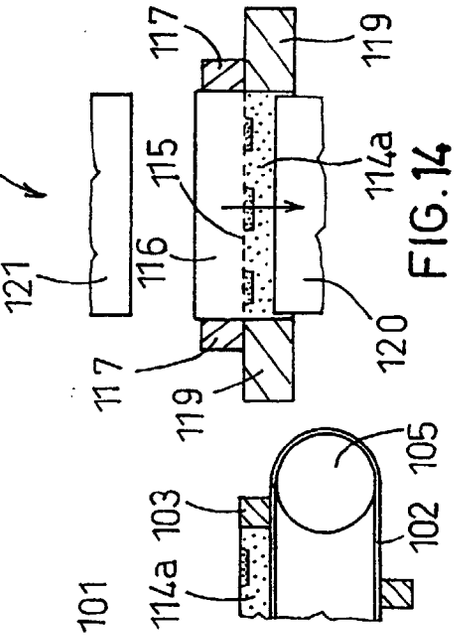
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FIG.14
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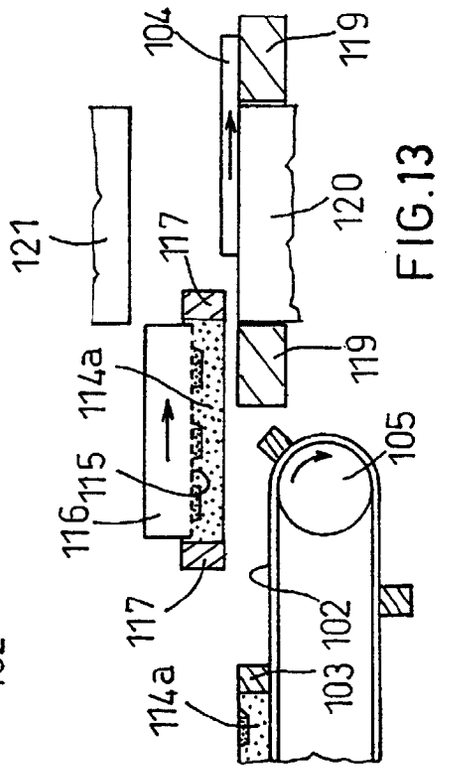
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FIG.13

