



(11)

EP 4 094 846 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
30.11.2022 Bulletin 2022/48

(51) International Patent Classification (IPC):
B05C 5/02 (2006.01)

(21) Application number: **21305674.0**

(52) Cooperative Patent Classification (CPC):
B05C 5/0254

(22) Date of filing: **24.05.2021**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

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(54) METHOD FOR PREVENTING GHOSTING IN A SLOT COATING DIE

(57) The invention relates to a slot coating die for applying a fluid composition on a substrate, comprising: an upstream die part (1) having a first face (5); a downstream die part (2) having a second face (7), the first face (5) of the upstream die part (1) facing and being parallel to the second face (7) of the downstream die part (2); wherein at least one of the upstream die part (1) and the downstream die part (2) comprises at least one fluid inlet (12) configured for making the fluid composition flow between the upstream die part (1) and the downstream die part (2), and wherein at least one of the upstream die part (1) and the downstream die part (2) comprises at least one horizontal channel (13) on the first face (5) or second face (6), wherein the horizontal channel (13) is at least partially blocked so that the fluid composition is prevented from flowing through at least part of the horizontal channel (13).

The invention further relates to a method for applying a fluid composition on a substrate by using said slot coating die and the use of said slot coating die to reduce or prevent ghosting during a slot die coating process.

The invention further relates to a method of restructuring an initial slot coating die for applying a fluid composition on a substrate.

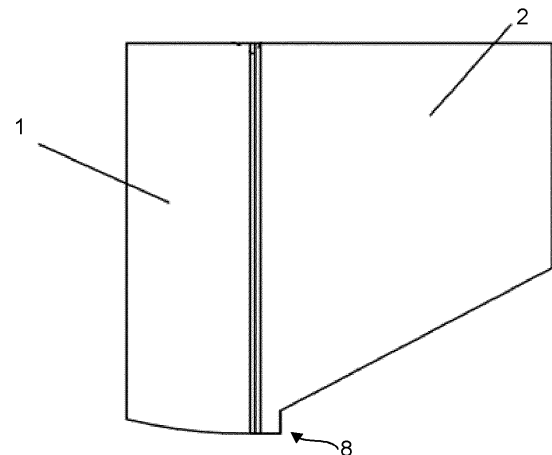


Fig. 1

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Description**Technical field**

5 **[0001]** The present invention relates to a slot coating die for reducing or preventing ghosting of a fluid composition in particular an adhesive composition, during a slot coating die process. The present invention further relates to a method for applying the composition on the substrate by using said slot coating die.

Technical background

10 **[0002]** Coating processes can involve the application of a thin film of fluid material to a substrate, such as for example, paper, fabric, film, foil or sheet stock. In many cases, coatings are applied to improve the surface properties of the substrate, such as the substrate's appearance, adhesion, wettability, corrosion resistance, wear resistance and scratch resistance. In various cases, including printing processes and semiconductor fabrication, coatings may also form an
15 essential part of the finished product.

[0003] A conventional slot coating die comprises an upstream die part and a downstream die part connected to the upstream die part such as to form a cavity therebetween. Pressurized fluid is introduced into the cavity and is then dispensed from the slot coating die onto the desired substrate. A conventional slot coating die may further comprise a patterned shim which makes it possible to control the width of the coating and obtain for example stripe patterns.

20 **[0004]** A common problem in a slot coating process is the "*ghosting issue*" or "*tailing issue*". Such issue occurs when a composition such as an adhesive is applied on a substrate (for example a low-viscosity adhesive such as a wetness indicator adhesive) and when a quantity of adhesive is present at an area which should be devoid of adhesive. In other words, the adhesive applied on the substrate is not cut off and continues to flow or leak on an undesired area of the substrate. The ghosting issue is more commonly present in case of intermittent slot coating applications (for example
25 when specific patterns should be formed on a substrate).

[0005] The length of ghosting (in other words the length of the adhesive leakage on an undesired area of the substrate) is variable and depends on the structure of the slot coating die and the adhesive to be applied.

[0006] The ghosting issue thus leads to defective, low-quality products or even failure of the manufacture process.

30 **[0007]** A possible solution to this issue would be the replacement of the slot coating die depending on the composition to be applied. However, this is an expensive process which would increase the overall production costs and would necessitate redesigning the whole slot coating die.

[0008] There is thus a need for a slot coating die and a coating method that make it possible to provide good quality products in an efficient and cost-effective manner without putting at risk the manufacturing process.

Summary of the invention

35 **[0009]** It is a first object of the invention to provide a slot coating die for applying a fluid composition on a substrate, comprising:

- 40
- an upstream die part having a first face;
 - a downstream die part having a second face, the first face of the upstream die part facing and being parallel to the second face of the downstream die part;

45 wherein at least one of the upstream die part and the downstream die part comprises at least one fluid inlet (configured for making the fluid composition flow between the upstream die part and the downstream die part, and wherein at least one of the upstream die part and the downstream die part comprises at least one horizontal channel on the first face or second face, wherein the horizontal channel is at least partially blocked so that the fluid composition is prevented from flowing through at least part of the horizontal channel.

50 **[0010]** According to some embodiments, at least part of the horizontal channel is filled with a filler material, preferably an organic material, an inorganic material or a metal, chosen from an epoxy resin, a polyurethane resin, a polyester resin, a metasilicate, tin, a peroxide and their mixtures.

[0011] According to some embodiments, the slot coating die comprises a blank shim plate located between the upstream die part and the downstream die part, the blank shim plate being configured to block the horizontal channel so as to prevent the fluid composition from flowing through the horizontal channel.

55 **[0012]** According to some embodiments, the slot coating die comprises a restructured shim plate located between the upstream die part and the downstream die part, the restructured shim plate comprising an additional horizontal channel configured so that the fluid composition flows through said additional horizontal channel.

[0013] According to some embodiments, the additional horizontal channel has a volume which is lower than the volume

of the horizontal channel.

[0014] According to some embodiments, the volume of the additional horizontal channel is from 50 to 25000 mm³, preferably from 50 to 1000 mm³, and preferably from 50 to 500 mm³.

[0015] According to some embodiments, the additional horizontal channel is vertically offset relative to the horizontal channel, and is preferably located above the horizontal channel.

[0016] According to some embodiments, the additional horizontal channel is at a distance from 2 mm to 50 mm, and preferably from 2 to 10 mm, from a lower edge of the restructured shim plate.

[0017] According to some embodiments, the thickness of the restructured shim plate is from 0.1 to 1 mm; and preferably from 0.2 to 0.5 mm.

[0018] According to some embodiments, the slot coating die further comprises a patterned shim plate between the upstream die part and the downstream die part, the patterned shim plate having a lower edge, wherein the lower edge comprises at least one cut-out.

[0019] The invention further relates to a method for applying a fluid composition on a substrate by using the above slot coating die, the method comprising:

- feeding the fluid composition to the at least one inlet;
- making the fluid composition flow between the upstream die part and the downstream die part;
- dispensing the fluid composition onto the substrate from the slot coating die.

[0020] According to some embodiments, the fluid composition is an adhesive material.

[0021] The invention further relates to the use of the above slot coating die to reduce or prevent ghosting during a slot die coating process, wherein the slot die coating process comprises applying a fluid composition on a substrate by the slot coating die.

[0022] The invention further relates to a method of restructuring an initial slot coating die for applying a fluid composition on a substrate, the initial slot coating die comprising:

- an upstream die part having a first face;
- a downstream die part having a second face, the first face of the upstream die part facing and being parallel to the second face of the downstream die part;

wherein at least one of the upstream die part and the downstream die part comprises at least one fluid inlet configured for making the fluid composition flow between the upstream die part and the downstream die part, and wherein at least one of the upstream die part and the downstream die part comprises at least one horizontal channel on the first face or second face;

wherein the method comprises modifying the initial slot coating die by at least partially blocking the horizontal channel so that the fluid composition is prevented from flowing through at least part of the horizontal channel, thus turning the initial slot coating die into the above slot coating die.

