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(54) **Method and apparatus for applying a layer having a relief on a flat face of a substrate.**

(57) The invention relates to a method and an apparatus for applying a layer having a relief on a substrate, comprising the steps of securing the substrate, applying a layer of a curable liquid on the substrate, bringing a mould having a relief being the negative of the relief to be provided on the substrate, into contact with a part of the upper surface of the liquid layer, curing the liquid layer while the mould is in contact with the liquid and separating the mould from the substrate, wherein initially the mould is brought into contact with the liquid in a bent position while the substrate is kept flat and subsequently the mould is brought into contact over an increasing surface area keeping the mould in a bent position until the complete liquid layer is in contact with the mould. This method provides the gradual bringing into contact of the mould with the fluid layer on the substrate, avoiding any air inclusions.

Method and apparatus for applying a layer having a relief on a flat face of a substrate

The present invention relates to a method for applying a layer having a relief on a flat face of a substrate.

In some situations there is a desire to provide a layer with a relief on a substrate. This may be the case in the provision of a frosted layer on clear glass or the provision of optical structures on printed matter to obtain visual effects. Although voluminous substrates are not excluded, it is envisaged that the layer having a relief is applied on a thin substrate, such as a card or a piece of paper. The substrate may be laminated but it may also be formed by a single layer. The substrate is preferably, but not necessarily formed by a security document such as an identity card, a personalized card in a passport or a credit card.

From the prior art a method is known, comprising the steps of securing the substrate with the surface onto which the relief is to be provided on top, applying a layer of a curable liquid on the upper surface of the substrate, bringing a mould having a counter relief into contact with at least a part of the upper surface of the liquid layer, curing the liquid layer while the mould is in contact with the curable liquid and separating the mould from the substrate.

This prior art method makes use of a rigid mould. This leads to the disadvantage that when the mould is bought into contact with the liquid on the substrate, air inclusions may develop, leading to bubbles in the liquid and to later to irregularities in the relief after curing. Further there the liquid may be pushed away from the substrate by the mould.

To avoid these disadvantages, another prior art method provides a method of the kind referred above wherein the mould is still rigid, but wherein the substrate is bent. Although possible if the substrate can be bended, this method has the disadvantage that, after making contact with the mould, the substrate must be brought back to its original flat shape before the curing can take place, requiring complicated machinery and likely

leading to deformation of the relief. The substrate can be brought back to its original flat shape after curing, but this would lead to deformation and breakage of the relief layer.

The present invention aims to avoid these disadvantages, by providing such a method wherein initially the mould is brought into contact with the upper surface of the liquid layer in bent position while the substrate is kept flat and subsequently the mould is brought into contact with an increasing surface area, keeping the mould in a bent position until the complete liquid layer is in contact with the mould and at least the part of the mould in contact with the liquid layer being flat, keeping the substrate flat.

This method provides the gradual bringing into contact of the mould with the fluid layer on the substrate, avoiding any air inclusions. Further it avoids the urging of the liquid away from the substrate, as the process is gradual. Finally it avoids deformation of the relief layer either in liquid or in cured form with the associated problems.

If the substrate is a security document, the substrate is provided with a print, often with a personalized section. The relief layer needs to be transparent for visible light to allow the print of the substrate to be viewed. For further enhancement of the security it is preferred that the relief layer itself is also provided with a print. This extra print on the relief layer may cooperate with the print under the relief layer to give a visible effect, possibly in cooperation with the relief layer. The relief layer may have properties leading to a visible effect such as a lenticular effect. All these features enhance the security, that is increase the difficulty of copying and falsification.

It is noted that in the above paragraph the mould is brought to the substrate; it will be clear that it is also possible to move the substrate to mould or to move both the substrate and the mould to each other. Any amendments to the apparatus required to perform these kinematic variations will be clear for a skilled man.

Further the present invention provides an apparatus for applying a layer having a relief on a flat surface of a substrate, the apparatus comprising a frame, securing means connected to the frame and adapted to secure the substrate with the surface of the substrate onto which the relief is to applied, on top, a flat mould carrying a counter relief, a radiation source adapted to emit radiation curing the liquid applied in a layer on

the substrate to a solid layer having a relief, wherein the mould is flexible and the apparatus comprises a manipulator connected to the frame, the manipulator being adapted to initially bring the mould into contact with the upper surface of the liquid layer and to subsequently bring the mould into contact over an adjacent upper surface area of the liquid layer until the complete liquid layer is in contact with the mould wherein the mould is kept bent until the complete liquid layer is in contact with the mould and at least the part of the mould in contact with the liquid layer is flat.

For most mould materials, such as silicone, the flexibility of the mould allows bending of the mould over a single axis only. Assuming the axis of the bent of the mould to be parallel to the upper surface of the substrate, the mould is initially brought into contact with the substrate over a line.

However it is also possible that the mould is initially brought into contact with the substrate in a point. This requires the axis of the bent of mould being tilted relative to the surface of the substrate during initial contact. Having such a tilted axis of bending prevents later contact of the mould over the complete surface of the substrate with the flat mould. To make contact over the full surface area of the substrate, the mould needs to be moved to a position with its axis of bending parallel to the surface of the substrate.

This embodiment also provides an apparatus wherein the clamps are connected to the yoke rotatably over an axis extending substantially between the centres of the clamps.

According to an embodiment, the initial contact location coincides with one side of the upper surface of the substrate and that subsequently the mould is brought into contact with the further upper surface area of the liquid layer in a single direction. Herein the complete surface of the liquid must be covered in a single process, but which requires complicated manipulation equipment and which requires some time.

It is however preferred that the initial contact location is on a distance from the sides of the upper surface of the substrate and that subsequently the mould is brought into contact with the further surface area of the liquid layer in two opposite directions. In this process the two areas at either side of the initial contact are covered simultaneously, hence requiring less time. Further the process is preferably executed symmetrically,

making the manipulator relatively simple as the flexible mould can be gripped at its ends, allowing the mould to sag so that the lowest part of the mould contacts the liquid initially.

According to another preferred embodiment the liquid layer applied is transparent for curing radiation when liquid and transparent for visible light when cured. The transparency in the liquid state allows to reach the complete layer with the radiation. Although it is possible to make the resulting cured layer opaque and coloured, it is preferred that the cured layer is transparent for visible light. This allows to provide optical features in the transparent layer such as small lenses etc.

The same feature provides an apparatus of the kind referred to above, wherein the mould is transparent for radiation emitted by the radiation source. Further it is noted that it is also possible to irradiate the liquid layer from the underside that is through the substrate. It will be clear that this would require the transparency of the substrate for the radiation curing the liquid.

As explained earlier the most attractive way of bringing the mould into contact with the liquid, is to make contact between the mould and the liquid in an intermediate position and to gradually increase the surface area of the contact in both directions. This is made easier when the manipulator comprises two clamps, each being adapted to grip one of two opposite sides of the mould and each being connected with a yoke moveable in a vertical direction and comprising driving means for driving the vertical movement of the yoke. Then the distance between the clamps is smaller than the length of the mould so that the mould sags and the lowest part of the mould contacts the liquid first and the contact face is increased when the clamps are lowered further.

To allow sagging of the mould, it is preferred when at least one of the clamps is mounted on the yoke rotatable around an axis extending parallel to the contact line and that the apparatus comprises rotation coupling means adapted to couple the rotation movement of the at least one clamp relative to the yoke to the vertical movement of the yoke. This feature allows to have the mould extend downwardly sloping from the clamps, wherein the slope may change during the lowering of the mould as caused by

the movement of the separation between the increasing part of the mould in contact with the liquid and the decreasing part of the mould, not in contact with the liquid.

For the same reason it is preferred when at least one of the clamps is mounted on the yoke translatable in horizontal direction and the apparatus comprises coupling means adapted to couple the horizontal movement of the at least one clamp relative to the yoke.

The same effect is reached when the clamps are symmetrically arranged relative to the centre of the fixation means.

