

Description

[0001] The present invention concerns a system for manufacturing powder material, in particular for the production of ceramic tiles.

[0002] PCT/EP95/04560 describes a system for pressing ceramic tiles, wherein a continuous strip of powders having a predetermined thickness and width is formed, predetermined areas of said strip being compacted to obtain tiles, or pre-compacted semimanufactured products which are precursors of the tiles to be formed. In the latter case there is provided pressing of semimanufactured products in a die to obtain corresponding tiles ready to be subsequently dried and fired.

[0003] US-A-3,540,093 describes an apparatus for manufacturing ceramic tiles, having substantially uniform compactness, homogeneity, density and thickness, wherein from a bottom end of a hopper, in which powders of ceramic material are contained, a vertical strip of compacted powders is formed by action of opposed pressing rolls, from said strip some pre-compacted products being subsequently severed by cutting and distributed on a horizontal conveyor from which the severed products are transferred to a die to obtain tile bodies.

[0004] GB-A-880,892 describes an apparatus for forming clay material in which a mass of clay, humidified in such a way as to result at a plastic state, is laminated between a pair of rolls to obtain a layer of plastic material and subsequently the layer is formed by a forming die, without substantial alteration of the volume, in such a way as to obtain a plurality of tiles interconnected by webs which are subsequently cut by rotating disks.

[0005] Prior art comprises also some apparatuses for making tiles in which powders are distributed in two superimposed layers during distinct strokes of a distributing trolley or distinct phases of the same stroke of a distributing trolley, the trolley being generally provided with grids and each one leading the powders of a determined layer at the matrix of the press. An example of such a kind of apparatuses is described in IT-A-1,069,458.

[0006] Moreover, in such apparatuses there is a productivity much greater than the productivity obtainable loading in just one layer, since providing distinct strokes for each trolley, or distinct phases of the stroke of loading, is time consuming, since the various layers are loaded into a matrix of a respective die in different steps and in a certain interval of time.

[0007] An object of the present invention is to improve the existent apparatuses for working ceramic tiles.

[0008] In a first aspect of the present invention, there is provided a method for pressing powdered material to obtain tiles, comprising the steps of:

- distributing powders on flexible conveyor means and advancing said powders along an advancing direction through a pressing station,
- containing laterally said powders on said conveyor

means by side containing means in said pressing station, said containing means being distinct from said powdered material,

- pressing said powders while advancing through said pressing station, characterized in that said containing means act on the powders to be pressed during said advancing and continue to act during said pressing.

[0009] In a second aspect of the present invention, there is provided apparatus for pressing powdered material in such a way as to obtain tiles, comprising flexible conveyor means for receiving powders thereon from distributing means and for advancing said powders along an advancing direction through a pressing station, containing means for laterally containing said powders on said conveyor means, said containing means being distinct from said powdered material, means for pressing said powders while advancing through said pressing station, characterized in that said side containing means are arranged to act on the powders to be pressed during said advancing and said pressing of the powders.

[0010] In a third aspect of the present invention, there is provided forming means for forming ceramic material comprising moving means arranged to move, along a reciprocal approaching direction, powders to be pressed and pressing means to decrease significantly the volume of said powders, the pressing means being arranged to press said powders along a pressing direction transversally disposed with respect to said approaching direction, characterized in that said pressing means are conformed to act on said powders with pressing intensity which increases along said approaching direction.

[0011] In an advantageous embodiment, said pressing means comprises continuous pressing means, as rotating bodies, arranged to progressively press powders while said material advances.

[0012] In a further embodiment, the pressing means comprises swinging pressing means disposed along the approaching direction.

[0013] Owing to providing continuous pressing means combined with horizontally-disposed moving means for moving powders, it is possible to obtain an optimal compacting of ceramic material without alteration of the stratigraphic distribution of the powders and with limited loads.

[0014] This allows to make ceramic tiles having valuable aesthetic effects in the surface even when an inexpensive ceramic support is used, because the aesthetic effects may occupy a thin surface layer of the ceramic tile.

[0015] Moreover, using continuous pressing means acting on a horizontal strip of powders allows to significantly reduce the width of the areas of the strip of powders to be pressed and furthermore to limit scrap material.

[0016] The forming of a continuous strip of pressed

material renders possible feeding of the mould without using particular conveyor means: in fact the pressed strip may be advanced toward the mould by the action of pressing means acting on the belt conveyor means.

[0017] To this end, the continuous pressing means may comprise rolls, belt conveyor means, swinging orbital elements and others.

[0018] The invention will be better understood and carried into effect referring to the attached drawings, wherein:

- Figures 1, 2, 3, 4, are schematic side views, partially sectioned and interrupted, of an apparatus for forming ceramic tiles, respectively showing in sequence the phases of pre-compacting of powdered material and loading of the press, pressing and delivery of the pressed tiles;
- Figures 5, 6, 7, 8 are views corresponding to Figures 1, 2, 3, 4, but in a version of the forming apparatus;
- Figure 9 is a schematic side view, partially sectioned and interrupted, of continuous means for forming powders comprising a plurality of pairs of rollers opposite to the strip of powders;
- Figure 10 is a top view of Figure 9, showing the obtaining of two parallel strips of compacted powders on the same belt conveyor means;
- Figure 11 is the transversal section XI-XI of Figure 10;
- Figure 12 is a section as in Figure 9, but in which on the rolls which are above the strips of powders, compacting belt means are rolled up;
- Figure 13 is a view as in Figure 7, but in an embodiment wherein the front part of the strip of powders is rotated downwardly;
- Figure 14 is an interrupted, schematic longitudinal section of a version of continuous forming means obtained with pressing elements orbitally movable and co-operating with a longitudinally movable controlling element;
- Figures 15 and 16 are enlarged sections of a detail of pressing mould in the severing area of the compacted material, respectively in the phase of pressing and at the begin of the phase of extracting the pressed tile;
- Figure 17 is a view as in Figure 13, but during the loading phase of the mould;
- Figure 18 is a plan view taken along the plane XVI-II-XVIII of Figure 17, wherein the compacted layer has dimension greater than the mould cavities;
- Figure 19 is a schematic side view of a version of forming apparatus showing severing means of the strip of compacted powders;
- Figure 20 is the schematic, top view of a layer of powders distributed on a belt conveyor means and pressed by continuous pressing rolls;
- Figure 21 is the section XXI-XXI of Figure 20;
- Figure 22 is a section as in Figure 21, but with con-

tinuous pressing means having an endless belt structure;

- Figures 23 is a schematic side view as in Figure 22, but in further embodiments;
- Figure 24 is a section as in Figure 14, but in an embodiment with belt conveyor means provided with cavities or hollows arranged to receive powders to be pressed;
- Figure 25 is a schematic, interrupted, vertical section of pressing means for pressing a pre-compacted ceramic product;
- Figure 26 is a section as in Figure 25, but in an intermediate phase of pressing and finishing of the edge of a product during pressing;
- Figure 27 is a section as in Figure 25, but in a final phase of pressing;
- Figure 28 is a section as in Figure 25, but in a phase of extracting the pressed tile;
- Figure 29 is a schematic, interrupted, vertical section of a further embodiment of pressing means for pressing a pre-compacted ceramic product;
- Figure 30 is a section as in Figure 29, but in an intermediate phase of pressing;
- Figure 31 is a front view, partially sectioned, of belt means with powders distributed thereon, roll pressing means and side containing means for lateral containing of said powders;
- Figure 32 is a schematic and interrupted top view of Figure 31;
- Figure 33 is a top view as in Figure 31, but without pressing means and in an embodiment with lateral containing means formed by swinging rigid side-walls;
- Figure 34 is a view as in Figure 32, but with containing means mainly obtained with exceed of powders;
- Figure 35 is the schematic section XXXV-XXXV of Figure 34;
- Figure 36 is a detail, enlarged and interrupted, of pressing means for pressing powders on belt conveyor means in a further embodiment;
- Figure 37 is a schematic, interrupted, side section of hopper distributing means arranged to distribute powders on belt conveyor means;
- Figure 38 is an enlarged and interrupted detail of a portion of end of the belt conveyor means for conveying powders provided with a tension device of the lateral containing means;
- Figure 39 is the section XXXIX-XXXIX of Figure 38.

[0019] In the context of the following description, with the reference V is indicated the longitudinal direction of advance of loose or compacted powders on belt conveyor means. With the term "powders", each movable material at the solid state, including granular materials, ceramic glazes and clay compounds is indicated.

[0020] As shown in Figures 1 to 4, powders 1 are contained in hopper distributing means 2 having an outlet section controlled by a dosing squeegee 2a, which is ad-

justable in height and faces with a horizontal upper part of belt conveyor means 3, advancing the powders to be pressed at a press with mould means 4 for ceramic tiles 5 (Figure 4), in such a way as to form a strip 6, or main layer, of powders. Between the hopper 2 and the mould means 4, distributing decorating means 7 may be interposed to pour on the strip 6 a decorating layer 8, the decorating means possibly comprising further hopper means 9 containing a decorating granular material 10, having the outlet section facing the strip 6 and controlled by a rotating dosing roll 11.

[0021] The belt conveyor means 3 is partially rolled up on a roll 12 which defines an end of the belt conveyor means near to the mould 4, rotating about a first, substantially horizontal axis A, defining a vertical plane whereon, above the strip 6, a second axis B lies around which a second pressing roll 13 for pressing powders 6, 8 is rotatable. The strip of powders 6, 8 which passes on the belt conveyor means 3 between the rolls 12 and 13 is compacted to a greater or lower extent depending on the distance between the axes A and B, in such a way as to obtain, at the exit of the rolls 12, 13, from powders forming the strip 6, 8, a compacted layer 14, which is coherent, i.e. non-loose, and able to advance along a transferring plane 15 towards the mould means 4 under the action of a force exerted by the rolls 12 and 13. The mould means 4 are provided with lower frame means 16, substantially complanate with the transferring plane 15, and defining a lower cavity 17 (Figure 2) arranged to contain longitudinally consecutive portions of layer 14 of compacted powders and to allow their pressing between a punch 18 and a bottom portion 19 of the mould means 4. Advancing of the compacted layer 14 is controlled by the motion of the rolls 12 and 13: thus, at the end of the pressing cycle, the layer 14 is advanced by the said rolls until the elimination, from the pressing area, of scrap materials 20 which may be collected by a crusher 21 and introduced again into the process as powders. The diameter of the rolls 12 and 13 has to be sufficiently large so that the rolls are sufficiently resistant to flexing during pressing and define a pressing sector C having suitable width. As shown in Figure 2, the width of the sector corresponds to the angle C of incidence defined between the tangent to the roll in the contact area at the entry of the powders and a direction parallel to the plane of the strip: to be successful the angle C of incidence should be suitably low.

[0022] Referring to Figures 1 to 8, a pressing cycle comprises the following phases:

- 1) advancing the compacted layer 14 by driving the rolls 12 and 13 up to superimpose it to the lower cavity 17 (Figures 1 and 5);
- 2) approaching the punch 18 to the portion 22 of the compacted layer 14 which is above the lower cavity 17 and descending the punch 18 and the bottom portion 19, underneath the moving plane 15, defined by lower frame means 16 to sever said portion

from the compacted layer 14 and insert it into the lower cavity 17 (Figure 2);

3) pressing of the portion 22 by descending of the punch towards the bottom portion 19 (Figures 3 and 7);

4) lifting the punch 18 and the bottom portion 19 in such a way as to be able to exit the tile 5 by exerting thereon a force by the compacted layer 14 which is arriving.

[0023] It is observed that in the embodiments of the Figures 1 to 4 the lower frame means 16 are not vertically movable.

