Method and means for transfer of granular materials

A method includes preparing together first layer means (112, 209, 256) and second layer means (108) in order to form layer means (108, 112; 108, 209; 108, 256) of ceramic granular material on support means (102), subjecting at least a portion of said layer means (108, 112; 108, 209; 108, 256) to a vacuum, to transfer together said first layer means (112, 209, 256) and said second layer means (108) of at least a portion of said layer means (108, 112; 108, 209; 108, 256) and pressing said at least a portion of said layer means (108, 112; 108, 209; 108, 256) in order to obtain a ceramic tile (104); an apparatus includes preparing means (206, 213, 210) arranged in order to prepare together first layer means (108) and second layer means (112, 209, 256) of ceramic granular material on support means (102) and transfer means (114) arranged to transfer together said first layer means (112, 209, 256) and said second layer means (112, 209, 256) through vacuum means in order to obtain a ceramic tile (104).
The invention relates to a method and a relative apparatus for transferring granular material in a controlled manner toward means arranged for receiving it; particularly, the invention can be applied to the loading of a die for the moulding of ceramic tiles.

In the context of the present description with the "granular material" term one means a loose product capable to flow, constituted by powders, granules of any form and dimension, scales, small tesserae, or any mixture of said elements.

The demand of transferring granular material is particularly desired especially after the recent commercial success of the so-called products of "grès porcellanato" which require that the whole aesthetical effect of the surface is obtained at the pressing without the aid of a coating applied later by glazing.

Therefore the problem exists of being able to reproduce well defined and controllable decorations using "dry" material, in the context of a suitable high productivity.

One of the technologies turned to the solution of said technical problem is described in the Italian patent for industrial invention n. 1269368, wherein a membrane is provided which transfers the decorating powders into a ceramic mould in which basic powders have been otherwise loaded. This system does not allow the basic layer to be inserted in the pressing mould at the same time as the decorating layers; at least two loading operations are therefore necessary, the first one for the basic layer, the second one for the decorating layer, that remarkably increase the pressing cycle; furthermore, since two distinct mould loading means are necessary, they must be placed one at front side and the other at the rear side of the press, which involves a remarkable complication.

IT-A-1104301 describes an apparatus in which a layer of cement material is moved through a sucking bell onto a further layer already positioned inside a cavity of a pressing mould.

Also this apparatus involves the need to load the layer and the further layer in subsequent times, with the consequence that a very complex and expensive rotating press is provided in order to prevent an excessive loss of productivity.

In the Italian patent applications for industrial invention RE96A000061 and RE9GA000080, methods are described for filling the mould through a belt that supplies the powders directly inside the cavity of the mould; in both cases, in addition to a difficult control on the thickness uniformity of the layer loaded into the mould, it is not possible to obtain patterns with defined contours since the powder is subject to a remarkable free fall run.

In the Italian patent for industrial invention n° 1287519 there is provided the adoption of a decorating image in the form of transfer, directly inserted in the pressing mould of the tile. Such a method allows a good definition of the decorating pattern to be obtained, but involves a remarkable increase of the costs, which depends, in the first place, on the fact that the insertion of the transfer into the mould must be carried out necessarily before or after the insertion of the powder constituting the body of the tile; a greater number of operations in the loading of the mould is therefore necessary, which remarkably increases the duration of the working cycle. In the second place, the cost is further increased because said transfers have to be prepared in advance by external specialized companies with all the consequent problems related to provisioning, transport, storage etc. In the third place, the transfer is always associated to a support sheet that has to be subsequently separated from the pressed tile, which involves further not simple interventions and problems also of ecological nature since such support sheet has to be subsequently eliminated. A purpose of the present invention is to improve the known systems for the transfer of granular material: particularly to substantially overcome and resolve, totally or partially, the problems just described i.e. to allow the insertion of a decorating layer, for example a transfer, inside a pressing mould at the same time as the powder constituting the body of the tile, with working cycles substantially equal to those required for a normal tile without decorations.

Another purpose of the present invention is to allow to obtain said transfer directly during the productive cycle related to the pressing.

A further purpose of the present invention is to realize a device, that may be applied also to the presses more largely in use for the moulding of the ceramic tiles, i.e. those presses having mould of the type with die, lateral frame and punch always aligned, that allows, in a productive cycle with single pressing, a filling of the mould cavity without relative movements between the granules themselves, i.e. allowing different granular materials to be introduced into the mould in only one filling operation, also according to well defined patterns in the layers disposition and the surface, without the presence of excesses of powder to be recycled and without loss of productivity.

A further purpose of the present invention is to improve the explained technology in order to overcome its drawbacks, allowing, in the first place, a mould to be filled with only one loading operation, with a well defined and controlled stratigraphical and in plant disposition of different powders.

