



(43) International Publication Date
27 September 2012 (27.09.2012)

(51) International Patent Classification:

G02B 26/02 (2006.01) **B05D 1/00** (2006.01)
B05C 11/02 (2006.01) **G03F 7/16** (2006.01)

(21) International Application Number:

PCT/EP2012/054710

(22) International Filing Date:

16 March 2012 (16.03.2012)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

1104713.1 21 March 2011 (21.03.2011) GB

(71) Applicant (for all designated States except US): **SAM-**

SUNG LCD NETHERLANDS R & D CENTER B.V.
[NL/NL]; Building TAM, Zwaanstraat 1, NL-5651 CA
Eindhoven (NL).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **GREGORY, John**

[GB/GB]; 21 Glebe Close, Manea March, Cambridgeshire
PE15 0LR (GB). **HARCO, Jansen** [NL/NL]; Bree 12, NL-
5501 JD Veldhoven (NL). **SCHRAM, Ivar** [NL/NL];
Peelbeemd 5, NL-6005 LH Weert (NL).

(74) Agents: **BLASEBY, Matthew** et al.; EIP, Fairfax House,

15 Fulwood Place, London, Greater London WC1V 6HU
(GB).

(81) Designated States (unless otherwise indicated, for every

kind of national protection available): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ,
CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO,
DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN,
HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR,
KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME,
MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ,
OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD,
SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR,
TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every

kind of regional protection available): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ,
UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU,
TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE,
DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU,
LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK,
SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ,
GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: DISPENSING METHOD AND DEVICE FOR DISPENSING

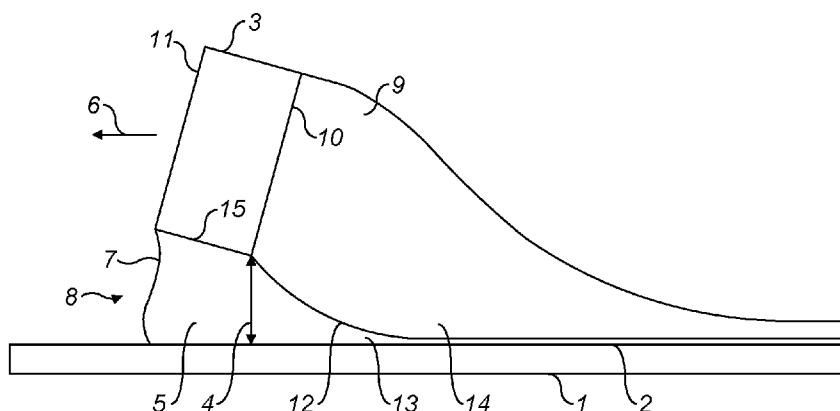


FIG. 1

(57) **Abstract:** This invention relates to a method of providing a layer of a first liquid on a first area of a surface using an elongate applicator, an elongate gap being formed between the applicator and the surface, the gap being filled with an elongate globule of the first liquid, and an amount of a second liquid being arranged in contact with the applicator and with the globule, the first liquid and the second liquid being immiscible and the first area having a higher wettability for the first liquid than for the second liquid, the method including the step of applying a relative motion between the applicator and the surface, said amount of second liquid being arranged only on a trailing side of the applicator.

Dispensing method and device for dispensing

Field of the Invention

5 The present invention relates to a method for providing a layer of a first liquid on a first area of a surface by means of a dispenser. The invention also relates to an apparatus for carrying out the method.

Background of the Invention

10 A method of providing a layer of a first fluid on an area of a surface of a support plate for use in an electrowetting display is known from international application WO 2010/133690. In the method a slanting support plate is immersed in a second fluid, immiscible with the first fluid. The second fluid forms a gutter near the surface of the support plate, the gutter being filled with first fluid. The gutter is moved along the surface by increasing the level of the
15 second fluid with respect to the surface. The surface is initially covered by air, is subsequently covered by the first fluid and finally submersed in the second fluid. When the second fluid covers the entire support plate, the first fluid forms a thin layer on the area of the surface, between the support plate and the second fluid.

20 A disadvantage of this known method is that it consumes a substantial amount of second liquid and that all surfaces of the support plate are covered by the second fluid, whereas coverage of only one surface is necessary. The other surfaces have to be cleaned after application of the method. It is an object of the invention to overcome this disadvantage.

25 Summary of the Invention

In accordance with one aspect of the present invention, there is provided a method of providing a layer of a first liquid on a first area of a surface using an elongate applicator, an elongate gap being formed between the applicator and the surface, the gap being filled with an elongate globule of the first liquid, and
30 an amount of a second liquid being arranged in contact with the applicator and with the globule, the first liquid and the second liquid being immiscible and the

first area having a higher wettability for the first liquid than for the second liquid,

the method including the step of applying a relative motion between the applicator and the surface, said amount of second liquid being arranged only on a trailing side of the applicator.

The support plate of which a surface has to be provided with a layer of the first liquid need not be submersed in a bath filled with the second liquid as in the prior art. Instead, application of a relatively small amount of second liquid between the applicator and the surface suffices. Other surfaces of the support plate can be kept free from the second liquid, thereby reducing the requirements of cleaning these surfaces after application of the method. The method also obviates the need for large volumes of the second liquid.

