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DEVICE FOR LACQUERING OR COATING PLATES OR PANELS**DESCRIPTION**

The subject of the invention is a device for lacquering or coating a substrate by means of a capillary gap which is filled with a liquid coating medium and over the upper end of which the downwardly facing surface of the substrate which is to be lacquered or coated is conveyed during the coating operation, so that a thin layer is deposited on this surface by capillary and adhesive action, wherein a transport device for the substrate to be lacquered is provided above the capillary gap to convey the substrate over and past the upper end of the capillary gap.

A device of this type is known from US-A-2 046 596. That document shows a device for the coating of a continuous cellulose film strip with liquid nitrocellulose. The device in question has a liquid cellulose reservoir, and a side wall of that reservoir forms a capillary gap with a panel which runs parallel to the said wall and is secured in the reservoir structure in such way that the liquid rises up through the gap from the reservoir. At the top of the side wall, and at the point where the capillary gap ends, the side wall has a straight border; the film strip is pressed against the said border by an endless conveyer belt and drawn obliquely upwards over the capillary gap, in such a way that the film strip lies on the border at an angle, and a nitrocellulose film forms on the film strip by the forces of adhesion. Such a device is not however suitable for complex plate or panel coating operations, since the plates or panels may be damaged by being pressed against a border of the capillary gap, by scratches for example.

One objective of the invention is to provide a device which is suitable for lacquering and coating operations carried out on plates or panels.

According to the invention this objective is attained with a device as referred to above, by the fact that the transport device takes the form of a linear transport device with a holding device for a substrate requiring lacquering, in the form of a plate or a panel, to enable the said plate or panel to be conveyed during the lacquering or coating operation over the capillary gap and its borders in close proximity thereto, without contact between them.

Appropriate enhancements of their invention are the subject of the dependant claims.

The invention is particularly suitable for thin-film technology, particularly for the manufacture of LCD screens, masks for semiconductor manufacture, and semiconductor or ceramic substrates, for the provision in this context of rectangular or round plates with a uniform coating of lacquer or other initially liquid media such as light filters or special protective coatings. The plate or panel is conveyed over the upper end of the capillary gap and its borders in close proximity thereto, with the



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surface to be lacquered facing downwards. The capillary gap automatically supplies the lacquer, at a particularly consistent speed. As a result of the capillary effect, the lacquer or other coating liquid automatically rises up through the capillary gap against the force of gravity at a constant speed and emerges at the upper end of the gap. Above the capillary gap the flow of lacquer meets the plate surface to be lacquered in the form of a narrow line; the surface requiring lacquering is conveyed by the linear transport device at a uniform, low speed, and the flow of lacquer is secured thereto by adhesion, is deposited thereon in a layer of a given thickness, according to the speed at which the plate is moving, and coats the service. Furthermore, because of the adhesion of the lacquer to the plate surface, there is no risk of the lacquer flowing off to the side on exit from the capillary gap, which could otherwise have a negative effect on the uniformity of the layer thickness.

The interval between the capillary gap and the substrate during the coating operation is preferably less than 0.2 mm.

The capillary gap is advantageously formed according to claim 3, and is advantageously less than 0.5 mm wide.

A very advantageous enhancement of the invention is characterised by the provision of an adjusting device for the variation of the width of the capillary gap over a continuous range which enables the capillary gap width to be modified during the operation of the device. In this way it is possible to form a capillary gap which will have the most suitable width in terms of the capillary effect over its entire length. This means that the capillary geometry can be adjusted according to the various types of plate requiring coating.

The device is preferably enhanced in such a way that means are provided to open the capillary gap, preferably to a width of 2 to 3 mm, after each lacquering operation. This prevents the lacquer from automatically rising up in the capillary gap, which is not desirable at any time other than during a lacquering operation. It has been found that lacquer remaining for a protracted period in the capillary gap loses its characteristic properties, which has a negative effect on the lacquering outcome. If the capillary gap is widened to 2 to 3 mm, the lacquer remaining in the gap is not affected.

A further advantageous enhancement of the invention is characterised in that means are provided to narrow the capillary gap immediately prior to the start of each lacquering or coating operation to capillary width, a small amount of the liquid coating medium is squeezed out of the top of the capillary gap, and the lacquering or coating operation is started in this way. As a result of this mechanical narrowing of the capillary gap, the lacquer present in the capillary gap is initially mechanically forced upwards until it emerges from the upper end of the capillary gap and meets the plate surface requiring

coating which is placed at that location. This starts the lacquering operation, which then continues in the manner described above on the basis of the capillary effect in what is now a capillary gap, as a result of the movement of the plate and the adhesion effect.

Embodiments of the invention are shown in the drawing, and are described in detail below.

The Figures are as follows:

Fig. 1 shows a view of the construction of a lacquering and coating device according to the invention, and

Fig. 2 shows a cross-section through a channel with capillary gap according to Fig. 1 at the start of a coating operation.

Fig. 1 shows a first embodiment of a coating device 10 according to the invention. A channel 12 and posts 13 and 14 for a linear transport unit 15 are attached to a frame 11. The moveable part of the linear transport unit 15 points downwards. To that moveable part is secured a rotatable holding device 16 for a plate requiring lacquering 17. The plate 17 is for example a glass plate which is to be coated with lacquer for the subsequent manufacture of a mask or an LCD screen. The plate 17 is secured, by vacuum for example, against the plate holding device 16. For this purpose the holding device 16 has appropriate vacuum holes, not shown here.

