(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 621 309 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
01.02.2006 Bulletin 2006/05

(51) Int Cl.:
B28B 13/02 *(2006.01)* ***B30B 15/30*** *(2006.01)*

(21) Application number: **05106227.1**

(22) Date of filing: **07.07.2005**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

(30) Priority: **08.07.2004 IT MO20040176**

(71) Applicant: **Inteco Ceramic Supplies S.R.L.**
41100 Modena (IT)

(72) Inventor: **Gerardi, Elio**
41100 MODENA (IT)

(74) Representative: **Modiano, Micaela Nadia**
Modiano Gardi Patents SAS
Via Meravigli 16
20123 Milano (IT)

(54) Method for loading molds for the dry pressing of ceramic articles having an irregular shape, particularly roofing tiles and the like

(57) A method for loading molds for the dry pressing of ceramic articles having an irregular shape, particularly roofing tiles and the like, comprising dividing the final shape of an article (1) to be formed into multiple sectors (5), calculating the amounts of ceramic material suitable to fill the sectors with preset densities of material, loading the mold (3, 4) of a press for shaping the article with the calculated amounts of ceramic material in the form of granular powder, each amount being distributed at the portion of the mold that is suitable to form the corresponding sector (5) of the final shape.

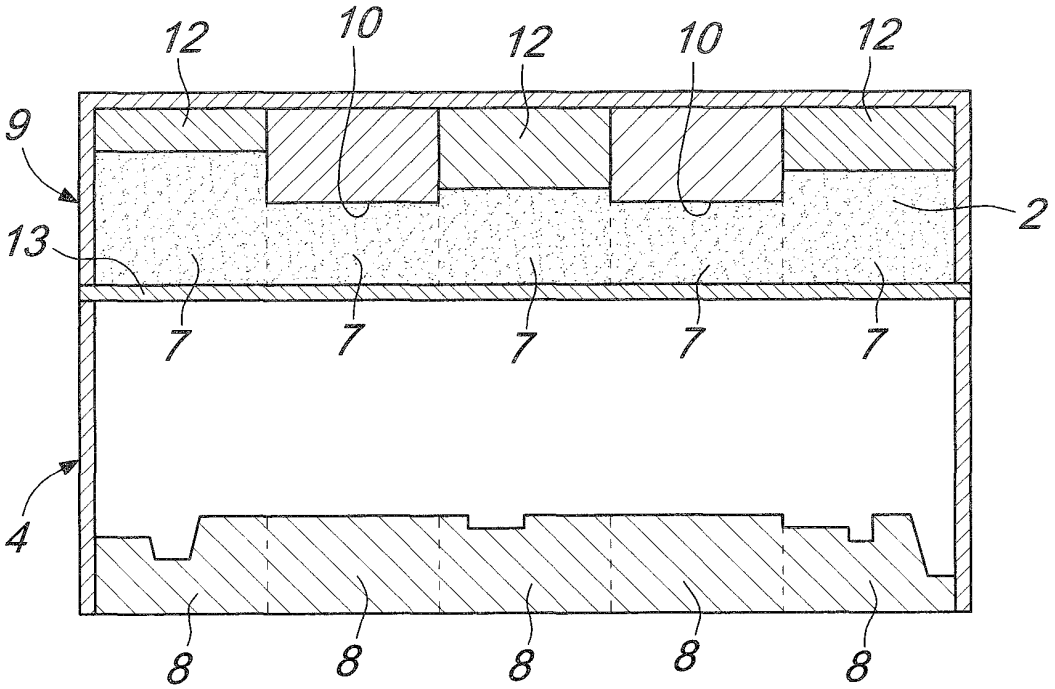

Fig. 7

EP 1 621 309 A2

Description

[0001] The present invention relates to a method for loading molds for the dry pressing of ceramic articles having an irregular shape, particularly roofing tiles and the like.

[0002] Various processes and machines for forming special articles, provided with irregular shapes, grooves, protrusions and/or variable thicknesses, such as for example particular varieties of tiles, are known in the ceramic field.

[0003] Depending on the type of ceramic mix that is used, the forming of these articles is divided into plastic or dry processes.

[0004] In plastic forming, the ceramic mix is in the form of a cohesive, pasty and deformable material, which contains an amount of water generally comprised between 15 and 25% by weight.

[0005] This type of mix can be modeled by means of the conventional technique of extrusion, which consists in pushing the mix by means of an appropriate pusher device against an orifice, termed die, which has an opening of preset shape and size; the mass of the mix, in passing through the die, is compacted, assuming the shape of the opening.

[0006] As an alternative to this technique, the ceramic mix in the plastic state can be subj ected to shaping by pressing, which is based on compressing the material between the molds of a press, so that it fills its cavities, assuming their shape.

[0007] Both of these plastic forming techniques are not free from drawbacks, including the fact that due to the high water content in the mix, at the end of the forming process it is necessary to dry the articles in order to make them acquire the cohesion and solidity required for finishing and placement in the kiln and in order to prevent an excessively swift and intense evaporation during firing from causing deformations, breakages and even explosion of the parts.