In a first aspect of the present invention, there is provided a method comprising preparing a layer of granular ceramic material on support means, subjecting at least a portion of said layer to a vacuum, transferring said at least a portion of said layer and pressing said at least a portion of said layer in order to obtain a ceramic tile from it, characterized in that, said preparing comprises preparing together decorating materials and basic materials in said layer and said transferring com-
prises transferring together said decorating materials and said base materials of said at least one portion of said layer.

[0014] In a second aspect of the present invention, an apparatus is provided comprising preparing means arranged for preparing a layer of granular ceramic material on support means and transferring means arranged for transferring said layer into pressing means using vacuum means in order to obtain a ceramic tile, characterized in that, said preparing means are capable of preparing together decorating materials and base materials in said layer and said transferring means are capable of transferring together said decorating materials and said base material.

[0015] In this way, it is possible to transfer simultaneously to a ceramic press both the base material and the decorating material.

[0016] This makes possible a more high productivity in comparison with the loading systems in which only the decorating material, or only the base material are singularly transferred.

[0017] Furthermore an optimal definition of the decorating pattern is obtained due to the absence of mixing between the decorating material and the base material during transferring.

[0018] The invention can be better understood and carried out with reference to the enclosed drawings, that illustrate exemplifying and not restrictive embodiments, wherein:

Figure 1 is a schematic side view, with sectioned and interrupted portions, of an apparatus according to the invention, used for filling a pressing mould through transfer means, at the end of the filling step of the transfer means;

Figure 2 is partial view of the apparatus like that of Figure 1, during a translation step of the transfer means;

Figure 3 is a view of the apparatus like that of Figure 2, during a filling step of the mould;

Figure 4 is a view of the apparatus like that of Figure 2, during a return step of the of the transfer means;

Figure 5 is a view of the apparatus like that of Figure 2, during the filling step of the transfer means;

Figure 6 is a view of the apparatus like that of Figure 1, but according to a further version;

Figure 7 is a partial view of the apparatus like that of Figure 6, during the filling step of the transfer means;

Figure 8 is a view of the apparatus like that of Figure 6, during a translation step of the transfer means;

Figure 9 is a view of the apparatus like that of Figure 6, in a filling step of the mould;

Figure 10 is a schematic side and interrupted view of a terminal portion of the apparatus in a further version;

Figure 11 is a side sectioned view, strongly enlarged, of the detail in the K frame in Figure 10;

Figures 12, 13 and 14 are views of the apparatus of Figure 10, during different operational steps;

Figure 15 is a schematic side view of a further version of the apparatus according to the invention;

Figure 16 is a schematic section of a version of the apparatus wherein the powder material is transferred while the support belt is moving.

[0019] An apparatus 101 (Figure 1) comprises an endless belt 102 of material permeable to the air, for example a fine wire netting or woven material, that is provided, on its outer surface, with some dividing walls 103 forming compartments having dimensions corresponding to that of the tile 104, said belt being moved in a controlled manner by rolls 105.

[0020] Granules 108 are disposed between the dividing walls 103 on the belt 102 forming a base layer onto which a different granular material 112 forming a decorating pattern is disposed, that are advanced towards a terminal portion 113 of said belt 102 cooperating with sucking hood shaped transfer means 114.

[0021] Said sucking hood shaped transfer means 114 includes a porous diaphragm 115, overhung by a room 116 suitable to be subject to a vacuum through known means, not shown, and by side walls forming a frame 117 axially movable with respect to the said porous diaphragm 115.

[0022] The sucking hood shaped transfer means 114 is horizontally movable and translate from a position overhanging the terminal portion 113 of the belt 102 (as in Figures 1, 5, 6 and 7) to a position inside the open mould 118 (as in Figures 3 and 9), and vice versa.

[0023] Said mould 118 is constituted by a lateral frame die 119, a lower die 120 and an upper punch 121; obviously a mould of the type known as "double mirror" may be used, i.e. a mould with two lateral frame dies axially movable, or any other suitable mould.

[0024] At every drawing and translating cycle of the sucking hood shaped transfer means 114 the belt 102 advances by one step bringing a new portion of the granular mass 108, 112 in a position suitable for it being collected.

[0025] In Figures 6 to 9 a variation of the apparatus is shown without dividing walls 103, therefore on the belt 102 a continuous layer of granules 108 is formed, while the different granules 112 are arranged only in the regions designed to be withdrawn by the sucking hood shaped transfer mean 114.

[0026] The transfer means 114 are provided with lateral walls 122 connected to the porous wall 115 and protruding toward the belt 102. The walls 122 have a comparatively thin thickness, i.e. suitable for penetrating in a mass of granules 108 without considerably throwing it into disorder, or having a cross section shaped as a "wedge" with the tip turned downward.