According to the invention it is however also possible to use other holding devices familiar to persons skilled in the art.

The channel 12 is shown in cross-section in Fig. 1, and in an enlarged view in Fig. 2. The cavity 18 in the channel 12 is partially filled with lacquer. Two thin plates 19 and 20 dip from above into this lacquer. The plate 19 is firmly attached at a point 33 to the upper border of the channel 12. It is not movable. In contrast, the plate 20 is attached by means of an appropriate device to an adjusting device in the form of a linear movement unit 22. Via the linear movement unit 22 the plate 20 can be moved back and forth in the direction of the arrow. This makes it possible for the width of the gap 24 between plates 19 and 20 to be adjusted over a continuous range.

For ideal lacquering or coating results the coating liquid in question must be at a certain temperature and must be very clean. To this end it is conveyed from a storage tank 28 via a temperature adjustment unit 29 and a filter 30 into the channel 12. This conveyance operation may be carried out, for example, by creating an excess pressure (gas cushion) in the storage tank 28, or by means of an appropriate arrangement of the

storage tank 28, so that the liquid will be conveyed by geodetic height difference into the channel 12. However, other liquid conveyance options are also possible, as familiar to the person skilled in the art.

For a fully automated version of the coating device an automatic loading device is placed at the point numbered 31, with an automatic unloading device placed at the point numbered 32. The loading device 31 takes a plate 17 to be lacquered from a magazine placed at a particular point and conveys it to the plate holding device 16. The unloading device 32 takes the plate 17 from the holding device 16 and loads it back into a magazine placed at a particular point.

Operation of the lacquering and coating device 10

A plate 17 is first either automatically or manually secured to the holding device 16. This position can be further adjusted by rotation of the holding device 16. The plate holding device 16 is now in the vicinity of the point numbered 31 in Fig. 1. If the plate 17 is secured in the correct position on the holding device 16, the linear transport unit 15 starts to move in the direction of the arrow numbered 26, that is to say in the direction of the channel 12.

The plate 17 is in this way conveyed from the side towards the upper edge of the capillary gap 24. As soon as the front edge 25 of the plate 17 is directly above the gap 24, the plate 20 is moved a sufficient distance in the channel 12 towards the plate 19 as to create the appropriate capillary gap between them. This narrowing of the gap 24 causes a small quantity of liquid to be pressed up out of the upper side of the gap 24 against the forwardmost line of the surface of the plate 17 requiring coating. This is the start of the coating operation. The plate 17 is now moved further by the linear movement unit 15 at a uniform speed in the direction of the arrow 26, whereupon a thin film of liquid is deposited by adhesion on the plate surface. The required flow of liquid is supplied by capillary effect in the capillary gap 24.

The coating operation is complete as soon as the rear edge 27 of the plate 17 has passed the capillary gap 24. The plates 19 and 20 are then moved to a distance of 2-3 mm from each other until such time as the next coating operation starts, for the reasons given above. The coated plate 17 moves on to the area numbered 24, where it is automatically or manually released from the holding device 16.

Claims

1. Device for lacquering or coating a substrate (17) by means of a capillary gap (24), which is filled with a liquid coating medium and over the upper end of which the substrate (17) is, during the coating, guided past by its downwardly facing surface to be lacquered or coated, so that a thin layer is deposited on this surface by capillary and adhesive action, wherein a transport device (15) for the substrate (17) to be lacquered is provided above the capillary gap (24) in order to move this substrate past over the upper end of the capillary gap (24),

characterised in that the transport device is constructed as a linear transport device (15) with a holding device (16) for a substrate (17), which is formed as a plate or disc and is to be lacquered, in order during the lacquering or coating to guide this past without contact with the edges of the capillary gap (24) at a small spacing above this and the edges thereof.

2. Device according to claim 1, characterised in that the spacing between the capillary gap (24) and substrate (17) during the coating amounts to less than 0.2 millimetres.

3. Device according to claim 1 or 2, characterised in that the capillary gap (24) has two parallel plates (19, 20) which both dip into a channel (12) containing liquid coating medium.

4. Device according to claim 2 or 3, characterised in that the capillary gap (24) is smaller than 0.5 millimetres wide.

5. Device according to one or more of the preceding claims, characterised in that an adjusting device (22) for stepless variation in the width of the capillary gap (24) is provided and enables an adjustment of the capillary gap width during operation of the device.

6. Device according to claim 5, characterised in that means are provided in order to open the capillary gap (24) after each lacquering process.

7. Device according to claim 6, characterised in that the adjusting device (22) is constructed for opening the capillary gap (24) to a width of 2 to 3 millimetres.

8. Device according to claim 6 or 7, characterised in that means are provided in order to narrow the capillary gap directly before the beginning of each lacquering or coating process to capillary gap width, to force out a small quantity of the liquid coating medium from the capillary gap (24) at the top and thereby to bring the lacquering or coating of the plate of disc (17) into action.

9. Device according to one or more of the preceding claims, characterised in that it is provided with an automatic charging station (31) and an automatic discharging station (32).

10. Device according to one or more of the preceding claims, characterised in that it is operable with a stationary holding device (16) and a movable coating channel (12).

11. Use of a device according to one or more of the preceding claims in the production of LCD display screens, masks for semiconductor manufacture, or of semiconductor or ceramic substrates.