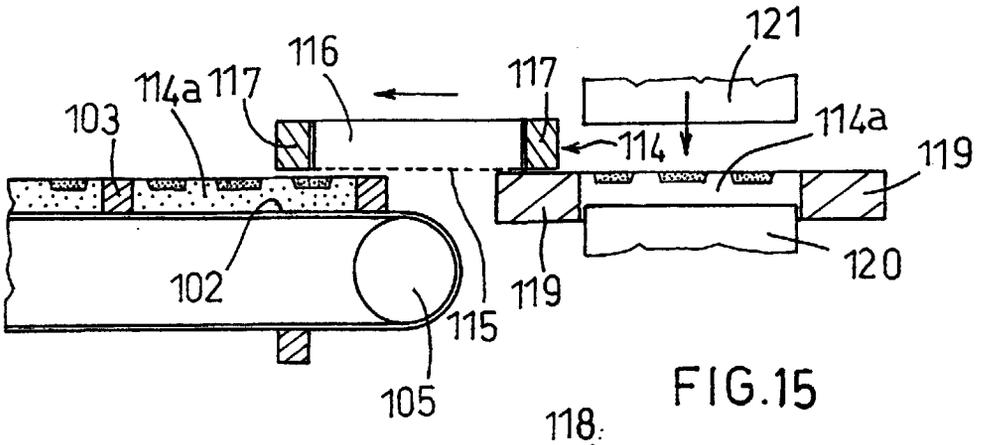

FIG.15

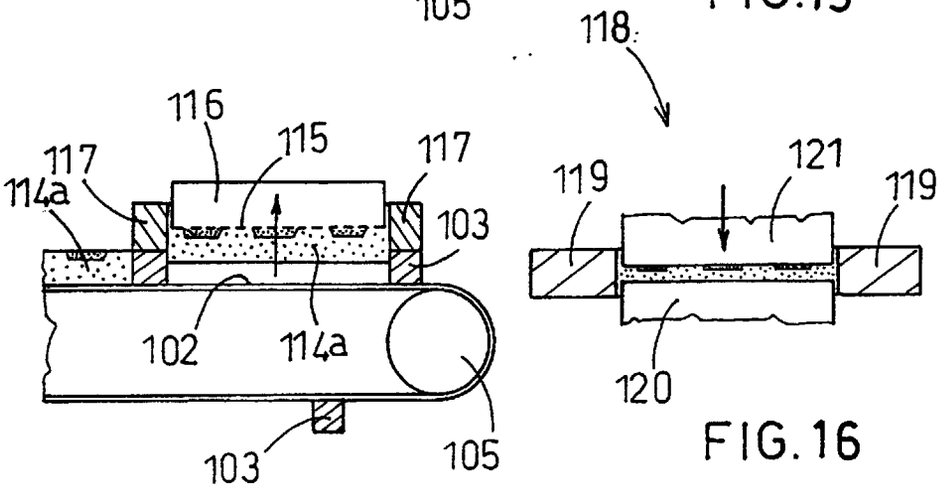

FIG.16

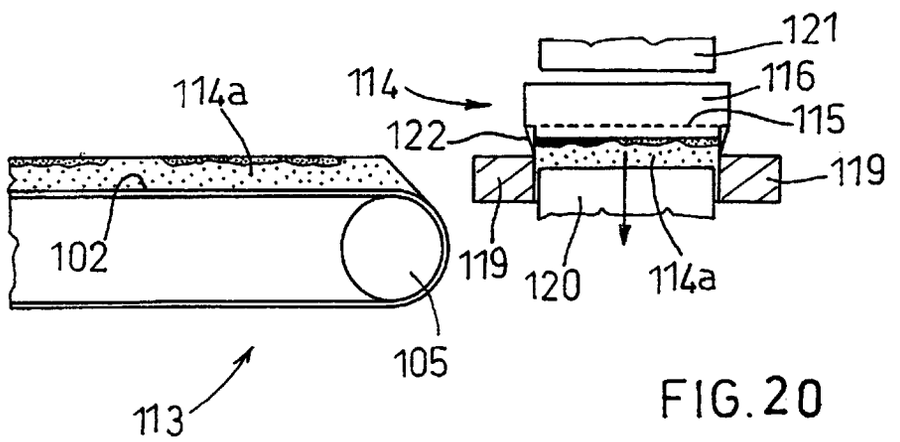

FIG.20

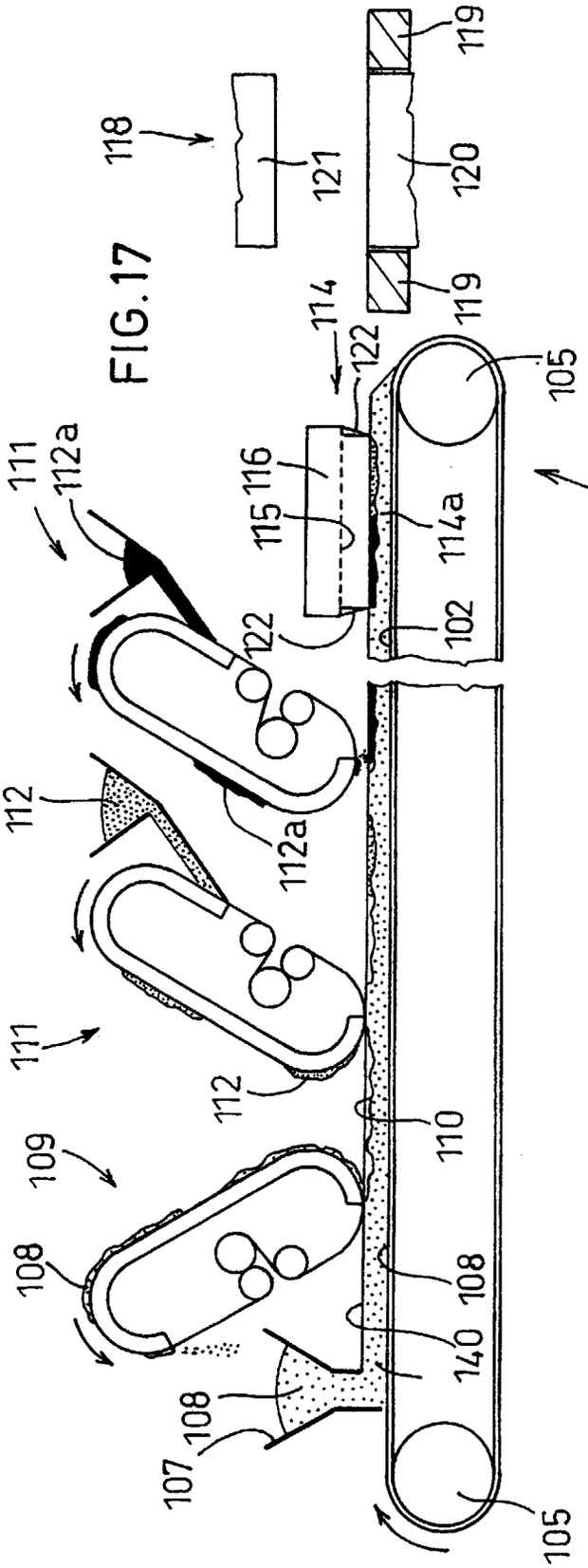