[0008] In this regard, it is noted that during drying the articles are subjected to a more or less substantial shrinkage caused by the evaporation of the water, and in some cases said shrinkage can spoil the articles irreparably.

[0009] Moreover, one cannot ignore the fact that drying the articles causes an additional cost in terms of installation and maintenance of the corresponding plant, an increase in energy consumption, and an increase in production times.

[0010] In dry forming, the ceramic mix instead consists of a perfectly dry granular powder or of a powder with a limited degree of humidity, generally not more than 15% by weight of the mix.

[0011] Such a mix is normally shaped by pressing within the molds of a press; the action of the pressure and of the molds shapes the granular powder according to a preset geometry, providing cohesion and mechanical strength which allow the article to withstand most of the handling and stresses to which it is subjected during subsequent production steps.

[0012] The molds of the press are normally two, an upper one and a lower one; before pressing, the lower mold is loaded with the required mix by means of a slide valve, which places the granular powder uniformly over the entire surface of said mold.

[0013] Even this technique, despite allowing to shape articles which do not need to be dried, or which require a drying which is particularly short and inexpensive in terms of energy and cost, is not free from drawbacks.

[0014] With the dry pressing technique, it is in fact possible to shape articles that have a rather simple shape and a thickness that is not too uneven, since the compaction of the granular powder is hardly ever uniform at portions of the article that protrude particularly or are provided with grooves; in practice, some points of the ceramic article have a porosity and a density of material that may even be very different from each other.

[0015] These unevennesses of the part may cause the onset of internal tensions, which especially during firing can produce deformation, cracks and breakages.

[0016] Localized differences in porosity, furthermore, can cause the ceramic material to be incompletely impermeable; articles such as roofing tiles or the like, therefore, which must be absolutely impenetrable to liquids, inevitably must be subjected to a subsequent enameling operation meant to coat them with an impermeable coating layer, accordingly increasing their overall production times and costs.

[0017] The aim of the present invention is to eliminate the drawbacks noted above of the background art, by providing a method for loading molds for the dry pressing of ceramic articles having an irregular shape, particularly roofing tiles and the like which, at the end of the forming process, allows to obtain articles which do not require, except marginally, inconvenient drying operations, have even highly variable shapes and thicknesses, and at the same time do not have considerable and unwanted differences in the density and porosity of the material.

[0018] Within this aim, an object of the present invention is to be particularly convenient from an economic standpoint, since it allows to reduce the overall production costs of the articles.

[0019] Another object of the present invention is to achieve the above aim and object with a structure that is simple, relatively easy to provide in practice, safe in use, effective in operation, and has a relatively low cost.

[0020] This aim and these and other objects that will become better apparent hereinafter are achieved by the present method for loading molds for the dry pressing of ceramic articles having an irregular shape, particularly roofing tiles and the like, characterized in that it comprises:

- dividing the final shape of an article to be formed into multiple sectors;
- calculating the amounts of ceramic material adapted to fill said sectors with preset densities of material;

- loading the mold of a press for shaping said article with said calculated amounts of ceramic material in the form of granular powder, each amount being distributed at the portion of said mold that is adapted to form the corresponding sector of said final shape.

[0021] The slide valve for performing the method according to the invention is characterized in that it is provided with an open top and with a bottom divided into substantially flat portions arranged at variable heights.

[0022] Further characteristics and advantages of the present invention will become better apparent from the following detailed description, given by way of non-limiting example and accompanied by the corresponding drawings, wherein:

Figure 1 is a perspective view of an article having an irregular shape, divided into sectors according to the method of the invention;
Figure 2 is a plan view of the article of Figure 1;
Figure 3 is a plan view of the slide valve provided by the method according to the invention for loading the mold of a press which is suitable to shape the article of Figure 1;
Figure 4 is a sectional view, taken along the plane IV-IV of Figure 3;
Figure 5 is a sectional view of the slide valve of Figure 4 during filling with the ceramic material;
Figure 6 is a sectional view of the slide valve of Figure 5 during closure with a lid;
Figure 7 is a sectional view of the slide valve of Figure 6 and of the lower mold of the press suitable to shape the article of Figure 1;
Figure 8 is a sectional view of the slide valve and of the mold of Figure 7 during mold filling;
Figure 9 is a sectional view of the lower mold and of the upper mold of the press during the pressing of the ceramic material.

[0023] With reference to the figures, the reference numeral 1 generally designates an article having irregular shapes and thicknesses, in the specific case a roofing tile, to be obtained by pressing a ceramic mix in the form of a granular powder 2.

[0024] The method according to the invention is designed to load the granular powder 2 into a press; the upper mold 3 and the lower mold 4 of the press are shaped so as to impart to the ceramic material the shape of, respectively, the upper surface and the lower surface of the tile 1.