[0024] In particular, referring to Figures 5 to 8, wherein the mould means are further provided with upper frame means 23 extending around the punch 18, the pressing cycle comprises the phases 1) and 3) as defined above, and the phases 2a) and 4a) described below:

2a) approaching the punch 18 and the upper frame means 23 to the portion 22 of the compacted layer 14 which is above the lower cavity 17 and descending the upper frame means 23 and the lower frame means 16 underneath the upper plane of the bottom portion 19 to sever said portion 22 from the compacted layer 14 and insert it into the upper cavity 23a of the upper frame means 23, said upper cavity 23a having the same shape and dimensions as the lower cavity 17 of the lower frame means 16 (Figure 6);

4a) lifting the punch 18, the upper frame means 23 and the lower frame means 16 in such a way as to be able to exit the tile 5 exerting thereon a force by the compacted layer 14 which is arriving, or, as shown in Figure 8, by means of suitable extracting means 24, provided, for example, with suckers 25 and with rotating cleaning brush 26 for the punch 18.

[0025] In the phase 2a), the lowering of the lower frame means 16 takes place together with the lowering of the moving plane 15, and, preferably, the belt conveyor means 3 with respective rolls 12 and 13, in the direction shown by the arrow F.

[0026] In the phases 2) and 3), as well as in the phases 2a) and 3), the rolls 12 and 13 are still, i.e. they do not rotate about the respective axes A and B.

[0027] Figures 15 and 16 show the use of a mould such as that shown in Figures 5 to 8 to obtain a tile 5 having a spacing portion 25 of greater dimension and a front face 26 formed above.

[0028] As shown in Figure 15, in the pressing a transversal expansion of the tile 5 takes place to occupy the peripheral game G between the edge of the upper surface of the lower portion 19 of the mould and the internal surface of the cavity 23a. Moreover, during lifting of the frame means 16 and 23 after pressing, shown by the

upwardly oriented arrow in Figure 16, an interference occurs between the edge of the pressed tile 5 and the corresponding edge of the compacted layer 14 with removal of powders 27 of the same layer. To prevent the powders 27 from obstructing the movement between the lower frame means 16 and the bottom portion 19, between said means and said bottom portion a hollow annular area 28 is peripherally defined, as shown in Figures 15 and 16.

[0029] Figure 9 shows that, in addition to the rolls 12 and 13, there may be provided further upper rolls 29 and lower rolls, parallel to each other and to rolls 12 and 13, the centrelines distance between the further upper rolls 29 and the corresponding further lower rolls 30 being progressively increasing moving away from the rolls 12 and 13 in such a way as to allow a more gradual compacting of the powders 6. In this way, the angle C of incidence is conveniently small for each upper rolls 29, so as to decrease the risk of heterogeneities in compactation which would arise from longitudinal movings of the powders.

[0030] Figure 12 shows that on the plurality of upper pressing rolls 13, 29 compacting belt means 31 are peripherally rolled up to render more homogeneous and progressive the compacting of the powders.

[0031] The compacting belt means 31 allow to define carefully a predetermined value of the angle of incidence C and allow to exert on the powders 6, 8 a particularly gradual action.

[0032] Figures 13 and 18 show that the end area of the belt conveyor means 3 and the transferring plane 15 next thereto may be hinged by a transversal axis Z passing through the strip of powders 6, before the area of beginning of compacting, in such a way as to allow the compacted material 14 to follow the lowering and the lifting of the transferring plane 15 and of the lower frame means 16 in the phases of the pressing cycle described referring to Figures 5 to 8. To allow maintenance of the continuity of compacting, also the upper compacting belt means 31 must be free to rotate about the axis Z of a relatively wide angular sector.

[0033] Figure 18 shows that the lower frame means 16a may be open towards the moving plane 15, in such a way as to surround the bottom 19 only in three side, so as to limit the discharged material. In fact, in the pressing cycle, the areas of the layer of compacted material 14, which are subjected to the action of the upper frame means 23, cause an interruption of the continuity of such a layer; when the moving plane 15, rotating about the axis Z, goes down with respect to the bottom 19, its edge nearest to the bottom 19 is no longer coplanate thereto and thus only the portion 35 of the layer of compacted material 14, which are not subjected to the action of the frame means 23 and of the punch 18, are severed from the layer 14 along a fracture line Y.

[0034] As shown in Figures 10 and 11, the belt conveyor means 3 may be provided with projections acting as longitudinal severing means 36 for severing powders

6, said severing means being received into respective recess means 38 of the pressing rolls 13, 29, and with lateral containing means 37, or side-walls, in such a way as to obtain two parallel layers 14a of compacted material from two respective layers 6a of powdered material.

[0035] The recess means 38 may define pressing means 38a arranged to keep pressed, and, as a consequence, larger than their initial dimensions, the longitudinal severing means 36 and the lateral containing means 37 during pressing. This decreases the possibility of undesired moving of the severing means during pressing. Moreover, this supports the delivery of the pressed products 14 because, when the action of the pressing means 38a finishes, the longitudinal severing means 36 and the lateral containing means 37 assume again their initial dimensions, so detaching from the pressed products.

[0036] Near to the compacting area, there are provided, acting on the lateral containing means 37, lateral control means 39 limiting the deformations of the lateral containing means 37 during pressing, the lateral control means 39 advantageously comprising some rolls having vertical axes interacting with the lateral containing means 37 to avoid said lateral containing means 37 deforming outwardly during pressing.

[0037] Preferably, the lateral containing means 37 define side walls having wide-apart shape toward the outside of the belt conveyor means 3 in such a way as to support the delivering of the layer 14, 14a.

[0038] The severing means 36 and the lateral containing means 37 may be made in elastic material in such a way as to be able to lengthen in the rolling on the rolls of the end of the belt conveyor means 3. Preferably the containing means are made in elastomeric material. This further supports the delivering of the compacted material 14 from the side of the mould 4.

[0039] If it is necessary to avoid, for further increasing the homogeneity of the pressing and the speed of the forming cycle, the layer of powders 14 remaining still under the action of the pressing rolls 13, 29 in the time the punch 18 needs for forming tiles into the mould 4, the entire group defined by the front end of the belt conveyor means 3 comprising the roll 12 and the pressing rolls 13, 29 may be translated far away from the mould 4 in such a way as to maintain uniform the relative speed of the powders 6 with respect to such rolls. At the end of pressing, said group will be moved again near to the mould 4.

[0040] The same could be made with the distributors of decorating substances 7 and with the hopper 2.

[0041] Figure 14 shows that, to obtain the compactation of the layer 6, 8, it is possible to use a compacting means 40 provided with orbital motion, or provided with a swinging, or vibrating motion, generally generating a circular action shown by arrows F4 and such as to compress the powders 6 and advance together with them along a portion of route of the belt conveyor means 3. Underneath the belt conveyor means 3 there is a mov-

able controlling block 41, whereon the belt conveyor means 3 rests, the block being free to move along the direction Y1 toward the mould means 4 when the compacting means 40 compresses the powders 6 and to return at the initial position, under the action of a return spring 42, when the compacting means 40 does not compress the powders 6. For this purpose, the movable block 41 is set up on rolls 43 interposed between the block 41 and a base body 44.

[0042] The compacting action of the compacting means 40 may also be obtained by a suitable vibrating-generator device: therefore the action of the compacting means 40 on the powders 6 may take place in a vertical plane orthogonal to the belt conveyor means 3.

[0043] In an embodiment not shown, between the rolls 12, 13 and the mould means 4, further decorating means may be inserted to distribute decorating substances on the upper face of the layer 14 of compacted powders.

[0044] Moreover, the surface of the roll 13 may be suitably hollow, or in relief, to obtain reliefs or, respectively depressions, in the upper face of the strip 6, 8 in such a way as to be able to produce seats on the strip 14 suitable to receive further decorating substances.

[0045] In the embodiment with mould means 4 shown so far, the contact between the upper frame means 23 and the lower frame means 16 in the respective stroke downward to isolate the areas 22 is to be prevented in such a way as to maintain the layer 4 integral: for the purpose, as shown in Figure 17, between said upper and lower frame means there are advantageously spacing means 45, comprising for example mechanical controlling means, or electronic control means, such as to maintain a predetermined distance between the upper and lower frame means: in this way the action of first vertical driving means 46 for driving the upper frame means 23 and of second vertical driving means 47 for driving the lower frame means 16 is controlled. The first vertical driving means 46 are connected with a crossbar 48 of the press, while the second vertical driving means 47 are connected with the base 49.

[0046] Referring to Figure 19, between the continuous pressing means 12, 13 and the mould means 4, severing means 50 may be inserted to sever, from the layer 14, pre-formed elements to insert into the mould 4 by suitable forcing means, eventually incorporated into the severing means, which may be provided, in addition to a motion in the plane which is transverse with respect to the layer 14, as shown by the arrow F2, also with a motion in a longitudinal direction shown by the arrow F3 and parallel to the direction V of advancing of the powders 6, 8. This allows not to interrupt the action of the pressing rolls 12, 13 when the mould means 4 are driven.

[0047] Advantageously, the severing means 50 may be constituted by rotating disks or by a pair of cutters lying in opposite side with respect to the compacted layer 14 to cause its cut or fracture along a predetermined

fracture line.

[0048] Figure 20 and 21 show an embodiment of apparatus for pressing powders on belt conveyor means 3 wherein the powders 54 are pressed by a pair of rolls 12, 13 eventually co-operating with one or more further pair of rolls formed by an upper roll 29 and by a lower roll 30.

[0049] As shown, in particular, in Figure 21, the transversal containing means may be formed by transversal lips 52a projecting from the belt conveyor means 3 and having narrowing section going far from the belt conveyor means. In particular, the powders 54 may be distributed in a layer having initial thickness greater than the height of the lips 52a and the height of the lips 52a may be such that, after pressing, the powders of a cavity 53 may result severed from the powders of the next cavities 53 by means of the lips 52a.

[0050] Figure 22 shows a further embodiment of the apparatus for pressing powders wherein a non-pressed layer 6 distributed on belt conveyor means 3 is pressed by belt pressing means 58 comprising upper belt means 59 ring-rolled up on the roll 13 and on an auxiliary roll 60: between the rolls 13 and 60 there is lodged in an adjustable way a controlling block 61, whereon some rolls 62 are rolling-coupled, said rolls 62 being operatively interposed between an active part of the belt means 59 facing the powders, which have being pressed, and the controlling block 61. Below the belt conveyor means 3 for supporting the powders 6 there is advantageously provided an analogous controlling block 61a with respective rolling rolls 62a which are operatively interposed between the block 61a and the belt conveyor means 3.

[0051] The arrangement is such that the belt means 59 is tilted in the direction of advancing of the powders in such a way that between the belt conveyor means 3 and the upper belt means 59 a thickness of powders, which progressively decreases in the V-direction of advancing of the powders, is defined.

[0052] Figure 23 shows that, to feed a press 4 with pre-compacted elements 14, a roll means 15a may be used and that the powders 6, 8 may be pressed on the belt conveyor means 3 by belt pressing means 58a comprising the belt means 59 rolled up on the rolls 13, 60, without the adjustable block 61 and the respective rolling rolls 62. It is also shown that the tile obtainable from pressed powders 14 may be formed with the decorated face facing downwards, if the decorating substances 8 are distributed on the belt conveyor means 3 before the thicker portion of powders 6 forming the support is distributed thereon.

[0053] Figures 20 to 23 show versions wherein powders to be pressed interact with pressing means on belt conveyor means in a particularly gradual way and therefore the risk of their being pushed back on the belt conveyor means 3 thereby is greatly reduced.

[0054] Figure 24 shows that the space defined between the compacting layer 40 and the belt conveyor

means 3 has a first portion R with decreasing height to decrease the thickness of the powders 6, 8 in the pressing and a second portion R1 having constant height to stabilize the pressed powders and prevent uncontrolled movings of the powders in the pressing.

[0055] The use of the portions R, R1 in sequence, having respectively decreasing and constant height in the direction shown by arrow V, is obtainable in the embodiments of Figures 9, 10, 11, 12, 13, 14, 17, 20, 21, 22, 23 with a suitable arrangement of the pressing means.