In a constructive simple embodiment the rotation coupling means comprise an arm of which one end is rotatably connected to the frame and the other end is solidly connected to the clamp and wherein the yoke comprises a part slidably connected to the arm.

Although other means of temporary fixation are not excluded, it is preferred when the securing means for fixation of the substrate, comprise a carrier provided of switchable vacuum securing means.

Preferably the carrier is moveable in substantial horizontal direction on a rail. This feature allows to transport the substrate with the liquid from a station wherein the liquid is applied to the substrate to the apparatus according to the invention and to transport the substrate with the cured liquid away for further processing.

In another constructive simple embodiment the radiation source is formed by a LED mounted on the yoke. The mounting on the yoke, makes the distance between the radiation source and the liquid to be cured small, allowing to use a small radiation source such as a LED.

Of course the apparatus may accept substrates already provided with a layer of liquid to be cured. It is however preferred when the apparatus comprises an applicator for application of the layer of liquid on the substrate.

To allow an easy exchange of moulds it is preferred that the clamps each comprise a pair of jaws mutually moveable between an active and an inactive position and a spring adapted to urge the jaws to towards one another in the active position, both jaws being adapted to pinch opposite strips of the mould.

In many cases the flexibility of the mould combined with the ability to contain a relief, can be obtained with materials possibly having the structure of a gel, making it troublesome to be securely gripped. To allow a sure gripping of opposite ends of the mould, it is preferred when at least one of the jaws on its pinching surface comprises an friction layer, such as a layer of sanding paper. Silicone is a good example of a material to be used for the mould, although other materials, such as other polymers, are not excluded.

Subsequently the present invention will be elucidated with the help of the following drawings, wherein depict:

Figures 1A-1C: cross sectional diagrams depicting three phases in the process of applying the mould to the liquid layer according to a first embodiment;

Figures 2A-2C: diagrams depicting three phases in the process of applying the mould to the liquid layer according to a second, alternative embodiment;

Figure 3: a diagrammatic perspective view of an apparatus adapted to perform a method according to the second embodiment;

Figures 4A-4E: diagrams showing different constructional possibilities of the second embodiment;

Figure 5: a cross section view of a clamp to be used in the apparatus according to the invention; and

Figure 6: a view similar to figure 3, depicting an alternative embodiment.

The present invention relates to the application of a relief layer on a substrate such as a plastic card, like a credit card. The method according to the invention comprises - assuming the presence of a card with a layer of curable liquid – the application of a mound on the liquid, wherein the mould has a relief which is the negative of the relief to be applied to the layer. The invention provides the gradual bringing into contact of the mould with the layer avoiding the inclusion of air between the mould and the liquid. After the mould has been brought into contact with the liquid, the liquid is cured by

radiation. The gradual contact between the mould and the liquid requires a flexible, that is a bendable mould. This mould is initially brought into contact with the liquid on the substrate in a single line, and figure 1 depicts a first embodiment in cross section.

Figures 1A-C depict a card 1, acting as a substrate onto which a thin layer 2 of curable liquid has been provided. In figure 1A an edge 4 of a mould 3 is brought into contact with the liquid layer 2. This figure shows that the part of the mould 3 in contact with the liquid extends substantially parallel to the surface of the liquid as a preparation for the next step. In figure 1B roughly half of the surface of the liquid layer 2 is covered by the mould 3. Again the part 3a of the mould 3 in contact with the liquid layer 2 extends parallel to the surface of said layer. Due to the flexibility of the mould, the angle of the part 3b of the mould not in contact with the liquid 2 with the horizontal increases gradually from zero, as caused by the flexibility of the mould 3. In the final situation, depicted in figure 1C, the complete mould 3 extends parallel to the surface of the liquid layer 2. It is however also possible that only the part of the mould extending parallel to the substrate is flat and that the part of the mould not in contact with the substrate is curved, but the tangent to the curve at the border of the substrate is parallel to the substrate.

In the embodiment discussed above, it is assumed that the substrate is substantially rectangular, and that the initial contact line between the edge 4 of the mould coincides with an edge of the liquid layer on the substrate. It is however also possible that the substrate 1 has another, non-rectangular shape and or that the initial contact line is formed by a single point on a corner of the substrate 1.

Another possibility is represented in figure 2. Herein the middle of the flexible mould 3 is initially brought into contact with a line 4 traversing the surface area of the liquid layer 2. This situation is represented in figure 2A. This embodiment is preferably although not necessarily symmetrical. The process of bringing the mould 3 into contact with the liquid layer 2 is substantially equivalent to that described with the help of the figure 1, although performed at both sides of the initial contact line. Again the parts 3b, 3b' respectively not being in contact with the liquid layer extend under an increasing angle with the horizontal. When the edges of the mould 3 are lowered, the surface area of the part 3a of the mould 3 being into contact with the liquid layer 2 increases, as is

represented in figure 3b. This process is continued until the full surface area of the liquid layer 2 is covered by the mould 3, as is represented in figure 2C.

The above two figures only relate to the actual process. An apparatus is required to allow the process to be performed. Figure 3 depicts an embodiment of such an apparatus. This apparatus comprises a base plate 10 onto which a column 11 is solidly connected. The base plate 10 and the column 11 together form a frame. On the column 11 a yoke 12 is slidably connected, to drive the yoke in the vertical direction drive means not depicted in the drawing, comprising and electric motor, and possibly a rack and pinion system may be provided. The yoke 12 comprises two clamps 13A, 13B connected symmetrically to the yoke 12. The clamps 13 are adapted to clamp the two opposite edges of the flexible mould 3. Please note that usually the distance between the clamps is smaller than the Under the position between the clamps a support 14 is provided for supporting and fixating the substrate to be provided of a relief layer. This support may be firmly connected to the base plate 10, but in the embodiment depicted, it is slidably connected to a rail 15, allowing the support to transferred between the position under the mould 3 and a second position 16 in which the substrate may be provided with the liquid layer or which the substrate may be provided complete with a liquid layer. Further the substrate 2, complete with the cured layer 3 can be removed from said second position 16, to allow further processing. Finally a LED 17 functioning as a radiation source is provided on the yoke 12. The Led 17 may however also be located in another position adapted to let the radiation emitted by the LED to reach the liquid layer to be cured.

The connection between the clamps 13 and the yoke 12 can be embodied in different ways. The connection may be fixed, so that the clamps 13 are fixed to the yoke 12. This embodiment is only applicable if the mould 3 is substantially longer than the length of the substrate 2, to allow the flexibility of the mould 3 to cater for the variations in shape of the mould 3, such as the rate of sagging.

It is however preferred that the clamps 13 are connected slidably with a horizontal component to the yoke 12 to allow variation of the distance between the clamps 13. This variation caters for the decreasing rate of sagging of the mould 2 when the yoke 12 is lowered and the contact surface area between the mould 3 and the liquid layer 2

increases. The horizontal movement of the clamps 13 is preferably coupled to the vertical movement of the yoke 12 .

It is also preferred to connect the clamps 13 rotatably to the yoke 12, possibly in combination with the slidable connection between the clamps 13 and the yoke 12. This feature allows to cater for the decreasing angle at the clamps 13 between the mould 3 en the horizontal when the mould 12 covers an increasing area of the fluid layer 2. It is possible to have the clamps 13 freely rotatable, but it is preferred that the rotation of the clamps 13 is preferably coupled to the vertical movement of the yoke 12.

Figures 4A-4E show several different embodiments of the connection between the clamps and the yoke. It is noted that only a half of a yoke 12 is depicted in drawing. In the embodiment depicted in figure 4A a carriage 18 has been slidably mounted to the yoke 12 and the clamp 13 is rotatably connected to the carriage 18 by a shaft 19, thus allowing for both translation and rotation of the clamp 13. In the shaft 19 a through going slot 20 has been provided and a curved leaf spring 21 fixed to the column extends through the slot 20. The vertical movement of the yoke 12 relative to the column 11 results in a relative movement of the shaft 19 relative to the leaf spring 21 and the curved shape of the leaf spring 21 results in both rotation and translation of the shaft 19 and the clamp 13 connected to the shaft 19. Your attention is drawn to the fact that only one half of the apparatus is depicted in this figure and that the complete apparatus comprises a second mirrored half. Further it is possible that the complete apparatus comprises a single leaf spring 21 with double length extending to both sides of the column 11.