[0025] The granular powder 2 can be completely dry or can receive the addition of plasticizers, such as for example water or the like.

[0026] Preferably, the water is mixed with the granular powder 2 in quantities comprised between 4 and 15% by weight in order to increase the flow of the ceramic material during pressing, improving its ability to adapt uniformly and evenly to the molds 3 and 4.

[0027] The method comprises a first step, which consists in dividing the final shape of the article 1 into multiple sectors 5, each of which has a lateral surface which is substantially cylindrical, i.e., constituted by a continuous bundle of mutually parallel segments, the directing vector of which is substantially parallel to the approach and spacing direction of the molds 3 and 4, said the direction being designated by the arrow A in Figure 9.

[0028] The sectors 5 are such as to cross completely the final shape of the article 1; in practice, their top and bottom faces coincide with corresponding parts of the upper and lower surfaces of the article 1.

[0029] In the particular embodiment of the present invention shown in the figures, the transverse cross-sections, i.e., the cross-sections at right angles to the direction A, of the sectors 5 are substantially rectangular except for two corner sectors 5a, which duplicate corresponding slotted profiles of the article 1; the protrusion of the lateral surfaces of the sectors 5 on a plane at right angles to the direction A in practice forms a substantially regular subdivision grid 6.

[0030] However, alternative embodiments are also possible in which the sectors 5 are shaped differently, as in the case in which, for example, they have at least partly curved transverse cross-sections.

[0031] Preferably, the sectors 5 have a substantially limited extension; in particular, the linear dimensions of each transverse cross-section of the sectors 5 are no more than 2-3 centimeters long.

[0032] Once the roofing tile 1 has been divided into sectors 5, the present method provides for a second step, which consists in calculating the amounts 7 of ceramic material that are suitable to fill the sectors 5 with preset densities of material, chosen depending on the type of article 1 to be obtained.

[0033] In this regard, it is noted that if these densities are all mutually identical, it is possible to shape a roofing tile 1 that has a substantially uniform and constant density of material; otherwise it is possible to resort to the present invention in order to obtain articles 1 that have different concentrations of material which are located at will.

[0034] In practice, the second step of the method consists in obtaining the volume of each sector 5 and in then multiplying said volume by the corresponding preset density of material.

[0035] The third and final step of the method according to the invention consist in loading the lower mold 4 with the calculated amounts 7 of granular powder 2, each amount being distributed at the portion 8 of the lower mold 4 that is adapted to shape the sector 5 that corresponds to said amount.

[0036] Advantageously, such step comprises first of all distributing the granular powder 2 inside a slide valve 9 which has an open top and in which the bottom is divided into flat portions 10 arranged at variable heights, each portion having shapes and dimensions that are substantially identical to the transverse cross-section of a corresponding sector 5.

[0037] Furthermore, the distance between each portion 10 and the open top 11 of the slide valve 9 is such that the space comprised between them is suitable to contain a corresponding amount 7 of granular powder 2.

[0038] In the particular embodiment of the present invention shown in Figures 3 to 8, the bottom of the slide valve 9 is constituted by a set of blocks 12, which can be associated detachably within said slide valve, one of their faces being suitable to form the portions 10.

[0039] The slide valve 9 is provided, adjacent to the blocks 12 related to the corner sectors 5a of the article 1, with additional blocks 12a, whose height is substantially equal to the height of said slide valve and one side of which is shaped complementarily with respect to said corner sectors.

[0040] Conveniently, by having several variously shaped blocks 12 available, the slide valve 9 can be rendered substantially modular depending on the final shape of the article 1 and on the calculated amounts 7 of granular powder 2.

[0041] Alternative embodiments of the present invention are also possible in which for example the bottom of the slide valve 9 is formed monolithically and dedicated to forming a single type of article 1.

[0042] During this step, the filling of the slide valve 9 must be complete and the level of granular powder 2 must reach the open top 11.

[0043] For this purpose, the distribution of the granular powder 2 can continue beyond the rim of the side valve 9 and it is possible to provide subsequently an additional step, which consists in flattening the granular powder 2 at the open top 11.

[0044] Such additional step can be performed for example by resorting to an operation for skimming the slide valve 9, which is meant to remove the granular powder 2 that protrudes beyond the open top 11 without compressing or compacting the ceramic material within said slide valve.

[0045] The third step of the present method then continues with the closure of the open top 11 by means of a lid 13.

[0046] Advantageously, the step for flattening the granular powder 2 and the step for closing the slide valve 9 can occur simultaneously, by making the lid 13 slide parallel to the open top 11; in practice, the lid 13 is inserted in a guillotine fashion on the top of the slide valve 9, removing the excess granular powder 2.

[0047] Once the slide valve 9 has been closed, according to the present invention it is tilted about a horizontal axis in order to position it above the lower mold 4, each one of the portions 10 being arranged above the portion 8 of the lower mold 4 that corresponds to the same sector 5.

