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METHOD FOR PLACING FILM MASK IN CONTACT WITH
AN OBJECT AND APPARATUS THEREFOR

5 The present invention relates to a method for placing
film mask in contact with an object and an apparatus
therefor, for use in producing printed circuit boards.

A photolithographic method has been utilized in a
10 production of integrated circuits. Recently, the
photolithographic method has been utilized in the
production of the printed circuit boards to form a
circuit pattern on a board.

15 The photolithographic method utilizes an original plate
on which the pattern, to be formed on the printed
circuit board, is drawn, and light is directed through
the original plate onto a printed circuit board to form
thereon the same pattern as on the plate thereon. Glass
20 plates are used as the original plate in manufacturing
integrated circuits because high accuracy is required.
Film masks are usually utilized, however, in producing

printed circuit boards because rather lower accuracy is allowable in this field.

5 When a film mask is employed as an original plate, it is very important to contact the film mask closely against the printed circuit board. If the contact between the film mask and the board is incomplete, the pattern projected on the board will be incomplete. In particular, the width of the pattern on the board will
10 be wider than the original pattern. In the prior art the gap between the film and the board is subjected to a vacuum after abutting of the film and board so that they closely contact each other.

15 However, it is difficult, using this method, to ensure that the film is almost completely in contact with the board. Furthermore, the cost of producing the vacuum is high and the apparatus therefor is complex and expensive.

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The present invention makes use of an alternative approach in which fluid pressure is applied to the back

side of the film to bring it into intimate contact with the board.

According to the present invention there is provided an
5 apparatus for placing a film mask in contact with an
object, comprising: means for supporting a back side of
a film mask, means for fastening said film mask at the
periphery thereof to said supporting means, means for
abutting a front side of the film mask to an object,
10 means for introducing a fluid between the film mask and
the supporting means so as to press the film mask into
in contact with the object, and an accumulator which
prevents rapid variation of the pressure of the fluid
introduced between the mask and the supporting means,
15 for preventing elongation or deformation of the film
mask.

In carrying out the invention in one preferred
embodiment, a film mask is abutted to the object at the
20 one side thereof. The object may be a printed circuit
board to be patterned with the circuit pattern of the
film mask. The film mask can be supported by a support

made of transparent materials such as glass at the other side thereof. In a preferred embodiment, air is introduced into the gap between the film mask and the support. The film mask is blown by the pressure of the introduced air so as to be closely in contact with the printed circuit board. The air may be cooled to prevent the extension of the film mask. The support may be provided with a groove for introducing the air uniformly.

In another preferred embodiment, the air in the gap is exhausted to keep the pressure of the gap at predetermined value and to prevent rising of the temperature of the introduced air.

An embodiment of the invention will now be described, by way of example, reference being had to the accompanying drawings, in which:

Figure 1 is a schematic view showing an embodiment for explaining the general principles of operation;

Figure 2 is a plan view showing a glass plate;

Figure 3 is a front view of the glass plate;

5 Figure 4 is a plan view showing a position of a groove
on the glass plate;

Figure 5 is a plan view showing another embodiment of
the invention;

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Figure 6 is a perspective view showing a positioning
operation;

15 Figures 7 and 8 are front views showing one embodiment
of the process of the invention;

Figure 9 is a schematic view showing an embodiment of
the invention including an accumulator; and

20 Figure 10 is a perspective view showing a fastening
construction.

Referring now to Figure 1, a printed circuit board W is placed on a table 50 which is movable upwardly and downwardly so as to bring the printed circuit board W into contact with a film mask 1. The position of the printed circuit board W is adjusted on the table 50 so that a pattern formed on the film mask 1 is properly projected on the proper position thereof. The printed circuit board W may be sucked down onto the table 50 as shown in Figure 1.

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Adhesive tape 10 is used to stick the film mask 1 at its periphery onto the downwardly facing side of a transparent body such as a glass plate 2. The adhesive tape 10 may be arranged along the whole periphery of the film mask 1 as shown in Figure 4 or it may be arranged on a part of the periphery of the film mask 1 in order to let fluid escape from a space between the film mask 1 and the glass plate 2 in order to reduce the pressure in the space.

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The glass plate 2 is supported about its periphery by a support frame 20. An air supplying hole 3 is formed in

the support frame 20 and the glass plate 2. With this embodiment, two air supplying holes 3 are provided in parallel as shown in Figure 2 and the air supplying holes 3 are connected to an air supply 33 through the side of the support frame 20. A cooler 32, a selector valve 31 and a pressure control valve 30 are installed between the air supply 33 and the holes 3. The glass plate 2 is provided with an air supplying groove 4 on the surface facing the film mask 1. The air supplying groove 4 is positioned inside of said adhesive tape 10 and defines a square region including an exposure area R as shown in Figure 4. The air supplying holes 3 are connected to the air supplying groove 4 so that the fluid from the air supply 33 is introduced to the space formed between the glass plate 2 and the film mask 1 through the air supplying holes 3 and the air supplying groove 4. The cold air from the cooler 32 is introduced between the film mask 1 and the glass plate 2 at a pressure adjusted by the pressure control valve—30. The cold air cools the film mask 1 so as to prevent expansion of the film mask 1 with heat, which results in reliable exposure of the pattern.

The glass plate 2 may be replaced by other transparent materials such as an acrylic resin plate which can transmit the light from a projector (not shown) installed thereabove.