The embodiment depicted in figure 4B comprises a rack rail 23 extending over the base plate 10 and a gear 24 of which the teeth engage the rack rail 23. A first end of an arm 26 is rigidly connected with the gear 24, so that the rotation of the arm 26 causes rotation of the gear 24 and, as caused by the rack rail 23, translation of the gear 24 and of the first end of the arm 26. A slot 25 is located in the arm and a pin 25A is connected to the yoke 12 and extends through the slot 25. The clamp 13 is fixed to the second end of the arm 26. Vertical movement of the yoke 12 results in both a rotation and translation of the arm 26 relative to the base. This results in a involute movement of the clamp 13.

A simpler embodiment is depicted in figure 4C; one end of an arm 27 is rotatably connected to the base plate 10 or the column 11. A slot 28 is provided in the arm 27 and a pin 29 connected to the yoke 12 extends into the slot 28, allowing relative translation and rotation of the arm 27 relative to the yoke 12. The clamp 13 is fixed to the second end of the arm 27. Vertical movement of the yoke 12 results in both rotation of the arm 27, wherein the second end of the arm and hence the clamp 13 describes a rotation and a translation.

An embodiment allowing more freedom in design is depicted in figure 4D. This embodiment comprises a plate 30 extending in vertical direction perpendicular to the rail 15 and wherein two slots 31, 32 have been provided. The slots 31, 32 have a curved shape and they both extend with a horizontal and a vertical component. A carriage 33 is attached to the clamp 13 and two pins 34, 35 extend from the carriage 33 through the slots 31. The shape of the slots 31, 32 determine the path of the carriage 33 and of the clamp 13. One of the pins 34 extends also into a horizontal slot 36 provided in the yoke 12. Vertical movement of the yoke 12 results in vertical movement of the pin 34. As the pin 34 also extends through the slot 31 which has a horizontal component, the pin 34 also moves in horizontal direction, also moving the other pin 35, of which the movement is determined by the other slot 32. Now that the path of the movement of the both pins 34, 35 is determined, the path of the carriage 33 and the clamp 13 connected thereto is determined, both in translation and rotation.

Finally figure 4E shows an embodiment wherein the both the translation and the rotation of the clamp can be freely determined. Contrary to the embodiments discussed hitherto, each comprising one column 11 this embodiment comprises two columns 40, 41, one for each of the clamps 13 and only one of the columns 40 is depicted. The column 40 is mounted on a carriage 42, which is movable over a rail 44 mounted on the base plate. A controllable motor 46 is provided to drive the carriage over the rail 44. A yoke 48 is mounted movable in vertical direction over the column 40 and a controllable motor 50 is provided to drive the yoke 48 over the column 40. The clamp 13 is mounted rotatably relative to the yoke 48, and a controllable motor 52 is provided to drive the clamp 13. It will be clear that a similar, preferably mirrored structure is present to

control the other clamp 13. By controlling the motors 46, 50 and 52, the position in two directions and the angle of the clamp is controllable.

An embodiment of the clamps is shown in figure 5. As stated before the mould 3 has to be flexible, and at the same time to have a certain thickness to contain a counter relief, making the clamping of such a mould 3 cumbersome. The embodiment of the clamp 13 depicted in figure 5 comprises a fixed part 60 and a moveable part 61 swivably connected to the fixed part 60 by a shaft 62. On the moveable part 61 a pressing member 63 has been mounted, into which a cavity 64 has been provided. The cavity comprises a continuation 65 having a smaller diameter and extending through the moveable part 61. A screw 66 extends through the cavity 64 and its continuation 65 and it is screwed into the fixed part of the clamp 13. A helical spring 67 is pressed between the bottom of the cavity and the head of the screw 66, pressing the pressing member 63 and hence the moveable part 61 of the clamp to the fixed part thereof, thus providing a controllable pressing force for pressing the mould 3 between the two parts 60, 61 of the clamp. To increase the friction between the clamp 13 and the mould 2, a piece of sanding paper 68 is glued to the fixed part 60 of the clamp 13. However other friction materials may be used as well.

Figure 6 depicts an apparatus similar to that depicted in figure 3, but wherein the connection between the clamps 13 to the yoke 12 has been modified to allow rotation or tilt of the clamps 13 around an axis extending in the longitudinal direction of the mould 3. As the mould 3 extends between the clamps, the axis extends between the centres of the clamps 13. To control the tilt, two electric motors 70 are connected to the ends of the yoke 12 and a shaft 71 extends from each of the motors 70 to the clamps 13. The clamps 13 are fixed to the shafts 71. The motors 70 are controlled such that the motors rotate simultaneously. Tilting of the clamps 13 makes the mould 3 tilt such that, when the assembly of the yoke 12, the motors 70, the clamps 13 and the mould 3 lowers, the mould 3 initially touches the substrate 1, or rather the liquid layer 2 on the substrate 1 in a point, rather than over a line, as is the case in the situation depicted in figure 3. When the assembly is lowered further, the initial tilt of the mould 3 is to be reversed, preferably simultaneously with the lowering of the mould 3, to allow the mould to extend over the full surface area of the liquid layer 2 of the substrate 1.

Especially, though not exclusively it appears to be is attractive to apply the kinematic variations mentioned before in this embodiment, for instance by providing a lift for the block carrying the substrate.

The above description elucidates some embodiments of the invention, but the invention is not restricted to these embodiments, of which different features may be combined; rather the scope of the invention is determined by the claims.

Conclusies

1. Werkwijze voor het aanbrengen van een van een reliëf voorziene laag op een vlak van een substraat, omvattende de volgende stappen:
- het met het vlak waarop het reliëf moet worden gevormd naar boven fixeren van het substraat;
- het aanbrengen van een laag uithardbare vloeistof op het bovenvlak van het substraat;
- het in contact brengen van een van een contra-reliëf voorziene mal met ten minste een deel van het bovenvlak van laag vloeistof;
- het doen uitharden van de laag vloeistof; en
- het van het substraat scheiden van de mal,

met het kenmerk,
- dat de mal aanvankelijk in gebogen positie in contact wordt gebracht met het bovenvlak van de laag vloeistof terwijl het substraat vlak wordt gehouden; en
- dat vervolgens de mal in contact wordt gebracht met het bovenvlak van de laag vloeistof over een toenemend oppervlak, waarbij de mal gebogen blijft tot de gehele laag vloeistof door de mal wordt bedekt en tenminste het deel van de mal dat in contact is met de laag vloeistof, vlak is en het substraat vlak wordt gehouden.

2. Werkwijze volgens conclusie 1, **met het kenmerk**, dat de mal aanvankelijk over een lijn met de laag vloeistof op het substraat in contact wordt gebracht.

3. Werkwijze volgens conclusie 1, **met het kenmerk**, dat de mal aanvankelijk in een punt met de laag vloeistof op het substraat in contact wordt gebracht.

4. Werkwijze volgens conclusie 1, 2 of 3, **met het kenmerk**, dat de aanvankelijke contactlocatie samenvalt met een zijde van het bovenvlak van het substraat en dat de mal vanaf de contactlijn naar één richting met toenemend oppervlak in contact wordt gebracht met de laag vloeistof.

5. Werkwijze volgens conclusie 1, 2 of 3, **met het kenmerk**, dat de contactlijn zich tussen twee zijden van het bovenvlak van het substraat uitstrekt en dat de mal vanaf

de contactlijn in twee richtingen met toenemend oppervlak in contact wordt gebracht met de laag vloeistof.