[0048] The step for loading the lower mold 4 then ends with the removal of the lid 13 from the slide valve 5 in order to make the granular powder 2 fall into said mold.

[0049] Once loading has been completed, the article 1 can be shaped in a known manner by pressing and compacting of the ceramic material inside the molds 3 and 4 (Figure 9).

[0050] In practice it has been found that the described invention achieves the intended aim and objects, and in particular the fact is stressed that it allows to load the mold of the press according to the density of the material that one wishes to obtain in the article, in order to obtain, at the end of the pressing process, articles with or without considerable localized differences in density and porosity.

[0051] In particular, with the present method it is possible to obtain easily, practically and economically articles having even highly irregular shapes and thicknesses which feature substantially constant density and porosity, such as to reduce considerably production waste caused by any deformation/breakage during firing and to not require traditional enameling operations suitable to make them impermeable.

[0052] The invention thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the appended claims.

[0053] Further, all the details may be replaced with other technically equivalent elements.

[0054] In practice, the materials used, as well as the contingent shapes and dimensions, may be any according to requirements without thereby abandoning the scope of the protection of the appended claims.

[0055] The disclosures in Italian Patent Application No. M02004A000176 from which this application claims priority are incorporated herein by reference.

[0056] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. A method for loading molds for the dry pressing of ceramic articles having an irregular shape, particularly roofing tiles and the like, **characterized in that** it comprises:

   - dividing the final shape of an article to be formed into multiple sectors;
   - calculating the amounts of ceramic material adapted to fill said sectors with preset densities of material;
   - loading the mold of a press for shaping said article with said calculated amounts of ceramic material in the form of granular powder, each amount being distributed at the portion of said mold that is suitable to form the corresponding sector of said final shape.

2. The method according to claim 1, **characterized in that** the lateral surface of each one of said sectors is substantially cylindrical, its directing vector being substantially parallel to the approach and spacing direction of the molds of said press.

3. The method according to one or more of the preceding claims, **characterized in that** the transverse cross-sections of said sectors are substantially quadrangular.

4. The method according to one or more of the preceding claims, **characterized in that** the linear dimensions of said transverse cross-sections are substantially shorter than 2-3 centimeters.

5. The method according to one or more of the preceding claims, **characterized in that** said calculation comprises obtaining the volume of each one of said sectors and multiplying said volume by the corresponding preset density of material.

6. The method according to one or more of the preceding claims, **characterized in that** said loading comprises distributing said granular powder within an open-top slide valve, the bottom of which is divided into substantially flat portions arranged at variable heights, the space comprised between the open top of said slide valve and each one of said portions being suitable to contain a corresponding one of said amounts of granular powder.

7. The method according to one or more of the preceding claims, **characterized in that** said loading comprises flattening said granular powder at the open top of said slide valve.

8. The method according to one or more of the preceding claims, **characterized in that** said loading comprises closing with a lid the open top of said slide valve completely filled with said granular powder.

9. The method according to one or more of the preceding claims, **characterized in that** said flattening and said closure are simultaneous.

10. The method according to one or more of the preceding claims, **characterized in that** said loading comprises tilting said closed slide valve about a substantially horizontal axis and arranging it above said mold, each one of said portions of the bottom of the slide valve being arranged above the portion of said mold that corresponds to the same sector of said final shape.

11. The method according to one or more of the preceding claims, seek **characterized in that** said loading comprises removing said lid from said slide valve in order to make said granular powder form fall into said mold.

12. The method according to one or more of the preceding claims, **characterized in that** said granular powder is substantially dry.

13. The method according to one or more of the preceding claims, **characterized in that** said granular powder receives the addition of plasticizers.

14. The method according to one or more of the preceding claims, **characterized in that** said plasticizers comprise water or the like.

15. The method according to one or more of the preceding claims, **characterized in that** said water is mixed with said granular powder in quantities substantially comprised between 4 and 15% by weight.

16. A slide valve for performing the method according to claims 1 to 15, **characterized in that** it is provided with an open top and with a bottom which is divided into substantially flat portions arranged at variable heights.

17. The slide valve according to claim 16, **characterized in that** said bottom comprises a plurality of blocks, one face of which is suitable to form said portions.

18. The slide valve according to one or more of the preceding claims, **characterized in that** it comprises at least one additional block which is substantially as high as said slide valve.

19. The slide valve according to one or more of the preceding claims, **characterized in that** said blocks can be associated detachably within said slide valve.

20. The slide valve according to one or more of the preceding claims, **characterized in that** said bottom is formed monolithically.

21. The slide valve according to one or more of the preceding claims, **characterized in that** it comprises at least one lid for closing said open top.

22. The slide valve according to one or more of the preceding claims, **characterized in that** said lid can be inserted in a guillotine fashion on the top of said slide valve.