[0023] According to some embodiments, the method comprises a step of at least partly filling the horizontal channel with a filler material; and/or of adding a blank shim plate between the upstream die part and the downstream die part configured to block the horizontal channel so as to prevent the fluid composition from flowing through the horizontal channel; and/or of adding a restructured shim plate between the upstream die part and the downstream die part, the restructured shim plate comprising an additional horizontal channel.

[0024] The present invention enables to meet the abovementioned need. In particular, the invention provides a slot coating die and a coating method that make it possible to provide good quality products in an efficient and cost-effective manner without putting at risk the manufacture process.

[0025] This is achieved by the slot coating die of the present invention. More particularly, this is achieved by modifying an initial slot coating die comprising at least one horizontal channel on one of the upstream die part or the downstream die part, so as to at least partly block said horizontal channel in order to prevent the fluid composition from flowing through at least part of the horizontal channel. The fluid composition may flow through only one part of the horizontal channel, which has thus a reduced effective length; and/or it may flow through a different, additional horizontal channel, provided on a plate placed between the upstream die part and the downstream die part. Depending on the fluid composition to be dispensed, ghosting is advantageously reduced in the modified or restructured slot coating die relative to the initial slot coating die, without having to entirely manufacture a new slot coating die.

[0026] As will be explained in more detail below this can be carried out either by filling at least part of the horizontal channel with a filler material or by blocking the horizontal channel with a blank shim plate and by forming an additional horizontal channel. For example, the additional horizontal channel may have a smaller volume relative to the volume of the horizontal channel. Alternatively, the additional horizontal channel may be vertically offset relative to the horizontal channel.

Brief description of the drawings**[0027]**

Figure 1 illustrates a profile view of a slot coating die according to one embodiment of the present invention.

Figure 2 illustrates a front view of an upstream die part according to one embodiment of the present invention.

Figure 3 illustrates a front view of a downstream die part according to one embodiment of the present invention.

Figure 4 illustrates a front view of a blank shim plate according to one embodiment of the present invention.

Figure 5 illustrates a front view of a restructured shim plate according one embodiment of the present invention.

Figure 6A illustrates a front view of the superposition of a restructured shim plate and a die part comprising a filler material according to one embodiment of the present invention.

Figure 6B illustrates a front view of the superposition of a restructured shim plate, a blank shim plate and a die part according to one embodiment of the present invention.

Figure 7A illustrates a front view of the superposition of a restructured shim plate and a die part comprising a filler material according to another embodiment of the present invention.

Figure 7B illustrates a front view of the superposition of a restructured shim plate, a blank shim plate and a die part according to another embodiment of the present invention.

Figure 8A illustrates a front view of a patterned shim plate according to one embodiment of the present invention.

Figure 8B illustrates a front view of a patterned shim plate according to another embodiment of the present invention.

Detailed description

[0028] The invention will now be described in more detail without limitation in the following description.

[0029] In the following, reference is made to an initial slot coating die, which is a conventional slot coating die; and to a modified or restructured slot coating die, which is a slot coating die according to the invention and can be obtained by modifying the initial slot coating die.

[0030] Each slot coating die described herein is assumed to be oriented in the vertical direction, as shown in **Figure 1**, the substrate to be coated being disposed under the slot coating die. The terms "*lower*", "*upper*", "*vertical*" and the like are used with reference to this configuration.

[0031] The terms "*die*" or "*slot coating die*" refer to a shaped body or block comprising one or more portions through which a fluid material is extruded or drawn.

[0032] Therefore, the initial slot coating die comprises an upstream die part 1 and a downstream die part 2.

[0033] The terms "*upstream*" and "*downstream*" refer to the direction of travel of the substrate relative to the slot coating die. The substrate travels from "*upstream*" to "*downstream*" relative to the slot coating die. To put it otherwise, the portion of the substrate situated upstream of the slot coating die has not been coated yet, whereas the portion of the substrate situated downstream of the slot coating die has already been coated.

[0034] More particularly, with reference to **Figure 2**, the upstream die part 1 has a first face 5 and a lower edge 6 (or coating edge). With reference to **Figure 3**, the downstream die part 2 has a second face 7 and a lower edge 8 (or coating edge). The first face 5 of the upstream die part 1 faces and is parallel to the second face 7 of the downstream die part 2. Both faces are vertically oriented. The upstream die part 1 and the downstream die part 2 are spaced apart, so as to form an internal space, in which plates may be inserted.

[0035] The lower edge 6 of the upstream die part 1 is preferably aligned with the lower edge 8 of the downstream die part 2 (as can be seen on **Figure 1**). In other terms, both lower edges 6, 8 are at the same vertical level; or both lower edges 6, 8 are in the same horizontal plane; or the lower edge 6 of the upstream die part 1 faces the lower edge 8 of the downstream die part 8.

[0036] The upstream die part 1 may comprise one or more fixation holes 9 on the first face 5 of the upstream die part 1 (eight fixation holes 9 are illustrated in **Figure 2**). Generally, the number of fixation holes 9 is determined by the length of the upstream die part 1, the longer the upstream die part 1 is, the more fixation holes 9 are required.

[0037] Similarly, the downstream die part 2 may comprise at least one fixation hole 11 on the second face 7 of the downstream die part 2 (eight fixation holes 11 are illustrated in **Figure 3**). Generally, the number of fixation holes 11 is determined by the length of the downstream die part 2, the longer the downstream die part 2 is, the more fixation holes 11 are required.

[0038] It is preferable that the fixation holes 9, 11 have a round shape, in other words a circular shape.

[0039] The diameter of the fixation holes 9, 11 may be from 0.5 to 20 mm and preferably from 2 to 15 mm.

[0040] It is also preferable that the number of fixation holes 9 in the upstream die part 1 be equal to the number of fixation holes 11 in the downstream die part 2, and that the respective fixation holes 9, 11 in the two parts 1, 2 be aligned.

[0041] When the slot coating die is assembled, fixation elements are preferably inserted into the respective fixation holes 9, 11 so as to connect and firmly maintain together the upstream and downstream die parts 1, 2. Fixation elements

may e.g. include pins and screws.

[0042] The initial slot coating die comprises at least one fluid inlet 12 for introducing the fluid composition into the internal space between the upstream and downstream die parts 1, 2.

[0043] According to some embodiments, the at least one fluid inlet 12 is present on the upstream die part 1 of the slot coating die (not illustrated in the figures).

[0044] According to other embodiments, the at least one fluid inlet 12 is present on the downstream die part 2 of the slot coating die (as illustrated in **Figure 3**). The downstream die part 2 illustrated in **Figure 3** comprises one fluid inlet 12, but the presence of more than one (for example two, three or four) fluid inlets 12 are also possible.

[0045] The initial slot coating die comprises a horizontal channel 13 for channeling the fluid composition from the one or more fluid inlet(s) 12 to the outlet(s) of the slot coating die.

[0046] In the drawings, there is a single horizontal channel 13, in fluid communication with all the fluid inlet(s) 12. However, it is also possible to provide two or more separate horizontal channels 13, each channel 13 being in fluid communication with one or more fluid inlet(s) 12.

[0047] According to some embodiments, the horizontal channel 13 is present on the first face 5 of the upstream die part 1 of the slot coating die (as illustrated in **Figure 2**).

[0048] According to other embodiments, the horizontal channel 13 is present on the second face 7 of the downstream die part 2 of the slot coating die (not illustrated in the figures).

[0049] As illustrated in **Figure 2**, the horizontal channel 13 comprises an elongated, horizontal, section, configured for distributing fluid composition to a certain length of the die. In addition, the horizontal channel 13 may comprise one or more sections 13a perpendicular to the elongated section, so as to channel the fluid composition to the elongated section. The horizontal channel 13 has an upper edge 13b and a lower edge 13c.

[0050] The volume of the horizontal channel 13 may be from 100 to 100000 mm³, preferably from 100 to 20000 mm³ and preferably from 100 to 5000 mm³. By "*volume of the horizontal channel 13*" is meant the volume of the elongated, horizontal, section and the volume of the one or more sections 13a perpendicular to the elongated section.

