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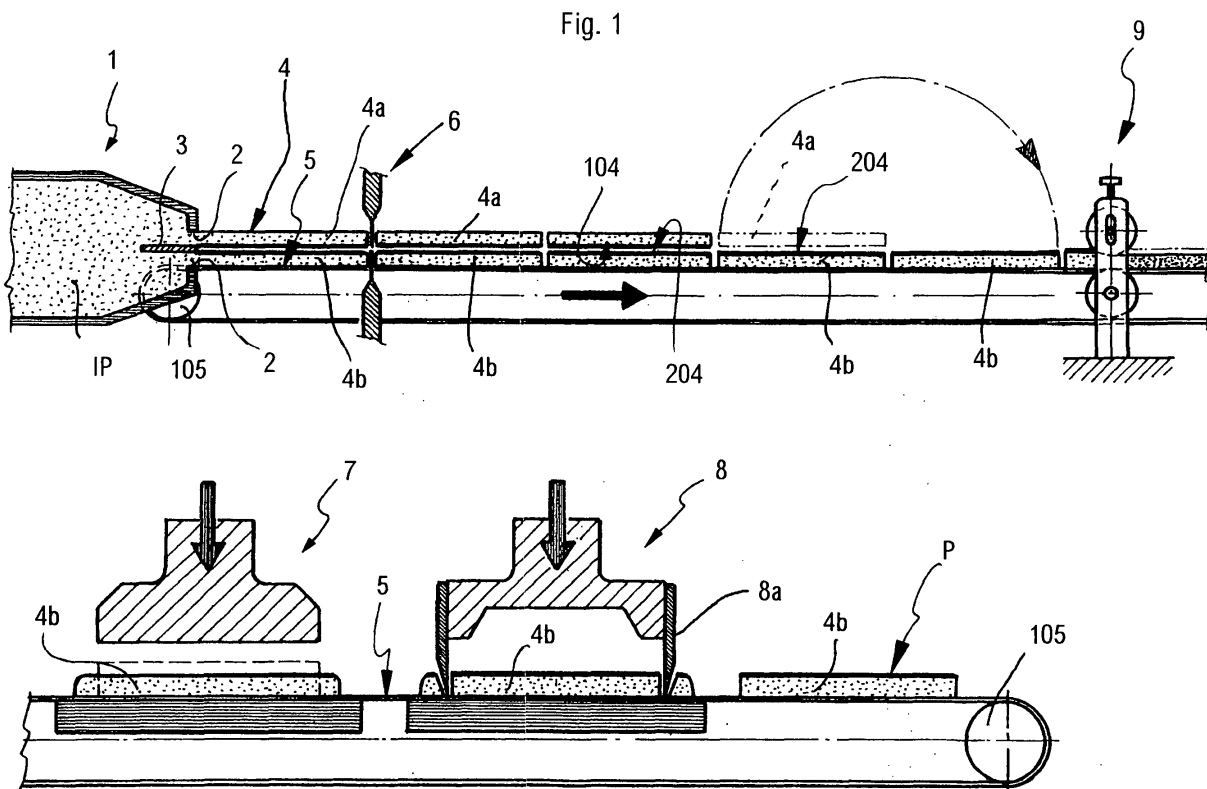
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(54) **Method and apparatus for forming flat ceramic products**

(57) A method of forming substantially flat ceramic products (P) comprises preparing a ceramic paste (IP), extruding the ceramic paste (IP) through an extrusion die (2) and over a cutter (3) to obtain a substantially continuous multiple ribbon (4) of paste with first and second ribbons (4a, 4b) of the multiple ribbon (4) not being joined together but having a separation plane that is

substantially parallel to the faces of the multiple ribbon (4), and severing the first and second ribbons (4a, 4b) transversely to provide the products (P), the extruding being performed substantially horizontally. The individual products (P) so obtained are squashed to reduce their thicknesses and to increase their plan areas and are then cut to size around their peripheries.



## Description

**[0001]** This invention concerns a method of and apparatus for forming substantially flat ceramic products.

**[0002]** One of the known techniques for forming substantially flat ceramic products, such as, for example, tiles, is the extrusion of a ceramic paste in the form of a continuous ribbon, the thickness of which is substantially the same as the final thickness that the finished products must have. The ribbon is then chopped up into pieces to size and as per specification to obtain tiles of preset dimensions.