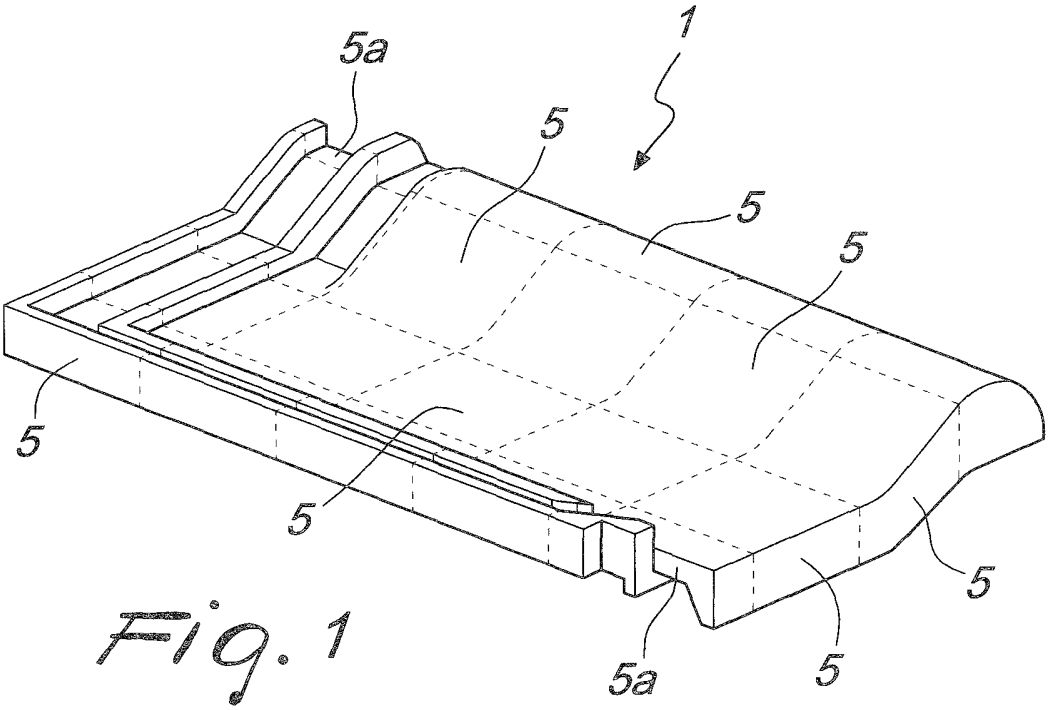

Fig. 1

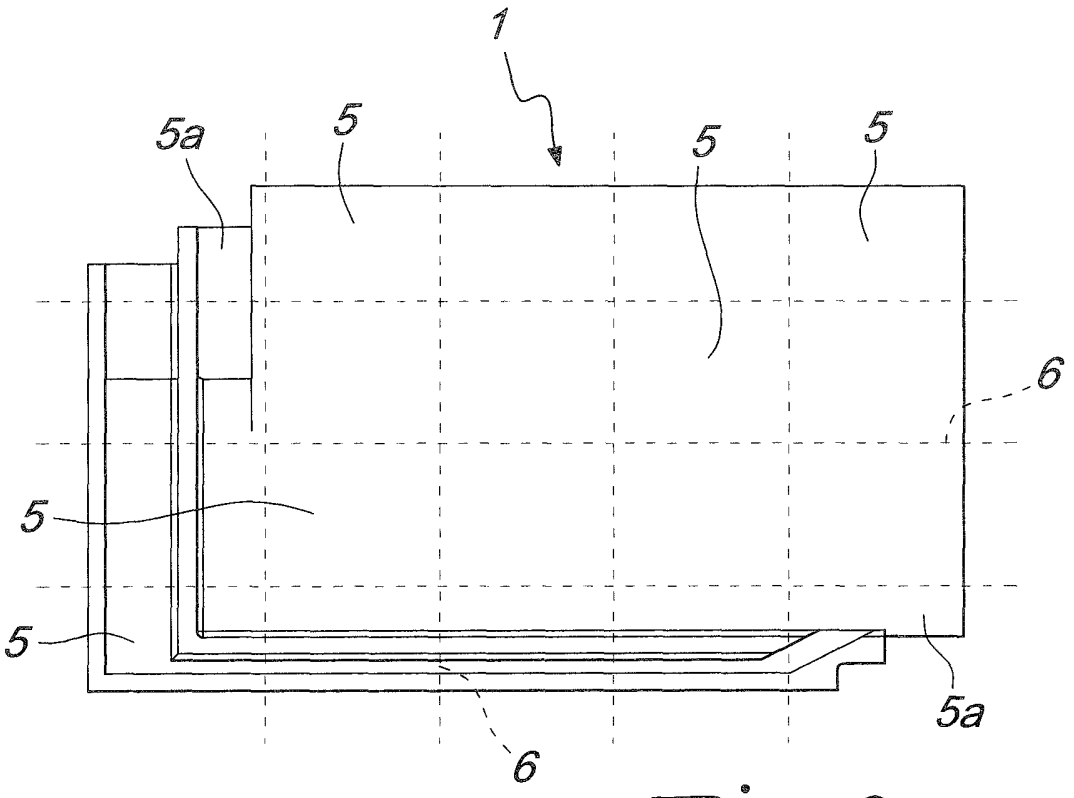

Fig. 2