The applicator may move with respect to the surface; the surface may also be moved with respect to the applicator. The applicator distributes the first liquid over the surface and thereby acts as a spreader. Since the amount of second liquid is only at the trailing side of the applicator, the surface in front of the applicator is not covered with the second liquid. The surface in front of the applicator is preferably adjoined by a gas, such as air. When the globule passes over the surface, a layer of first liquid is deposited on the first area and a layer of second liquid is deposited on the layer of first liquid. The second liquid will not displace the first liquid from the first surface because of the higher wettability of the first surface for the first liquid.

The method for depositing according to the invention is easier to scale up to larger support plate sizes than the prior art method.

When the second liquid is polar or electroconductive, the surface provided with the first and second liquid and forming part of a support plate is particularly suitable for use in a switchable optical elements, such as an electrowetting display device.

In a special embodiment, the method includes the step of filling the gap by depositing an amount of the first liquid in the gap. Capillary forces cause the first liquid to spread along the length of the gap and keeps the first liquid in the

gap during the motion of the applicator. The height of the gap is preferably smaller than 600 micrometer and more preferably smaller than 100 micrometer.

The first liquid may be deposited in the gap during movement of the applicator. The second liquid may be deposited as amount of the second liquid
5 on the surface along a side of the applicator. The second liquid is provided preferably after the provision of the first liquid to facilitate the deposition of the first liquid in the gap.

The normal of the surface may be arranged at a non-zero angle with the vertical. The angle can be used to tune the deposition process. When the surface
10 is substantially horizontal, i.e. the angle is substantially zero, the production process is simplified.

In a special embodiment a second area neighbouring the first area has a higher wettability for the second liquid than for the first liquid. Due to the difference in wettability, the first liquid will preferentially adhere to the first
15 areas and not to the second areas. Hence, during scanning of the applicator, the second liquid will adhere to the second areas and drive any first liquid off these areas. As a result, the first areas will be covered by a layer of the first liquid, the thickness depending, amongst others, on the shape of the globule and the speed of scanning, and the second areas will be covered by the second liquid.

20 When the size of the first area is small, the deposited first liquid may assume a shape approaching a semi-sphere. Such curved depositions are also covered by the term 'a layer of the first liquid'.

The surface may comprises a plurality of first areas separated by second areas and forming a pattern. The pattern or a sub-pattern may have a decorative
25 function or act as a signage.

The gap has preferably at least the same length as a dimension of the pattern parallel to a long axis of the applicator. When the gap has at least the same length as a dimension of the pattern parallel to a long axis of the applicator, a uniform deposition of the first liquid on the surface will be
30 achieved. If the first liquid is deposited on a pattern in two or more scans and part of the globule passes over a first area twice, the thickness of the layer

deposited on the first area will be different from first areas over which the globule has passed only once. Therefore, the thickness will be more uniform when the pattern is filled in one sweep of a larger applicator than in several sweeps of a smaller applicator.

5 In a preferred embodiment the relative motion between the applicator and the surface is in a direction substantially perpendicular to a long axis of the applicator. When the applicator and the surface move with respect to each other in a direction preferably substantially perpendicular to a long axis of the applicator, a maximum area is covered by a single sweep of the applicator.

10 A borderline between a first area and a second area and a direction of a long axis of the applicator may form an angle of zero degrees to simplify the apparatus for carrying out the method.

 In a special embodiment of the method the angle may be different from zero degrees. The direction of the long axis determines in part the direction of the trailing edge between the first and second liquid and the surface, i.e. the edge
15 where the first liquid is displaced from the surface by the second liquid. When this trailing edge forms a line contact with a borderline between first and second areas, not all first liquid in the second areas may be skimmed from the second area. When the borderline forms a non-zero angle with the trailing edge, there is
20 no line contact anymore but only a point contact, which hardly shows any pinning. As a result, about all first liquid is skimmed off the second areas. An angle of 5° or more between the borderline and the long axis causes a noticeable improvement. Very good skimming results are obtained for angles of 20° and more.

25 A rectangular pattern of first areas should therefore preferably be arranged with its borderlines at a non-zero angle with the long axis.

 A further scan of the surface by the applicator may be carried out. The uniformity of the thickness of the layer may be improved when the applicator is scanned two or more times over the surface is moved under the applicator two
30 or more times. During the first scan the first liquid is deposited on the surface; during the following scan or scans the first liquid is redistributed over the

surface, by supplementing first liquid where too little was deposited in the first scan and by removing first liquid where too much was deposited.

The surface may be part of a first support plate and the method includes the step of providing a second support plate defining a space between the first support plate and the second support plate, the space comprising the first liquid
5 and the second liquid.

The first support plate and the second support plate may form an electrowetting element. The surface provided with the first and second liquid layer can be converted to a closed system when the surface is part of a first support plate and a second support plate is provided defining a space between
10 the first support plate and the second support plate comprising the first liquid and the second liquid.