6. Werkwijze volgens één van de conclusies 1-5, **met het kenmerk**, dat de aangebrachte laag vloeistof in vloeibare vorm transparant is voor uithardende straling en transparant is voor zichtbaar licht wanneer deze is uitgehard.

7. Inrichting voor het aanbrengen van een van een reliëf voorziene laag op een plat vlak van een substraat, omvattende:

- een frame;
- aan het frame bevestigde fixatiemiddelen voor het fixeren van het substraat met het vlak waarop het reliëf moet worden aangebracht naar boven;
- een van een contra-reliëf voorziene mal; en
- een stralingsbron, die is ingericht voor het uitzenden van straling die een op het substraat aangebrachte laag vloeistof doet uithardt tot de van een reliëf voorziene laag, **met het kenmerk**, dat de mal flexibel is en dat de inrichting is voorzien van een met het frame verbonden manipulator die is ingericht voor het aanvankelijk in contact brengen van de mal met het bovenvlak van de laag vloeistof en voor het vervolgens in contact brengen van de mal met de laag vloeistof over een naburig bovenvlak van de laag vloeistof waarbij de mal gebogen wordt gehouden, tot de gehele laag vloeistof door de mal is bedekt en tenminste het deel van de mal dat in contact is met de laag vloeistof, vlak is.

8. Inrichting volgens conclusie 7, **met het kenmerk** dat de mal en de laag vloeistof hoofdzakelijk doorlaatbaar zijn voor de door de stralingsbron uitgezonden straling.

9. Inrichting volgens conclusie 7 of 8, **met het kenmerk** dat de manipulator is voorzien van twee klemmen, die elk zijn ingericht voor het aangrijpen van één van twee tegenover elkaar liggende zijden van de mal en die elk met een in verticale richting beweegbaar juk zijn verbonden en van aandrijfmiddelen die zijn ingericht voor het aandrijven van de verticale beweging van het juk.

10. Inrichting volgens conclusie 9, **met het kenmerk**, dat de klemmen om een zich parallel aan de middens van de klemmen uitstrekkende as roteerbaar op het betreffende juk zijn bevestigd.

11. Inrichting volgens conclusie 10 of 11, **met het kenmerk**, dat tenminste één van de klemmen roteerbaar om een zich parallel aan de contactlijn uitstrekken as met het juk is verbonden en dat de inrichting is voorzien van rotatiekoppelmiddelen die zijn ingericht voor het koppelen van de rotatiebeweging van de tenminste ene klem ten opzichte van het juk met de verticale beweging van het juk.

12. Inrichting volgens conclusie 9, 10 of 11, **met het kenmerk**, dat tenminste één van de klemmen in horizontale richting beweegbaar op het juk is bevestigd en dat de inrichting is voorzien van koppelmiddelen die zijn ingericht voor het koppelen van de horizontale beweging van de klem ten opzichte van het juk met de verticale beweging van het juk.

13. Inrichting volgens conclusie 10, 11 of 12, **met het kenmerk**, dat de klemmen symmetrisch ten opzichte van het centrum van de fixatiemiddelen zijn geplaatst.

14. Inrichting volgens conclusie 13, **met het kenmerk**, dat de rotatiekoppelmiddelen omvatten:

- een arm, waarvan één einde roteerbaar met het frame is verbonden en het andere einde vast met de klem is verbonden; en
- waarbij het juk een glijdbaar met de arm verbonden deel omvat.

15. Inrichting volgens één van de conclusie 7-14, **met het kenmerk** dat de fixatiemiddelen voor de fixatie van de drager een blok omvatten dat van in- en uitschakelbare vacuumfixatiemiddelen is voorzien.

16. Inrichting volgens conclusie 15, **met het kenmerk**, dat het blok in een hoofdzakelijk horizontale richting op een rail beweegbaar is.

17. Inrichting volgens één van de conclusies 7-16, **met het kenmerk** dat de stralingsbron een LED-lamp is die op het juk is geplaatst.

18. Inrichting volgens één van de conclusies 7-17, **met het kenmerk**, dat de inrichting is voorzien van een applicator voor het op de drager aanbrengen van een vloeibare laag.

19. Inrichting volgens één van de conclusies 7-18, **met het kenmerk**, dat de klemmen elk een paar kaken omvatten die onderling beweegbaar zijn tussen een actieve en een inactieve positie, die in hun actieve positie door een veer naar elkaar toe worden gedrongen en dat beide kaken zijn ingericht voor het vastknijpen van tegenoverliggende zijden van de mal.

20. Inrichting volgens conclusie 19, **met het kenmerk**, dat tenminste één van de kaken op zijn knijpvlak van een wrijvingslaag, zoals een laag schuurpapier is voorzien.