FIG.17
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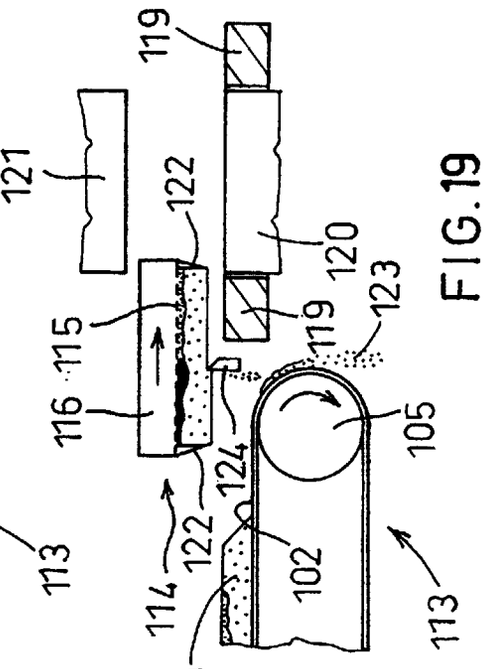
FIG.19
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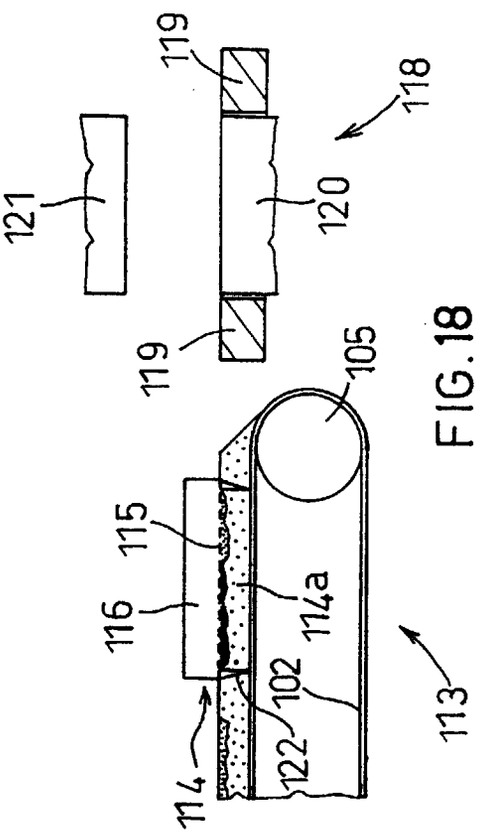