A further aspect of the invention relates to an apparatus including an applicator for providing a layer of a first liquid on a first area of a surface using
15 a method according to the invention.

The applicator is preferably elongate. The apparatus preferably includes a movement stage for moving the applicator and the surface with respect to each other. The apparatus preferably includes a controller for controlling a height of the applicator above the surface. The apparatus can be very similar to prior art
20 slit coating equipment, which facilitates the development of equipment that is suitable for mass production. The apparatus may have two applicators for performing a first scan and a subsequent second scan of the same surface; the gap of the two applicators may be the same; alternatively the gap of the applicator for the first scan may be larger or smaller than the gap of the
25 applicator for the second scan.

Further features and advantages of the invention will become apparent from the following description of preferred embodiments of the invention, given by way of example only, which is made with reference to the accompanying drawings.

Brief Description of the Drawings

Figure 1 shows an apparatus for depositing a layer of first liquid;

Figure 2 shows an applicator having dispensing channels;

5 Figure 3 shows a pattern of a surface partly covered by first liquid;

Figure 4(a), (b) and (c) show a first, second and third orientation for scanning the surface;

Figure 5 shows a cross-section of an electrowetting element; and

Figure 6 shows an apparatus for carrying out the method.

10

Detailed Description of the Invention

Figure 1 shows in cross-section an embodiment of an apparatus for depositing a layer of first liquid on a surface using a method according to the invention. A plate 1, also shown in cross-section, has a surface 2 on which a
15 layer of a first liquid is to be deposited. An applicator 3 in the form of bar or slide is suspended above the surface 2. The applicator and the surface form a gap 4, represented in the drawing by an arrow showing the minimum distance between the applicator and the surface. The applicator has a long axis perpendicular to the plane of the drawing; the gap is elongate in the direction of
20 the long axis. The gap is filled with an elongate globule 5 of a first liquid.

In operation the slide 3 is moved over the surface 2 in a direction 6. The globule 5 has a leading interface 7 with a gas 8 in front of the applicator 3. The interface 7 extends from the surface 2 to the applicator 3. An amount 9 of a second liquid, having an elongate shape, is arranged only at a trailing side 10 of
25 the applicator 3 and is in contact with the applicator. The trailing side 10 of the applicator is a side that faces away from the direction of motion 6. A side 11 of the applicator that faces the direction 6 is a leading side. The globule 5 has a trailing interface 12 between the first liquid and the second liquid. The first and second liquids are immiscible.

30 When the applicator 3 moves over the surface 2, the moving globule 5 of first liquid 5 wets the still dry surface 2 of the plate 1 with a layer 13 of first

liquid that decreases in thickness with distance from the applicator. After a certain distance, the thickness of the layer 13 becomes independent of the distance. Similarly, the amount 9 of second liquid forms a layer 14 of second liquid on the layer 13 of first liquid. In other words, the moving applicator 3
5 drags along a globule 5 of first liquid and an amount 9 of second liquid, both of which leave behind a layer 13, 14 on the surface 2.

The thickness of the layer 13 of first liquid that remains on the area of the surface after passage of the applicator depends, among others, on the size of the gap 4, its shape, the speed of movement of the applicator, the shape of the
10 interface 12, viscosities of the liquids, the amount of first and second liquid applied to the applicator, interfacial tensions of the two interfaces, and the chemical contrast, i.e. the difference in hydrophobicity between the various combinations of the two liquids and the surface and the applicator.

The first liquid may be an alkane, such as hexadecane, or an oil, such as
15 a hydro-carbon oil. The embodiment of Figure 1 uses a silicone oil. The second liquid may be any liquid that is non-miscible with the first liquid. The second liquid may be polar or electroconductive, which is useful in some applications of the plate 1 covered with the first and second liquid. The embodiment shown uses water as second liquid. Alternatively the second liquid may comprise a
20 combination of water and at least one non-aqueous component, or the second liquid may comprise a first non-aqueous component and a second non-aqueous component. An example of the first component is ethylene carbonate and an example of the second component is erythritol. The gas 8 can be any gas, such as air, nitrogen or argon. The embodiment uses air. Other immiscible liquids that
25 can be used are fluorocarbon and liquid metals such as mercury.

The area of the surface 2 shown in Figure 1 has a higher wettability for the first liquid than for the second liquid, which prevents the second liquid from displacing the first liquid from the area. In the embodiment shown, the plate 1
30 can be covered by a hydrophobic layer, e.g. an amorphous fluoropolymer such as AF1600. The hydrophobic layer increases the tendency of the first liquid to join with the surface and repel the second liquid.

The shape of the interface 7 depends, among others, on the wettability of the surface 2 and the surface of the applicator 3 for the first liquid and the gas 8, and the dimensions of the gap 4. The shape of the interface 12 depends, among others, on the wettability of the surface of the applicator 3 for the first and second liquid, the shape of the applicator near the position where the interface 12 touches the applicator, and the dimensions of the gap. In the embodiment shown in Figure 1, the shape can be changed by changing the tilt angle of the applicator.