**[0003]** To make such tiles with colouring extending through each tile and using that technique, polychrome mixtures of ceramic materials that are mutually compatible are made and extruded through a die slot.

**[0004]** IT MO94A000027 discloses a version of this process. According to a preferred embodiment of IT MO94A000027, in a conventional extruder for extruding clay materials, a forced injection of colouring materials is made at a location along the flow of materials advancing through the extruder. The injection can be obtained by arranging at least one injector close to the extruder screw which advances the material towards a location near the extrusion mouth. The injector or the injectors may also be positioned at locations along the extrusion direction at different distances from the extrusion mouth. Depending on the desired chromatic effects, the injector or injectors may be positioned on the extruder body or on the screw shaft. In the latter case, the shaft is internally provided with at least one conduit for feeding the colouring materials. During the extrusion operation, i.e. when the material passes through the extrusion mouth, an extruded product is formed, having a central internal portion of a colour different from the colour of the external portion. In other words, the extruded product has a monochromatic external rind (having the same colour as the initial colour of the clay), and an internal portion provided with coloured veins. The extruded product so obtained, having a core of different colour, is then also cut along a plane which is not perpendicular - usually parallel - to the extrusion direction, so as to remove the monochromatic rind and make the differently coloured central portion visible. The cutting operation, when performed parallelly to the extrusion direction, is preferably carried out during the extrusion process by introducing a cutting member near the extrusion mouth. The cutting member separates the rind from the internal portion of the extruded product. Obviously the cross-section of the extruder has to be so dimensioned that the desired cross-section of the extruded product is not affected by the cutting member. For example, to obtain parallelepipedic objects, an extruder having a rectangular cross-section is used, having a thickness twice the object's thickness and provided with a central cutting wire. Therefore, two objects exit from the extruder, the two objects being separated along a central plane parallel to the extrusion direction. By performing a cut along this

central plane it is possible to make visible the coloured central portion of the extruded product. According to another embodiment of the process disclosed in IT MO94A000027, the extruded product is cut, during its advancing, by inserting a stretched cutting wire, arranged near the extrusion mouth transversely with respect to the extrusion direction. The cutting wire is moved according to preset oscillating movements. For example, the cutting wire may be moved with a reciprocating motion along a plane perpendicular to the extrusion direction. The extruded product is therefore cut into two parts, each of these parts having an undulated surface. These parts are then flattened by pressing.

**[0005]** In another known version of the process, to highlight such veining on the visible face of the finished product, the ribbon is subjected to a process of surface stripping, i.e. a slice of extruded material that is a few millimetres thick and is still in the plastic state is removed.

**[0006]** The removed material is a noticeable percentage of the total material used to form the ceramic product (of the order of 10-20%) and has to be removed from the production line as waste material that can nevertheless be used in other industrial ceramic applications.

**[0007]** For example, US-A-4,292,359 discloses a process for the continuous production, by extrusion, of a partly finished clay product comprising a pair of parallel ribbons joined in back-to-back relation by a plurality of longitudinally extending walls in the form of frangible bridges which, when the partly finished clay product has been cut into blanks and fired to harden it, can be broken to separate the blanks into two ceramic pieces. The process comprises the steps of feeding a base material to a first screw extruder having two screw conveyors in series separated by a degassing chamber, and feeding a second, differently coloured, material to the degassing chamber, preferably through a second screw extruder.

**[0008]** Downstream of the degassing chamber the screw conveyor imparts a rotary mixing motion to the two-coloured clays to swirl these and then the mixture is pressed through a vertically extending die plate of suitable shape, which also strips the extruded, partly finished, clay product to expose faces having a wood grain effect. To this end, the die plate is provided with a pair of vertical knives each of which strips a lateral portion from the extruded strip.

**[0009]** According to one aspect of the present invention, there is provided a method of forming substantially flat ceramic products, comprising preparing a ceramic paste, extruding the ceramic paste through an extrusion die and over a cutter to obtain a substantially continuous multiple ribbon of paste with first and second ribbons of the multiple ribbon not being joined together but having a separation plane that is substantially parallel to the faces of the multiple ribbon, and severing the first and second ribbons transversely to provide the products, characterised in that said extruding is performed substantially horizontally.