[0051] According to some embodiments, the fluid inlet(s) 12 is(are) present on the die part (upstream or downstream) that comprises the horizontal channel 13. In this case, the fluid inlet(s) 12 is(are) continuous with the horizontal channel 13; or the fluid connection between the fluid inlet(s) 12 and the horizontal channel 13 may be provided owing to a connecting channel present on a plate pressed against the die part.

[0052] According to other embodiments, and as illustrated in the drawings, the fluid inlet(s) 12 is(are) present on the die part (upstream or downstream) which is devoid of horizontal channel 13.

[0053] The initial slot coating die may further comprise at least a patterned shim plate 18 between the upstream die part 1 and the downstream die part 2, as illustrated in **Figures 8A and 8B**.

[0054] The patterned shim plate 18 may for example have a rectangular shape, comprise two faces (face E illustrated in the figures and face F not illustrated in the figures) and four edges. More particularly the patterned shim plate 18 may be defined by an upper edge 18a, a lower edge 18b, and two lateral edges 18c, 18d.

[0055] It is preferable that the upper edge 18a and the lower edge 18b be longer than the two lateral edges 18c, 18d. In other words, it is preferable that the patterned shim plate 18 be elongated in a horizontal direction. The exact dimensions of the patterned shim plate 18 depend on the dimensions of the upstream die part 1 and of the downstream die part 2.

[0056] Therefore, the upper edge 18a and the lower edge 18b can have a length e.g. from 1 to 500 cm, preferably from 5 to 300 cm, and more preferably from 10 to 100 cm.

[0057] The two lateral edges 18c, 18d can have a length e.g. from 1 to 80 cm, and more preferably from 2 to 50 cm.

[0058] The patterned shim plate 18 according to the invention may have a thickness from 0.1 to 1 mm; and preferably from 0.1 to 0.5 mm and more preferably from 0.1 to 0.2 mm (for example approximately 0.15 mm). By "*thickness*" is meant the distance between face E and face F of the patterned shim plate 18.

[0059] The patterned shim plate 18 may also comprise at least one and preferably a plurality of fixation holes 19 through its entire thickness. The number, shape and positioning of the fixation holes 19 preferably correspond to number, shape and positioning of the fixation holes 9, 11 in the upstream and downstream die parts 1, 2.

[0060] They are used to align and assemble the patterned shim plate 18 with the other parts of the die, via fixation elements.

[0061] The patterned shim plate 18 may further comprise at least one fluid hole 20 through the entire thickness of the patterned shim plate 18. The number, size and positioning of the fluid holes 20 then preferably correspond to the number, size and positioning of the fluid inlets 12. The fluid composition may be fed by the fluid inlets 12, flow through the corresponding fluid holes 20 on the patterned shim plate 18, and then flow through the horizontal channel 13 when it is located on a different die part from the fluid inlets 12. Thus, the presence of the at least one fluid hole 20 on the patterned shim depends on the location of the horizontal channel 13 and the fluid inlets 12.

[0062] The lower edge 18b of the patterned shim plate 18 comprises at least one cut-out 21, preferably at least two, or at least three, or at least five cut-outs 21. For example, the patterned shim plate 18 may comprise from 1 to 3, or from 3 to 5; or from 5 to 7; or from 7 to 9; or from 9 to 11; or from 11 to 13; or from 13 to 15; or even more than 15 cut-outs

21. For example, the patterned shim plate 18 illustrated in **Figure 8A** comprises a single cut-out 21 while the patterned shim plate 18 illustrated in **Figure 8B** comprises three cut-outs 21. The cut-outs 21 may for example be rectangular-shaped or square-shaped. However, as the number of cut-outs 21 varies depending on the pattern, it is possible that the number of cut-outs 21 is more than 10, or more than 50, or even more than 100.

[0063] According to some embodiments, when more than one cut-outs 21 are present on the patterned shim plate 18, all cut-outs have the same horizontal length (length in a direction parallel to the upper edge 18a and the lower edge 18b of the patterned shim plate 18).

[0064] According to other embodiments, when more than one cut-outs 21 are present on the patterned shim plate 18, the length of the various cut-outs 21 may differ.

[0065] The (horizontal) length of each cut-out 21 may be for example from 1 mm to 250 cm; and preferably from 1 mm to 200 cm.

[0066] The cut-outs 21 are in fluid communication with the horizontal channel in the initial slot coating die. The cut-outs 21 form the outlets of the slot coating die.

[0067] Thus, in the initial slot coating die, the fluid composition flows from the fluid inlet(s) 20 to the horizontal channel 13, and then exits the slot coating die from the cut-outs 21.

[0068] As described above, the different parts of the slot coating die can be secured together using various fastening mechanisms such as screws, bolts and pins.

[0069] According to the invention, this initial slot coating die is modified so that the horizontal channel 13 is at least partially blocked. In other terms, the fluid composition is prevented from flowing through at least part of the horizontal channel 13. In some embodiments, only part of the horizontal channel 13 is blocked. In that case, the fluid composition may flow through the unblocked part of the horizontal channel 13 and then be dispensed through some or all of the cut-outs 21. Alternatively, the totality of the horizontal channel 13 may be blocked. In that case, an additional horizontal channel 17 is provided to dispense the fluid composition to some or all of the cut-outs 21.

[0070] The modification of the slot coating die can be performed by:

- disassembling the slot coating die,
- at least partially blocking the horizontal channel 13, for instance by adding filler material into the horizontal channel 13 or by adding a blank shim plate,
- optionally adding a restructured shim plate so as to introduce an additional horizontal channel 17, and
- reassembling the slot coating die.

[0071] Other modifications may be made at the same time, but this is not necessarily the case. For example, the patterned shim plate 18 can be replaced by another patterned shim plate 18.

[0072] As a result of the modification, the slot coating die comprises the parts described above, namely the upstream and downstream die parts 1, 2 and preferably the patterned shim plate 18, and further comprises the following features described below.

[0073] In the modified slot coating die, the horizontal channel 13 is configured so that the horizontal channel 13 is at least partially blocked.

[0074] According to some embodiments, this is achieved by filling the horizontal channel 13 with a filler material. Such filler material may be an organic material, an inorganic material or a metal. Preferably the filler material may be an inorganic material. For example, the filler material may be chosen from an epoxy resin, a polyurethane resin, a polyester resin, a metasilicate, tin, a peroxide and their mixtures.

[0075] According to some embodiments, the entire volume of the horizontal channel 13 is filled with the filler material. In other words, the effective volume of the horizontal channel 13 (available for the fluid composition) becomes zero (or approximately zero) and as a result, during the coating process the fluid to be applied does not flow through the horizontal channel 13. In this case, and as will be explained below, a restructured shim plate may be used to form an additional horizontal channel 17 different from the horizontal channel 13.

[0076] According to other embodiments, only part of the horizontal channel 13 is filled with a filler material. Thus, the volume of the horizontal channel 13 is reduced relative to its initial volume. In this case, when all the parts of the slot coating die are assembled and when the fluid composition is introduced through a fluid inlet (as detailed below), the fluid composition flows through the non-filled portion of the horizontal channel only.

[0077] According to preferred embodiments, in case only part of the horizontal channel 13 is filled with a filler material, such part is at least one, and more preferably both of the extremities of the horizontal channel 13. Thus, one or both of the extremities of the horizontal channel 13 may be filled with a filler material while the central part of the horizontal channel 13 is devoid of filler material so that the fluid composition can flow through the non-filled part of the horizontal channel 13.

[0078] The volume of the partially filled horizontal channel 13 may be from 50 to 25000 mm³, preferably from 50 to 1000 mm³, and preferably from 50 to 500 mm³. The volume of the partially filled horizontal channel 13 may depend on

the viscosity of the fluid composition. For example, the higher the viscosity of the fluid composition, the bigger the volume of the horizontal channel 13.

[0079] According to other embodiments, the horizontal channel 13 is blocked with a blank shim plate 3 devoid of a horizontal channel.

[0080] Thus, the blank shim plate 3 is inserted between the upstream and downstream die parts 1, 2 and fully obstructs the horizontal channel 13.