The size of the gap between the applicator 3 and the surface 2 in the embodiment of Figure 1 is 50 micrometer. During the motion of the applicator the size can be kept constant by controlling the position of the applicator and/or the surface 2, as is known for example from the air floating solutions for FPD (i.e. flat panel display) slit coating of the company CoreFlow or the doctor blade gap control of the coating equipment of the company Keko Equipment.

The size of the globule 5 is also determined by the amount of first liquid deposited in the gap 4. The first liquid can be deposited in the gap using for example a syringe or a pump mechanism for dispensing the desired amount of first liquid in the gap from the trailing side of the applicator. The first liquid will disperse evenly within the gap because of capillary forces. The second liquid can be deposited at the trailing side 10 also by a syringe or a pump mechanism. A pump mechanism has the advantage that the amount of first and second liquid in contact with the applicator can be controlled; for example, they can be kept substantially constant during operation of the applicator. The second liquid is preferably applied after the first liquid has been deposited in the gap.

The first and second liquid may be deposited using a first tube outside the applicator and extending close to the gap 4 from the leading side 11 and a second tube extending close to the trailing side 10. Alternatively, the first and second liquid may be deposited using a first channel 20 in the applicator and a second channel 21 as shown in Figure 2. The channels may be slits. A combination of tubes and channels is also feasible. A plurality of tubes and/or channels may be arranged along the length of the applicator 3.

Whereas the applicator 3 moves over a stationary surface 2 in the embodiment of Figure 1, the applicator may also be stationary and the plate moves under the applicator. A combined movement of both applicator and plate is possible such that the applicator scans the surface of the plate.

5 The trailing side 10 of the applicator 3 is preferably hydrophilic to improve dragging the amount 9 of second liquid over the surface 2. A surface 15 of the applicator 3, facing the surface, can be made hydrophobic to improve the containment of the first liquid in the gap.

10 Although the cross-section of the applicator in the embodiment of Figure 1 is a rectangle, it may also be round and have the shape of a rod. In the latter case, the position where the interface 12 touches the applicator may be fixed by making the trailing side of the rod hydrophilic and the side facing the gap hydrophobic. A rod-shaped applicator can be rotated to provide an extra process parameter for control, for instance for lifting the first liquid from the surface at areas that do not need to be coated.

15 Figure 3 shows a top view of a surface having a pattern. The pattern 30 comprises first areas 31, in this embodiment squares, having a higher wettability for the first liquid than for the second liquid. The squares may be made of a layer of AF1600. A neighbouring second area 32 has a higher wettability for the second liquid than for the first liquid. The second area 32 may be made of a layer of a variety of materials, including a photoresist, such as SU8. The second area may be formed by arranging a separate layer having the form of the second area on an uninterrupted layer that forms the first areas. When the first area is hydrophobic, the separate layer should be hydrophilic. The separate layer may be formed by e.g. a printing method or evaporation. The second areas may also be formed by walls having a height, which mechanically restrain the first liquid to the first area. The size of the first areas may be 170 micrometer by 170 micrometer and the width of the second areas 10 micrometer. When the second areas are not flat but have the form of walls, the height may for example be 5 micrometer.

20

25

30

When a plate has a patterned surface as shown in Figure 3, the deposition method provides a patterned layer of first liquid. The hatched area in the Figure is covered by the first liquid deposited by an applicator moving from right to left in the Figure. Line 33 is the intersection of the leading interface 7
5 with the surface 2. The surface to the left of the line 33 is covered with air. The wavy character of the line is caused by the different wettability of the areas 31 and 32 for air and first liquid. The surface under the gap of the applicator, indicated by a brace 34, is covered by the first liquid.

At the trailing side of the applicator the thickness of the layer 13 of first
10 liquid decreases, as shown in Figure 1. When the thickness has become sufficiently small, the second liquid will displace the first liquid from the second areas 32 because of the greater affinity of these areas for the second liquid than for the first liquid. The first liquid on the first areas 31 will not be displaced by the second liquid, because these areas have a greater affinity for the first liquid
15 than for the second liquid. As a result the method deposits a layer of first liquid only on the first areas 31.

Since the thickness of the layer of first liquid behind the applicator is relatively small, i.e. smaller than the height of the gap, it is relatively easy for the second liquid to remove the layer of first liquid from the second areas 32.
20 When the gap has a height of 50 micrometer, the layer of first liquid to be removed is thinner than 50 micrometer. This should be compared with a layer of more than 1 millimetre thickness of first liquid in the prior art method disclosed in WO 2010/133690, which has to be skimmed from second areas. As a consequence, the applicator according to the invention can scan the surface
25 substantially faster than the prior art gutter can scan the surface. A typical scan speed is 30 mm/s for the former and 3 mm/s for the latter.

In the embodiment of the method shown in Figure 3, the trailing edge 35
between parts still covered by first liquid and parts covered by second liquid in the second areas 32 runs parallel to borderline 36 between first areas and second
30 areas. In this situation it is more difficult for first liquid in a second area 37 to move away under the force of the second liquid and be replaced by it, because

the first liquid has to move in a direction parallel to the trailing edge. In the differently oriented second area 38 the first liquid can easily move off the second area in the direction of movement of the trailing edge. This effect may cause remnants of first liquid to remain on the second area 37.

