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Klapper

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[54] **METHOD FOR PRODUCING SUPER SMOOTH PHOTO PLATES**

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[52] **U.S. Cl.** **156/249,** 96/83, 156/267, 156/344

[51] **Int. Cl.**... **B32b 31/20,** B32b 31/18, B32b 31/12

[58] **Field of Search** 156/247, 249, 236, 235, 156/267, 344; 96/83; 161/406; 117/3.5, 3.6

[56] **References Cited**

UNITED STATES PATENTS

466,534	1/1892	Charlton	117/3.5 X
759,301	5/1904	McKeel	156/236 X
802,022	10/1905	Schill	156/249
1,989,017	1/1935	Neumann	96/83 X
2,182,814	12/1939	Marasco	96/83
2,386,602	10/1945	Gloseffi	96/83 X
2,489,987	11/1949	Barnola	156/235 X
2,604,398	7/1952	Soper	96/83
2,670,312	2/1954	Capstaff	156/235
3,334,003	8/1967	Edwards	156/249 X
3,607,346	9/1971	Darlow et al.	96/83 X

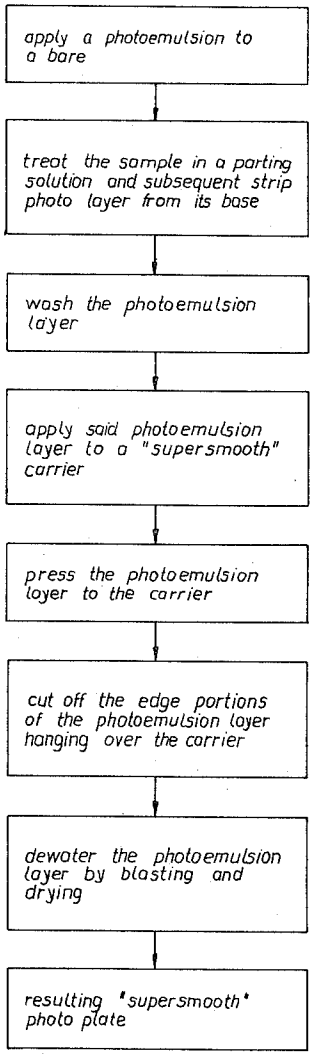
Primary Examiner—Charles E. Van Horn
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[57] **ABSTRACT**

A supersmooth photo-plate is produced by utilization of a prefabricated photographic film, from which the photo-emulsion layer is severed by submitting said photographic film to a "severing" solution.

The severed photo-emulsion layer is applied to a very smooth carrier. The resulting photo-plate possesses an even overall thickness and can assume stable values from 1 to 10 μ.