[0081] By "*shim plate*" is meant a thin, substantially planar sheet of material.

[0082] With reference to **Figure 4**, the blank shim plate 3 may have a substantially rectangular shape. It comprises two faces (face A illustrated in the figures and face B not illustrated in the figures) and may comprise four edges. More particularly the blank shim plate 3 may comprise an upper edge 3a, a lower edge 3b, and two lateral edges 3c, 3d. Each edge of the blank shim plate 3 may be devoid of cut-outs and protrusions, in other words each edge of the blank shim plate 3 may be straight (linear).

[0083] It is preferable that the upper edge 3a and the lower edge 3b be longer than the two lateral edges 3c, 3d. In other words, it is preferable that the blank shim plate 3 be elongated in a horizontal direction. Naturally, the exact dimensions of the blank shim plate 3 depend on the dimensions of the upstream die part 1 and of the downstream die part 2.

[0084] For example, the upper edge 3a and the lower edge 3b can have a length from 1 to 500 cm, preferably from 5 to 300 cm, and more preferably from 10 to 100 cm.

[0085] The two lateral edges 3c, 3d can have a length from 1 to 80 cm, and more preferably from 2 to 50 cm.

[0086] The blank shim plate 3 may have a thickness from 0.1 to 5 mm; preferably from 0.5 to 5 mm; and more preferably from 0.5 to 1.5 mm. By "*thickness*" is meant the distance between the face A and the face B of the blank shim plate 3.

[0087] According to some embodiments, the patterned shim plate 18 has the same thickness as the blank shim plate 3.

[0088] Alternatively, the patterned shim plate 18 may have a different thickness from the thickness of the blank shim plate 3. In this case it is preferable that the blank shim plate 3 be thicker than the patterned shim plate 18. For example, the blank shim plate 3 can be thicker than the patterned shim plate 18 by 0.05 to 1 mm, preferably from 0.1 to 0.5 mm, and even more preferably from 0.1 to 0.25 mm.

[0089] The blank shim plate 3 may further comprise at least one, preferably several fixation holes 14 through its entire thickness.

[0090] The number, shape and positioning of the fixation holes 14 preferably correspond to number, shape and positioning of the fixation holes 9, 11 in the upstream and downstream die parts 1, 2.

[0091] They are used to align and assemble the blank shim plate 3 with the other parts of the die, via fixation elements.

[0092] The slot coating die may further comprise a restructured shim plate 4 as illustrated in **Figure 5**, located between the upstream die part and the downstream die part as illustrated in **Figure 1**. More particularly, in case the horizontal channel 13 is (preferably completely) filled with a filler material, the restructured shim plate 4 is located so as to be in contact with the part (upstream or downstream) comprising the horizontal channel 13. Alternatively, in case the slot coating die comprises a blank shim plate 3, the blank shim plate 3 is located between the restructured shim plate 4 and the die part 1, 2 (upstream or downstream) comprising the horizontal channel 13.

[0093] The restructured shim plate 4 may for example have a rectangular shape and comprises two faces (face C illustrated in the figures and face D not illustrated in the figures) and may comprise four edges. More particularly the restructured shim plate 4 may be defined by an upper edge 15a, a lower edge 15b, and two lateral edges 15c, 15d.

[0094] It is preferable that the upper edge 15a and the lower edge 15b be longer than the two lateral edges 15c, 15d. In other words, it is preferable that the restructured shim plate 4 be elongated in a horizontal direction. It is even more preferable that the shape of the restructured shim plate 4 be substantially the same as the shape of the blank shim plate 3. Naturally, as for the blank shim plate 3, the exact dimensions of the restructured shim plate 4 depend on the dimensions of the upstream die part 1 and of the downstream die part 2.

[0095] Therefore, the upper edge 15a and the lower edge 15b can have a length e.g. from 1 to 500 cm, preferably from 5 to 300 cm, and more preferably from 10 to 100 cm.

[0096] The two lateral edges 15c, 15d can have a length e.g. from 1 to 80 cm, and more preferably from 2 to 50 cm.

[0097] According to some embodiments, the upper edge 15a of the restructured shim plate 4 has the same length as the upper edge 3a of the blank shim plate 3.

[0098] The restructured shim plate 4 according to the invention may have a thickness from 0.1 to 1 mm; and preferably from 0.2 to 0.5 mm. By "*thickness*" is meant the distance between face C and face D of the restructured shim plate 4.

[0099] In some embodiments, the thickness of the restructured shim plate 4 is greater than the thickness of the patterned shim plate.

[0100] The restructured shim plate 4 may also comprise at least one, preferably several fixation holes 16 through its entire thickness. The number, shape and positioning of the fixation holes 16 preferably correspond to number, shape and positioning of the fixation holes 9, 11 in the upstream and downstream die parts 1, 2.

[0101] They are used to align and assemble the restructured shim plate 4 with the other parts of the die, via fixation elements.

[0102] As illustrated in **Figure 5**, the restructured shim plate 4 comprises a horizontally elongated opening which forms an additional horizontal channel 17. This additional horizontal channel 17 comprises an elongated, horizontal, section. In addition, it may comprise one or more sections 17a perpendicular to the elongated section, so as to channel the fluid composition from the fluid inlet(s) 12 to the elongated section. The number of sections 17a perpendicular to the elongated section on the restructured shim plate 4 is preferably the same as the number of fluid inlet(s) 12. The additional horizontal channel 17 has an upper edge 17b and a lower edge 17c.

[0103] According to some embodiments, this additional horizontal channel 17 is formed by a through hole in the restructured shim plate 4. In this case, the additional horizontal channel 17 is closed by two parts pressed on either side of the restructured shim plate 4, such as a die part 1, 2 (upstream or downstream) comprising the (filled) horizontal channel 13 and the patterned shim plate 18; or such as the blank shim plate 3 and the patterned shim plate 18.

[0104] According to other embodiments, the additional horizontal channel 17 is formed as a depression in the restructured shim plate 4, which is not a through hole. In other words, the additional horizontal channel 17 is closed on one side by the restructured shim plate 4 itself, and on the other side by the die part 1, 2 (upstream or downstream) comprising the (filled) horizontal channel 13 or the blank shim plate 3 against which it is pressed.

[0105] In the above two cases, when all the parts of the slot coating die are assembled and when the fluid composition is introduced through the fluid inlet(s) 12, the fluid composition does not flow through with the horizontal channel 13 but flows directly through the additional horizontal channel 17 before being dispensed to the outlet(s) of the slot coating die.

[0106] According to some embodiments, the additional horizontal channel 17 has a volume which is lower than the volume of the (unblocked) horizontal channel 13 (in the initial slot coating die). By "*volume of the additional horizontal channel*" is meant the total volume of the elongated, horizontal, section and the volume of the one or more sections 17a perpendicular to the elongated section if present. By "*volume of the (unblocked) horizontal channel 13*" is meant the total volume of the elongated, horizontal, section and the volume of the one or more sections 13a perpendicular to the elongated section if present.

[0107] Such embodiment is illustrated in **Figures 6A and 6B**. In **Figure 6A** a restructured shim 4 is superposed on a die part (downstream or upstream) comprising a horizontal channel 13 (illustrated with a dotted line) entirely filled with a filler material 18. In **Figure 6B** a restructured shim 4 is superposed on a die part (downstream or upstream) comprising a horizontal channel 13 (illustrated with a dotted line) and a blank shim plate 3. In other words, the blank shim plate 3 is located between the die part (downstream or upstream) comprising a horizontal channel 13 and the restructured shim plate 4.

[0108] The smaller volume of the additional horizontal channel 17 makes it possible to increase pressure during the application of the fluid composition while applying the same amount of the adhesive and also allows to retain a smaller amount of the adhesive when the slot coating die is not applying any fluid composition on the substrate (in other words, when the slot coating is not operating). As a result, the ghosting of the fluid composition on the substrate is reduced.

[0109] The volume of the additional horizontal channel 17 may be from 50 to 25000 mm³, preferably from 50 to 1000 mm³, and preferably from 50 to 500 mm³. It goes without saying that the volume of this channel depends on the size of the slot coating die and the viscosity of the fluid composition to be applied.

