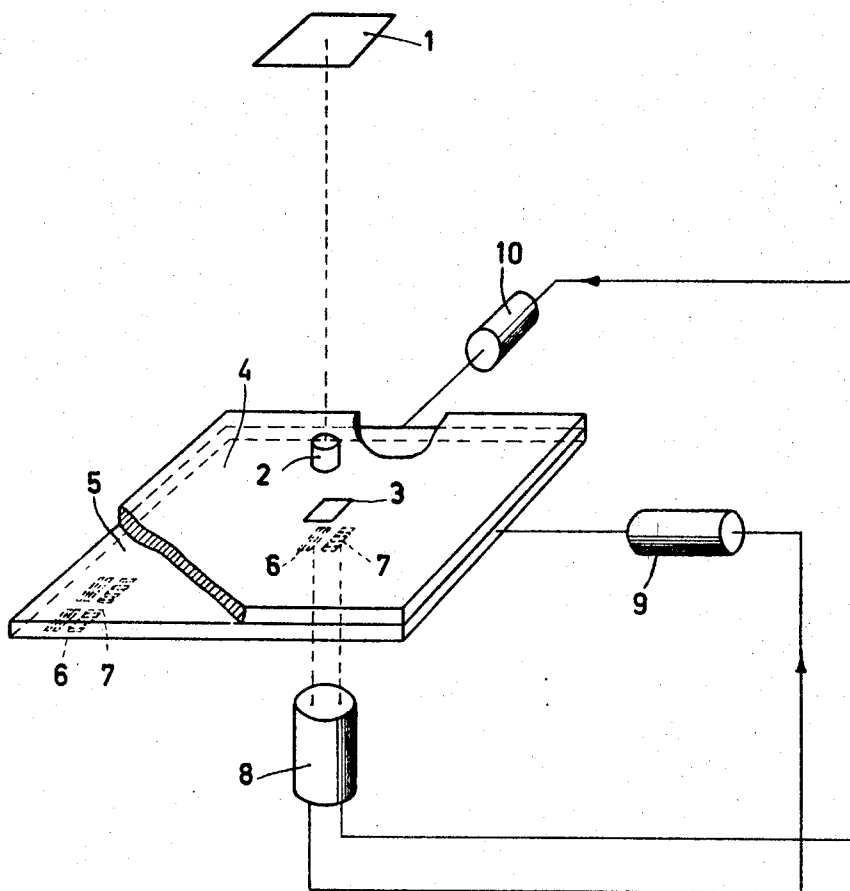


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ARRANGEMENT BY MEANS OF WHICH A MEMBER DISPLACEABLE IN A FLAT  
PLANE MAY REPEATEDLY BE ADJUSTED IN A REPRODUCIBLE MANNER  
TO A PLURALITY OF POINTS WITH PRE-DETERMINED  
PAIRS OF CO-ORDINATES  
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**ARRANGEMENT BY MEANS OF WHICH A MEMBER DISPLACEABLE IN A FLAT PLANE MAY REPEATEDLY BE ADJUSTED IN A REPRODUCIBLE MANNER TO A PLURALITY OF POINTS WITH PRE-DETERMINED PAIRS OF CO-ORDINATES**  
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2 Claims. (Cl. 95—73)

## ABSTRACT OF THE DISCLOSURE

A device for the manufacture of masks for integrated circuits including an arrangement for high precision adjustment of a member displaceable in a flat plane in a reproducible manner to a plurality of points with predetermined pairs of coordinates.

Improvements in or relating to arrangements by means of which a member displaceable in a flat plane may repeatedly be adjusted in a reproducible manner to a plurality of points with pre-determined pairs of co-ordinates.

The invention relates to an arrangement by means of which a member displaceable in a flat plane may repeatedly be adjusted in a reproducible manner to a plurality of points with predetermined pairs of co-ordinates.

Such an arrangement is used inter alia for the manufacture of masks consisting of a great plurality of images arranged according to a given pattern in a flat plane. These masks are manufactured in that a photographic plate is placed on a so-called cross slide, that is to say, a slide which is displaceable in two co-ordinate directions at right angles to one another, whereupon in a number of accurately determinable positions of the slide an image is projected through a microscope objective onto the photographic plate. It is thus possible to record a quadratic pattern of, for example, 80 x 80 identical images on the photographic plate.