[0027] In this version some excesses of granules
123 are produced that can be directly recycled.  

[0028] The possible inconvenience due to the installation of a transport means for said excesses of granules 123 is in any way counterbalanced, when the apparatus is designed to produce different tile sizes. In this case, in fact, the mechanical operations for the change of size are simple and rapid, because it is simply necessary to replace the frames 122 and to act on the regulations of the decorating means, if required; for this purpose, said side walls 122 will be removably fixed to the structure of said permeable wall 115 so as to allow them to be easily substituted.

[0029] As can be seen in Figure 8, during the translation of the drawer-shaped transfer means 114 a lower levelling can be made on the granules 108 in order to remove a possible excess or to level their surface through a scraper 124; such material will join automatically with the other excesses of granules 123.

[0030] With reference to Figures 10, 11, 12, 13 and 14 a low permeability layer is provided, constituted by a support sheet 203 and interposed between the base layer 108 and the belt 102.

[0031] A decorating layer of granular material 208 is interposed between the low permeability layer 203 and the base layer 108, the decorating layer 208 together with the support sheet 203 constituting therefore what is defined as a transfer 209. It is furthermore provided a station F1 equipped with means 206 suitable to cover said transfer 209 with powders contained in a hopper 206 and constituting the base layer 108 of the tile 104.

[0032] The decoration can be performed with powder or granular material in a dry state, as in the example, or with powder or granular material mixed with a liquid means according to known technologies; in the first case there will be preferably a further station (not shown) for fixing said decorating material, for example by applying a fixing agent, in the second case there will be preferably a following drying station (not shown).

[0033] As underlined in Figures 10 and 11, the whole portion of the belt 102 before the terminal section 113 lies on a permeable support 214, for example due to the presence of small holes 215; said support 214 together with a sealing wall 216 surrounds a room 217 inside which a light vacuum is maintained through known means, not shown. Said vacuum has the function of keeping firmly in position the sheet 203 and the respective transfer 209 on the belt 201.

[0034] The operation of the apparatus of Figures 10 to 14 is analogous to the operation described with reference to Figures 6 to 9.

[0035] The combination just described, i.e. the transfer of the powder layer 108 and of the low permeability layer 203 using said vacuum apparatus 114, is particularly effective and congenial, since the fact that said low permeability layer forms a substantially impermeable wall makes possible to hold the powders 108 at the inside of the device 114 by means of a "static vacuum" of minimal value. Without said low permeability layer it would be instead necessary a higher and dynamic vacuum for holding the powders 108, i.e. obtained through an air stream flowing continuously through the powders 108, which could generate separations amongst the different granulometric fractions of the powders 108 and decomposition of the aesthetical aspect of the decoration.

[0036] It may be also advantageous to use in place of the transfer 209 a thin sheet of paper, plastic material or a low permeability layer, designed to form said substantially impermeable wall for holding the powders 108, while the decorating materials can be disposed in an other position, for example above the powders 108 and directly in contact with, the permeable wall 115.

[0037] The transfers 209 can be prepared in advance.

[0038] The sheets 203 may have a peripheral plan dimension corresponding to the dimensions of the tile 104, but they may be also constituted by a thin continuous band, for example of thermofusible plastic material that can be automatically cut at the right size by the same frame 220 heated to a suitable temperature.

[0039] As shown in Figure 15, the low permeability layer can be obtained by distributing a first layer 253 of powder material 254 on the belt 102, preferably through isolated regions having a peripheral extension corresponding approximately to the peripheral dimension of the tile 104.

[0040] Said powder material 254 will not be necessarily composed of decorating materials, but can be the same material 108 suitable for forming the body of the tile 104, or another material having characteristics specifically suited for the treatment to which it has to be subjected and for the function it has to accomplish.

[0041] The layer 253 can be subjected to a compacting action by passing it through the rolls 255 so as to form the low permeability layer 256, said layer is then covered by the powder 108 and by optional decorating layers 112. The powders 256 may have advantageously a granular sizing less than the granular sizing of the powder layer 108. The bundle of layers so formed is then withdrawn by the sucking hood shaped transfer means 114 and transferred to the mould 118 as already described.

[0042] The decorating layer 112 and the layer 253 may be distributed with known distributing means 213.

[0043] The advantage of such version resides in the fact that, even if the transfer means 114 has a "static vacuum" operation, there is no presence of extraneous material which has to be detached and eliminated from the pressed tile 104 because said layer 253 constitutes an integral part of the tile 104; in addition, compacting said layer 253 is particularly easy because said layer has a small thickness so that great diameter rolls are not necessary; notable pressing strengths are either not necessary, because the instantaneous pressed region is somewhat restricted.