**[0010]** According to a second aspect of the present invention, there is provided apparatus for forming substantially flat ceramic products, comprising an extruder having an extrusion die slot, a cutter extending substantially parallelly to the die slot, and a severing device to provide the products downstream of the extruder, the arrangement being such that ceramic paste can be extruded from the die slot and cut by the cutter to obtain a substantially continuous multiple ribbon of paste with first and second ribbons of the multiple ribbon not being joined together but having a separation plane that is substantially parallel to the faces of the multiple ribbon, and the first and second ribbons can be severed transversely by the severing device to provide the products, characterized in that the die slot is directed substantially horizontally.

**[0011]** Owing to these two aspects of the invention, because the extruding is performed substantially horizontally, i.e. the die slot is directed substantially horizontally, we have found it to be possible readily to displace the products apart without any significant distortion of them.

**[0012]** According to a third aspect of the present invention, there is provided a method of forming substantially flat ceramic products, comprising preparing a ceramic paste, extruding the ceramic paste through an extrusion die to obtain a substantially continuous ribbon, and severing the ribbon to provide the products, characterised in that the individual products so obtained are squashed to reduce their thicknesses and to increase their plan areas and are then cut to size around their peripheries.

**[0013]** According to a fourth aspect of the present invention, there is provided an apparatus for forming substantially flat ceramic products, comprising an extruder having an extrusion die slot, and a severing device to provide the products downstream of the extruder, the arrangement being such that ceramic paste can be extruded from the die slot to obtain a ribbon, and the ribbon can be severed by the severing device to provide the products, characterised in that the apparatus further comprises a squashing device downstream of the severing device for squashing the products and a trimming device downstream of the squashing device for cutting the products to size around their peripheries.

**[0014]** Owing to these two aspects of the invention, it is possible to produce a fully finished product, for example fired tiles, to a high degree of accuracy without the tiles requiring to be processed to size after firing.

**[0015]** A preferred embodiment of the present method and of forming flat ceramic products with colouring extending throughout substantially the whole of their bodies, comprises passing the prepared ceramic paste through an extrusion die slot and over at least one cutter to form a substantially continuous multiple ribbon which is deposited on a moving conveyor surface, the cutter (s) providing at least one longitudinal cut down the multiple ribbon on at least one plane that is substantially

parallel to the top and bottom faces of the multiple ribbon, thereby creating at least two superimposed and distinct ribbons with cut faces which are in contact with one another, transversely cutting the superimposed ribbons at right angles to the top and bottom faces of the multiple ribbon to provide a series of piles of at least two unfinished products, turning over, so as to place the products of each pile side-by-side with one another on the moving conveyor surface with cut faces turned upwards, flattening the unfinished products with calibrated force to reduce the thickness thereof to a preset amount and trimming the perimeter of each product to size (and to shape) on the conveyor.

**[0016]** In order that the invention may be clearly and completely disclosed, reference will now be made, by way of example, to the accompanying drawings, in which:

- Figure 1 shows schematically in two parts a vertical, longitudinal section through a portion of a system for forming flat ceramic products with colouring throughout substantially the whole of their bodies;
- Figure 2 illustrates schematically a side elevation of the system;
- Figure 3 illustrates very diagrammatically and in side elevation an overturning device for top unfinished products in the system; and
- Figure 4 is a diagrammatic perspective view of a squashing device of the system, but illustrating a modified version of a trimming device of the system.

**[0017]** In Figure 1, 1 indicates an end portion of a batching/mixing device 101 shown in Figure 2, which is provided with an extrusion die slot 2 and wherein a ceramic paste IP with at least two chromatic components is prepared.

**[0018]** The extrusion die slot 2 is provided with a transverse blade 3 that cuts longitudinally, thereby minimising attrition phenomena, as extrusion progresses, the continuously extruded ceramic paste IP, on a horizontal plane, subdividing it into two ribbons 4a, 4b, the cut faces 104 and 204 of which are in substantial contact with one another, although, solely for the sake of clarity, in Figure 1 they are shown slightly separated from one another.

**[0019]** The continuous multiple ribbon 4 at the outlet of the extrusion die slot 2 is collected and supported by a mobile conveying surface 5, for example consisting of an endless conveyor belt on motor-driven and idle rollers 105, and conveyed to a transverse cutting station where cutting-to-size with a suitable means 6 occurs.