FIG.18
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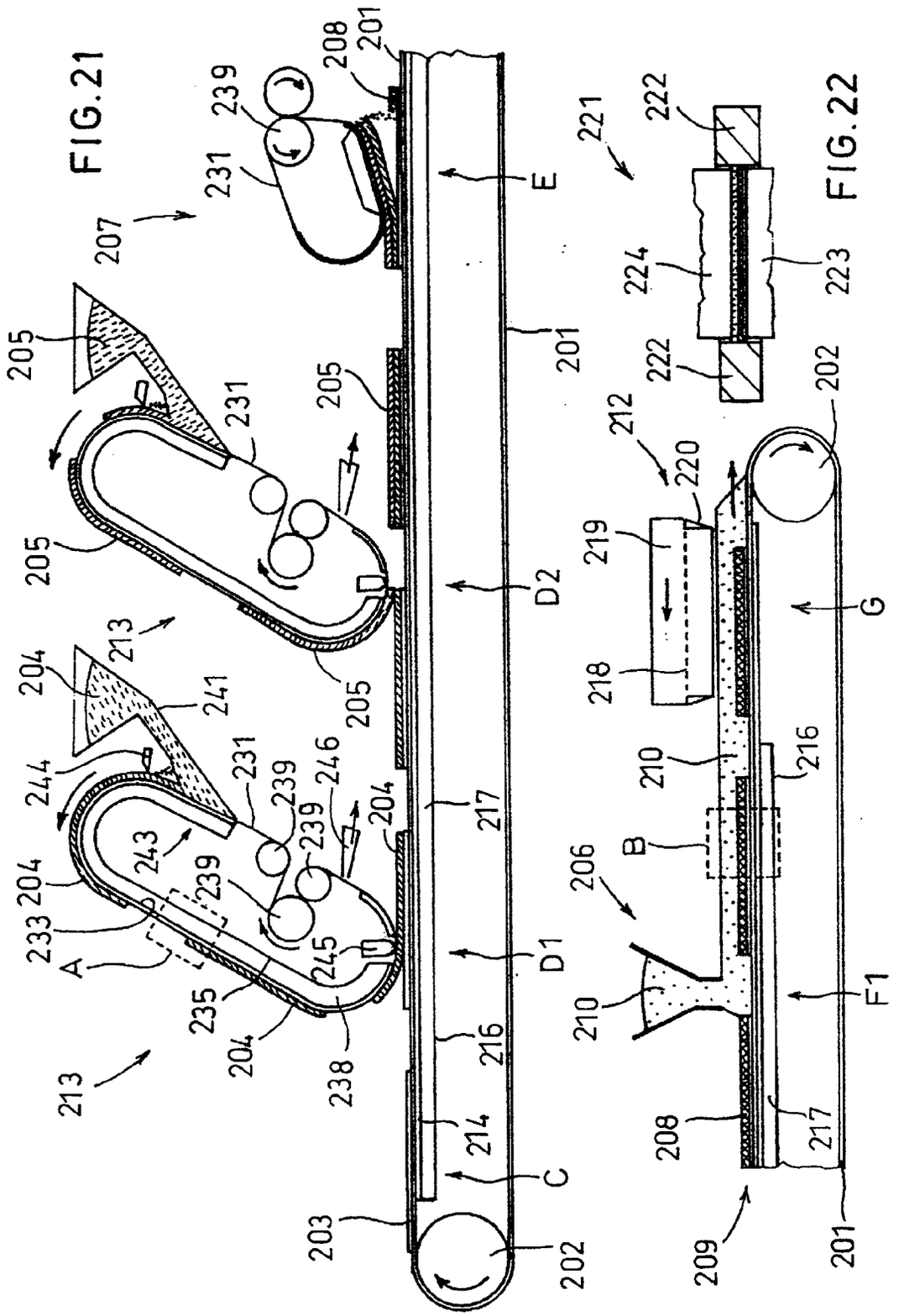
FIG.21
FIG.22
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F1
G