[0110] According to preferred embodiments, the volume of the additional horizontal channel 17 may be reduced relative to the volume of the horizontal channel 13 by from 5 to 95 %, preferably from 10 to 90 %.

[0111] Alternatively or additionally, the distance between the lower edge 17c of the additional horizontal channel 17 and the lower edge 15b of the restructured shim plate 4 is different from, preferably higher than the distance between the lower edge 13c of the horizontal channel 13 and the lower edge 6 of the upstream die part 1 if the horizontal channel 13 is located on the upstream die part 1 (as illustrated in **Figure 2**), or the lower edge 8 of the downstream die part 2 if the horizontal channel 13 is located on the downstream die part 2 (not illustrated in figures). In other terms, the additional horizontal channel 17 is vertically offset (preferably upwards) relative to the horizontal channel 13.

[0112] Such embodiment is illustrated in **Figures 7A and 7B**. In **Figure 7A** a restructured shim 4 is superposed on a die part (downstream or upstream) comprising a horizontal channel 13 (illustrated with a dotted line) entirely filled with a filler material 18. The additional horizontal channel 17 is located above the horizontal channel 13 in the vertical direction. In **Figure 7B** a restructured shim 4 is superposed on a die part (downstream or upstream) comprising a horizontal channel 13 (illustrated with a dotted line) and a blank shim plate 3. In other words, the blank shim plate 3 is located between the die part (downstream or upstream) comprising a horizontal channel 13 and the restructured shim plate 4. The additional horizontal channel 17 is located above the horizontal channel 13. This offset makes it possible to reduce ghosting of the fluid composition on the substrate.

[0113] This vertical offset between the channels may be from 1 to 10 mm; and preferably from 1 to 5 mm. For example, this difference may be from 1 to 2 mm; or from 2 to 3 mm; or from 3 to 4 mm; or from 4 to 5 mm; or from 5 to 6 mm; or from 6 to 7 mm; or from 7 to 8 mm; or from 8 to 9 mm; or from 9 to 10 mm.

[0114] The distance of the lower edge 17c of the additional horizontal channel 17 and the lower edge 15b of the restructured shim plate 4 may be from 2 mm to 50 mm, and preferably from 2 to 10 mm.

[0115] The distance between the lower edge 13c of the horizontal channel 13 and the lower edge 6 of the upstream

die part 1 if the channel 13 is located on the upstream die part 1 (as illustrated in **Figure 2**) or the lower edge 8 of the downstream die part 2 if the channel 13 is located on the downstream die part 2 (not illustrated in figures) may be from 1 to 40 mm and preferably from 1 to 5 mm.

[0116] According to preferred embodiments, the restructured shim plate 4 may have the features of both **Figure 6A** and **Figure 7A**. In other words, the additional horizontal channel 17 may have a volume which is lower than the volume of the horizontal channel 13 and it may be vertically offset relative to the horizontal channel 13.

[0117] Similarly, the restructured shim plate 4 may have the features of both **Figure 6B** and **Figure 7B**.

[0118] In some embodiments, the slot coating die of the invention comprises the following layered arrangement:

- one die part 1, 2 comprising a partially filled horizontal channel 13;
- the patterned shim plate 18 pressed against said die part 1, 2;
- the other die part 1, 2 pressed against the patterned shim plate 18.

[0119] In some embodiments, the slot coating die of the invention comprises the following layered arrangement:

- one die part 1, 2 comprising a fully filled horizontal channel 13;
- the restructured shim plate 4 pressed against said die part 1, 2;
- the patterned shim plate 18 pressed against the restructured shim plate 4;
- the other die part 1, 2 pressed against the patterned shim plate 18.

[0120] In some embodiments, the slot coating die of the invention comprises the following layered arrangement:

- one die part 1, 2 comprising a horizontal channel 13;
- the blank shim plate 3 pressed against said die part 1, 2;
- the restructured shim plate 4 pressed against the blank shim plate 3;
- the patterned shim plate 18 pressed against the restructured shim plate 4;
- the other die part 1, 2 pressed against the patterned shim plate 18.

[0121] Preferably, the upstream die part 1 and the downstream die part 2 can for example be manufactured from stainless steel.

[0122] Each of the blank shim plate 3, restructured shim plate 4 and patterned shim plate 18 can for example be manufactured from a material chosen from stainless steel, aluminum, ceramic, titanium, nickel, copper, tin, tungsten, molybdenum, alloys and/or combinations thereof. According to preferred embodiments, they are manufactured from stainless steel. According to preferred embodiments, these plates are manufactured from the same material.

[0123] In order to coat a substrate with the slot coating die of the present invention, the fluid composition is fed to the additional horizontal channel 17 via the fluid inlet(s) 12 (if the horizontal channel 13 is fully blocked); or the fluid composition is fed to the unblocked (e.g. unfilled) portion of the horizontal channel 13 (if it is not fully blocked); and the fluid composition is then dispensed through the outlet(s) of the slot coating die. The composition can be applied in the form of patterns, especially strips, depending on the shape, number and positioning of the outlet(s) formed by the one or more cut-outs 21.

[0124] The fluid composition may be introduced into the fluid inlet(s) 12 using for example a metering pump configured to pump and transport the pressurized fluid composition through a hose and into the fluid inlet(s) 12. During this step, the fluid composition may have a temperature from 25 to 250°C.

[0125] The fluid composition is preferably an adhesive material. The adhesive material may for example comprise a rubber-based polymer such as a styrene block copolymer, butyl rubber and ethylene vinyl acetate. According to some preferred embodiments, the adhesive material is a wet-indicator adhesive material for a sanitary absorbent article, such as a diaper or an adult incontinence product.

[0126] The substrate may be for example a film, or a woven or nonwoven material, which may for example be made of polypropylene, polyethylene, polyethylene terephthalate, polyamide, paper or any other cellulose-based material, natural fibers such as cotton fibers, and combinations thereof.

[0127] The substrate may move from upstream to downstream. A lower part of the slot coating die may contact the substrate.

[0128] The temperature of the fluid exiting the slot coating die and being applied onto the substrate can be from 30 to 350°C, and preferably from 100 to 200°C.

[0129] In addition, the speed of the coating of the substrate may be from 5 to 800 m/min, and preferably from 100 to 500 m/min.

[0130] The fluid applied on the substrate may have a thickness of 0.001 to 5 mm.

[0131] According to some embodiments, the coating of a substrate with the slot coating die of the present invention may be a continuous process.

[0132] According to other preferred embodiments, the coating of a substrate with the slot coating die of the present invention may be a discontinuous (intermittent) process.

[0133] As indicated above, the present invention makes it possible to reduce the ghosting of the fluid composition on the substrate. Therefore, the ghosting length may be from 0 to 60 mm, preferably from 0 to 20 mm, more preferably from 0 to 10 mm, even more preferably from 0 to 5 mm. By "*ghosting length*" is meant the length of the fluid composition applied on the substrate adjacent an area of the substrate on which the fluid composition is sought to be applied.

[0134] Since the ghosting phenomenon is highly dependent on the nature of the fluid composition and in particular on its viscosity, the present invention makes it possible to modify an existing slot coating die in order to reduce or suppress ghosting when it is observed.

[0135] According to some embodiments, the ghosting phenomenon may occur for a fluid composition having a viscosity from 100 to 10000 cps, and preferably from 200 to 5000 cps.

Examples

[0136] The following example illustrates the invention without limiting it.

[0137] In this example, a wetness indicator adhesive was coated on the surface of a polyethylene film at a temperature of 90°C or 110°C and with a speed of 250 m/min.

[0138] Coating of the substrate with the adhesive was achieved first by using a slot coating die comprising a blank shim plate and a restructured shim plate (Tests 1 to 7), then by using a slot coating die wherein the horizontal channel was filled with a filler material (mixture of organic peroxides and polyester resin) and comprising a restructured shim plate (Tests 8 to 12) and then by using a slot coating die devoid of filler material and devoid of blank shim plate and restructured shim plate (Tests 13 to 14 - comparative). In all configurations, a patterned shim plate having a thickness of 0.15 mm was used. When a restructured shim plate was used, different vertical offset values relative to the horizontal channel were tested.