**[0020]** Subsequently, the conveying surface 5 carries the unfinished products 4a and 4b to an overturning station where, by a means 108 (Figure 2) known per se to those skilled in the art, turning over of the top product 4a in relation to the bottom product 4b occurs; the product 4a is thus placed next to the bottom product 4b with its cut face 104 upwards, as is the cut face 204 of the

bottom product 4b.

**[0021]** Further along, the products 4a and 4b reach a presser unit 7 whereat a squashing of the products 4a and 4b is performed under a preset force, so that their thickness is reduced to a set amount.

**[0022]** The compressing action causes the raw paste that makes up the unfinished products 4a and 4b to become homogenous and stable, thereby greatly reducing any internal stresses generated during the extrusion and therefore any consequential defects induced during firing of the ceramic products.

**[0023]** The flattening phase is followed by a phase of trimming of the products 4a and 4b, and possibly a phase of dividing each product according to preset sizes, as indicated by the cut lines 19 in Figure 4, with a suitable apparatus 8, to obtain the perimeter dimensions required of the products P which are sent for firing.

**[0024]** The trimming device 8 shown in Figure 1 includes a vertically reciprocable rectangular cutting ring 8a.

**[0025]** In the version shown in Figure 4, the device 8 includes a pair of cutting wheels 8b mounted on a shaft 8c reciprocable by a piston-and-cylinder drive 8d. The device 8 also includes another pair of cutting wheels 8e mounted upon a transverse shaft 8f.

**[0026]** In a possible alternative embodiment, upstream of the flattening phase there may be an additional phase of spreading, on the cut faces 104 and 204, decorative materials that are suitable for being incorporated in the faces 104, 204 during the flattening phase, in particular dissolved or inconsistent decorating materials such as, for example, oxides, powder or granular glazes, or also materials in flakes or three-dimensional bodies that are distributed over the faces 104 and 204 with distribution devices or decorating machines that are per se known and are indicated in Figure 2 with the overall reference numeral 110. The length of the section of mobile conveying surface 5 under the apparatus 110 may vary according to the number of chromatic applications that are to be performed and the type of apparatus 110 to be used.

**[0027]** During the flattening phase, it is also possible to print high- or low-relief decorations on the cut faces 104 and 204, by providing suitable dies on the presser unit 7.

**[0028]** In a further possible embodiment, the flattening phase can be performed by using a suitable roller device 9 shown in Figures 1 and 2 instead of the presser unit 7 or in combination therewith.

## Claims

1. A method of forming substantially flat ceramic products (P), comprising preparing a ceramic paste (IP), extruding the ceramic paste (IP) through an extrusion die (2) and over a cutter (3) to obtain a substantially continuous multiple ribbon (4) of paste

with first and second ribbons (4a, 4b) of the multiple ribbon (4) not being joined together but having a separation plane that is substantially parallel to the faces of the multiple ribbon (4), and severing the first and second ribbons (4a, 4b) transversely to provide the products (P), **characterised in that** said extruding is performed substantially horizontally.

2. A method according to claim 1, and further comprising, after said severing, squashing the products (P) to reduce their thicknesses and to increase their plan areas.

3. A method according to claim 2, and further comprising, after said squashing, trimming the products (P) to size around their peripheries.

4. A method according to claim 2 or 3, wherein, during said squashing, relief decoration is produced on the products (P).

5. A method according to any preceding claim, wherein the multiple ribbon (4) has a width dimension which is substantially horizontal and a thickness dimension which is substantially vertical.

6. A method according to claim 5, wherein said severing produces an upper row of products (P) and a lower row of products (P), and said method further comprises turning-over the products (P) of the upper row, so that those surfaces of the products (P) of the upper and lower rows initially adjacent the separation plane all face upwards.

7. A method according to claim 6, wherein said turning-over causes the products (P) of the upper row to be placed side-by-side with the products (P) of the lower row.

8. Method according to claim 6 or 7, and further comprising, after said turning-over, applying decorative material to said surfaces (104, 204).