[0056] Moreover, there is provided a compacting belt 59a interposed between the powders 6 to be pressed and the compacting means 40, advantageously provided with transversal severing means 52b extending toward the belt conveyor means 3 to sever, from the top, the layer of powders 6 during pressing.

[0057] The compacting means 40 may be elastically coupled with supporting means through elastic harmonizing means 40a and may be also coupled with vibration generating means 40b.

[0058] With reference to Figures 14 and 24, it is observed that the compacting means 40 may also be provided only with a reciprocating motion in a direction orthogonal to the belt conveyor means 3 and, in this case, the belt conveyor means 3 has to be driven with intermittent motion, i.e. step by step.

[0059] Figures 25 to 28 show that the press 4 may have, close to the internal edge of the upper frame means 23, an annular edge-zone 23b being part of the cavity 23a and made in such a way as to correspondingly form an external edge of the tile 5; advantageously, the annular edge-zone 23b is provided with a cutting corner 23c to remove an exceeding portion of the pre-compacted product 14 when the upper frame means 23 descend toward the product 14 to be pressed.

[0060] Positioning means 63 bring the product 14 under the punch 18 in a central position with respect to the hollow defined by upper frame means 23 and extracting means 64 extract the formed tile 5 from the pressing area.

[0061] The extracting means 64 may be provided with a depressurizing element 65 extending along an edge of the tile 5 and provided with an opening 66 through which, for difference in pressure, the corresponding edge of the tile is caught with a force sufficient to keep caught the tile while it is moved.

[0062] As shown in Figures 29 and 30, the upper frame means 23 may be provided with a diverging area 23d which spreads toward the product 14 to be pressed in such a way as to fix it in the centre thereof when the frame means 23 are descended for the pressure.

[0063] In this embodiment it is not necessary to position the products 5 accurately under the punch 18.

[0064] In the embodiments shown in Figures 31 to 34, the lateral containing means for containing powders are boundless to the belt conveyor means 3 and act directly on the powders 6, 8, or 54; therefore the belt conveyor

means 3 has not side walls or longitudinal severing partitions 36. The lateral containing means may comprise belt conveyor means 67 formed by a pair of belt means 68 rolled up on respective pulleys 69 supported to rotation about axes substantially orthogonal to the belt conveyor means 3 near to the pressing rolls 12, 13.

[0065] Figure 31 and 32 show embodiments wherein the belt conveyor means 3 has not transversal severing means and, thus, from the powders 6, 8 a continuous pressed product 14 is obtained.

[0066] In the embodiment of Figure 33, the belt conveyor means 3 is provided with transversal severing means 52 and the lateral containing means for containing powders 54 are formed by rigid side walls 70 which extend laterally to the cavity in which the said powders are contained and may swing between the position indicated with continuous line and the position with dashed line to unengaged from the powders 54 after pressing has taken place with one of the systems described so far.

[0067] In Figures 34, 35 the lateral containing means are formed by exceeding portions 71 of powders 6, 8 which contain the same powders up to the pressing area where the lateral roll containing means 39 laterally compact them during the action of compressing carried out by the rolls 12 and 13.

[0068] Figure 36 shows an embodiment of pressing means for pressing powders wherein the powders 6, 8 are compacted between the belt conveyor means 3 and the upper belt means 59a between which a thickness of powders is defined, said thickness being progressively decreasing toward the V-direction of advancing of the powders. A plurality of plates 76, severed in two groups of plates hinged to form rings, acts on the belt means 3, 59a from the side opposite to the one in contact with the powders, said rings being an upper ring 77 of plates acting on the upper belt means 59a and a lower ring 78 of plates acting on the lower belt conveyor means 3. Upper rolls 79 and lower rolls 80, defining planes of advancing of the plates 76, act on the rings of plates 77 and 78, from the side opposite to the one facing the belt means 59a and respectively 3.

[0069] It is observed that the belt means 3, 59a may be omitted and, in this case, the powders 6, 8 result in direct contact with the plates 76: the plates 76 disposed below the powders 6, 8 acting as conveyor means for the same powders.

[0070] The rolls 79, 80 may have axes in fixed position, i.e. they may be rotatably supported by side walls, not shown, or they may be rollingly coupled with controlling blocks like the blocks 61, 61a already described, in the latter case the respective axes being movable along the peripheral portion of the respective controlling blocks.

[0071] It is observed that the belt conveyor means 3 is provided with transverse lips 52b extending, inside the powders 6, 8 to be pressed, for a relatively small portion, i.e. such that the lips 52b remain inserted inside the

thickness of the powders 6, 8 also at the end of the pressing. In such a case, the lips 52b define some predetermined fracture planes Z for the pressed powders.

[0072] Figure 37 shows that in an apparatus for pressing ceramic tiles there are provided hopper distributing means 81 which pour various types of powders 6, 8, 82 contained therein, on the belt conveyor means 3 through a single outlet 81a, in such a way as to form on said belt conveyor means a formation of powders defining grains simulating the effect of natural stones.

[0073] To obtain the greatest variety of decorating effects, the types of powders 6, 8, 82 are introduced into the hopper 81 by respective conduit means 83, 84, 85 which are coupled with respective driving means inside the hopper distributing means 81, in such a way as to allow to vary the allocation of the powders inside the hopper distributing means and consequently vary the structure of the layer of powders 6, 8, 82 to compact.

[0074] Figure 38 shows that the lateral containing means may be formed by belts 100 rolled up on the belt conveyor means 3.

[0075] Advantageously, the belts 100 are rolled up on rolling means 101 different from the roll 12 whereon the belt conveyor means is rolled up, with the transversal containing means 52a. In this way it is possible to lengthen the belts 100 in the portion comprised between the detaching zone from the belt conveyor means 3 and the respective rolling means 101 in such a way as to decrease the section S1 with respect to the section S2 which the belts have in the remaining portions.

[0076] Preferably, the belts 100 are pressed on the rolling means 101 by anti-sliding means 102. The belts 100 are so detained between the pressing means 38a which keep them on the belt conveyor means 3 and the rolling means 101 whereon they are kept by the anti-sliding means 102. In this way, the peripheral speed of the rolling means 101 may be greater than the peripheral speed of the roll 12 so as to determine an elongation on the belts 100 with reduction of transverse section.

[0077] This allows to support the extraction of the pressed product 14 from the cavities obtained on the belt conveyor means 3.

[0078] Figure 39 shows that the belts 100, when they are kept between the rolls 12 and 13 with interposition of the belt conveyor means 3, have a section S3 lowered toward the belt conveyor means 3 and widening towards the powders during pressing. Therefore, at the end of the action of the rolls 12 and 13, the section S3 would tend, anyway, to go far away from the pressed powders and have the initial section S2 supporting the delivery of the pressed product 14.

Claims

1. Method for pressing powdered material to obtain tiles, comprising the steps of:

- distributing powders on flexible conveyor means and advancing said powders along an advancing direction through a pressing station,
- containing laterally said powders on said conveyor means in said pressing station by side containing means distinct from said powdered material,
- pressing said powders while advancing through said pressing station, **characterized in that** said containing means act on the powders to be pressed during said advancing and continue to act during said pressing.

2. Method according to claim 1, wherein said containing means are movable along a plane substantially parallel to said conveyor means.

3. Method according to anyone of the preceding claims and further comprising, after said pressing, severing portions from said pressed powders in such a way as to obtain, from said portions, corresponding tiles.

4. Method according to anyone of the preceding claims, wherein said distributing comprises distributing said powders in different zones of said conveyor means.

5. Method according to anyone of the preceding claims and further comprising further pressing said powders after said pressing.

6. Method according to claim 1, wherein said pressing comprises acting on said powders with pressing intensity which increases along said advancing direction.

7. Apparatus for pressing powdered material in such a way as to obtain tiles, comprising flexible conveyor means for receiving powders thereon from distributing means and for advancing said powders along an advancing direction through a pressing station, containing means for laterally containing said powders on said conveyor means, said containing means being distinct from said powdered material, means for pressing said powders while advancing through said pressing station, **characterized in that** said side containing means are arranged to act on the powders to be pressed during said advancing and said pressing of the powders.

8. Apparatus according to claim 7, **characterized in that** said conveyor means are selected in a group comprising belt conveyor means, articulated-plate conveyor means.

9. Apparatus according to claim 7, or 8, wherein said containing means comprise at least a pair of con-

taining elements co-operating with said conveyor means.

10. Apparatus according to anyone of the claims 7 to 9, wherein said containing elements comprise at least a pair of wall means obtained in said conveyor means. 5
11. Apparatus according to anyone of the claims 7 to 10, wherein said containing means comprise a pair of rolling means acting on edge zones of said conveyor means. 10
12. Apparatus according to anyone of the claims 7 to 11, and further comprising severing means to sever from the pressed powders portions defining tiles. 15
13. Apparatus according to anyone of the claims 7 to 12, wherein said pressing means comprise roll pressing means which define a passing section for said material which decreases along an advancing direction (V) of the material. 20
14. Apparatus according to claim 13, wherein on a portion of said roll pressing means compacting belt means (31, 59) are rolled up. 25
15. Apparatus according to claim 14, wherein said compacting belt means co-operate with controlling means and with rolling means interposed between said compacting belt means (31, 59) and said controlling means. 30
16. Apparatus according to anyone of the claims 7 to 13, wherein said pressing means comprise at least a compacting means (40) provided with swinging motion. 35
17. Apparatus according to anyone of the claims 7 to 16 wherein said pressing means comprises at least a compacting means (40) provided of a first pressing surface portion forming an angle with said conveyor means and a second pressing surface portion substantially parallel to said conveyor means. 40
18. Apparatus according to anyone of the claims 7 to 17, wherein said conveyor means is indexable along a rectilinear path in a direction orthogonal to a direction along which said pressing means (40) are movable. 45
19. Apparatus according to anyone of the claims 7 to 17, wherein said pressing means (40) is movable along more than one rectilinear directions. 50
20. Apparatus according to anyone of the claims 16 to 19, wherein on a portion of said pressing means (40) compacting belt means (59a) are cooperating. 55

21. Apparatus according to anyone of the claims 14 to 20, wherein said compacting belt means (31, 59, 59a) are provided with severing means (52b) oriented towards said powder material (6, 8).