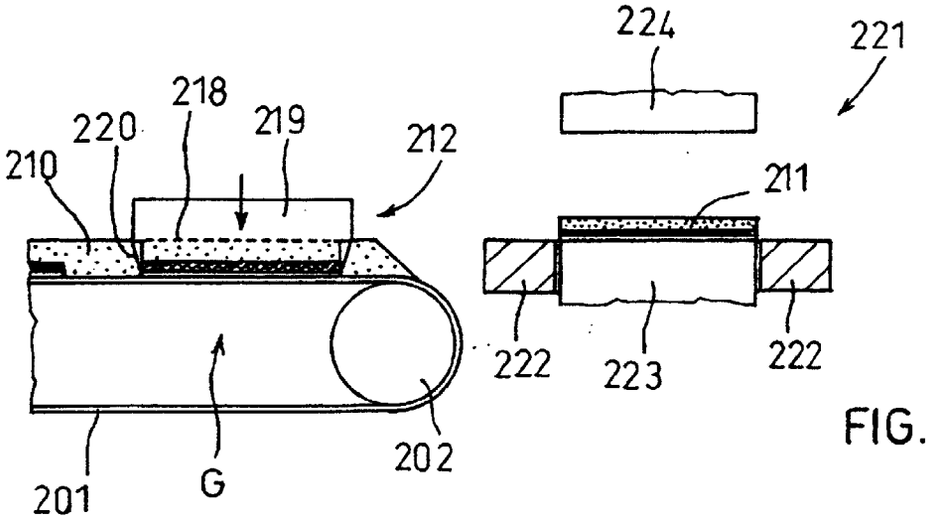

FIG.24

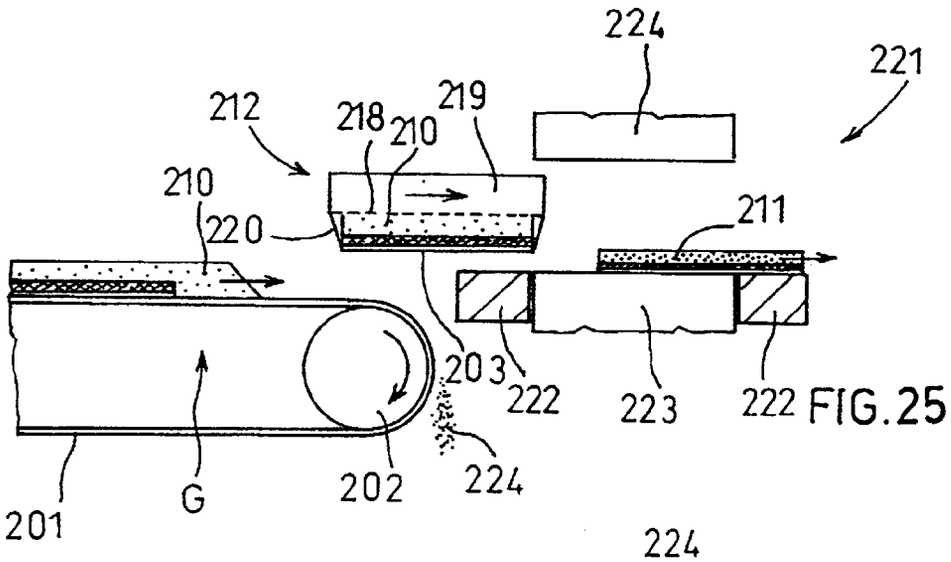

FIG.25

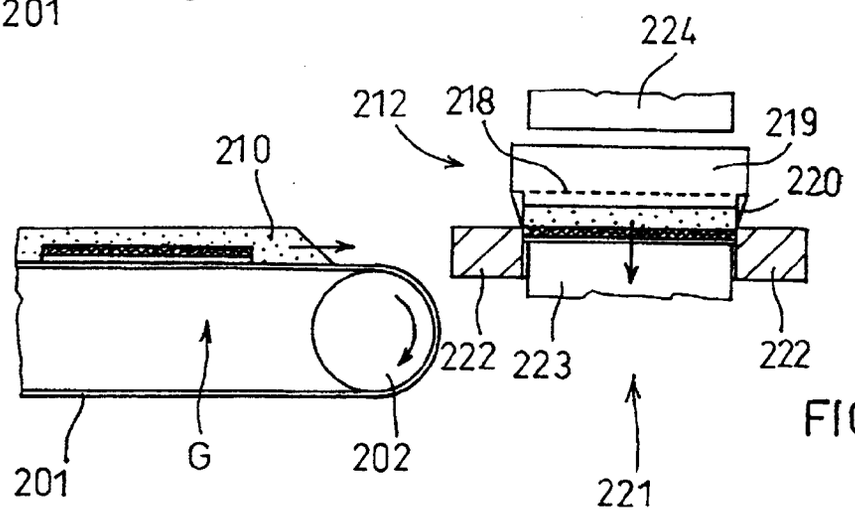