5 Figure 4(a) shows a first orientation of the applicator 60 with respect to a surface having a pattern 61 of first and second areas arranged on a plate 62. The direction of scanning is indicated by arrow 63. The first orientation is the same as the orientation shown in Figure 3. Figure 4(b) shows a second orientation, in which the plate 62 together with the pattern 61 is rotated over an angle of
10 approximately 8 degrees compared to the orientation in Figure 4(a). The long axis 65 of the applicator 60 is now at the same angle of 8 degrees with the borderline 54. The trailing edge 35 in the second areas of the pattern will no longer run parallel to the borderline 36. As a result, the first liquid on the second area 37 can now easily flow away from the second areas. As a result, the first
15 liquid is skimmed better off the second areas than in the case of Figure 4(a). An improvement of uniformity is observed for angles larger than 5 degrees and for angles larger than 22.5 degrees the uniformity does not improve further noticeably. Note that the direction of scanning 63 in Figure 4(b) may also be changed to 63', where the direction of scanning is parallel to the orientation of
20 the pattern but is at an angle with the direction of the long axis 65. This direction of scanning is simpler to realize in a production apparatus.

 Figure 4(c) shows an alternative configuration, wherein the plate 64 has one of its edges parallel to the applicator 60 and the pattern 65 has borderlines at an angle unequal to zero with the leading interface of the dispenser. The trailing
25 edge for a straight, elongate applicator is straight and has a direction equal to that of the long axis of the applicator. When the applicator is curved in a plane parallel to the surface, the trailing edge will also be curved. To avoid the above stick-slip motion, the local direction of the trailing edge should form a non-zero angle with the direction of the borderlines.

30 Figure 5 shows a cross-section of a series of electrowetting elements made using the deposition method according to the invention. A first substrate

70 is provided with electrodes 71, deposited as a thin-film conductor on the substrate. Each electrode is connected to a signal line 72 for providing a voltage. The electrodes are covered by a thin hydrophobic layer 73 of the amorphous fluoropolymer AF1600. The first substrate with the layers applied to it form a
5 first support plate. A pattern of a thin hydrophilic layer 74 of SU8 divides the surface of the support plate in hydrophobic first areas 75 between the hydrophilic second areas 74. The size of the first areas is 160 micrometers square, the second areas have a width of 10 micrometers and a height of 3 to 6 micrometer.

10 The first substrate 70, provided with the layers 71, 73 and 74, is subjected, similar to plate 1, to the deposition method according to the invention using oil as first liquid and water as second liquid or any other combination of liquids, for example as given above. After carrying out the method the first areas 75 are uniformly covered by an oil layer 76 having a thickness of between 3 and
15 6 micrometer, for example 5 micrometer. The second areas 74 and the oil layer are covered by water 77. The water may contain salt to increase its electrical conductivity and to enlarge the temperature window for the method. The second liquid, water in this example, used during the method is preferably the same liquid used in the product that includes the support plate, which avoids changing
20 the second liquid after the execution of the method by another liquid.

A second support plate 78 forms a closed space between the first and second support plate. The space is protected from the environment by seals, not shown in the Figure, attached to both support plates. The pattern of the layer 74 defines elements on the support plate to which the oil layer 76 is confined. Each
25 element has an electrode 71. Another electrode 79, connected to a signal line 80, is in contact with the water 77, forming a common 15 electrode for a plurality of elements. When a voltage is applied between the common electrode 79 and the electrode 71 of an element, the oil layer 76 in that element moves to the side of an element or breaks up and the first surface will at least partly be covered by
30 the water 77. This so-called electrowetting effect is more fully described in international patent application W003/071346. When the oil and / or the water

has specific optical properties for absorption, reflection and / or transmission of light, the element can operate as a light valve. The electrowetting elements may be used in a display apparatus, in which a plurality of electrowetting elements forms a display device. A display driving system in the apparatus provides the
5 voltages for setting the elements in the desired state.

Figure 6 shows an apparatus for depositing a layer of liquid on a surface of a plate according to the invention. The plate can be arranged on a stage 84. An applicator 85 forming a gap 86 with the surface is mounted on a translation stage, not shown in the Figure, that enables the applicator to scan over the stage
10 84. Alternatively, the applicator is fixed and the surface is mounted on a translation stage. A first container 87 for the first liquid is connected to a first control unit 88, e.g. a valve or a pump, that controls the amount of first liquid to be delivered to the applicator 85 via a connection 89. A second container 90 for the second liquid is similarly connected to a second control unit 91 for
15 delivering the second liquid to the applicator via a connection 92. A controller 93 provides signals for setting the first and second controller to the desired settings. The apparatus may include a measurement device for determining the thickness of the deposited layer. The thickness value may be used as input for setting the control units. The apparatus may also include a device for measuring
20 the shape and / or the size of the globule of first liquid or the volume of second liquid between the applicator and the surface, e.g. using a camera observing the applicator in the direction of its long axis, and use this input for setting the control units. The height of the dispenser above the surface may be kept at a desired value, for example by measuring the height at the two far ends of the
25 elongate dispenser and maintaining these at equal values. The controller may also use manual input from an operator of the apparatus instead of measured values.