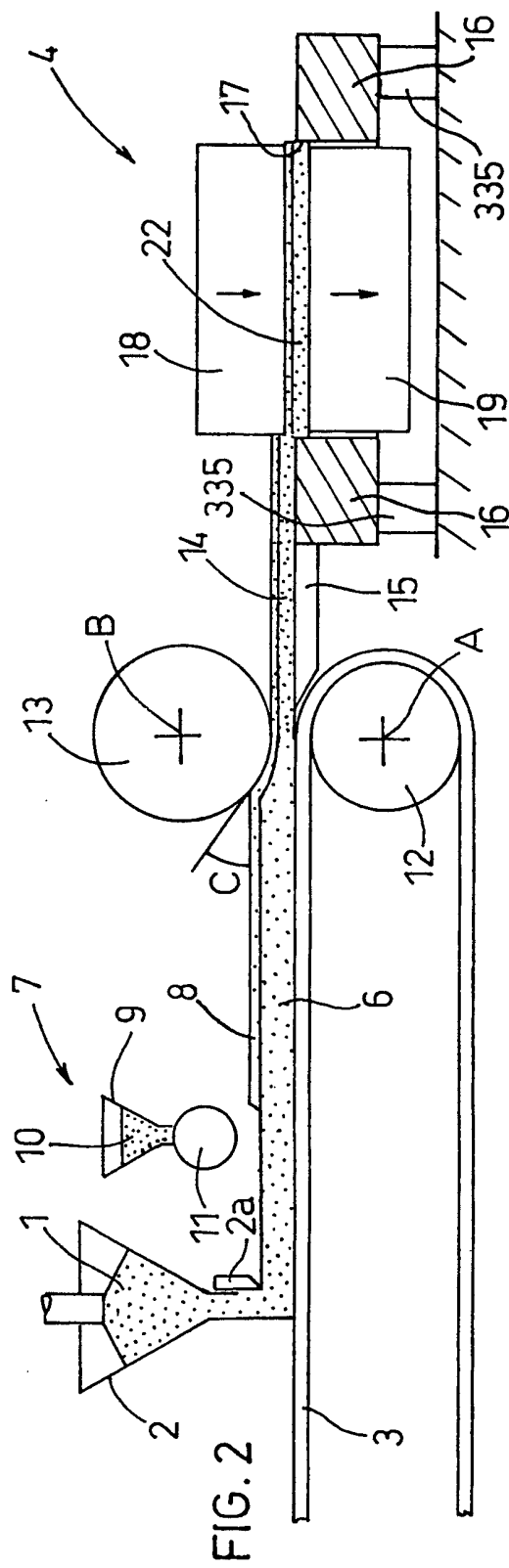
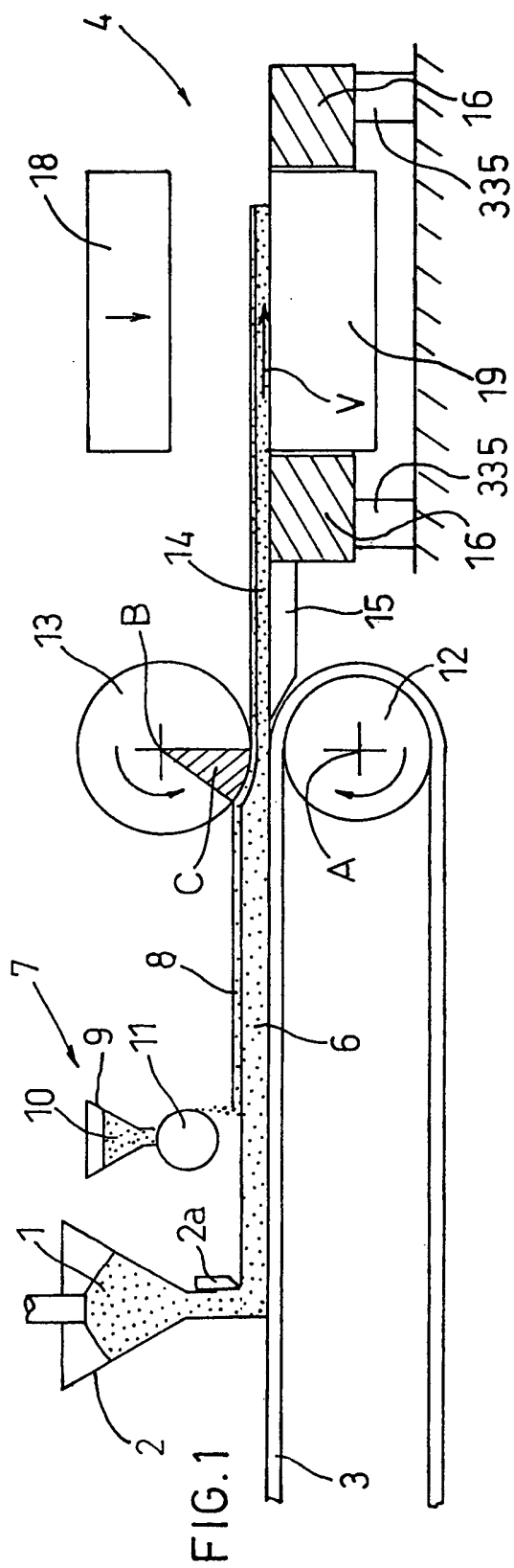
22. Apparatus according to claim 21, wherein said severing means (52b) are defined by oblique walls inclined with respect of said compacting belt means (31, 59, 59a).

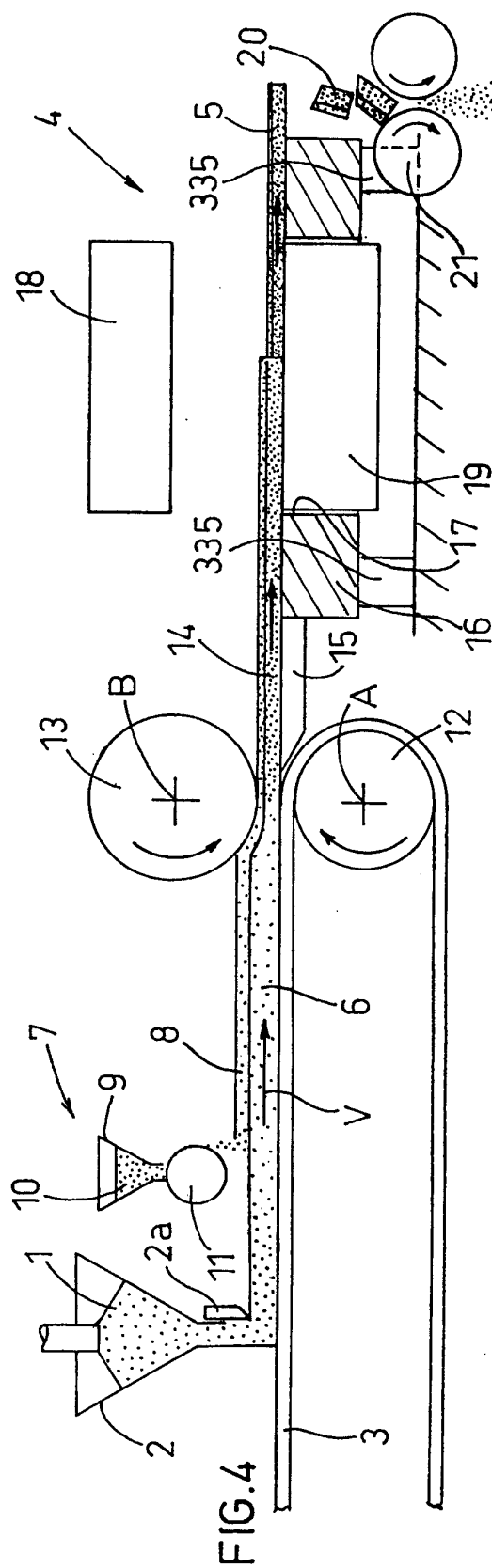
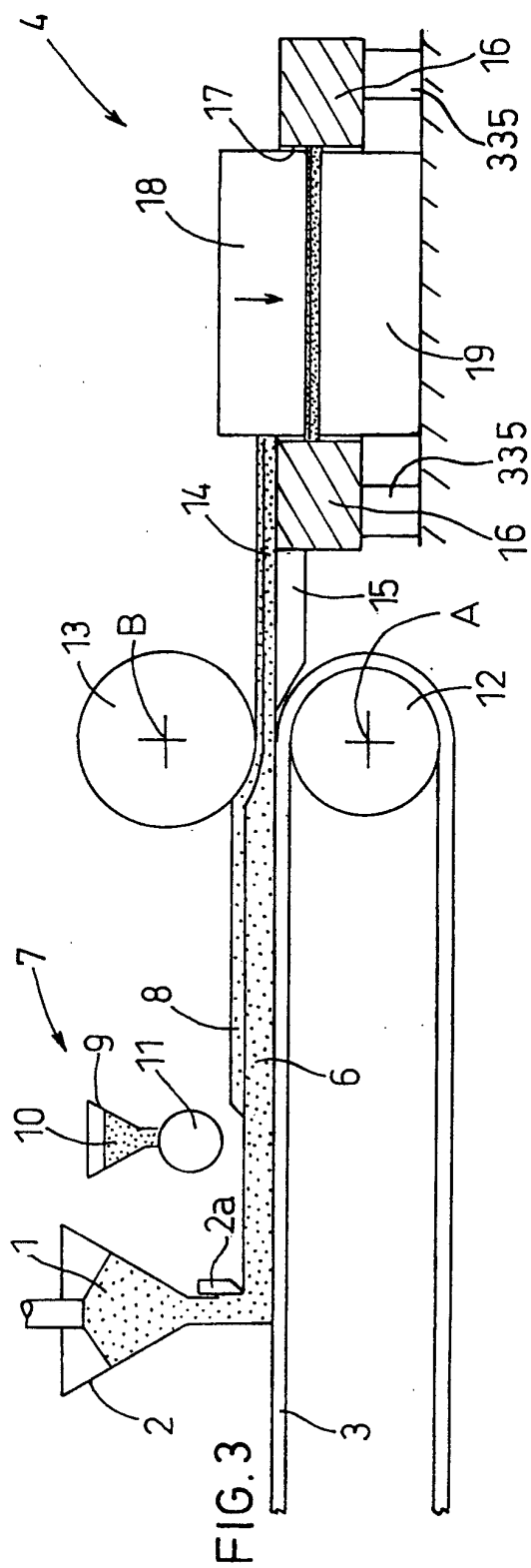
23. Apparatus according to anyone of the claims 7 to 22, wherein, downstream of said pressing means (12, 13; 12, 30, 13, 29; 12, 30, 13, 29, 31; 40, 41) there are provided further pressing means (4) for further compacting said material.

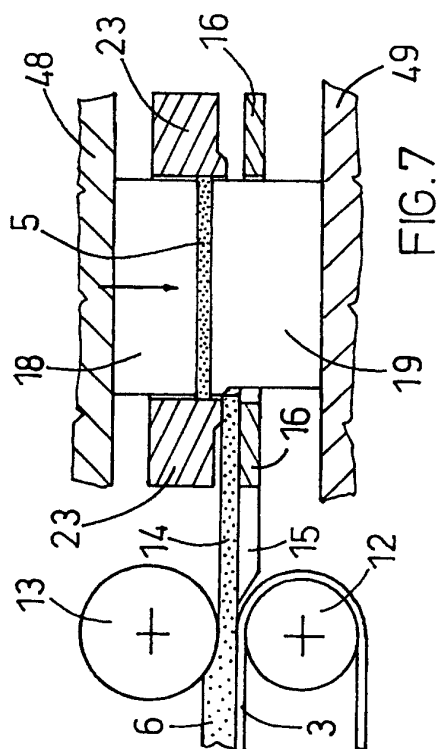
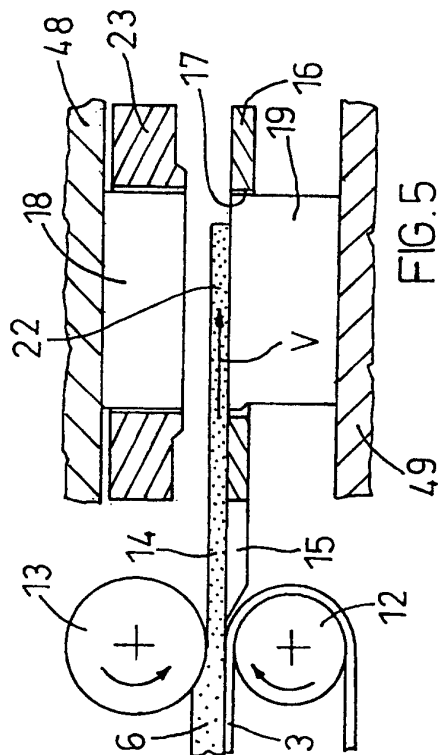
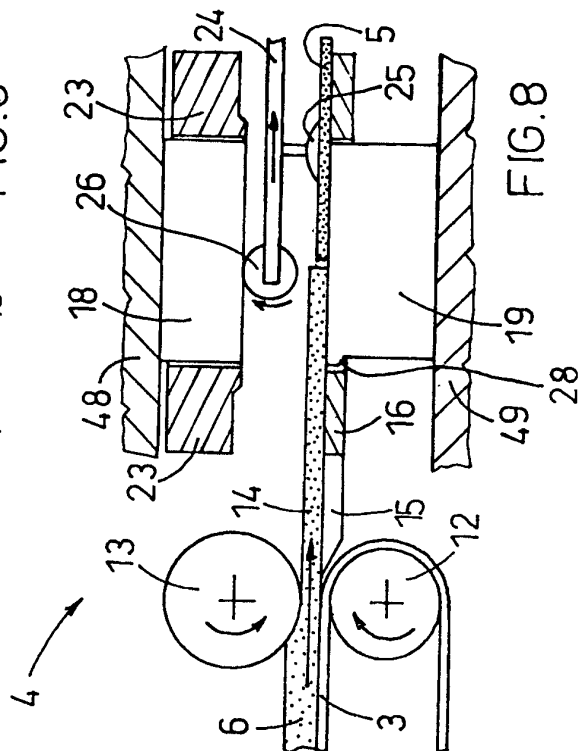
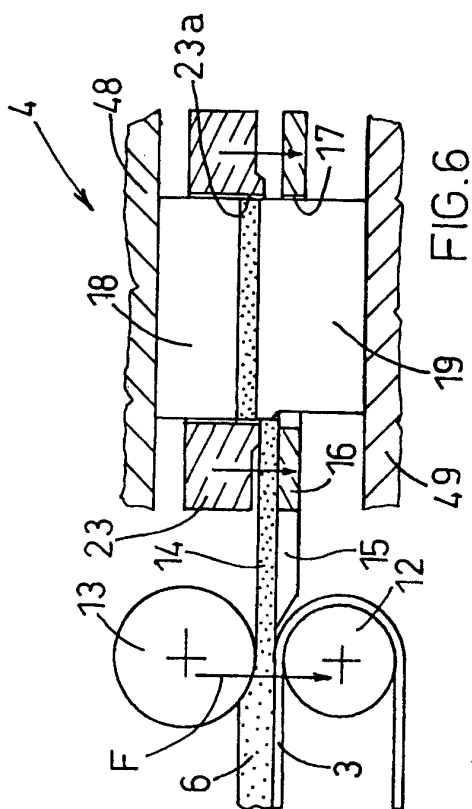
24. Apparatus according to anyone of the claims 7 to 23 wherein said distributing means comprise hopper distributing means.