FIG.26

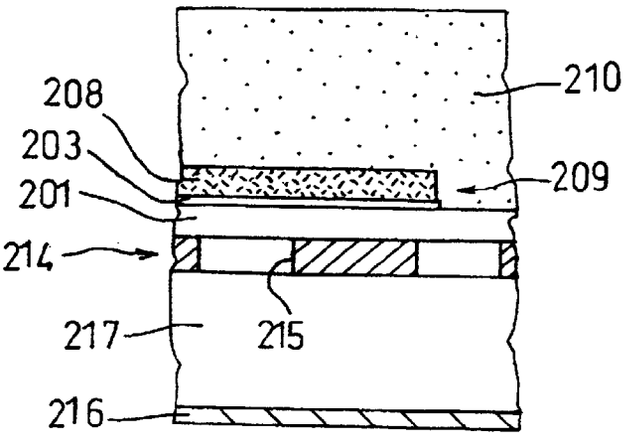

FIG.23

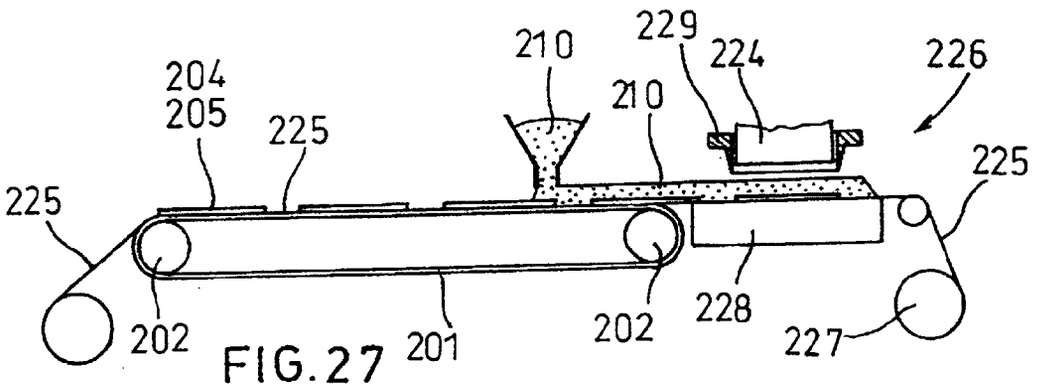

FIG.27