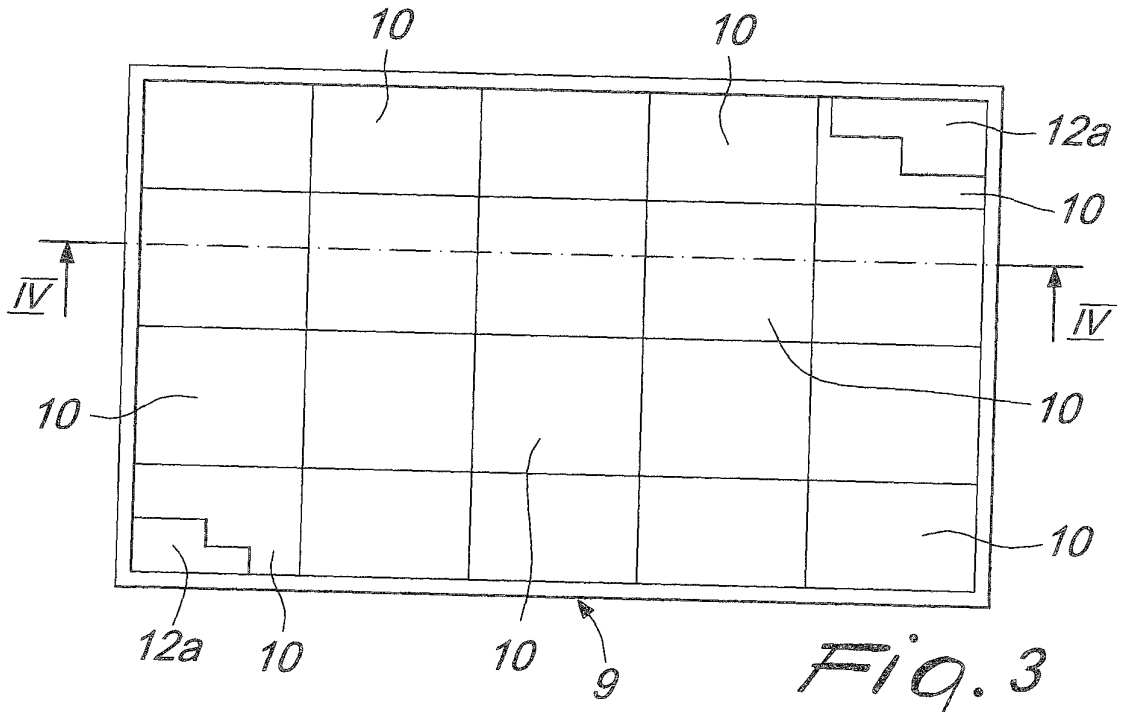

Fig. 3

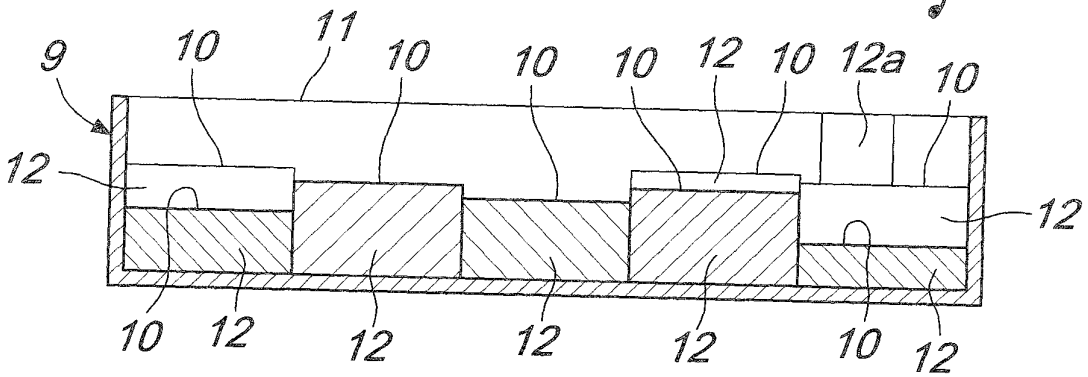

Fig. 4

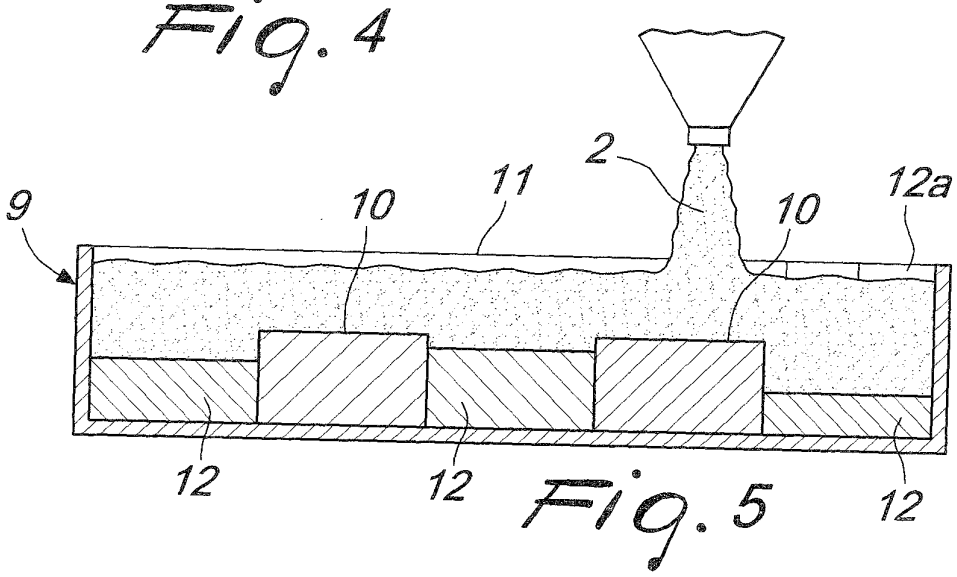