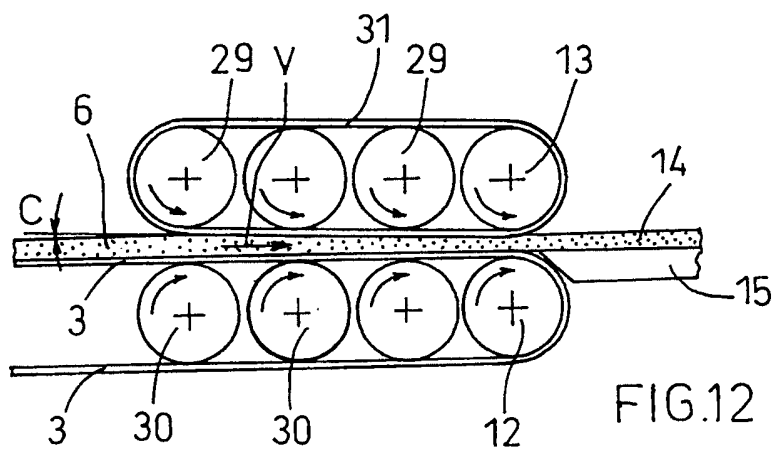
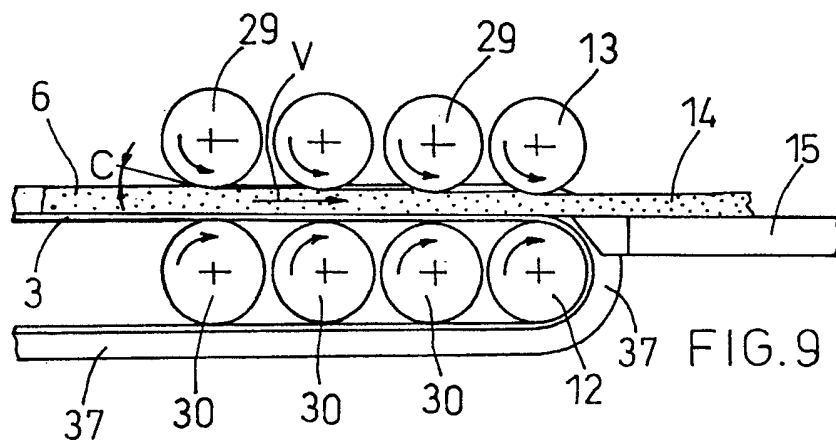
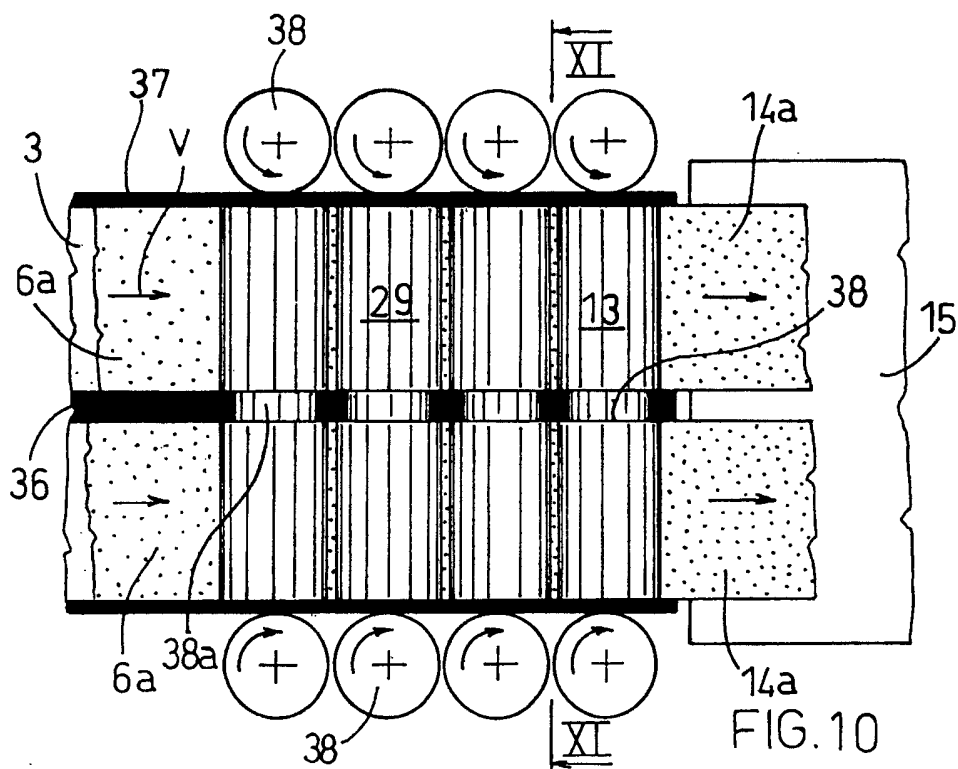
25. Apparatus according to anyone of the claims 7 to 24, wherein said distributing means comprise belt distributing means.

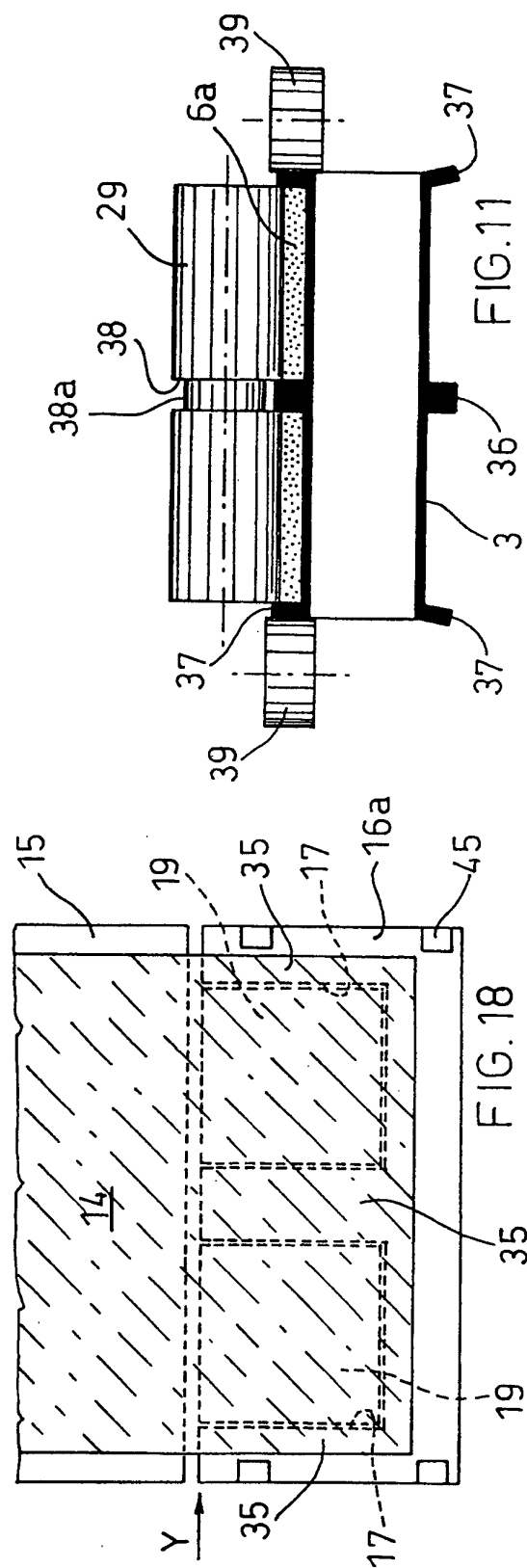
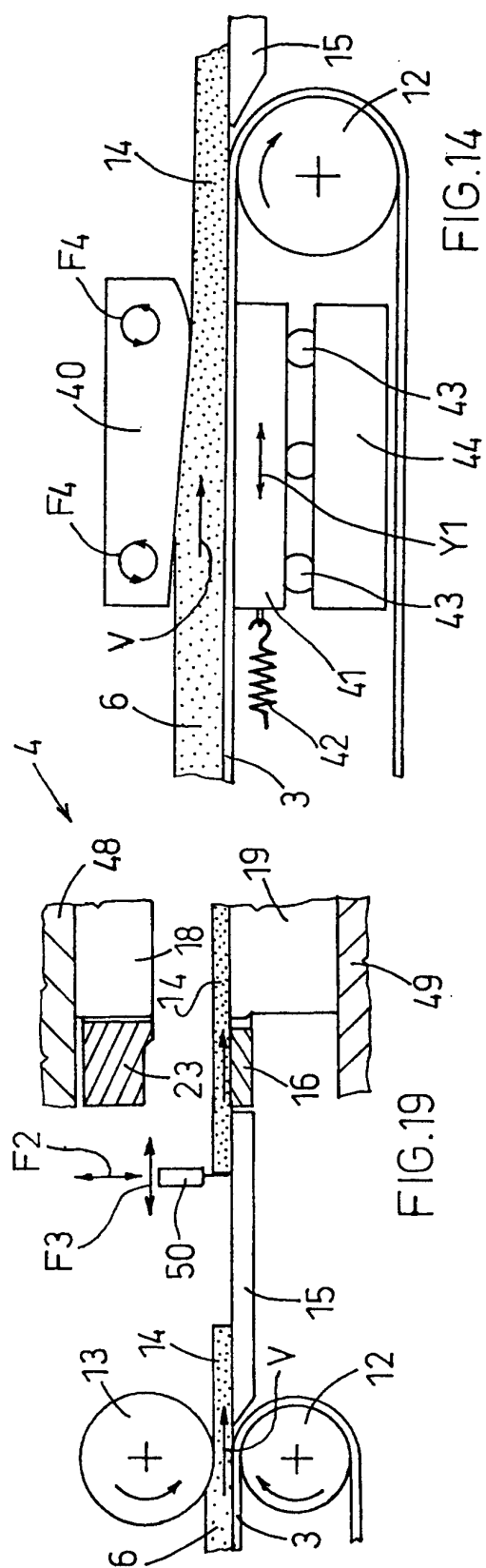
26. Forming means for forming ceramic material comprising moving means arranged to move, along a reciprocal approaching direction, powders to be pressed and pressing means to decrease significantly the volume of said powders, the pressing means being arranged to press said powders along a pressing direction transversally disposed with respect to said approaching direction, **characterized in that** said pressing means are conformed to act on said powders with pressing intensity which increases along said approaching direction.