3 Claims, 6 Drawing Figures



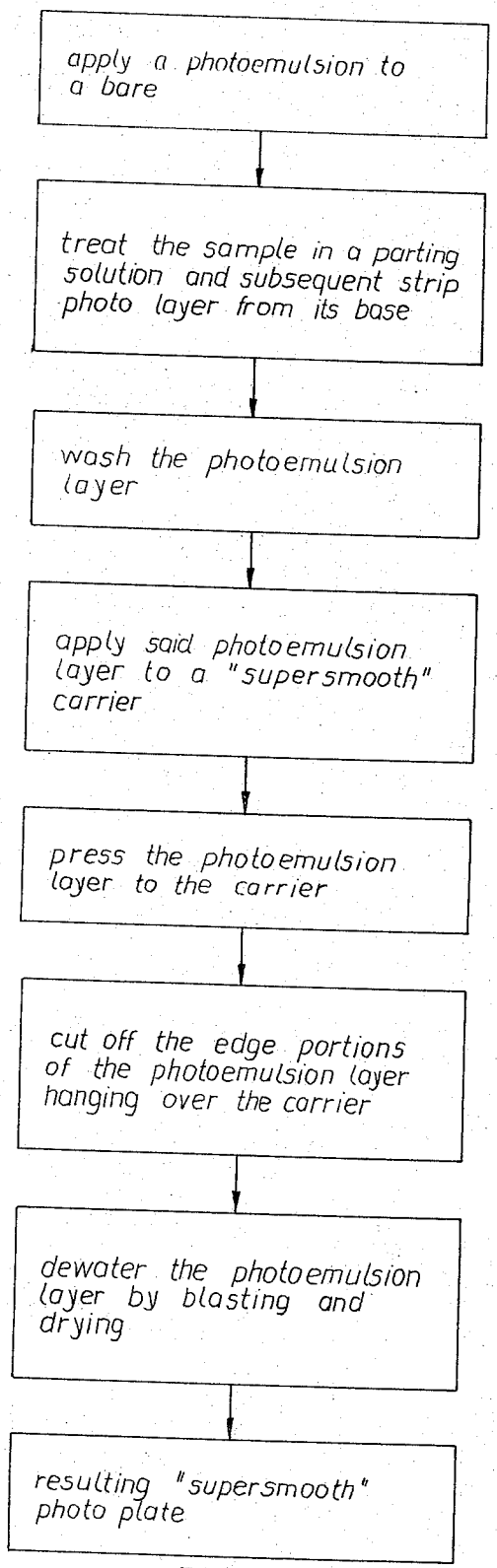


Fig. 1

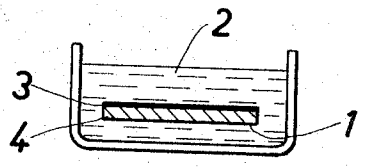


Fig. 2

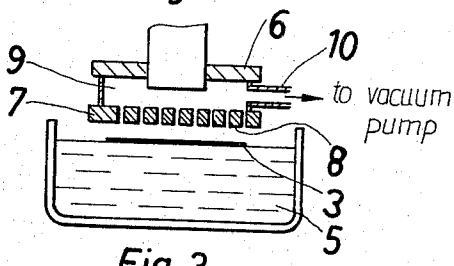


Fig. 3

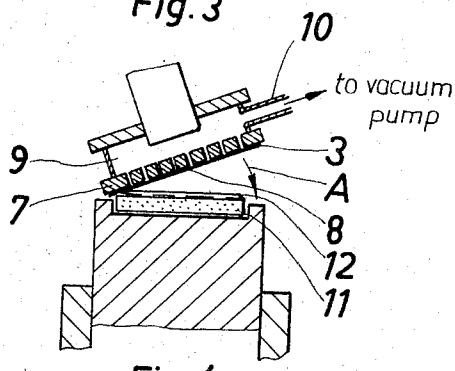


Fig. 4

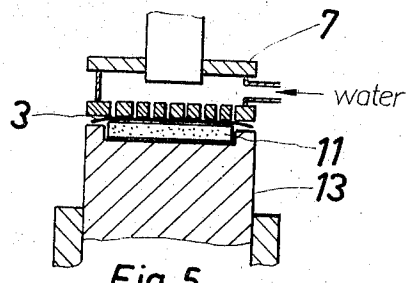


Fig. 5

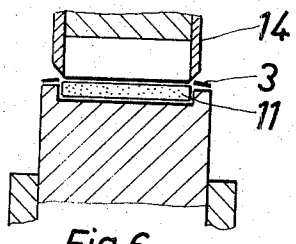


Fig. 6

METHOD FOR PRODUCING SUPER SMOOTH PHOTO PLATES

This invention concerns a method for producing supersmooth photo-plates, the photo-emulsion layer thereon having an equal overall thickness, which can have stable values from 1 to 10 microns. Such photo-plates are particularly suited for recording microstructures, in micro-electronics, for example photo-masks. They may also be applied for recording holograms and optical grids. With the heretofore methods photo-plates are produced by coating a carrier, preferably glass, with a photo-emulsion. After drying the emulsion layer, the carrier is cut to the desired sizes. Owing to the cutting action undesired tensions are provoked within the glass, leading to considerable warpage, which in turn causes picture distortions in a later record. Furthermore, it has not yet been accomplished to evenly coat a pre-fabricated carrier material with a liquid photo-emulsion. Accordingly the surface of the liquid emulsion, due to the inherent surface tensions, declines towards the edge portions, resulting in a slope or bulged region of about 5 to 10 mm width, in the dried state. Therefore it is difficult to define a recording area, which is suited for and required by the micro-precise recording techniques for producing, for example, photo-masks.

It is an object of the present invention to obviate the above disadvantages.

It is a further object to provide a method for producing a supersmooth photo-plate, by the application of which method a preselected size carrier is coated with a photo-emulsion layer of equal thickness on its entire surface. Accordingly, the present invention is in concern of a method for producing a supersmooth photo-plate comprising the steps of severing the photo-emulsion layer from a carrier after submitting a prefabricated photographic film to an aqueous hydro-fluoric acid bath containing 0.1 to 0.4 per cent hydrofluoric acid, washing the stripped off photo-emulsion layer in distilled water in order to remove impurities and residual hydro-fluoric acid, subsequent applying said photo-emulsion layer on a clean and very smooth carrier, and cutting off the portions of the photo-emulsion layer projecting over the carrier, removing the residual water from said photo-emulsion layer by means of a pressure-gas stream and finally drying the resulting very smooth photo-plate at a temperature of about 30°C. Preferably, the prefabricated photographic film is immersed into said 0.1 to 0.4 percent aqueous hydro-fluoric acid bath for about 20 seconds, in order to expedite the action of severing said photo-emulsion layer from said carrier. Furthermore, the inventional method provides means for removing said photo-emulsion layer from the distilled water bath and for applying said photo-emulsion layer to and pressing it on said very smooth carrier.

In order that the invention may be more readily understood, reference is made to the accompanying drawings which illustrate diagrammatically and by way of example the method and embodiments thereof, and in which

FIG. 1 is a chart illustrating the most important steps of the inventional method.

FIG. 2 shows schematically a "severing" bath,

FIG. 3 and FIG. 4 exemplify the operation of coating a carrier with the photo-emulsion layer.

FIG. 5 represents the process of pressing the photo-emulsion layer onto the carrier and

FIG. 6 shows a device for cutting off those portions of the photo-emulsion layer which project over the carrier.