Fig. 5

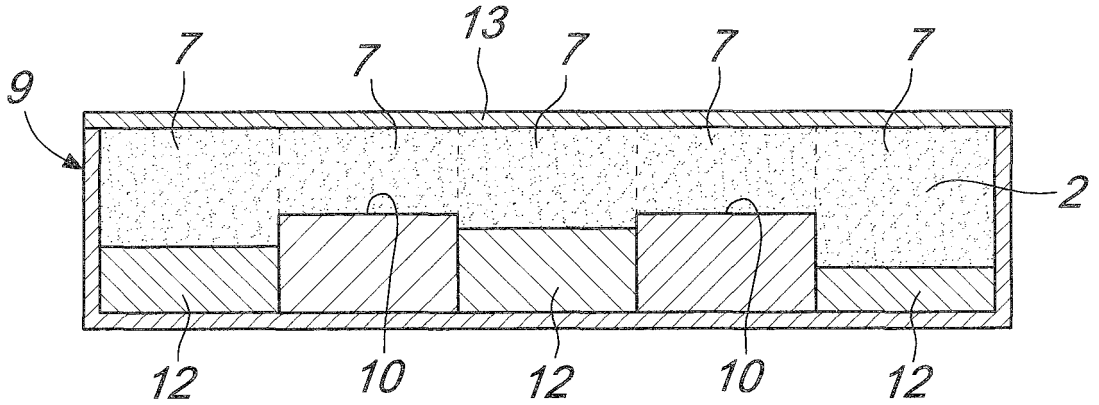

Fig. 6

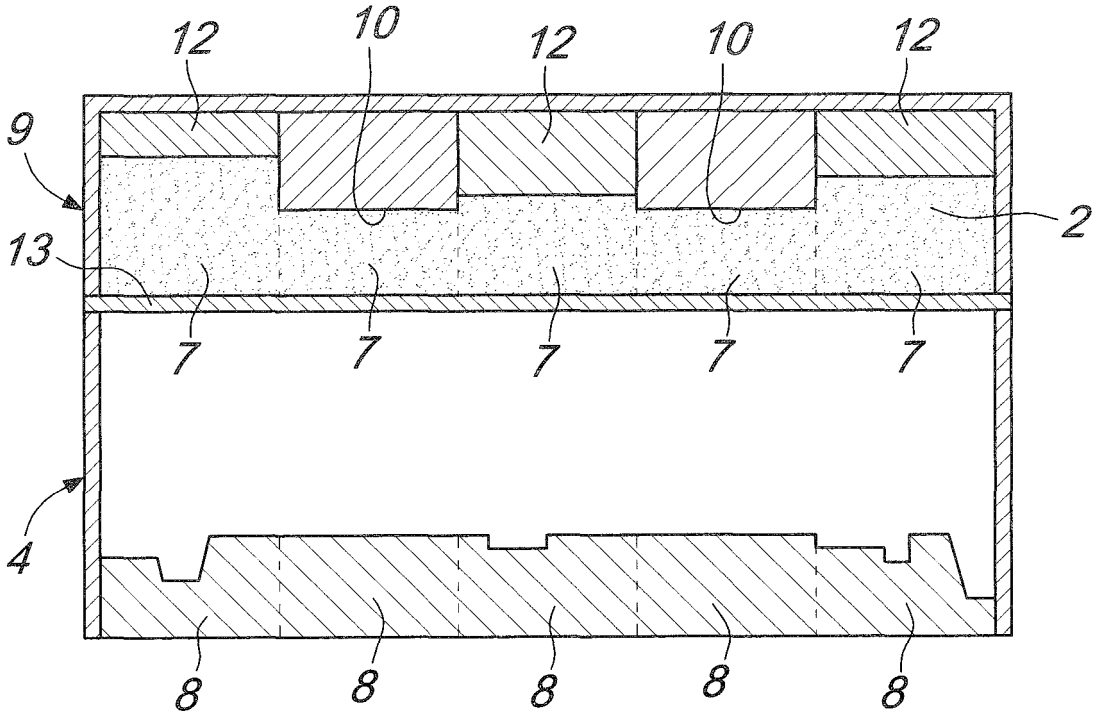