Difficulties are met with when this process must be repeated several times with a plurality of photographic plates with different images which must be in register with an accuracy of, for example, 1 $\mu$ . The requirements imposed on the cross slide are then particularly severe and can be fulfilled only with difficulty due to the inevitable clearance in the guide members.

The invention provides an arrangement by means of which in the manufacture of such masks the cross slide may always be adjusted to the correct position with the required accuracy.

The invention consists in that in an arrangement as described in the preamble, a reference mark is associated with each point and coincides at least substantially with this point, while means are provided which indicate the deviation from the correct position, two quantities corresponding to the co-ordinate directions being obtained by means of which the co-ordinates are adjusted to the correct values.

The member may be constituted by a plate adjustable in two co-ordinate directions at right angles to one another, to which plate for example, a photographic plate is secured and which in the aforesaid case comprises 80 rows each having 80 reference points. This reference plate is driven in the said directions by driving motors to which when the plate is approximately adjusted to a predetermined position voltages are applied which are derived

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from a photo-electric device co-operating with the associated reference point in a manner such that with any deviation in one of the co-ordinate directions a motor causes a movement of the plate such that the deviation is eliminated. Thus, any deviation in the co-ordinate values which may arise as a result of clearance in the straight line guidings is neutralized.

Each reference mark preferably consists of two gratings having lines at right angles to each other, while optical-electrical means are provided with the aid of which control voltages are derived which are dependent upon the positions of the gratings and which each serve for the displacement of the member in one co-ordinate direction. In the case of a deviation from the correct position the first grating gives rise to a voltage resulting in a displacement at right angles to the lines of the grating, for example in the X-direction; in the same manner, the other grating gives rise to a voltage resulting in a displacement in the Y-direction. When the gratings are located in the proximity of the associated image projected on the photographic plate, deviations of the slide guide are harmless.

The voltages indicating the deviation may be obtained with the use of a reflection grating in a known manner by scanning this grating photo-electrically by optical means. With a grating constant of 100 microns, an accuracy of 1 $\mu$  is readily obtainable. This only requires that the position is previously adjusted within a given range of, for example, 12 microns.

The accuracy with which the reference marks are located at the prescribed areas need not be great with arrangements as described hereinbefore, since only the repetition of the same pattern is concerned.

The invention will now be described more fully, by way of example, with reference to the accompanying drawing.

In the figure, reference numeral 1 denotes a plate bearing a pattern which is projected through a microscope objective 2 on a photographic plate 4 at an area 3 so that an image may be produced photographically. The photographic plate 4 is provided on a reference plate 5 which may be driven by means of motors 9 and 10 in the two co-ordinate directions in the plane of the plates. The plate 4 is to be provided with a plurality of rows of images 3 which are projected on this plate in order of succession. The pattern which is projected may have to be replaced by another pattern which must be projected with a great accuracy on the same areas as the former image. In order to obtain the required accuracy, each position is associated with a reference mark 6, 7 consisting of gratings the lines of which are at right angles to one another. In order to show more clearly the various reference marks, part of the photographic plate 4 has been broken away in the drawing. The reference marks are provided on the lower side of the plate 5 which is made, for example, of metal. The accurate location of each reference mark is observed by means of an optically photo-electric device 8 comprising a pair of photo-electric cells to detect separately reference mark 6 and reference mark 7. When the cross slide is first adjusted approximately to the correct position two control voltages are obtained each of which is derived from a grating and by means of which the motors 9 and 10 are driven so that they move the plate 5 to the correct position.

What is claimed is:

1. A device for repeatedly adjusting a reference member displaceable in a flat plane and in two directions in a reproducible manner to a plurality of points with predetermined pairs of coordinates, comprising a reference mark associated with each point on said reference member and coincides at least substantially with said point, said reference mark being constituted of two gratings, the lines of which are at right angles to each other, a

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photographic member secured to and movable with said reference member and adapted to have images produced thereon photographically, and separate electro-optical means for each grating for indicating the deviation from the correct position, said electro-optical means generating control voltages dependent upon the positions of said gratings and which each serve for the displacement of the reference member in one of the coordinate directions to the correct position.

2. A device as claimed in claim 1 whereby said indicating means for recording the deviation from the correct

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position are a pair of photo-electric devices, and the means for adjusting the coordinates to the correct positions are a pair of motors.

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