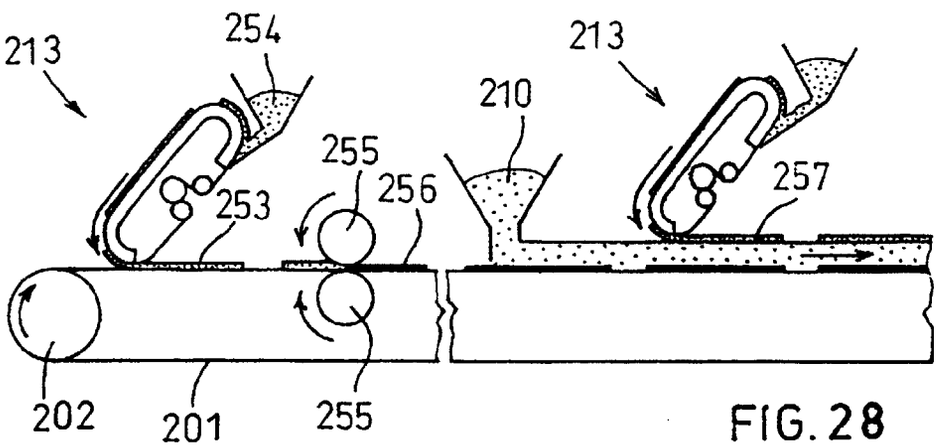

FIG.28

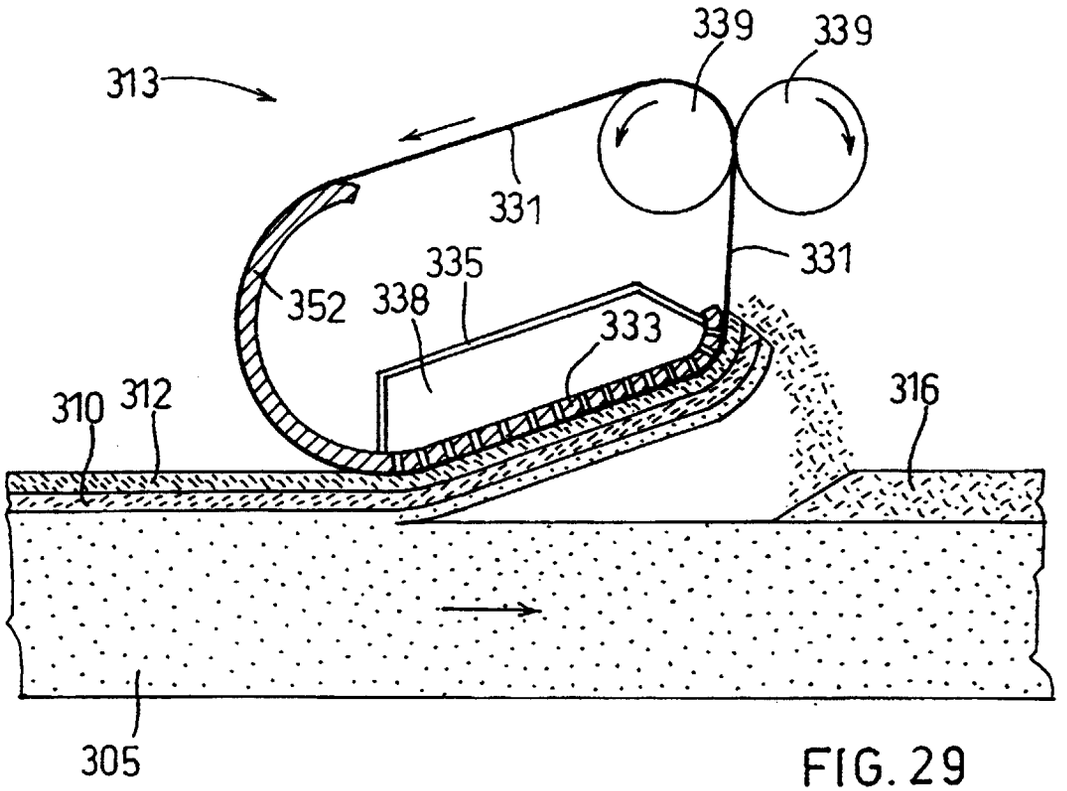
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FIG. 29