9. Apparatus for forming substantially flat ceramic products (P), comprising an extruder (1) having an extrusion die slot (2), a cutter (3) extending substantially parallelly to the die slot (2), and a severing device (6) to provide the products (P) downstream of the extruder (1), the arrangement being such that ceramic paste (IP) can be extruded from the die slot and cut by the cutter to obtain a substantially continuous multiple ribbon (4) of paste with first and second ribbons (4a, 4b) of the multiple ribbon (4) not being joined together but having a separation plane that is substantially parallel to the faces of the multiple ribbon (4), and the first and second ribbons (4a, 4b) can be severed transversely by the sever-

ing device (6) to provide the products (P), **characterized in that** the die slot (2) is directed substantially horizontally.

10. Apparatus according to claim 9, and further comprising a squashing arrangement (7; 9) downstream of the severing device (6) for squashing the products (P). 5
11. Apparatus according to claim 10, wherein the squashing arrangement (7; 9) comprises a pressing plate (7) reciprocable substantially perpendicularly to the products (P). 10
12. Apparatus according to claim 10, or 11, wherein the squashing arrangement (7; 9) comprises at least one squashing roller (9). 15
13. Apparatus according to any one of claims 10 to 12, wherein the squashing arrangement (7; 9) is provided with a squashing surface having relief ornamentation thereon for producing relief decoration on the products (P). 20
14. Apparatus according to any one of claims 10 to 13, and further comprising a trimming device (8) downstream of the squashing arrangement (7; 9) for cutting the products (P) to size around their peripheries. 25
15. Apparatus according to claim 14, wherein the trimming device (8) comprises a first pair of cutting elements (8b) reciprocable in a first direction and a second pair of cutting elements (8e) reciprocable in a second direction substantially perpendicular to the first direction. 30
16. Apparatus according to any one of claims 9 to 15, wherein the die slot (2) has a width dimension which is substantially horizontal and a thickness dimension which is substantially vertical, the cutter (3) extends substantially horizontally, and the severing device (6) severs the first and second ribbons (4a, 4b) into an upper row of products (P) and a lower row of products (P). 35
17. Apparatus according to claim 16, and further comprising a turning-over device (108) for turning-over the upper row of products (P). 40
18. Apparatus according to claim 17 as appended to claim 10, and further comprising a distribution device (110) between the turning-over device (108) and the squashing arrangement (7; 9) for distributing decorative material over the products (P). 45
19. Apparatus according to any one of claims 8 to 18, and further comprising a horizontal conveyor (5) for

receiving the multiple ribbon (4) as it leaves the die slot (2).

20. Apparatus according to any one of claims 8 to 19, wherein the cutter (3) is provided with cutting surfaces having a low-friction coating thereon.
21. A method of forming substantially flat ceramic products (P), comprising preparing a ceramic paste (IP), extruding the ceramic paste (IP) through an extrusion die (2) to obtain a substantially continuous ribbon (4), and severing the ribbon (4) to provide the products (P), **characterised in that** the individual products (P) so obtained are squashed to reduce their thicknesses and to increase their plan areas and are then cut to size around their peripheries.
22. A method according to claim 21, wherein, as the products (P) are squashed, relief decoration is produced thereon.
23. A method according to claim 21 or 22, and further comprising, before the squashing, applying decorative material to upwardly-facing surfaces (104, 204) of the products (P).
24. Apparatus for forming substantially flat ceramic products (P), comprising an extruder (1) having an extrusion die slot (2), a severing device (6) to provide the products (P) downstream of the extruder (1), the arrangement being such that ceramic paste (IP) can be extruded from the die slot (2) to obtain a ribbon (4), and the ribbon (4) can be severed by the severing device (6) to provide the products (P), **characterised in that** the apparatus further comprises a squashing arrangement (7; 9) downstream of the severing device (6) for squashing the products (P) and a trimming device (8) downstream of the squashing arrangement (7; 9) for cutting the products (P) to size around their peripheries.
25. Apparatus according to claim 24, wherein the squashing arrangement(7; 9) comprises a pressing plate (9) reciprocable substantially perpendicularly to the products (P).
26. Apparatus according to claim 24 or 25, wherein the squashing arrangement (7; 9) comprises at least one squashing roller (9).
27. Apparatus according to any one of claims 24 to 26, wherein the squashing arrangement (7; 9) is provided with a squashing surface having relief ornamentation thereon for producing relief decoration on the products (P).
28. Apparatus according to any one of claims 24 to 27, and further comprising a trimming device (8) down-

stream of the squashing arrangement (7;9) for cutting the products (P) to size around their peripheries.