The above embodiments are to be understood as illustrative examples of the invention. Further embodiments of the invention are envisaged. It is to be
30 understood that any feature described in relation to any one embodiment may be used alone, or in combination with other features described, and may also be

used in combination with one or more features of any other of the embodiments, or any combination of any other of the embodiments. Furthermore, equivalents and modifications not described above may also be employed without departing from the scope of the invention, which is defined in the accompanying claims.

Claims

1. A method of providing a layer of a first liquid on a first area of a surface using an elongate applicator,
5 an elongate gap being formed between the applicator and the surface, the gap being filled with an elongate globule of the first liquid, and
an amount of a second liquid being arranged in contact with the applicator and with the globule, the first liquid and the second liquid being immiscible and the first area having a higher wettability for the first liquid than
10 for the second liquid,
the method including the step of applying a relative motion between the applicator and the surface, said amount of second liquid being arranged only on a trailing side of the applicator.
- 15 2. A method according to claim 1, including the step of filling the gap by depositing an amount of the first liquid in the gap.
3. A method according to claim 2, wherein the first liquid is deposited in the gap during movement of the applicator.
20
4. A method according to claim 1, 2 or 3, including the step of providing the second liquid by depositing an amount of the second liquid on the surface along a side of the applicator.
- 25 5. A method according to any one of claims 1 to 4, wherein the surface is substantially horizontal.
6. A method according to any one of claims 1 to 5, wherein the surface has a second area neighbouring the first area having a higher wettability
30 for the second liquid than for the first liquid.

7. A method according to claim 6, wherein the surface comprises a plurality of first areas separated by second areas and forming a pattern.

8. A method according to claim 7, wherein the gap has at least the same length as a dimension of the pattern parallel to a long axis of the applicator.

9. A method according to any one of claims 1 to 8, wherein the relative motion between the applicator and the surface is in a direction substantially perpendicular to a long axis of the applicator.

10. A method according to claim 7, 8 or 9, wherein a borderline between a first area and a second area and a direction of a long axis of the applicator form an angle different from zero.

11. A method according to any one of claims 1 to 10, including the step of applying a further scan of the surface by the applicator.

12. A method according to any one of claims 1 to 11, wherein the surface is part of a first support plate and the method includes the step of providing a second support plate defining a space between the first support plate and the second support plate, the space comprising the first liquid and the second liquid.

13. A method according to claim 12, wherein the first support plate and the second support plate form an electrowetting element.

14. An apparatus including an applicator for providing a layer of a first liquid on a first area of a surface using a method according to any one of the claims 1 to 13.