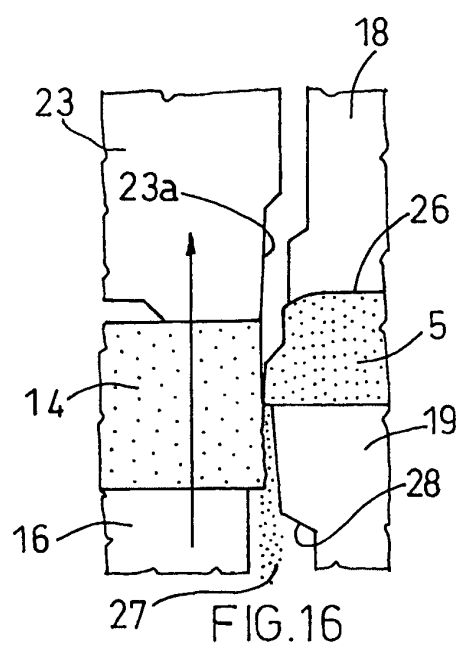
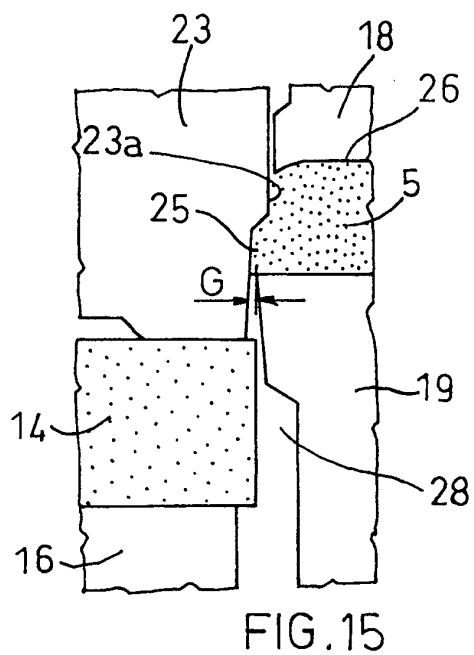
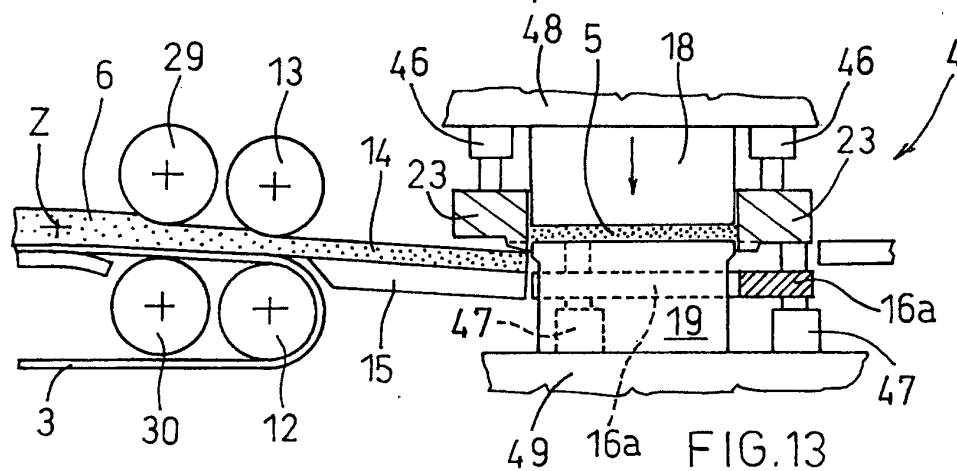
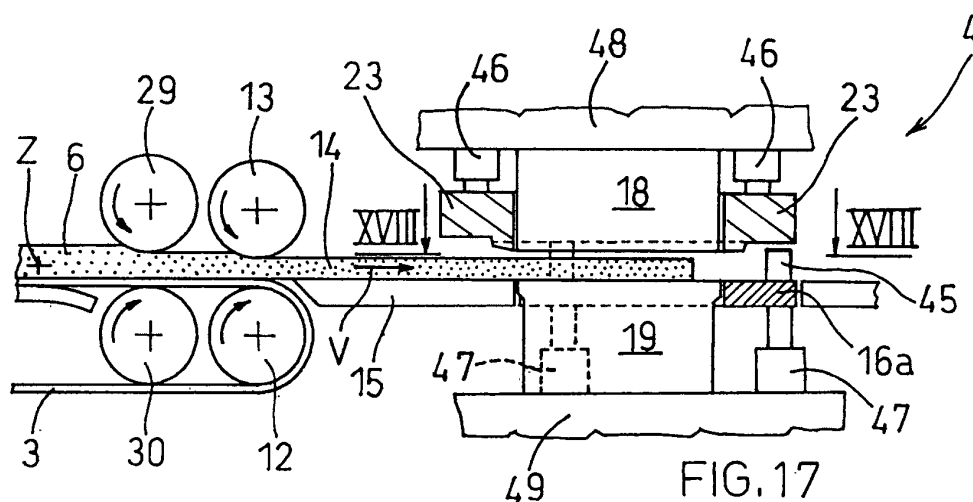


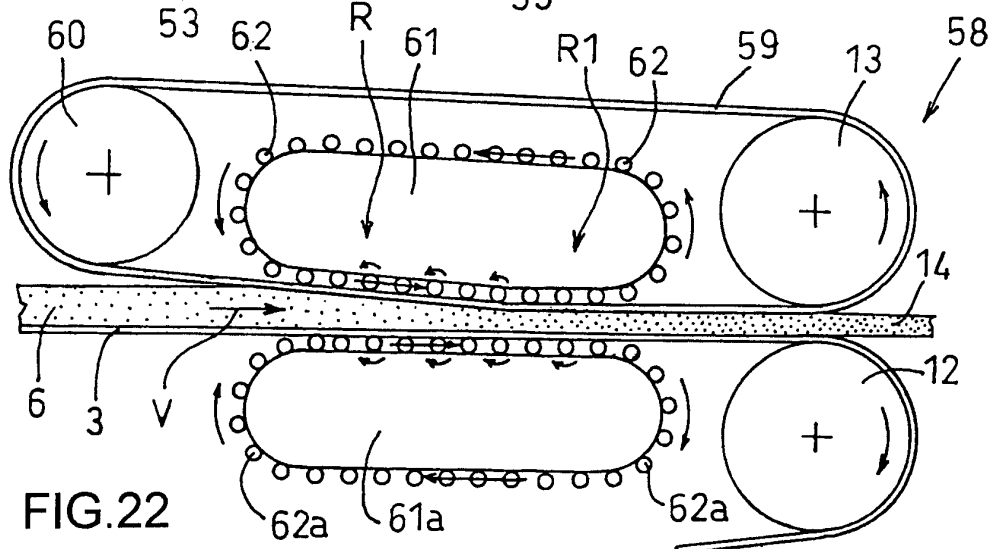
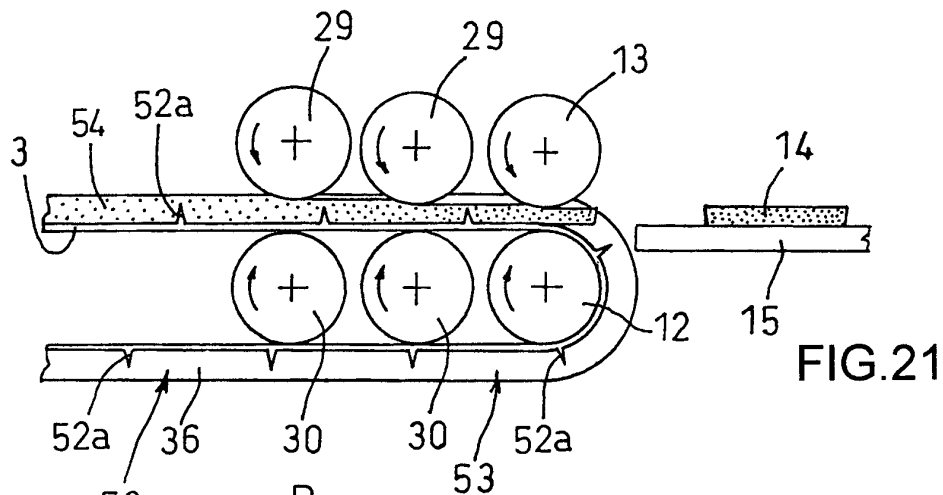
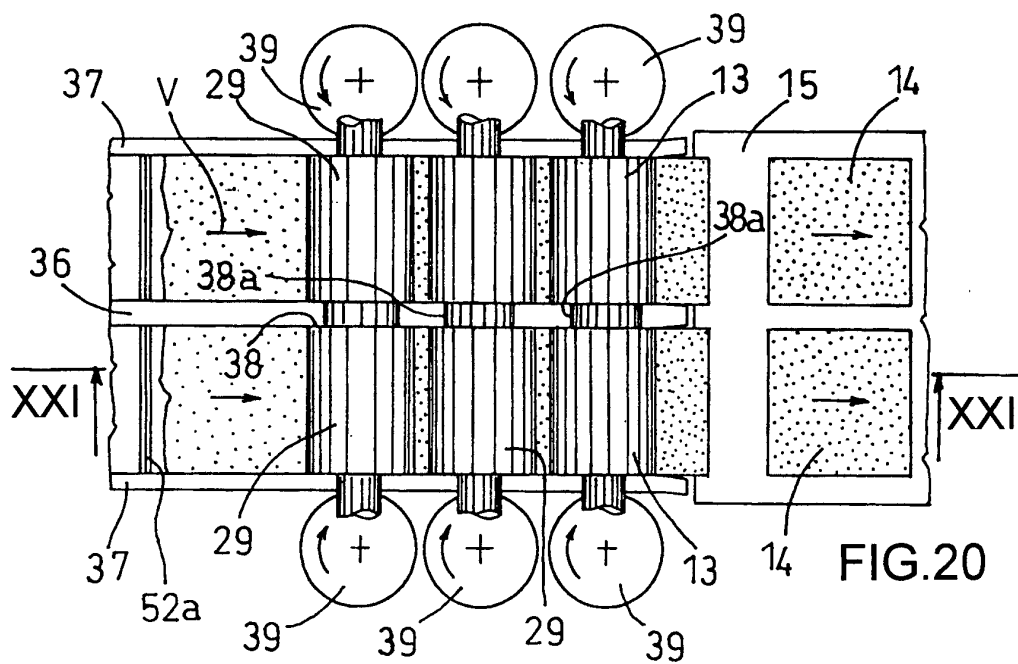