- 29.** Apparatus according to claim 28, wherein the trimming device (8) comprises a first pair of cutting elements (8b) reciprocable in a first direction and a second pair of cutting elements (8e) reciprocable in a second direction substantially perpendicular to the first direction. 5  
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- 30.** Apparatus according to any one of claims 24 to 29, and further comprising a distribution device (110) upstream of the squashing device (7; 9) for distributing decorative material over the products (P). 15

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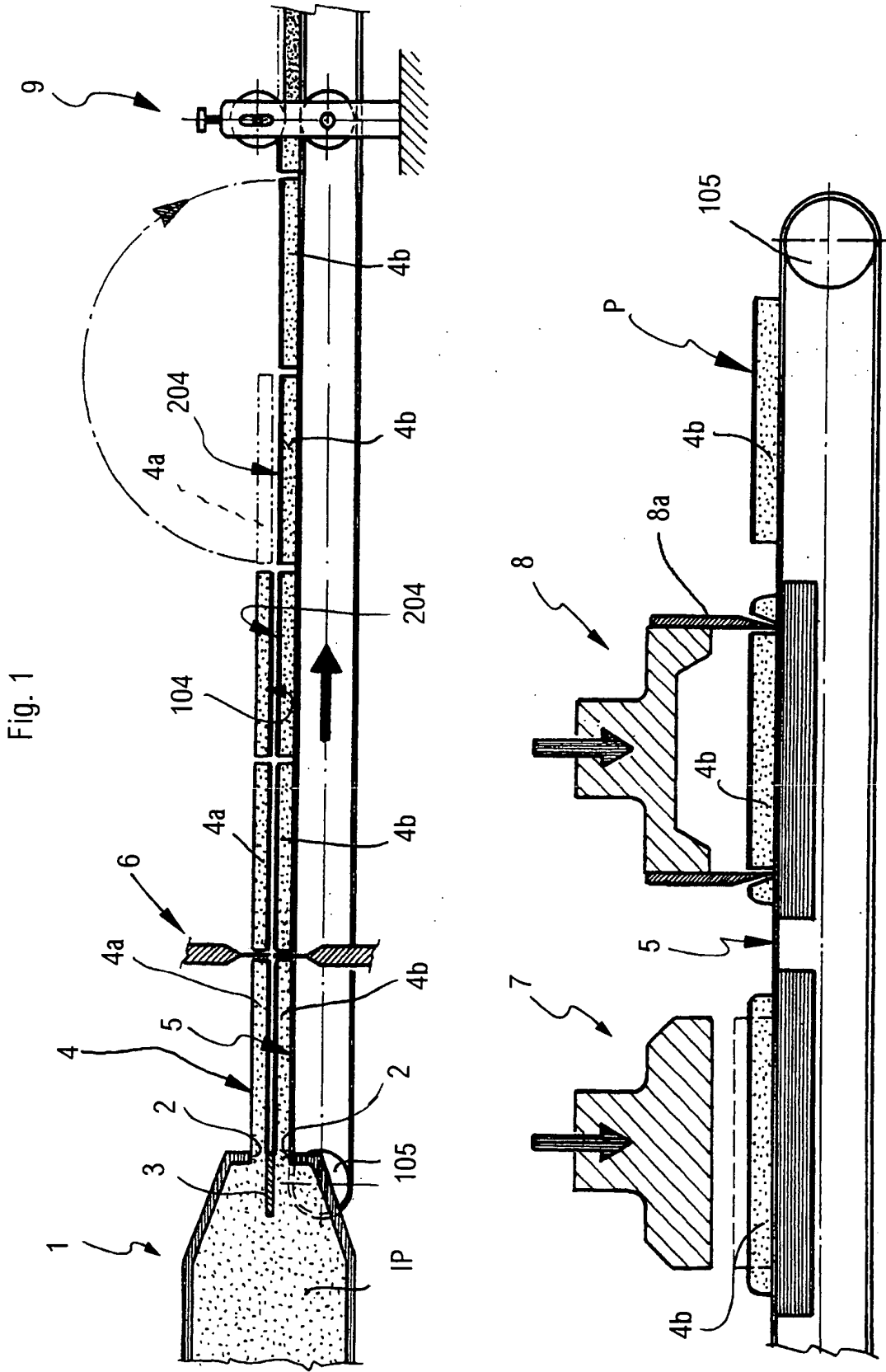
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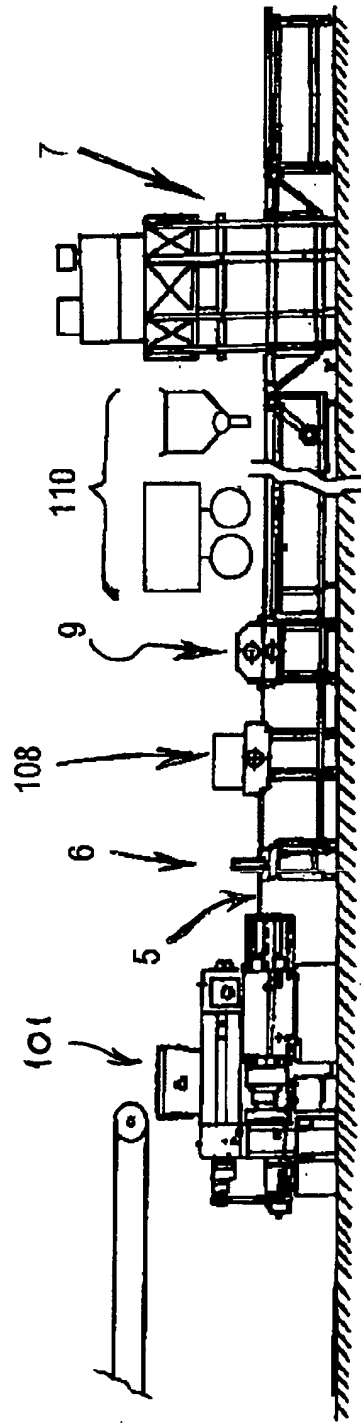