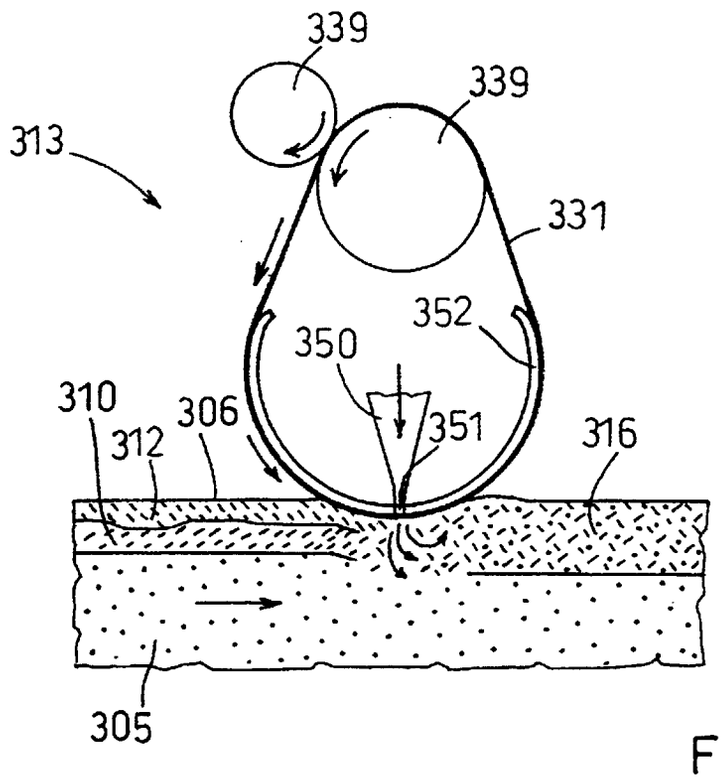
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FIG. 30

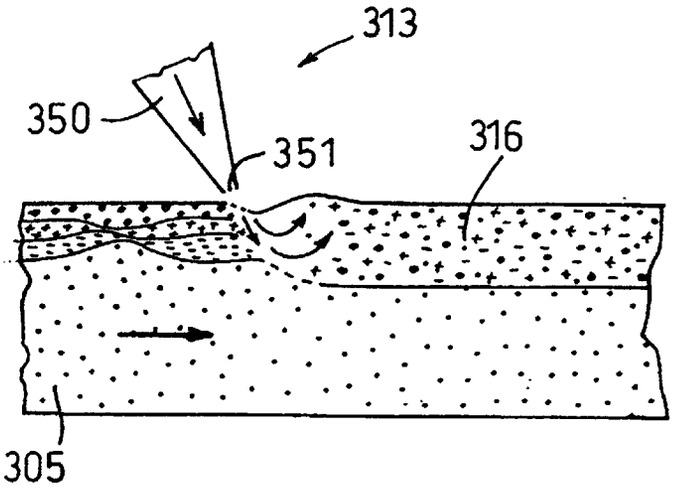

FIG. 31

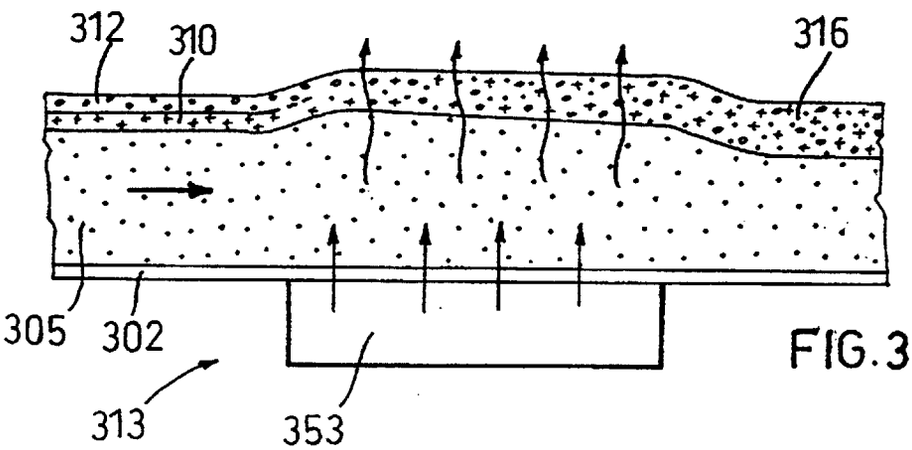

FIG. 32