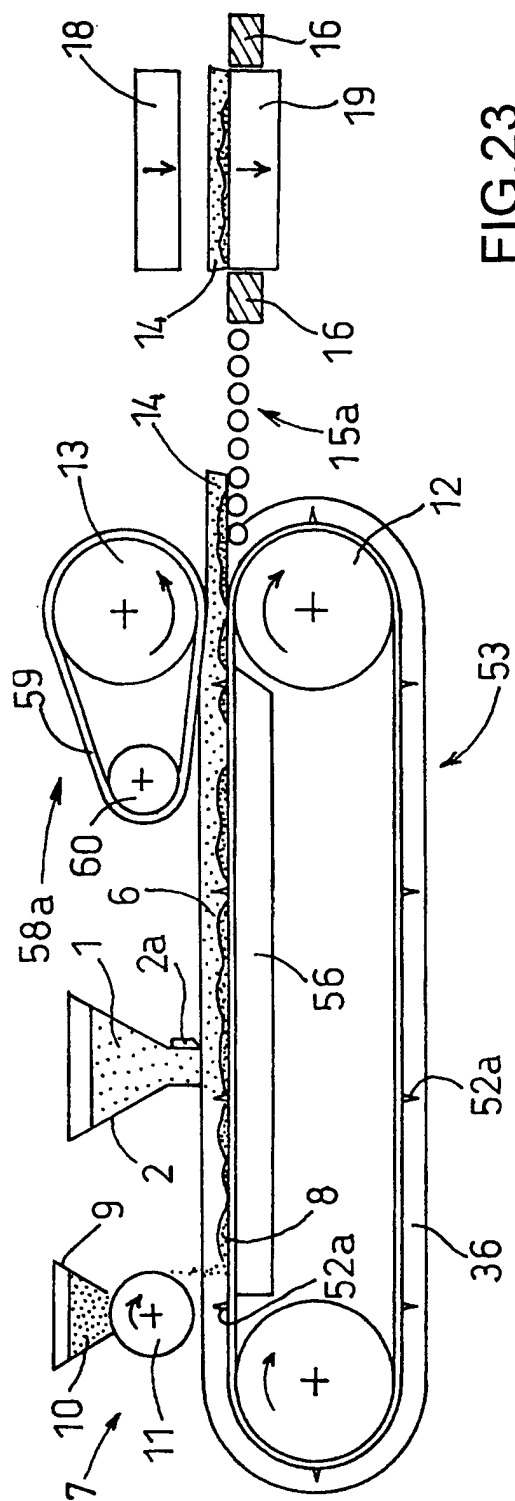


FIG. 23

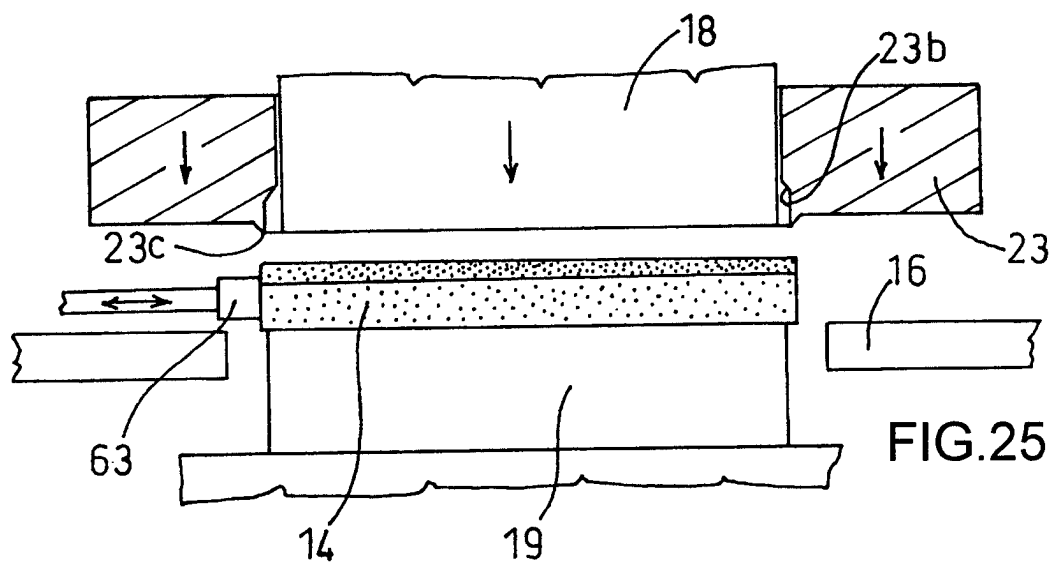


FIG. 25

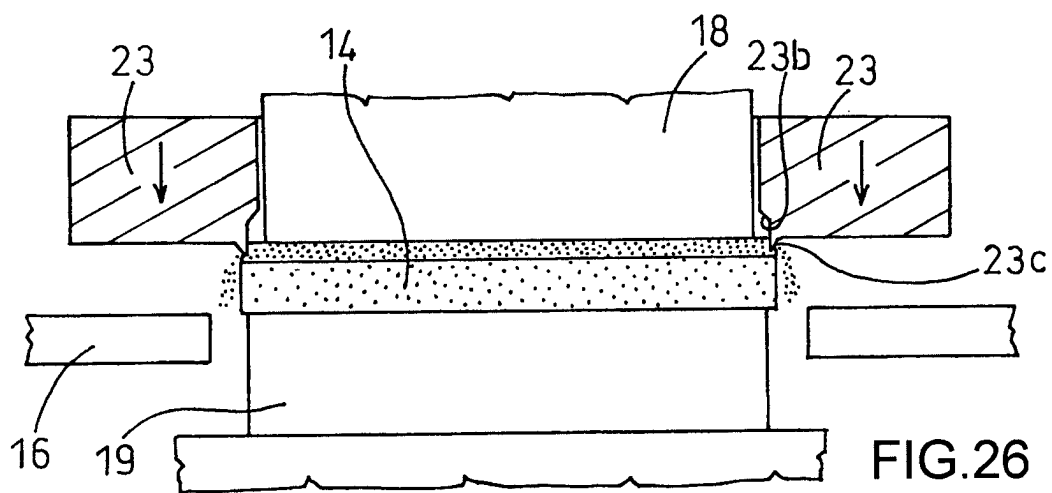


FIG. 26

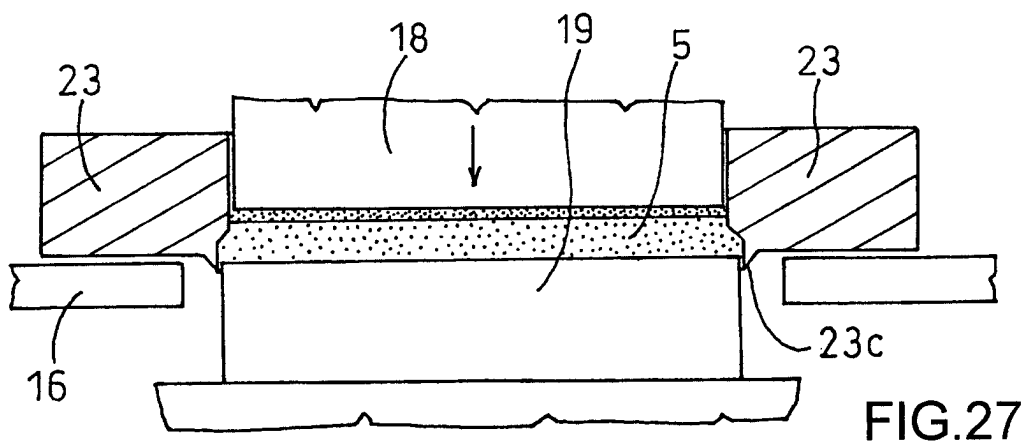
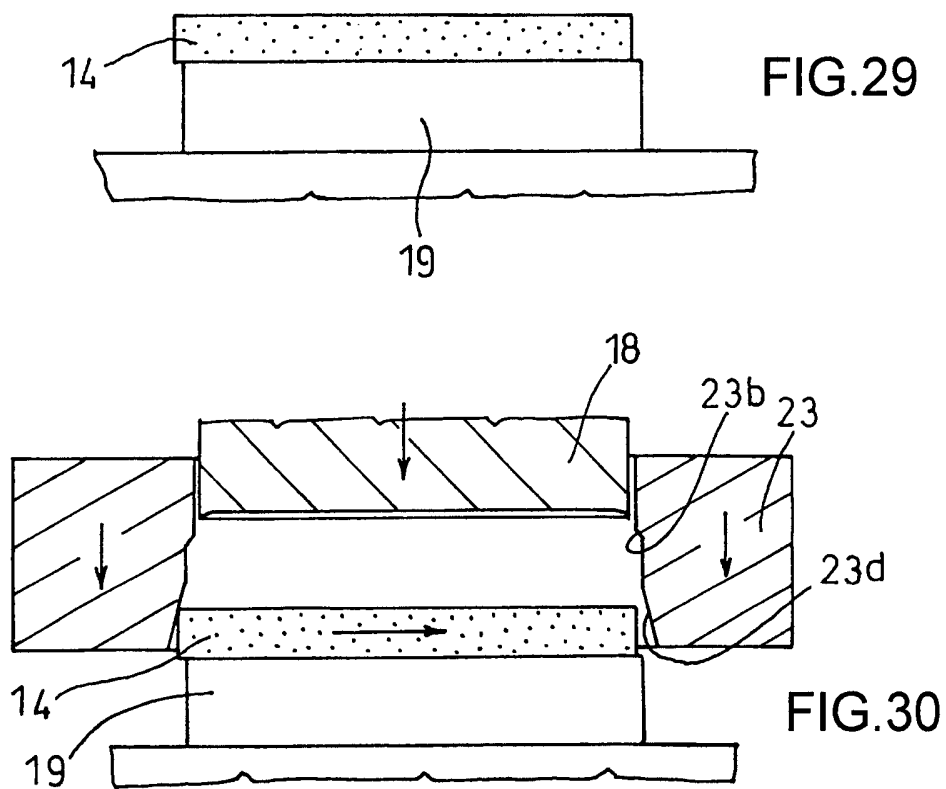
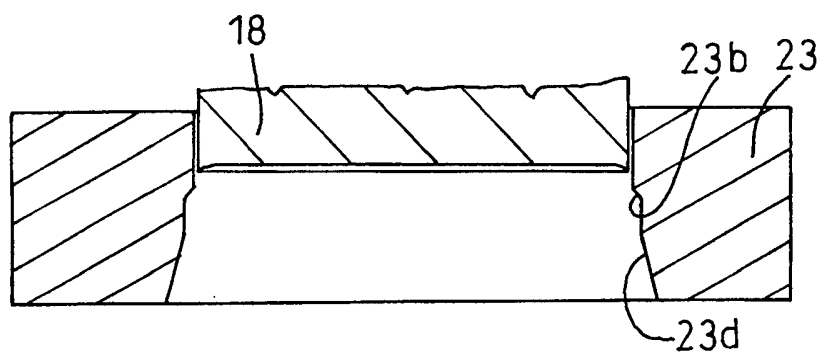