Fig. 7

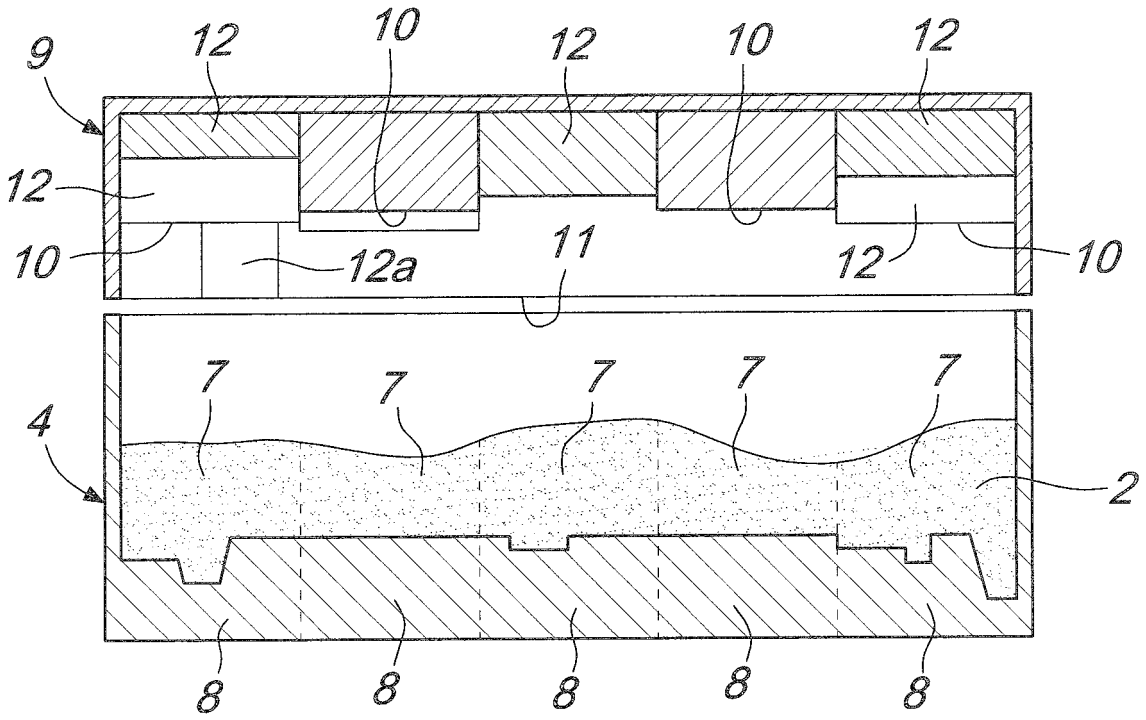

Fig. 8

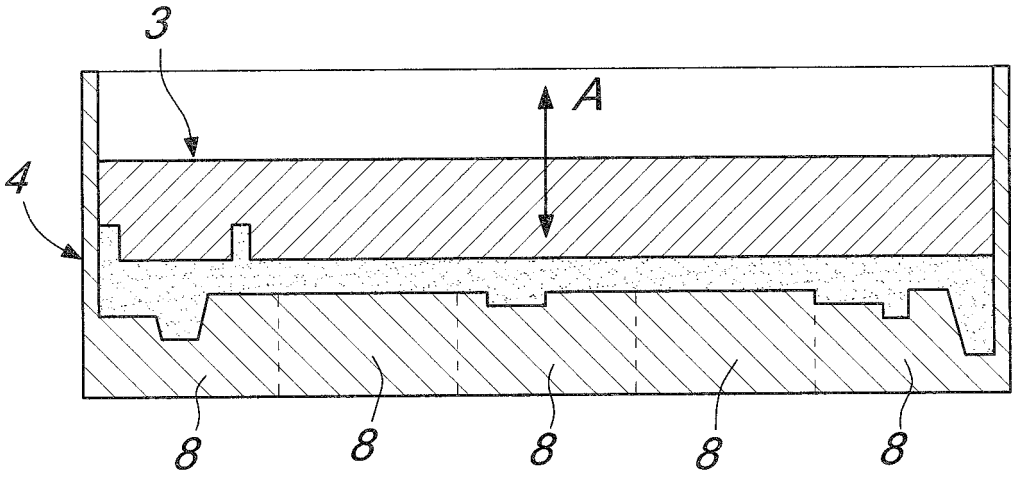

Fig. 9