[0139] The adhesive was coated on the substrate at a quantity of 25 g of adhesive/m², at a speed of 250 ppm.

[0140] The coating of the substrate is a discontinuous (intermittent) process to form alternating 200 mm coated areas and 270 mm uncoated areas.

[0141] The distance between the lower edge of the horizontal channel and the lower edge of the die part comprising the horizontal channel is 1 mm.

Test	Blank shim plate	Filler material	Vertical offset (mm)	Restructured shim thickness (mm)	Application temperature (°C)	Length of ghosting (mm)
1	Yes	No	4	0.2	90	10
2	Yes	No	4	0.2	110	10
3	Yes	No	1	0.2	90	40-50
4	Yes	No	1	0.2	110	20-40
5	Yes	No	4	0.5	90	20-50
6	Yes	No	4	0.5	110	20-40
7	Yes	No	1	0.5	90	30-60
8	No	Yes	4	0.2	90	10-15
9	No	Yes	4	0.2	110	10-15
10	No	Yes	1	0.2	90	40-50
11	No	Yes	1	0.2	110	25-35
12	No	Yes	4	0.5	90	20-30
13	No	No	1	-	90	No cut-off
14	No	No	1	-	110	No cut-off

[0142] No-cut-off: No uncoated substrate was observed between the areas of coated substrate.

[0143] The ghosting length is measured by measuring the length of the fluid composition applied on the substrate adjacent the area of the substrate on which the fluid composition was applied.

Claims

1. A slot coating die for applying a fluid composition on a substrate, comprising:

- an upstream die part (1) having a first face (5);
- a downstream die part (2) having a second face (7), the first face (5) of the upstream die part (1) facing and being parallel to the second face (7) of the downstream die part (2);

wherein at least one of the upstream die part (1) and the downstream die part (2) comprises at least one fluid inlet (12) configured for making the fluid composition flow between the upstream die part (1) and the downstream die part (2), and wherein at least one of the upstream die part (1) and the downstream die part (2) comprises at least one horizontal channel (13) on the first face (5) or second face (6), wherein the horizontal channel (13) is at least partially blocked so that the fluid composition is prevented from flowing through at least part of the horizontal channel (13).

2. The slot coating die according to claim 1, wherein at least part of the horizontal channel (13) is filled with a filler material, preferably an organic material, an inorganic material or a metal chosen from an epoxy resin, a polyurethane resin, a polyester resin, a metasilicate, tin, a peroxide and their mixtures.

3. The slot coating die according to claim 1 or 2, comprising a blank shim plate (3) located between the upstream die part (1) and the downstream die part (2), the blank shim plate (3) being configured to block the horizontal channel (13) so as to prevent the fluid composition from flowing through the horizontal channel (13).

4. The slot coating die according to any one of claims 1 to 3, comprising a restructured shim plate (4) located between the upstream die part (1) and the downstream die part (2), the restructured shim plate (4) comprising an additional horizontal channel (17) configured so that the fluid composition flows through said additional horizontal channel (17).

5. The slot coating die according to claim 4, wherein the additional horizontal channel (17) has a volume which is lower than the volume of the horizontal channel (13).

6. The slot coating die according to any one of claims 4 or 5, wherein the volume of the additional horizontal channel (17) is from 50 to 25000 mm³, preferably from 50 to 1000 mm³, and preferably from 50 to 500 mm³.

7. The slot coating die according to any one of claims 4 to 6, wherein the additional horizontal channel (17) is vertically offset relative to the horizontal channel (13), and is preferably located above the horizontal channel (13).

8. The slot coating die according to claim 7, wherein the additional horizontal channel (17) is at a distance from 2 mm to 50 mm, and preferably from 2 to 10 mm, from a lower edge (15b) of the restructured shim plate (4).

9. The slot coating die according to any one of claims 4 to 8, wherein the thickness of the restructured shim (4) plate is from 0.1 to 1 mm; and preferably from 0.2 to 0.5 mm.

10. The slot coating die according to claims 1 to 9, further comprising a patterned shim plate (18) between the upstream die part (1) and the downstream die part (2), the patterned shim plate (18) having a lower edge (18b), wherein the lower edge (18b) comprises at least one cut-out (21).

11. A method for applying a fluid composition on a substrate by using the slot coating die according to any one of claims 1 to 10, the method comprising:

- feeding the fluid composition to the at least one inlet (12);
- making the fluid composition flow between the upstream die part (1) and the downstream die part (2);
- dispensing the fluid composition onto the substrate from the slot coating die.

12. The method according to claim 11, wherein the fluid composition is an adhesive material.

13. The use of the slot coating die according to any one of claims 1 to 10 to reduce or prevent ghosting during a slot die coating process, wherein the slot die coating process comprises applying a fluid composition on a substrate by the slot coating die.

14. A method of restructuring an initial slot coating die for applying a fluid composition on a substrate, the initial slot coating die comprising:

- an upstream die part (1) having a first face (5);
- a downstream die part (2) having a second face (7), the first face (5) of the upstream die part (1) facing and being parallel to the second face (7) of the downstream die part (2);

wherein at least one of the upstream die part (1) and the downstream die part (2) comprises at least one fluid inlet (12) configured for making the fluid composition flow between the upstream die part (1) and the downstream die part (2), and wherein at least one of the upstream die part (1) and the downstream die part (2) comprises at least one horizontal channel (13) on the first face (5) or second face (6);

wherein the method comprises modifying the initial slot coating die by at least partially blocking the horizontal channel (13) so that the fluid composition is prevented from flowing through at least part of the horizontal channel (13), thus turning the initial slot coating die into a coating die according to any one of claims 1 to 10.

15. The method of claim 14, comprising a step of at least partly filling the horizontal channel (13) with a filler material; and/or of adding a blank shim plate (3) between the upstream die part (1) and the downstream die part (2) configured to block the horizontal channel (13) so as to prevent the fluid composition from flowing through the horizontal channel (13); and/or of adding a restructured shim plate (4) between the upstream die part (1) and the downstream die part (2), the restructured shim plate (4) comprising an additional horizontal channel (17).