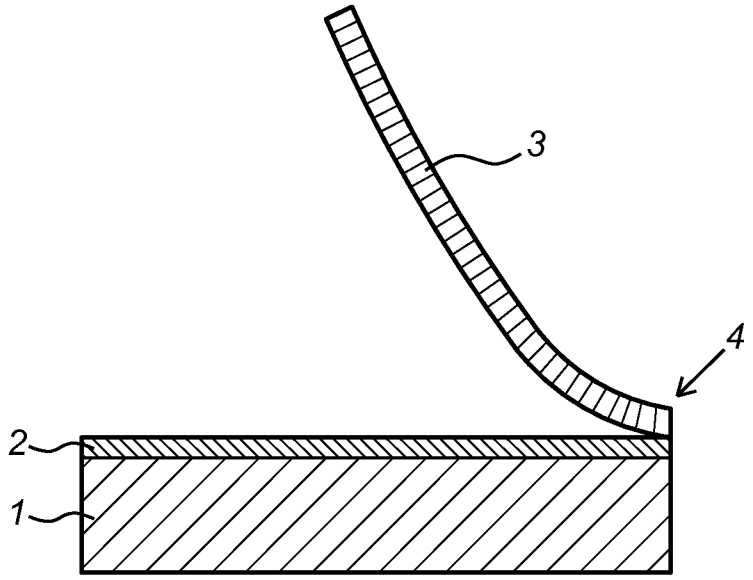

Fig. 1A

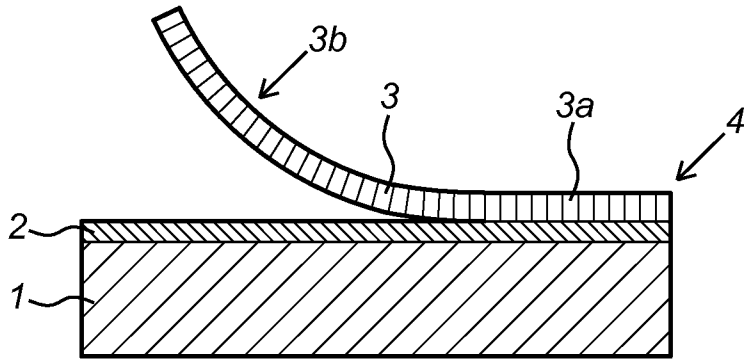

Fig. 1B

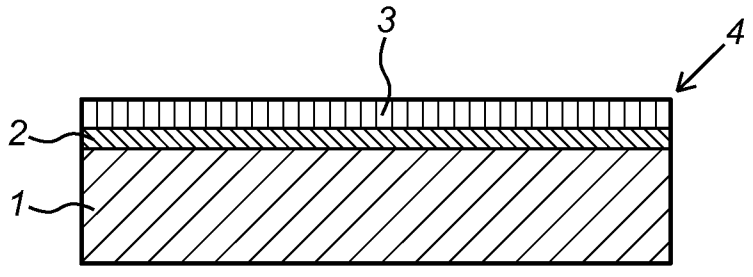

Fig. 1C

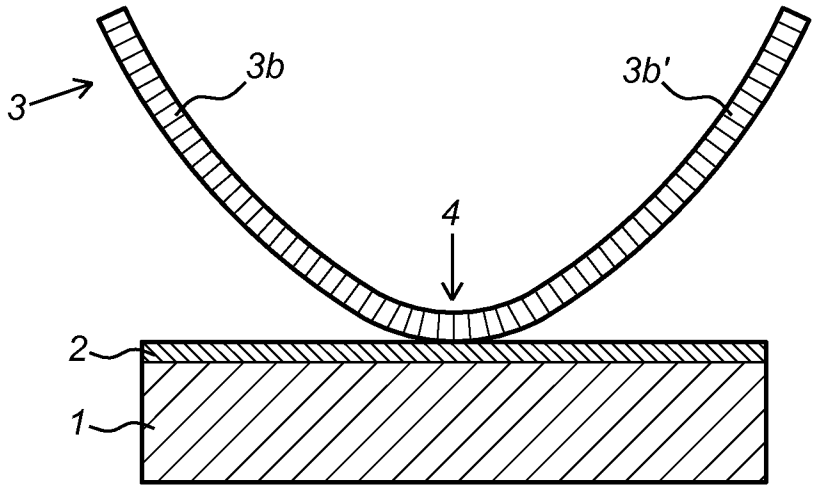

Fig. 2A

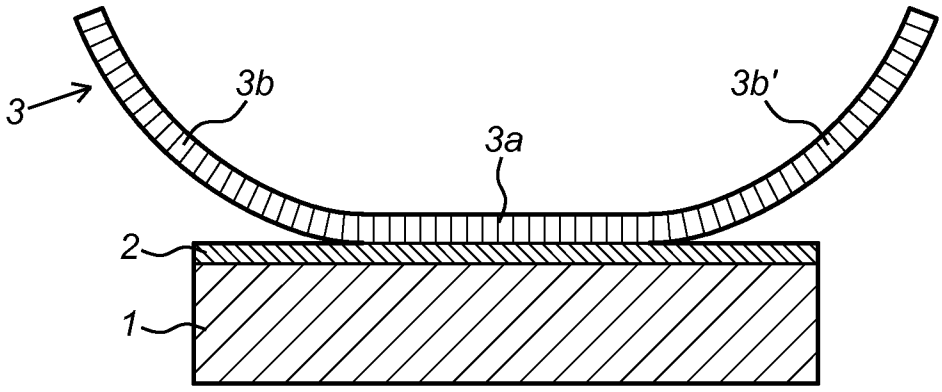

Fig. 2B

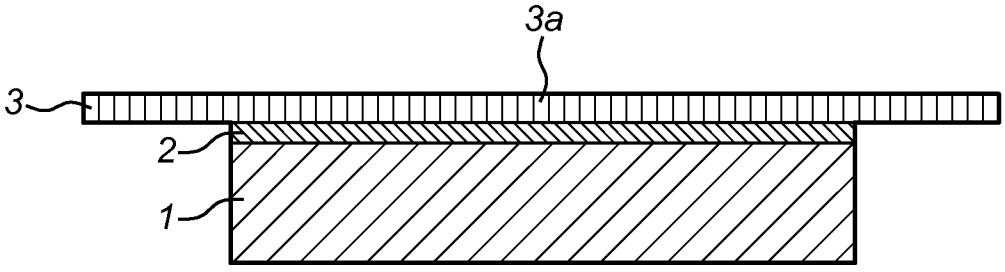

Fig. 2C

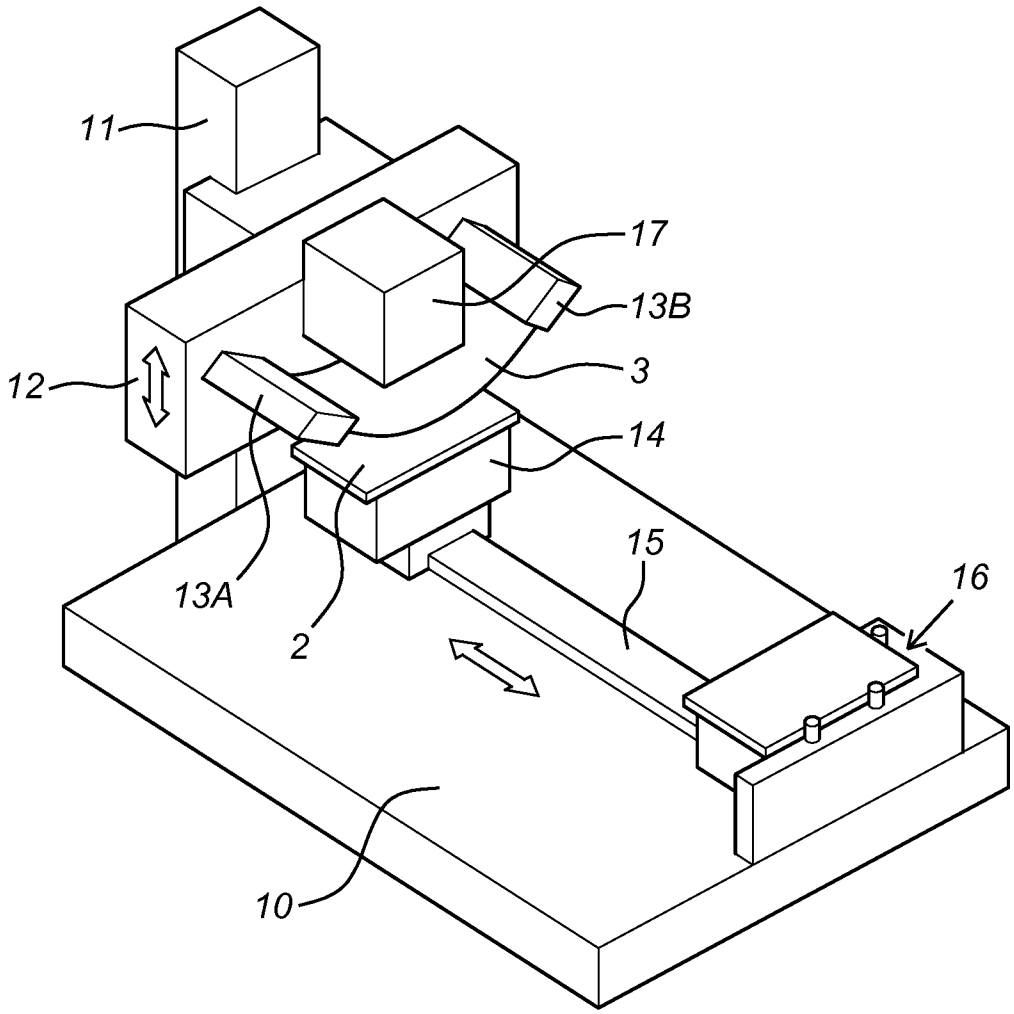

Fig. 3

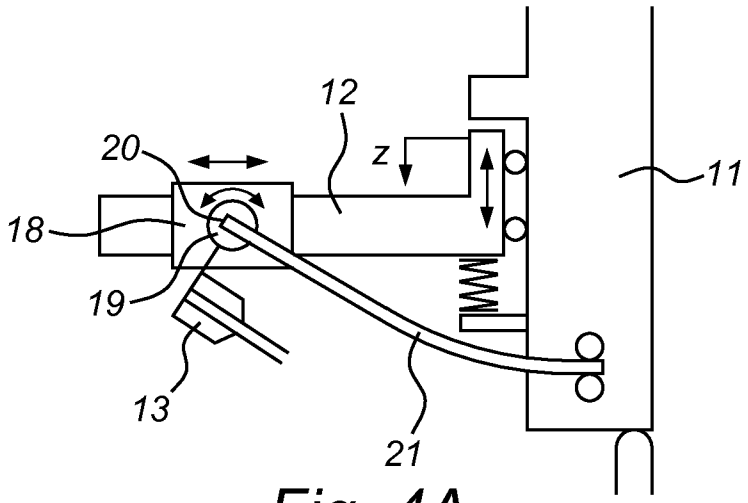

Fig. 4A

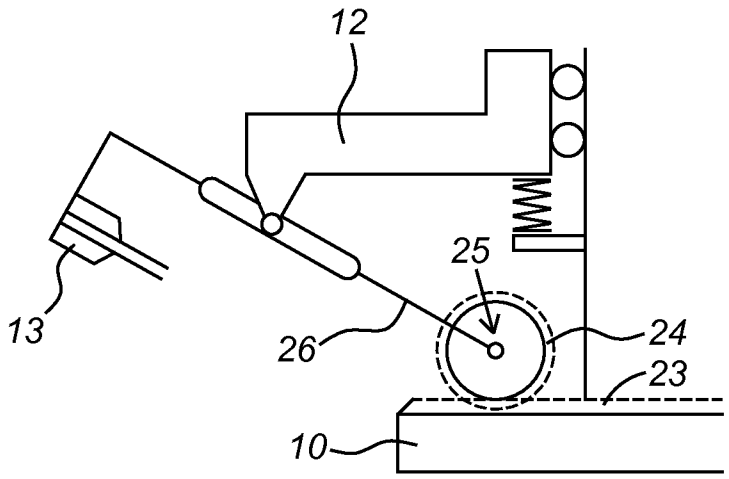

Fig. 4B

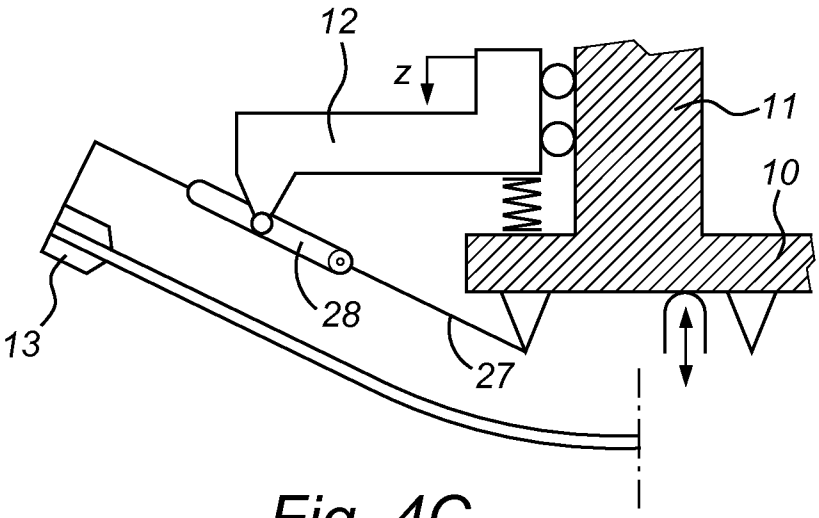

Fig. 4C

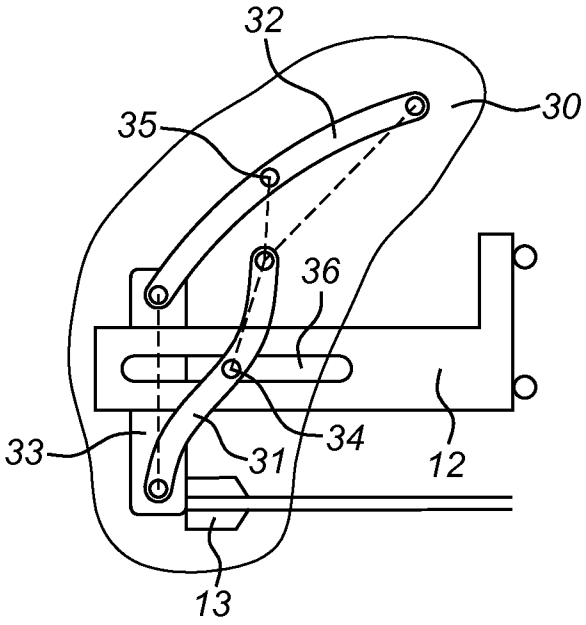

Fig. 4D

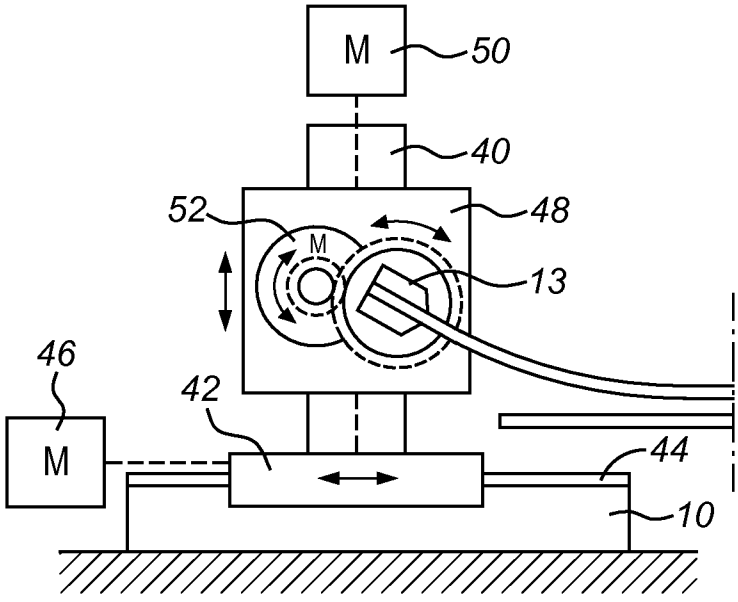

Fig. 4E

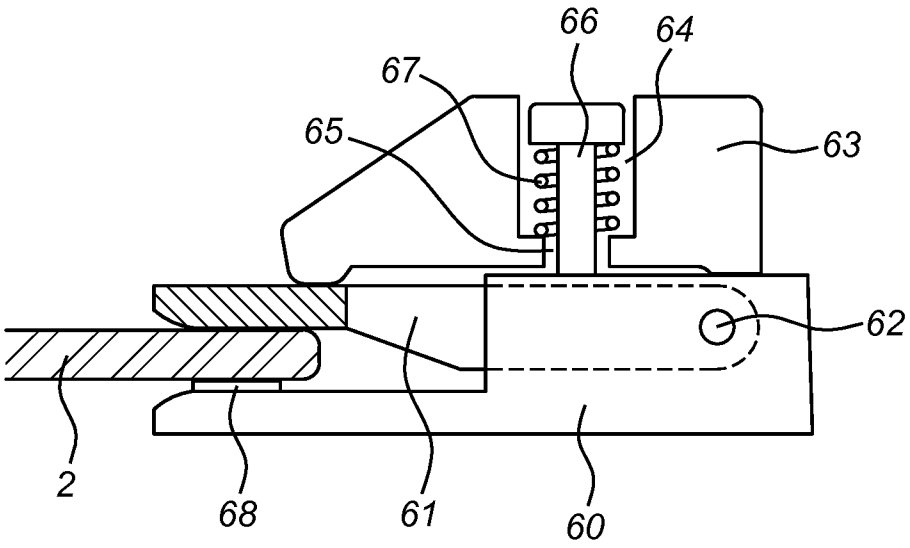

Fig. 5

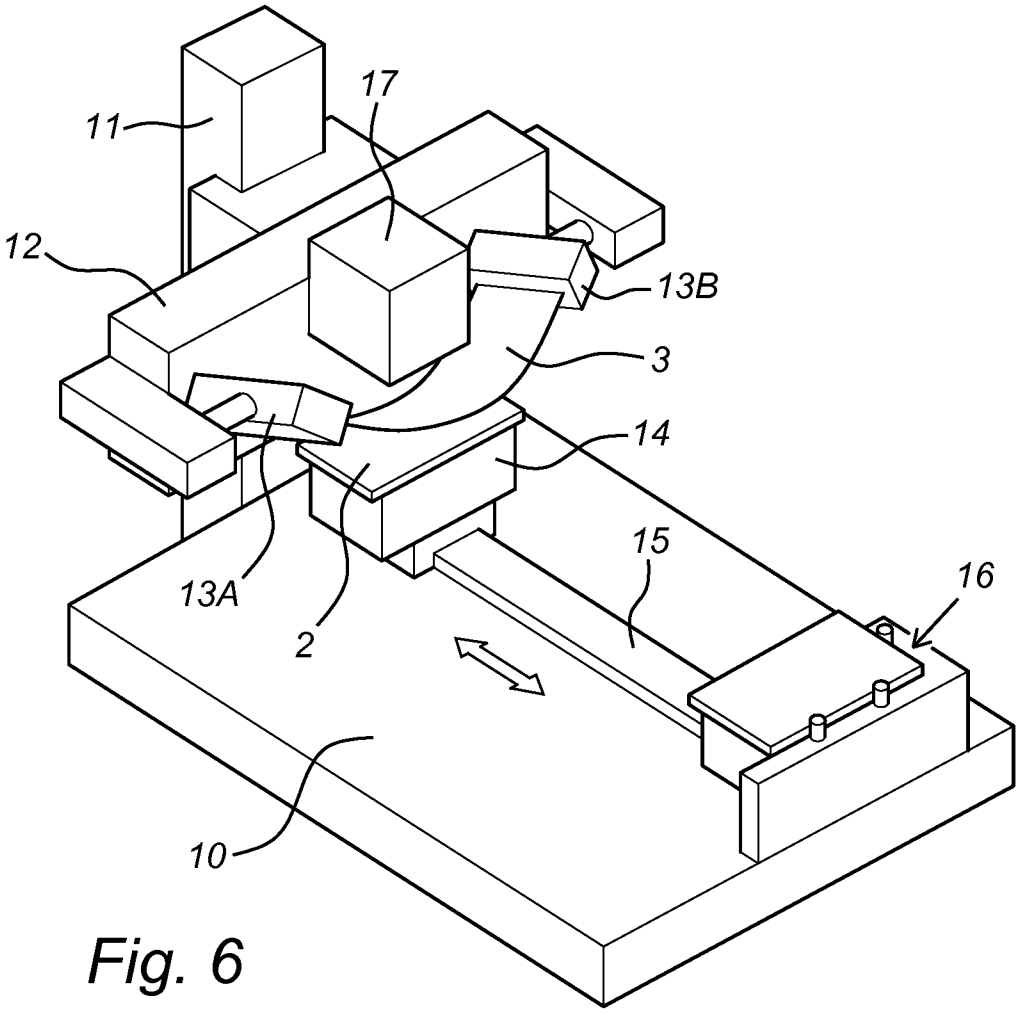

Fig. 6

Abstract

The invention relates to a method and an apparatus for applying a layer having a relief on a substrate, comprising the steps of securing the substrate, applying a layer of a curable liquid on the substrate, bringing a mould having a relief being the negative of the relief to be provided on the substrate, into contact with a part of the upper surface of the liquid layer, curing the liquid layer while the mould is in contact with the liquid and separating the mould from the substrate, wherein initially the mould is brought into contact with the liquid in a bent position while the substrate is kept flat and subsequently the mould is brought into contact over an increasing surface area keeping the mould in a bent position until the complete liquid layer is in contact with the mould. This method provides the gradual bringing into contact of the mould with the fluid layer on the substrate, avoiding any air inclusions.

SAMENWERKINGSVERDRAG (PCT)

RAPPORT BETREFFENDE NIEUWHEIDSONDERZOEK VAN INTERNATIONAAL TYPE

IDENTIFICATIE VAN DE NATIONALE AANVRAGE	KENMERK VAN DE AANVRAGER OF VAN DE GEMACHTIGDE
	1.244.014 NL