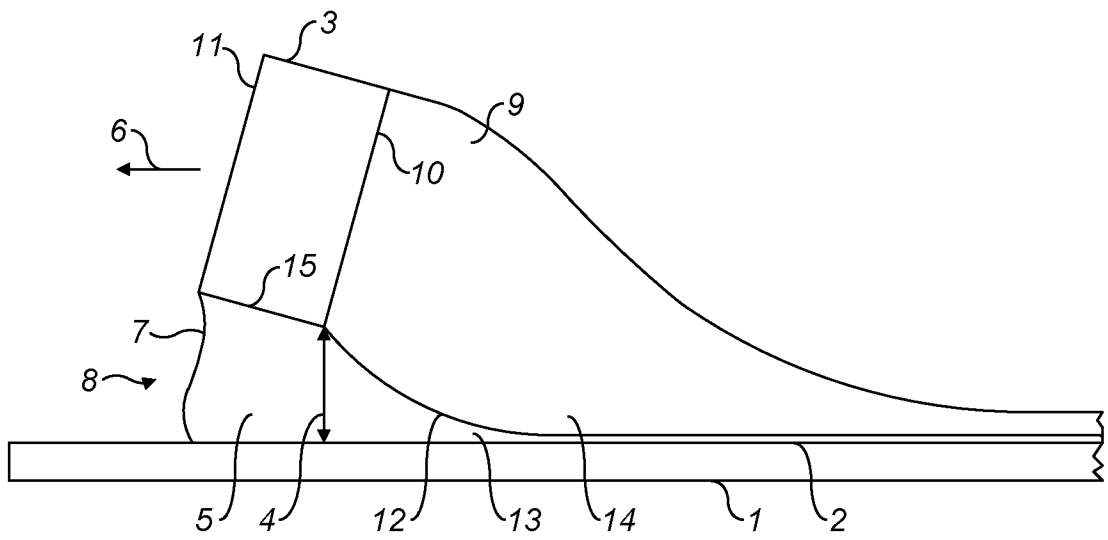


FIG. 1

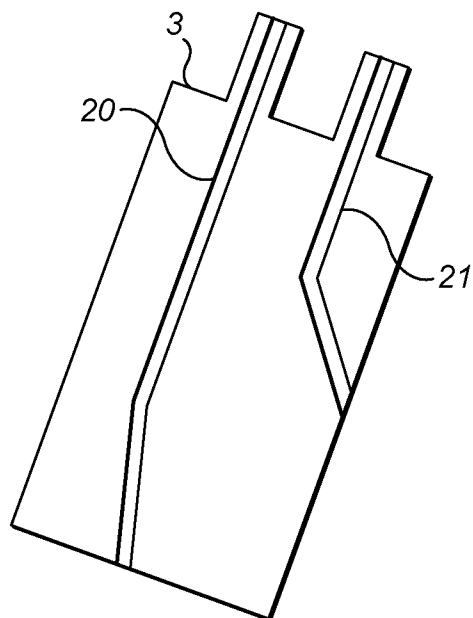


FIG. 2

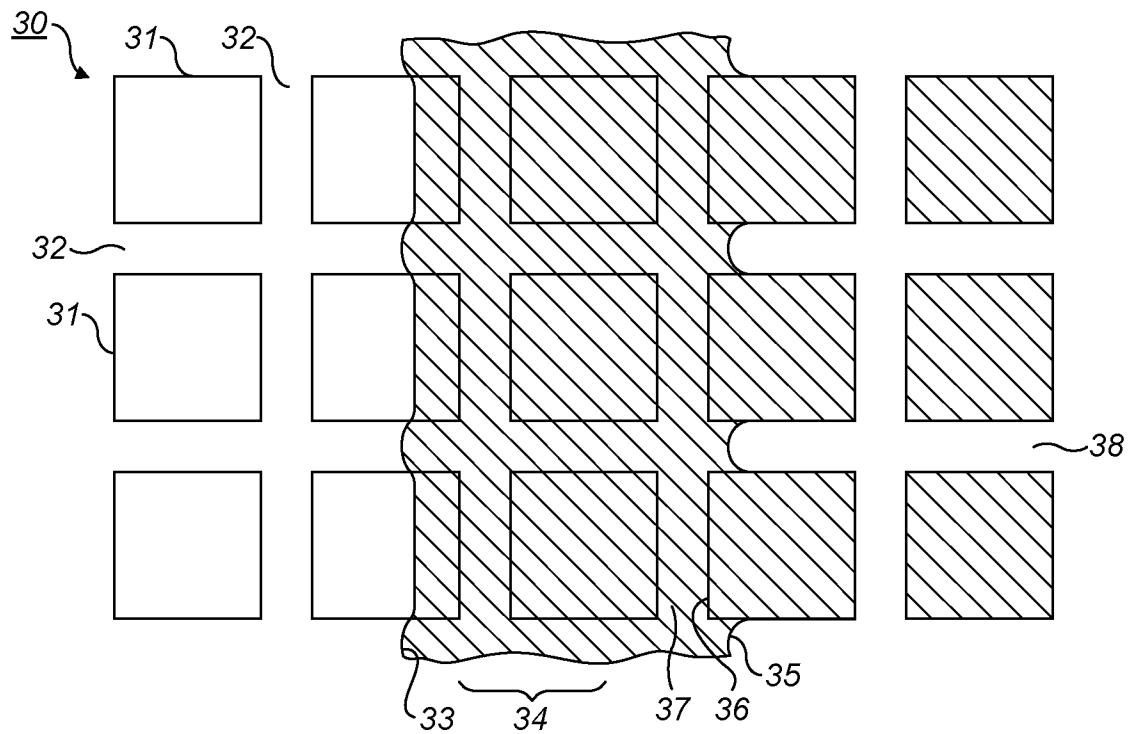


FIG. 3

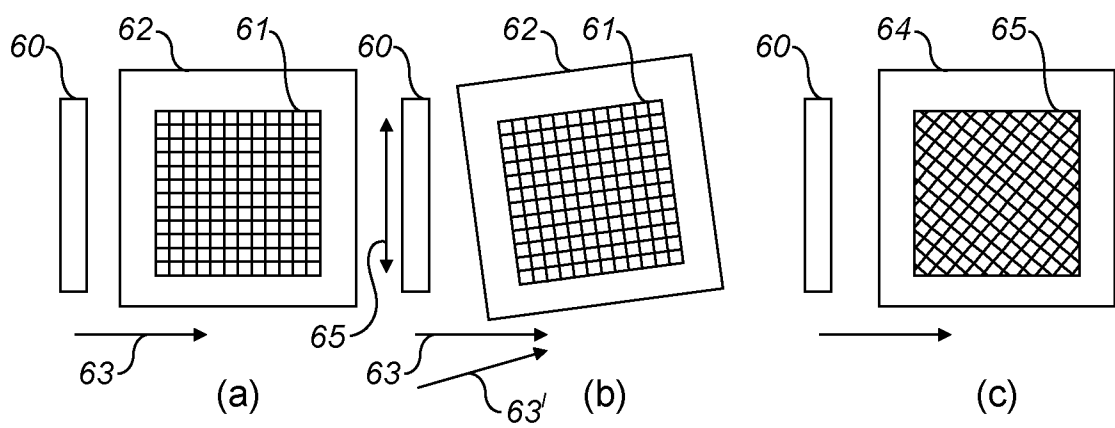


FIG. 4

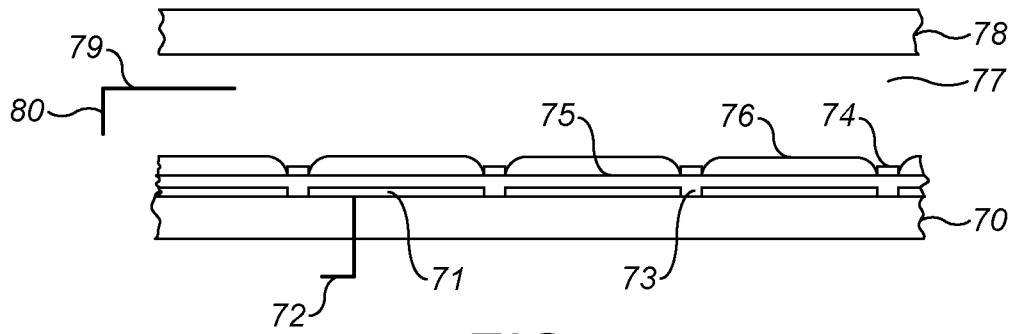


FIG. 5

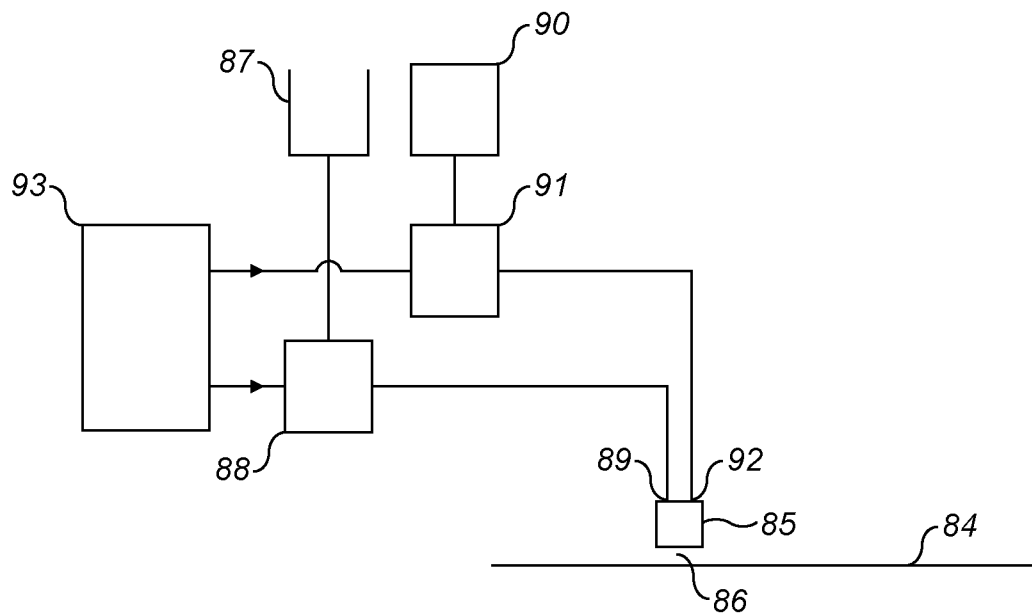


FIG. 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2012/054710

A. CLASSIFICATION OF SUBJECT MATTER INV. G02B26/02 B05C11/02 B05D1/00 G03F7/16 ADD.		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) G02B B05C B05D G03F		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 938 994 A (CHOINSKI EDWARD J [US]) 3 July 1990 (1990-07-03) figure 8	1-14
A	----- WO 2005/098797 A2 (KONINKL PHILIPS ELECTRONICS NV [NL]; HAYES ROBERT A [NL]; FEENSTRA BOK) 20 October 2005 (2005-10-20) figure 6 -----	1-14
<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="display: flex; align-items: center;"> <input type="checkbox"/> Further documents are listed in the continuation of Box C. </div> <div style="display: flex; align-items: center;"> <input checked="" type="checkbox"/> See patent family annex. </div> </div>		
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>* Special categories of cited documents :</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&" document member of the same patent family</p> </div> </div>		
Date of the actual completion of the international search <div style="text-align: center; font-size: 1.2em;">31 May 2012</div>	Date of mailing of the international search report <div style="text-align: center; font-size: 1.2em;">14/06/2012</div>	
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer <div style="text-align: center; font-size: 1.2em;">Quertemont, Eric</div>	

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2012/054710

Patent document cited in search report		Publication date		Patent family member(s)		Publication date
US 4938994	A	03-07-1990	EP	0464238 A1		08-01-1992
			US	4938994 A		03-07-1990

WO 2005098797	A2	20-10-2005	CN	101023460 A		22-08-2007
			EP	1738345 A2		03-01-2007
			JP	4849640 B2		11-01-2012
			JP	2007532942 A		15-11-2007
			KR	20070029701 A		14-03-2007
			US	2008014823 A1		17-01-2008
			WO	2005098797 A2		20-10-2005