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Figure 5 shows another arrangement where an exhaust hole 9 is added in order to exhaust air from between the film 1 and the glass plate 2. The exhaust hole 9 is also formed both in the glass plate 2 and the support frame 20 and is connected to the air supplying groove 4 and to a suction apparatus (not shown). The cross-sectional area of the air supplying groove 4 is smaller than that of the air supplying hole 3. Therefore, the air volume exhausted from the air supplying groove 4 is smaller than that supplied from the air supplying hole 3 so that the pressure between the film mask 1 and the glass plate 2 can be kept at the predetermined pressure higher than atmospheric pressure. By using the exhaust hole 9 the air between the film mask 1 and the glass plate 2 is kept refreshed so that the film mask 1 is cooled to some extent.

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As shown in Figure 6, the film mask 1 has a sensing hole 15 for aligning it on the printed circuit board W which has a corresponding sensing hole 15'. The table 50 is movable in the X and Y directions to adjust the relative position of the film mask 1 and the printed circuit board W using the sensing hole 15,15'. In this embodiment, the light is utilized to identify the positions of the sensing holes 15 and 15'.

10 The printed circuit board W is set on the table 50 at first, and the relative positions of the printed circuit board W and the film mask 1 are adjusted by moving the table 50. Then the table 50 is lifted up to abut the printed circuit board W against the film mask 1 as shown in Figure 7. Air is supplied at an appropriate pressure from the air supply 33 through the cooler 32, the selector valve 31, the pressure control valve 30 and the air supplying hole 3. The air is introduced into the air supplying groove 4 and passes
15 into the gap between the film mask 1 and the glass plate 2 which keeps the gap at the predetermined pressure higher than atmospheric pressure. The film
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mask 1 is blown up as shown in Figure 8 by the air pressure and comes into close contact with the printed circuit board W. Then a light is applied from above the glass plate 2 so that the pattern on the film mask 1 is printed on the printed circuit board W. A high accuracy of exposure is achieved because the film mask 1 is closely in contact with the printed circuit board W. Furthermore, the cooler 32 prevents the extension of the film mask 1, which also assists the attainment of high accuracy pattern exposure.

After the exposure is over, the table 50 is moved downwardly and the printed circuit board W is picked up and sent to a development and etching process.

In accordance with the invention an accumulator for controlling the fluid pressure is used, as will now explained with reference to Figure 9. The film mask 1 shown in Figure 9 is secured to the glass plate 2 by means of a fastener 7 located about the periphery of the film mask 1. The glass plate 2 is supported at its periphery by a base frame 5 and the air supplying hole

3 is formed through the base frame 5 and the glass plate 2. The air supplying hole 3 is connected to fluid source 11 through a switching valve 8, an accumulator 12 and a reducing control valve 13. The
5 accumulator 12 prevents rapid variation of the pressure of the fluid introduced into the gap between the film mask 1 and the glass plate 2, so that the film mask 1 may be prevented from becoming elongated or deformed. Since the reducing control valve 13 can control
10 linearly the pressure of the fluid introduced into the air supplying hole 3, precise control of the pressure can be achieved depending on the situation, for example
an initial high pressure may be used to force the film mask 1 against the printed circuit board W and
15 thereafter a lower pressure may be used to maintain the film mask 1 in contact with the printed circuit board W. The accumulator 12 enables the required pressure to be achieved in a short time. An exposure lighting apparatus 40 is installed above the glass plate 2.

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A fastener 7 fastens the film mask 1 to the glass plate 2 using a mask press plate 6. The film mask press

plate 6 is a frame of thin plate, the centre part of which corresponding to the exposure area R is cut away. The plate 6 secures the periphery of the film mask 1 at constant pressure by fastening of the fastener 7. As shown in Figure 10, four pieces of the fastener 7 are provided at four sides of the film mask press plate 6 so as to clip the margin of the film mask 1. The fastener 7 is mounted on the base frame 5 by bolts or the like so as to fasten the film mask press plate 6, film mask 1 and the glass plate 2.

The glass plate 2 and the film mask 1 are cooled by air blown by fans 25. The fans 25 supply cooled air sent from an air cooler 22 through ducts 21. The cooled air can suppress elongation of the film mask 1. The air cooler 22 is furnished outside of the cover 23 of the apparatus.

CLAIMS

1. An apparatus for placing a film mask in contact
5 with an object, comprising:
means for supporting a back side of a film mask,
means for fastening said film mask at the periphery
thereof to said supporting means,
10 means for abutting a front side of the film mask to
an object,
means for introducing a fluid between the film mask and
the supporting means so as to press the film mask into
in contact with the object, and
an accumulator which prevents rapid variation of the
15 pressure of the fluid introduced between the mask and
the supporting means, for preventing elongation or
deformation of the film mask.
2. An apparatus according to claim 1, wherein
20 introduced fluid is air.



3. An apparatus according to claim 1 or 2 wherein said supporting means is a transparent plate.

5 4. An apparatus according to any preceding claim, wherein said means for introducing fluid continuously replaces the fluid whilst keeping the fluid pressure sufficient to press the film mask against the object.

10 5. An apparatus according to any preceding claim, wherein said means for introducing a fluid keeps the temperature of the fluid at the predetermined value.

15 6. An apparatus according to any preceding claim, wherein said means for introducing a fluid includes a means for controlling the pressure of said fluid.

20 7. An apparatus according to any preceding claim, including means for blowing cooling fluid on to said film mask or said glass plate.



8. An apparatus for placing a film mask in contact with an object substantially as hereinbefore described with reference to Figures 9 and 10 of the accompanying drawings.



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