Nederlands aanvraag nr. **2016593**	Indieningsdatum **12-04-2016**
	Ingeroepen voorrangsdatum
Aanvrager (Naam) **IAI Industrial systems B.V.**	
Datum van het verzoek voor een onderzoek van internationaal type **11-06-2016**	Door de Instantie voor Internationaal Onderzoek aan het verzoek voor een onderzoek van internationaal type toegekend nr. **SN66582**

I. CLASSIFICATIE VAN HET ONDERWERP (bij toepassing van verschillende classificaties, alle classificatiesymbolen opgeven)

Volgens de internationale classificatie (IPC)

B29C59/02;G03F7/00

II. ONDERZOCHTE GEBIEDEN VAN DE TECHNIEK

Onderzochte minimumdocumentatie

Classificatiesysteem	Classificatiesymbolen
IPC	**B29C;G03F**

Onderzochte andere documentatie dan de minimum documentatie, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen

III.	☐	**GEEN ONDERZOEK MOGELIJK VOOR BEPAALDE CONCLUSIES**	(opmerkingen op aanvullingsblad)
IV.	☐	**GEBREK AAN EENHEID VAN UITVINDING**	(opmerkingen op aanvullingsblad)

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 2016593

A. CLASSIFICATIE VAN HET ONDERWERP
INV. B29C59/02 G03F7/00
ADD.

Volgens de Internationale Classificatie van octrooien (IPC) of zowel volgens de nationale classificatie als volgens de IPC.

B. ONDERZOCHTE GEBIEDEN VAN DE TECHNIEK

Onderzochte minimum documentatie (classificatie gevolgd door classificatiesymbolen)
B29C G03F

Onderzochte andere documentatie dan de minimum documentatie, voor dergelijke documenten, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen

Tijdens het onderzoek geraadpleegde elektronische gegevensbestanden (naam van de gegevensbestanden en, waar uitvoerbaar, gebruikte trefwoorden)
EPO-Internal, WPI Data

C. VAN BELANG GEACHTE DOCUMENTEN

Categorie *	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
X	US 8 163 222 B2 (DONE STEPHEN [GB] ET AL) 24 april 2012 (2012-04-24) * kolom 1, regel 6 - kolom 2, regel 31 * * kolom 2, regel 63 - kolom 3, regel 31 * * kolom 4, regel 1 - kolom 5, regel 22 * * figuren *	1-20