FIG. 1 shows the operation sequence of the method, in which as a first step a carrier is coated with a liquid photo-emulsion layer. After congealing and drying, the layer is cut into desired sizes, thus forming the individual photo-plates. Subsequent thereto, as shown in FIG. 2, the individual photo-plates **1** are immersed into a bath **2** for severing a photo-emulsion layer **3** from a carrier **4**. The bath which effects the disconnection is composed of aqueous solution containing 0.1 to 0.4 percent hydro-fluoric acid. By immersing the photo-plates into the bath, the adhesive forces between the photo-emulsion layer and the carrier are decomposed or destroyed. As a consequence thereof the photo-emulsion layer "peels" off. The solution does substantially not affect the photographic properties of the emulsion layer, such as speed, grain size, fog formation and sensitization. When the photo-emulsion layer **3** has been severed, the continuous film is washed (FIG. 3) by submitting it to at least one bath of distilled water **5**, in order to remove any residual hydrous fluoric acid solution, which might adhere to the film or has entered into it. Therefore it is necessary to take up said film, which action is not easily accomplished, since said film is moved even by the least water undulations. Preferably, shovel-shaped plastic siphons are used. In order to avoid wrinkle formation in the course of the washing, the film is advantageously placed on the water surface, as shown in FIG. 3, in which the surface tension of the water bath is exploited for straightening out the film. However, it is necessary to remove any water drops from the film surface before bringing it down to the water surface, since said water drops by unification with the water of the bath would cause sagging of the photo-emulsion layer, particularly of its edge portions. Said sagging would favour wrinkle formation of the film while taking it up. In order to maintain the surface tension of and to keep away impurities from the photo-plates, the inventional method has entirely to be carried out under clean-room-conditions. After washing, the photo-emulsion layer **3** is removed from the bath by means of a transporter **6**, which comprises a fine-mesh screen lifter **7**, the orifices **8** therein having a diameter of about 0.5 mm, and a chamber **9**, being rear-sidedly mounted on said lifter **7**. Said chamber is connected by means of a duct **10** to a vacuum pump and to a water pump, respectively. Said transporter **6** is adjacently positioned over said photo-emulsion layer **3**. By evacuating said chamber **9** the emulsion-layer is drawn up to and firmly held by the very smooth surface of the lifter **7**. Subsequently, said transporter **6** and said emulsion-layer adhering thereto are brought to contact inclinedly one edge of a carrier **11** (FIG. 4) so that a water layer **12** thereon wets said photo-emulsion layer thus preventing air inclusions when the photo-emulsion layer is mounted on the carrier **11**, which action is accomplished by tilting said transporter **6** in the direction indicated by an arrow A. In order to avoid wrinkle formation in the photo-emulsion layer, the subpressure in chamber **9** is maintained during the tilting action. As a next step the transporter **6** softly presses said photo-emulsion layer to the carrier **11** (FIG. 5), secured to a mount **13**, thereby the water enclosed between the car-

rier and the emulsion layer is expelled. Only now a stabilization of the emulsion layer is obtained and via said duct **10** the chamber **9** is filled with pressure water, which by way of said orifices in said lifter **7** acts upon the emulsion layer and overcomes the adhesive forces between the lifter surface and said photo-emulsion layer, and, in addition thereto, the latter is pressed to the carrier **11**, which is to be coated. A high degree of smoothness is required from the surface of said lifter **7** on which the layer comes to rest, in order to evenly press said photo-emulsion layer **3** onto said carrier **11**, and to avoid a destruction of the photo-emulsion layer which otherwise might occur owing to an undue high local pressure. In a next operation, the transporter **6** is removed and the portions of the photo-emulsion layer which project over the carrier **11** are cut off by means of a punch knife **14** (FIG. **6**). Residual water, adhering to the photo-emulsion layer of the obtained photo-plate is blasted off by pressure gas. Finally, said photo-plate is dried at about 30°C.

I claim:

1. A method for producing a super-smooth photo-plate comprising the steps of

severing the photo-emulsion layer from a carrier after submitting a prefabricated photographic film to an aqueous hydro-fluoric acid bath containing 0.1 to 0.4 volume percent hydro-fluoric acid,

washing the stripped off photo-emulsion layer in distilled water in order to remove impurities and residual hydro-fluoric acid,

subsequent applying said photo-emulsion layer on a clean and very smooth carrier,

said photo-emulsion layer projecting over the edge of said clean and very smooth carrier,

and

cutting off the portions of the photo-emulsion layer projecting over the carrier edge,

removing the residual water from said photo-emulsion layer by means of a pressure-gas stream and finally

drying the resulting very smooth photo-plate at a temperature of about 30°C.

2. A method for producing a super-smooth photo-plate as claimed in claim **1**, wherein the prefabricated photographic film is immersed into said 0.1 to 0.4 volume percent aqueous hydrofluoric acid bath for about 20 seconds, in order to expedite the action of severing said photo-emulsion layer from said carrier.

3. A method for producing super-smooth photo-plates as claimed in claim **1**, wherein said photo-emulsion layer is removed from the distilled water bath and is applied under pressure to said very smooth carrier.

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