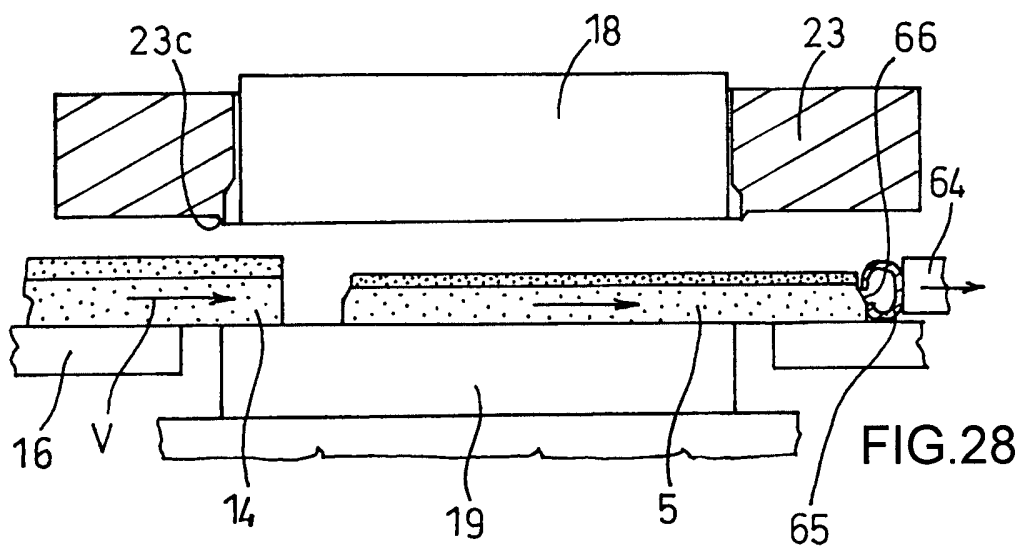
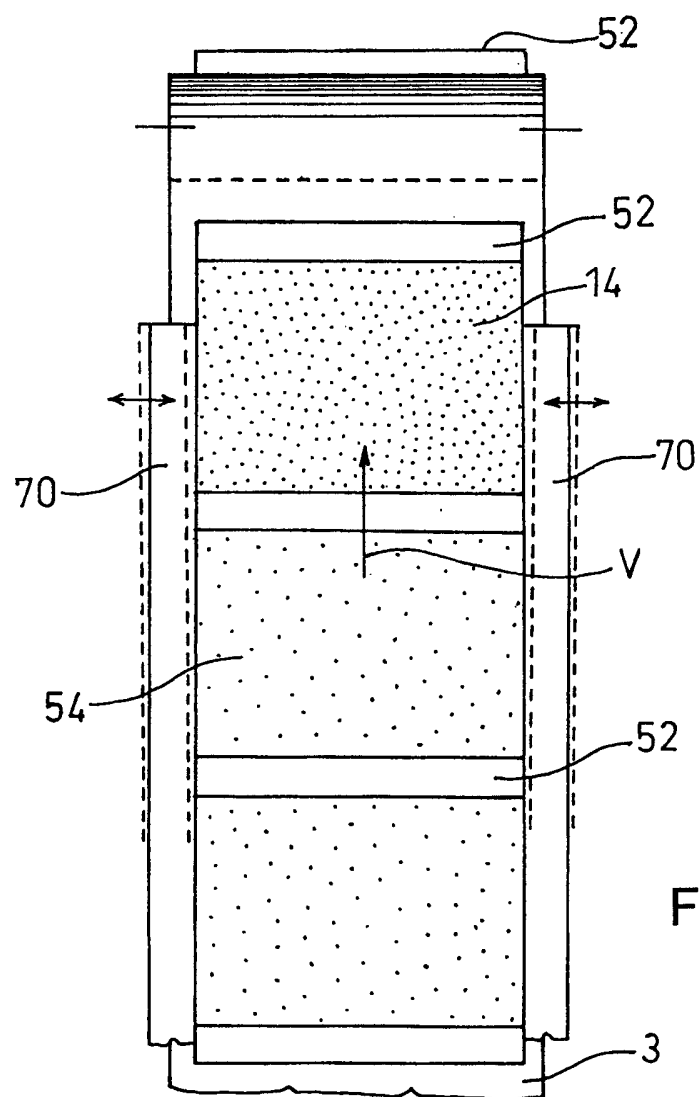
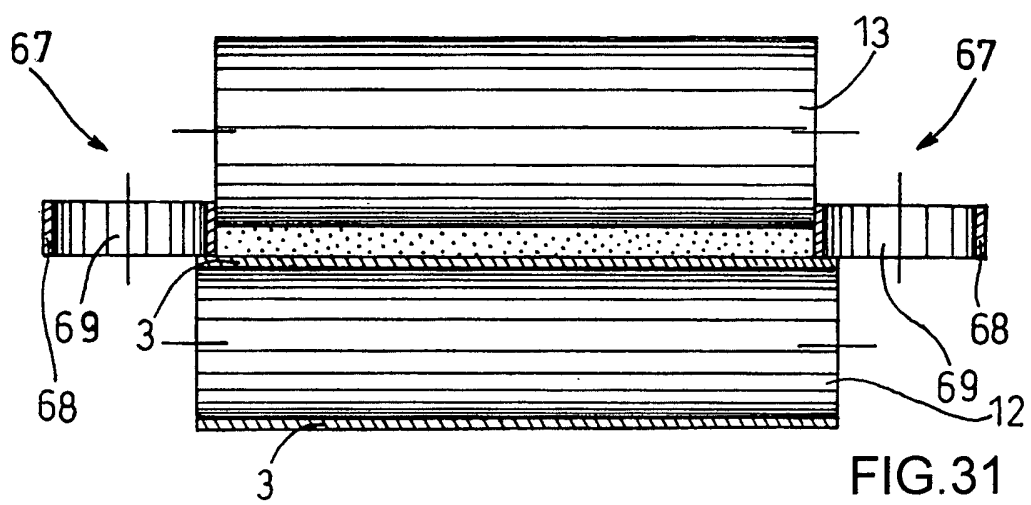
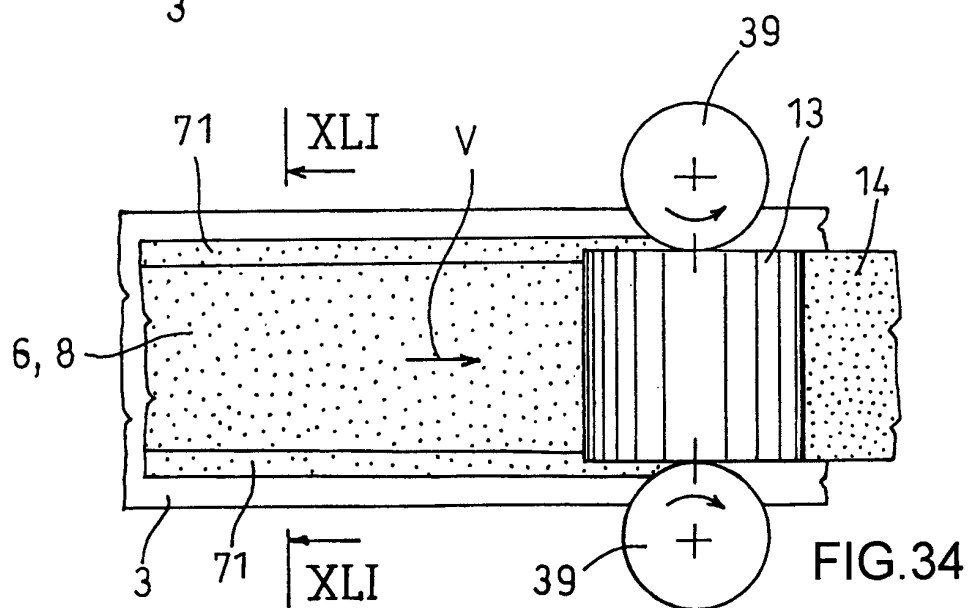
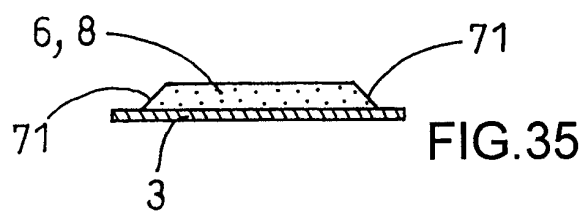
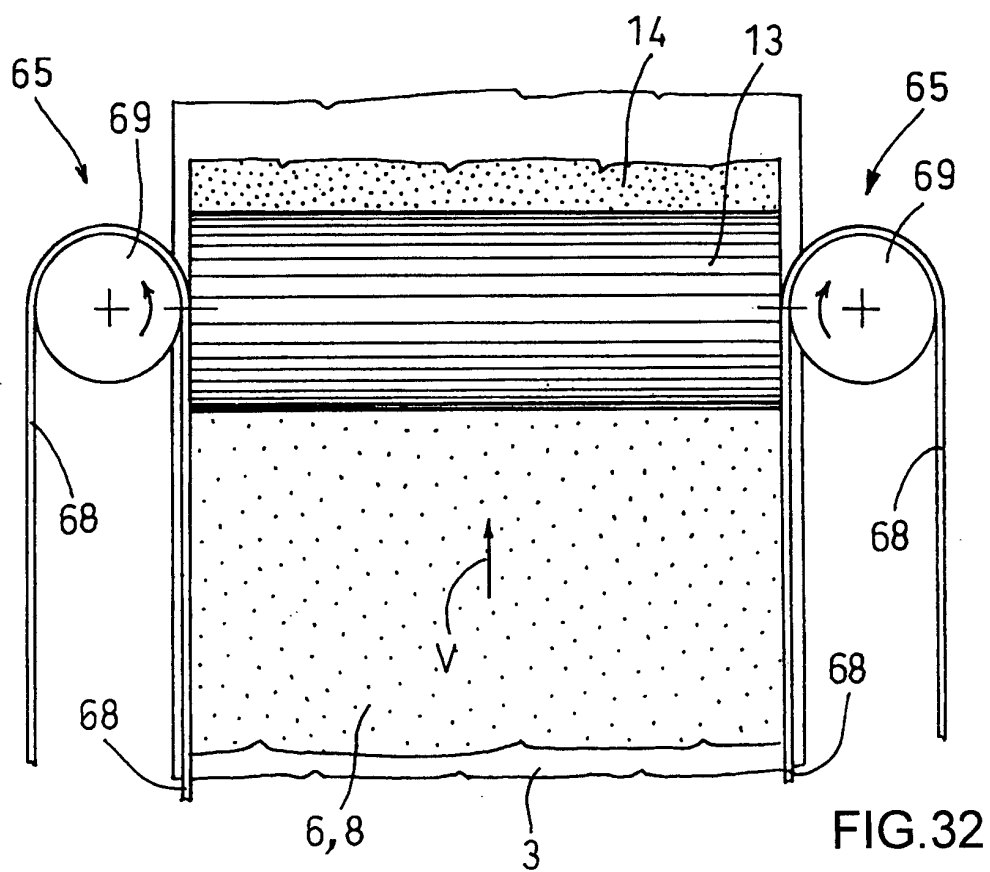


FIG. 27







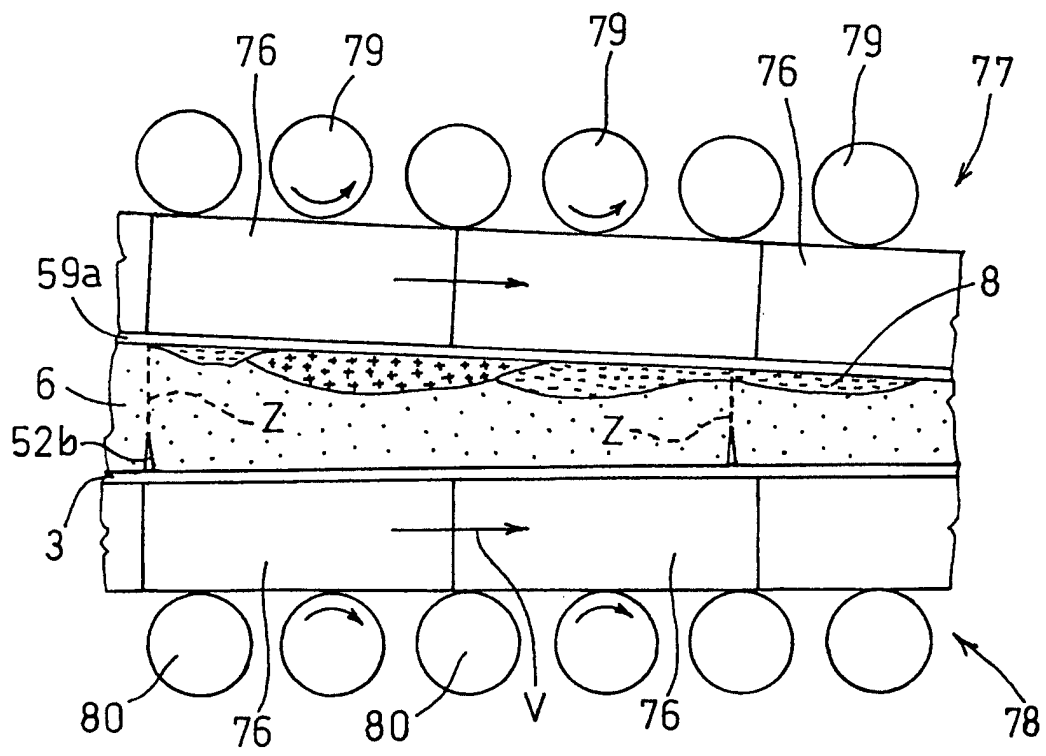


FIG.36