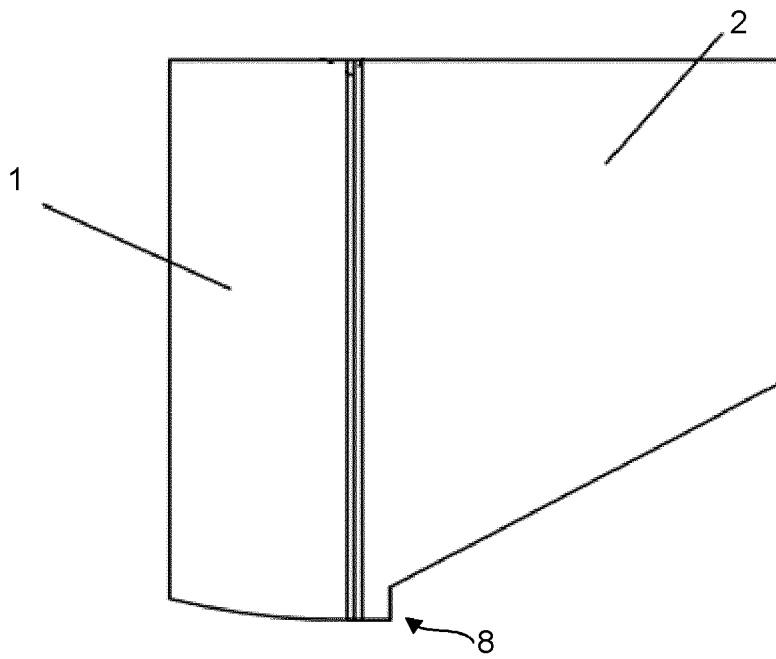


Fig. 1

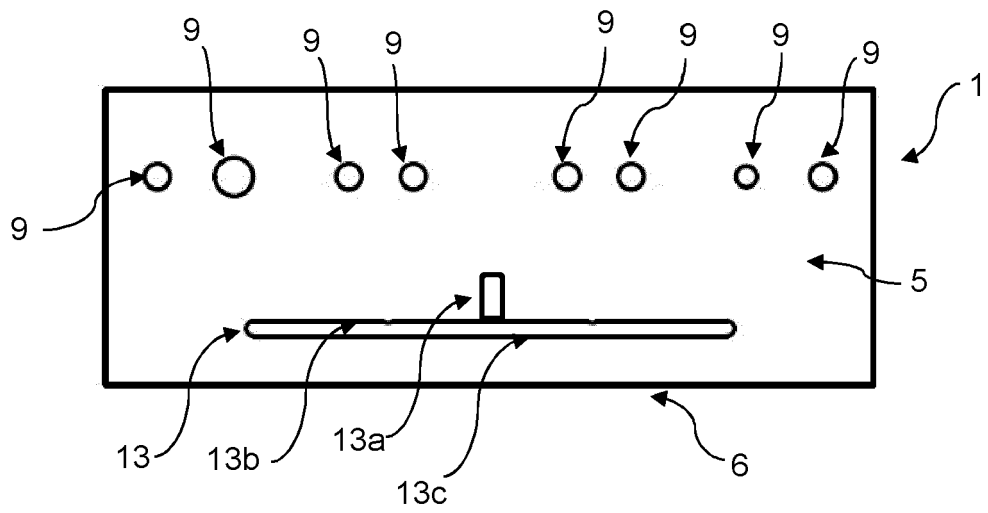


Fig. 2

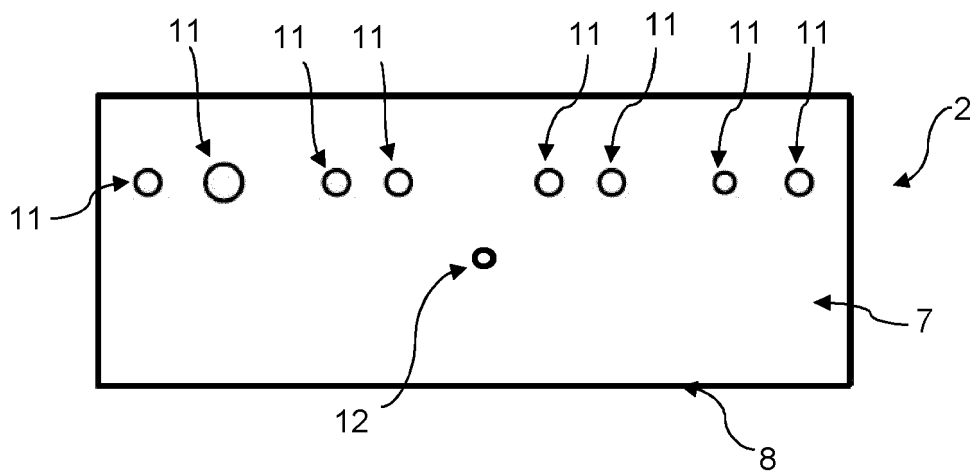


Fig. 3

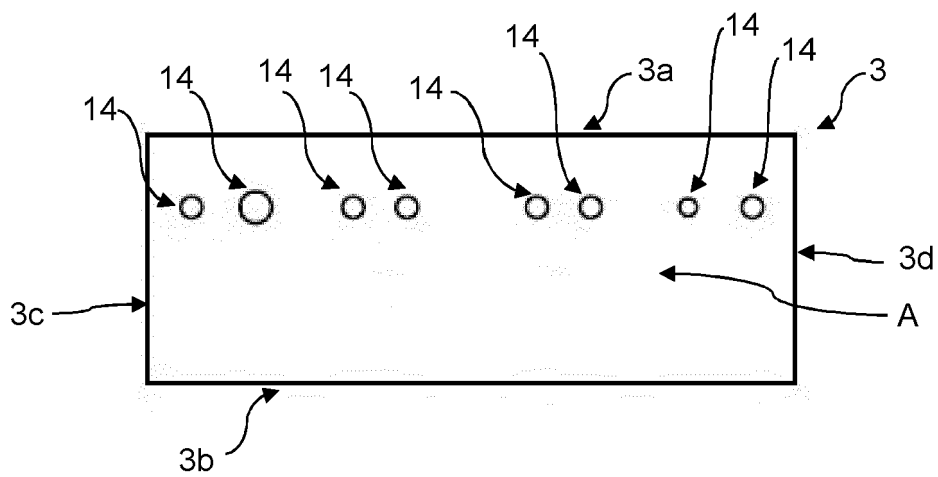


Fig. 4

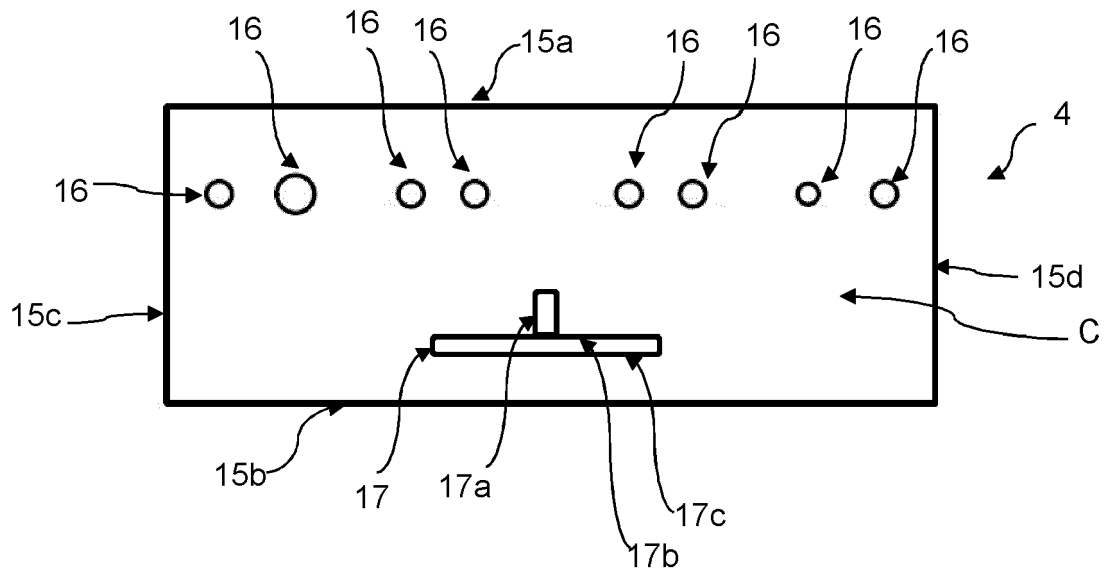


Fig. 5

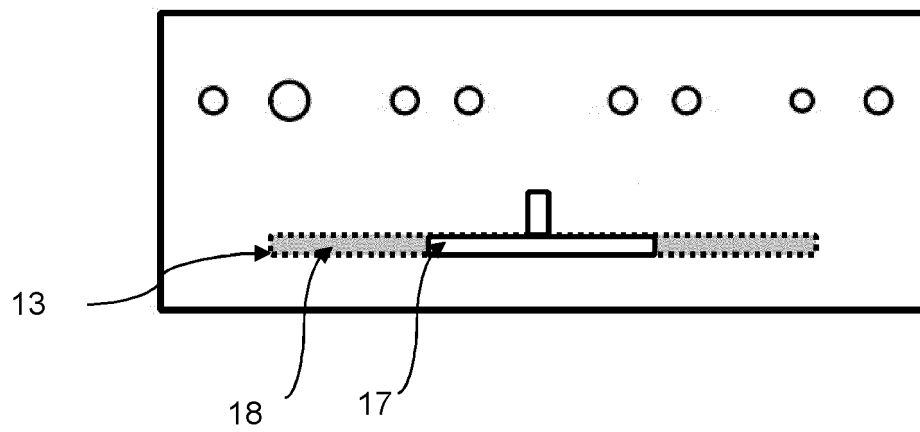
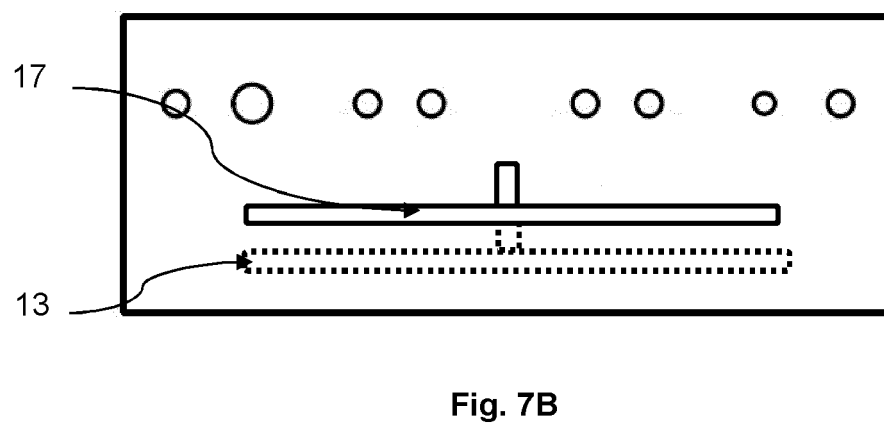
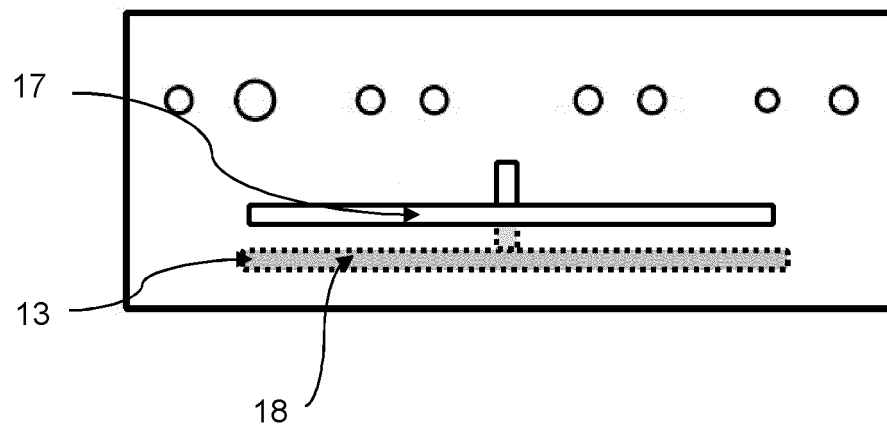
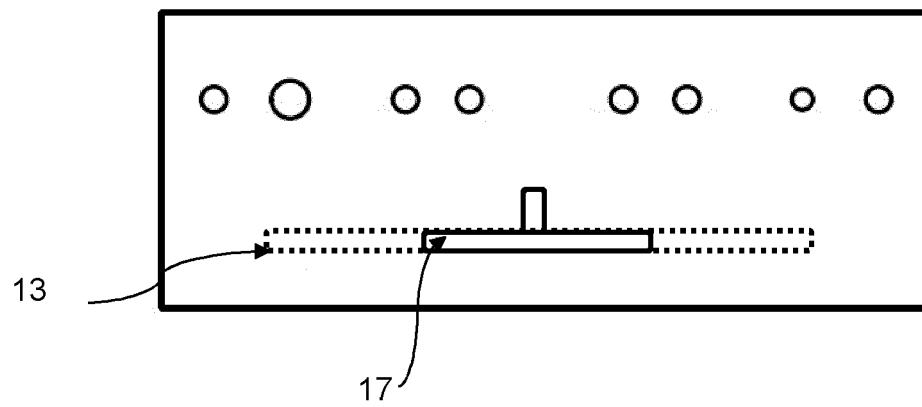


Fig. 6A



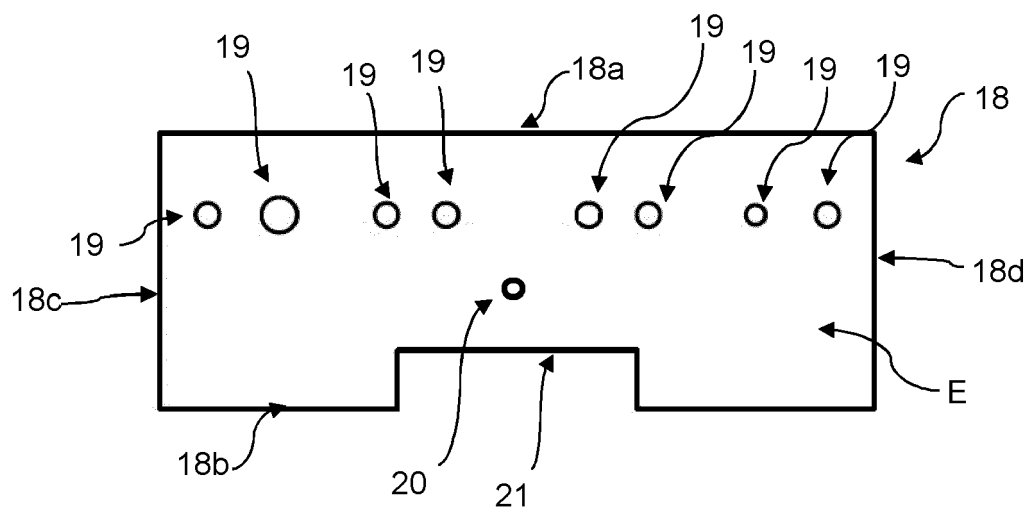


Fig. 8A

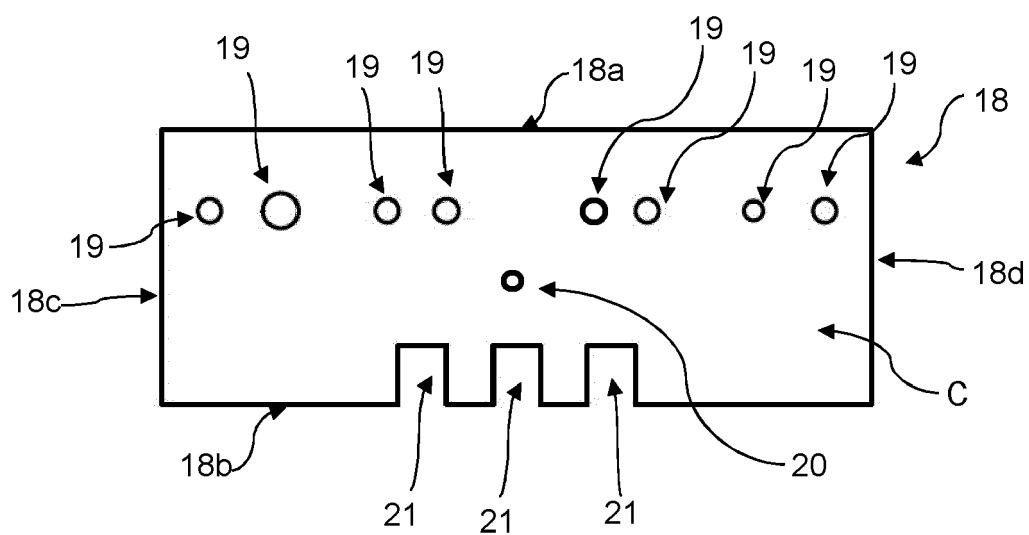


Fig.8B



EUROPEAN SEARCH REPORT

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 EP 21 30 5674

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X	US 2001/042507 A1 (ROTHEN JOSEF [DE]) 22 November 2001 (2001-11-22)	1,3, 10-15	INV. B05C5/02
A	* paragraph [0030]; figures 1,5 * -----	2,4-9	
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	* paragraph [0052] - paragraph [0054] * * figures *		
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	* column 5, line 40; figure 7 * -----		
			TECHNICAL FIELDS SEARCHED (IPC)
			B05C
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		8 November 2021	Barré, Vincent
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

**ANNEX TO THE EUROPEAN SEARCH REPORT
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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08-11-2021

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