[0044] Furthermore, the small thickness of the layer
253 allows a good compacting action to be obtained in the peripheral regions of said layer even in absence of walls for a lateral containment of the powder.

[0045] The belt 102 in this version may be also advantageously divided into two parts, the first part where the compacting action takes place having an impermeable surface, whilst the second part has a permeable surface, so as to make easier the operation of the transfer means 114.

[0046] The low permeability layer may also be obtained by treating the layer 253 with suitable waterproofing substances.

[0047] As shown in Figure 16, the translation of the device 114 towards the mould 118 may also take place keeping the frame 122 in contact with the belt 102 and moving said belt too synchronously. Such a method may be advantageous in order to promote a penetration of air under the base layer 108: in fact the air penetrates as the device 114 progressively protrudes from the end of the belt 1; therefore it could be possible to use a belt 102 made of a material non-permeable to the air.

Claims

1. Method comprising preparing layer means (108, 112; 108, 209; 108, 256) of granular ceramic material on support means (102), subjecting to a vacuum at least a portion of said layer means (108, 112; 108, 209; 108, 256), transferring said at least a portion of said layer means (108, 112; 108, 209; 108, 256) and pressing said at least a portion of said layer means (108, 112; 108, 209; 108, 256) in order to obtain a ceramic tile (104) from the compression of said layer means (108, 112; 108, 209; 108, 256), characterized in that, said preparing includes preparing together first layer means (112, 209, 256) and second layer means (108) in order to form said layer means (108, 112; 108, 209; 108, 256) and said transferring includes transferring together said first layer means (112, 209, 256) and said second layer means (108) of said at least a portion of said layer means (108, 112; 108, 209; 108, 256).

2. Method according to claim 1, wherein said preparing includes distributing said first layer means (108) on said support means (102) in order to form a base body of said tile (104).

3. Method according to claim 2, wherein said preparing includes distributing said second layer means (209, 256) on said support means (102) before said first layer means (108).

4. Method according to claim 3, wherein said second layer means (209, 256) has a lower permeability to fluids than said first layer (108).

5. Method according to claim 3 or 4 and further comprising pressing powder material (253) in order to obtain said second layer means (256).

6. Method according to one of claims 3 to 5, wherein said second layer means (209, 256) has a smaller granule sizing than said first layer means (108).

7. Method according to one of claims 3 to 6, wherein said second layer means (256) defines a decorating pattern of said tile (104).

8. Method according to one of preceding claims, wherein said second layer means (209) constitutes a continuous layer.

9. Method according to one of preceding claims, wherein said preparing includes arranging said layer means (108, 112; 108, 209; 108, 256) in cavities of said support means (102).

10. Method according to one of preceding claims, wherein said transferring includes moving said support means (102) with said layer means (108, 112; 108, 209; 108, 256) arranged on them while said vacuum is applied on said layer means (108, 112; 108, 209; 108, 256).

11. Apparatus, comprising preparing means (206, 213, 210) arranged to prepare layer means (108, 112; 108, 209; 108, 256) of granular ceramic material on support means (102) and transferring means (114) arranged to transfer said layer means (108, 112; 108, 209; 108, 256) of granular ceramic material on support means (102) and transferring means (114) arranged to transfer said layer means (108, 112; 108, 209; 108, 256) in order to obtain a ceramic tile (104) from the compression of said layer means (108, 112; 108, 209; 108, 256), characterized in that, said preparing includes preparing together first layer means (112, 209, 256) and second layer means (108) in order to form said layer means (108, 112; 108, 209; 108, 256) and said transferring includes transferring together said first layer means (112, 209, 256) and said second layer means (108) of said at least a portion of said layer means (108, 112; 108, 209; 108, 256).

12. Apparatus according to claim 11, wherein said preparing includes means (206, 213, 210) for distributing said first layer means (108) on said support means (102) in order to form a base body of said tile (104).

13. Apparatus according to claim 11 or 12, wherein said preparing means (206, 213, 210) includes further means (213) for distributing said second layer means (209, 256) on said support means (102).

14. Apparatus according to one of claims 11 to 13 and further comprising means (255) for pressing powder material (253) in order to obtain said second
layer means (256).

15. Apparatus according to one of claims 11 to 14, wherein said transfer means (114) includes sucking hood means (115, 116).

16. Apparatus according to claim 15, wherein said sucking hood means (115, 116) includes frame means (117) inside which said hood means (115, 116) are slidingly operated.

17. Apparatus according to one of preceding claims, wherein said support means (102) are provided with corrugations (103) defining hollow means in which said layer means are contained (108, 112; 108, 209; 108, 256).