X	US 2010/303947 A1 (MORI KYOICHI [JP] ET AL) 2 december 2010 (2010-12-02) * alinea [0001] * * alinea [0008] - alinea [0009] * * alinea [0040] - alinea [0064] * * figuren *	1,2,4, 6-8

-/--

[X] Verdere documenten worden vermeld in het vervolg van vak C.

[X] Leden van dezelfde octrooifamilie zijn vermeld in een bijlage

* Speciale categorieën van aangehaalde documenten

"A" niet tot de categorie X of Y behorende literatuur die de stand van de techniek beschrijft

"D" in de octrooiaanvrage vermeld

"E" eerdere octrooi(aanvrage), gepubliceerd op of na de indieningsdatum, waarin dezelfde uitvinding wordt beschreven

"L" om andere redenen vermelde literatuur

"O" niet-schriftelijke stand van de techniek

"P" tussen de voorrangsdatum en de indieningsdatum gepubliceerde literatuur

"T" na de indieningsdatum of de voorrangsdatum gepubliceerde literatuur die niet bezwarend is voor de octrooiaanvrage, maar wordt vermeld ter verheldering van de theorie of het principe dat ten grondslag ligt aan de uitvinding

"X" de conclusie wordt als niet nieuw of niet inventief beschouwd ten opzichte van deze literatuur

"Y" de conclusie wordt als niet inventief beschouwd ten opzichte van de combinatie van deze literatuur met andere geciteerde literatuur van dezelfde categorie, waarbij de combinatie voor de vakman voor de hand liggend wordt geacht

"&" lid van dezelfde octrooifamilie of overeenkomstige octrooipublicatie

Datum waarop het onderzoek naar de stand van de techniek van internationaal type werd voltooid	Verzenddatum van het rapport van het onderzoek naar de stand van de techniek van internationaal type
4 januari 2017	

Naam en adres van de instantie	De bevoegde ambtenaar
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Fageot, Philippe