Fig. 2

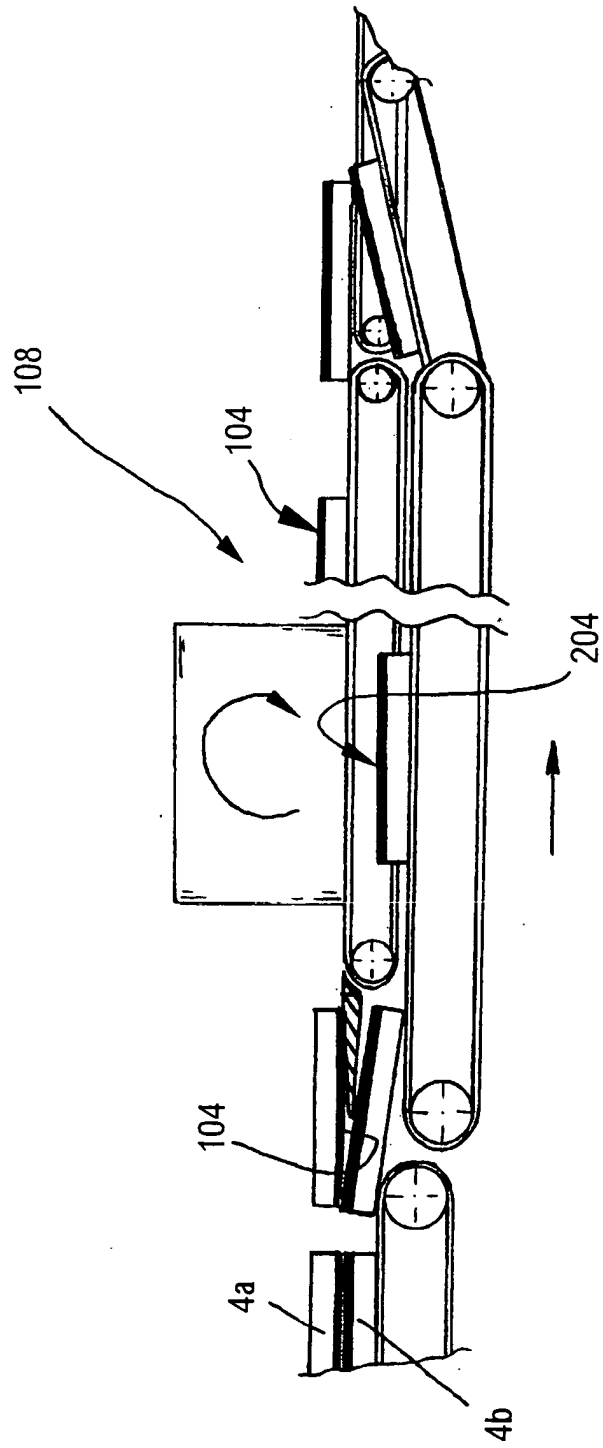


Fig. 3

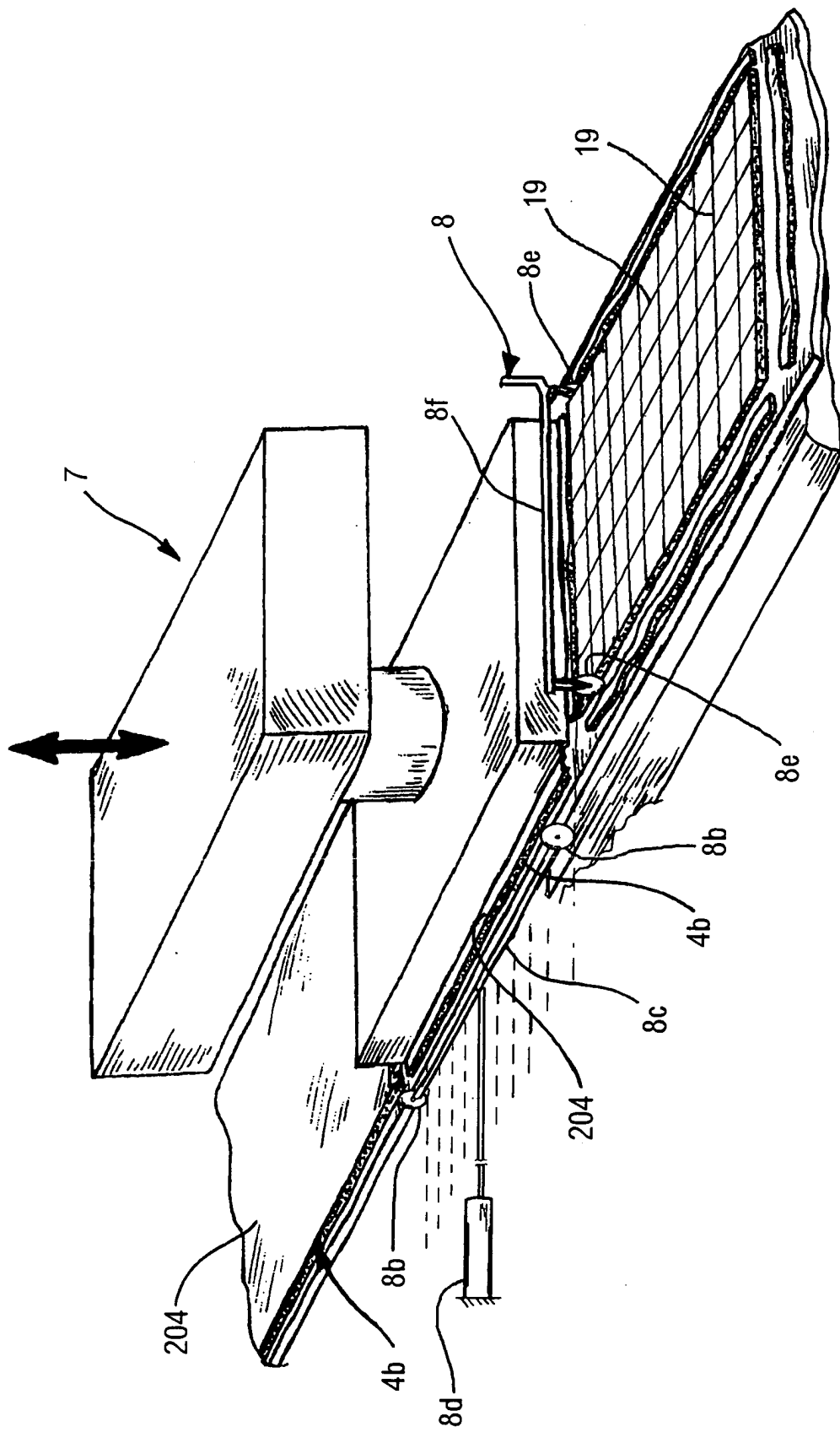


Fig. 4