1

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 2016593

C.(Vervolg). VAN BELANG GEACHTE DOCUMENTEN

Categorie *	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
X	US 2010/255139 A1 (WASHIYA RYUTA [JP] ET AL) 7 oktober 2010 (2010-10-07) * alinea [0003] * * alinea [0010] - alinea [0011] * * alinea [0029] - alinea [0057] * * figuren 1A-2D * -----	1,2,5-9, 18
X	US 2015/021798 A1 (KIMURA SATOO [JP] ET AL) 22 januari 2015 (2015-01-22) * alinea [0002] - alinea [0003] * * alinea [0091] - alinea [0108] * * alinea [0114] * * alinea [0196] - alinea [0227] * * figuren 2A-2B,9-10D * -----	1,2,5,7, 8

1

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Informatie over leden van dezelfde octrooifamilie

Nummer van het verzoek om een onderzoek naar de stand van de techniek: NL 2016593

In het rapport genoemd octrooigeschrift	Datum van publicatie	Overeenkomend(e) geschrift(en)	Datum van publicatie
US 8163222 B2	24-04-2012	EP 2221163 A1	25-08-2010
		GB 2468120 A	01-09-2010
		US 2010213637 A1	26-08-2010
US 2010303947 A1	02-12-2010	JP 5232077 B2	10-07-2013
		JP 2010280065 A	16-12-2010
		US 2010303947 A1	02-12-2010
US 2010255139 A1	07-10-2010	JP 5411557 B2	12-02-2014
		JP 2010240928 A	28-10-2010
		US 2010255139 A1	07-10-2010
US 2015021798 A1	22-01-2015	CN 104245279 A	24-12-2014
		EP 2829383 A1	28-01-2015
		KR 20140136003 A	27-11-2014
		US 2015021798 A1	22-01-2015
		WO 2013140815 A1	26-09-2013

WRITTEN OPINION

File No.	Filing date *(day/month/year)*	Priority date *(day/month/year)*	Application No.
SN66582	12.04.2016		NL2016593

International Patent Classification (IPC)
INV. B29C59/02 G03F7/00

Applicant
IAI Industrial systems B.V.

This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☒ Box No. VII Certain defects in the application
- ☐ Box No. VIII Certain observations on the application

Examiner
Fageot, Philippe

Application number

WRITTEN OPINION

NL2016593

Box No. I Basis of this opinion

1. This opinion has been established on the basis of the latest set of claims filed before the start of the search.
2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the application and necessary to the claimed invention, this opinion has been established on the basis of:

   a. type of material:

   ☐ a sequence listing

   ☐ table(s) related to the sequence listing

   b. format of material:

   ☐ on paper

   ☐ in electronic form

   c. time of filing/furnishing:

   ☐ contained in the application as filed.

   ☐ filed together with the application in electronic form.

   ☐ furnished subsequently for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
4. Additional comments:

Box No. V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty	Yes:	Claims	3, 12, 14-17, 19, 20
	No:	Claims	1, 2, 4-11, 13, 18
Inventive step	Yes:	Claims	
	No:	Claims	1-20
Industrial applicability	Yes:	Claims	1-20
	No:	Claims	

2. Citations and explanations

see separate sheet

WRITTEN OPINION

Box No. VII Certain defects in the application

see separate sheet

Re Item V.

1 The following documents are referred to in this communication:

D1 US 8 163 222 B2 (DONE STEPHEN [GB] ET AL) 24 april 2012 (2012-04-24)

D2 US 2010/303947 A1 (MORI KYOICHI [JP] ET AL) 2 december 2010 (2010-12-02)

D3 US 2010/255139 A1 (WASHIYA RYUTA [JP] ET AL) 7 oktober 2010 (2010-10-07)

D4 US 2015/021798 A1 (KIMURA SATOO [JP] ET AL) 22 januari 2015 (2015-01-22)

2 Independent claim **1**

2.1 Document D1, which is considered to represent the most relevant state of the art, discloses (the references in parenthesis applying to this document) :

Werkwijze voor het aanbrengen van een van een reliëf voorziene laag op een vlak van een substraat *(col. 1, lines 6-9)*, omvattende de volgende stappen:
- het met het vlak waarop het reliëf moet worden gevormd naar boven fixeren van het substraat *(col. 4, lines 16-37, fig. 2)*;
- het aanbrengen van een laag uithardbare vloeistof op het bovenvlak van het substraat *(col. 4, lines 16-37, fig. 2)*;
- het in contact brengen van een van een contra-reliëf voorziene mal met ten minste een deel van het bovenvlak van laag vloeistof *(col. 4, lines 38-50, fig. 3)*;
- het doen uitharden van de laag vloeistof *(col. 5, lines 8-22, fig. 5)*; en
- het van het substraat scheiden van de mal *(fig. 4)*,
- de mal aanvankelijk in gebogen positie in contact wordt gebracht met het bovenvlak van de laag vloeistof terwijl het substraat vlak wordt gehouden *(col. 2, line 63 - col. 3, line 31, col. 4, lines 16 - 50, fig. 1 and 2)*; en
- vervolgens de mal in contact wordt gebracht met het bovenvlak van de laag vloeistof over een toenemend oppervlak, waarbij de mal gebogen blijft tot de gehele laag vloeistof door de mal wordt bedekt en tenminste het deel van de mal dat in contact is met de laag vloeistof, vlak is en het substraat vlak wordt gehouden *(col. 4, lines 38 - 50, fig. 3)*.

The subject-matter of claim **1** is therefor not new.

2.2 Documents D2, D3 and D4 disclose also the combination of features of claim **1**. For more details see the Search Report.

3 Independent claim **7**

3.1 Document D1 also discloses (the references in parenthesis applying to this document) :

Inrichting voor het aanbrengen van een van een reliëf voorziene laag op een plat vlak van een substraat *(col. 1, lines 6-9)*, omvattende:
- een frame *(figures)*;
- aan het frame bevestigde fixatiemiddelen voor het fixeren van het substraat met het vlak waarop het reliëf moet worden aangebracht naar boven *(col. 4, lines 16-37, fig. 2)*;
- een van een contra-reliëf voorziene mal *(col. 2, line 63 - col. 3, line 31, fig. 1)*; en
- een stralingsbron, die is ingericht voor het uitzenden van straling die een op het substraat aangebrachte laag vloeistof doet uithardt tot de van een reliëf voorziene laag *(col. 5, lines 8-22, fig. 5)*,

de mal is flexibel en de inrichting is voorzien van een met het frame verbonden manipulator die is ingericht voor het aanvankelijk in contact brengen van de mal met het bovenvlak van de laag vloeistof en voor het vervolgens in contact brengen van de mal met de laag vloeistof over een naburig bovenvlak van de laag vloeistof waarbij de mal gebogen wordt gehouden *(col. 2, line 63 - col. 3, line 31, col. 4, lines 16 - 50, fig. 1 and 2)*, tot de gehele laag vloeistof door de mal is bedekt en tenminste het deel van de mal dat in contact is met de laag vloeistof, vlak is.

3.2 Documents D2, D3 and D4 disclose also the combination of features of claim **7**. For more details see the Search Report.

4 Dependent claims **2** - **6** and **8** - **20**

4.1 The subject-matter of dependent claims **2**, **4** - **6**, **8** - **11**, **13**, **18** is disclosed by the cited prior art documents and is therefore not novel.

4.2 The features of dependent claims **3**, **12**, **14** - **17**, **19** and **20** are merely some of several straightforward possibilities from which the skilled person would select, in accordance with circumstances, without the exercise of inventive skill, in order to apply a layer having a relief on a flat face. Consequently the subject-matter of claims **3**, **12**, **14** - **17**, **19** and **20** does not appear to be inventive.

Re Item VII.

5 The dependency of dependent claim **11** (according to claim 10 or **11**) should be amended.

6 The features of the claims should be provided with reference signs placed in parentheses to increase the intelligibility of the claims. This applies to both the preamble and characterising portion.

7 The relevant background art disclosed in document D1 should be mentioned and identified in the description.