

[54] **TARGET CHANGER FOR SPUTTERING BY IONIC BOMBARDMENT**

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[51] Int. Cl..... **C23c 15/00**

[58] Field of Search..... **204/298, 192**

[56]

**References Cited**

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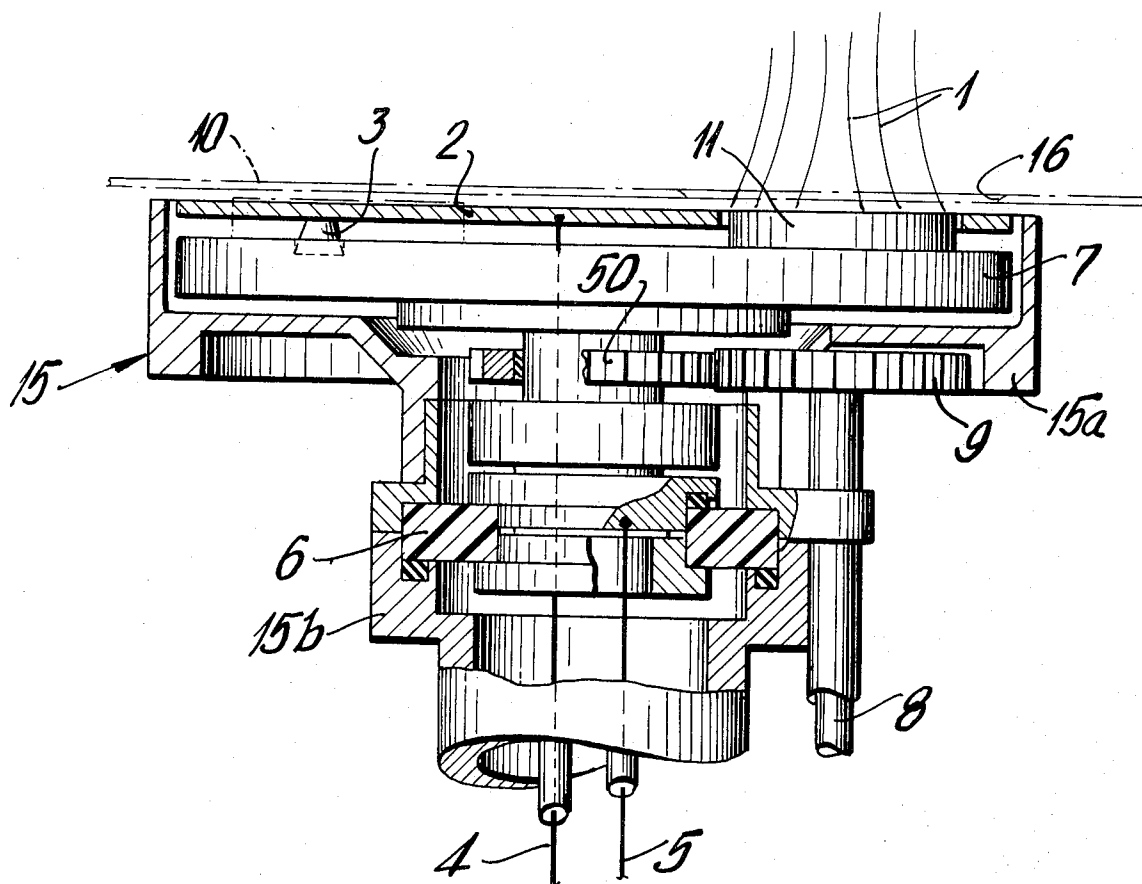
*Attorney, Agent, or Firm*—McGlew & Tuttle

[57]

**ABSTRACT**

A target changer for positioning targets which are to be subjected to electronic sputtering by ionic bombardment comprises a movable support for carrying the target with a cover mounted on the support by electrical insulation means and which comprises an ion shielding electrode which is capable of being charged with a positive potential relative to the target.

**7 Claims, 4 Drawing Figures**



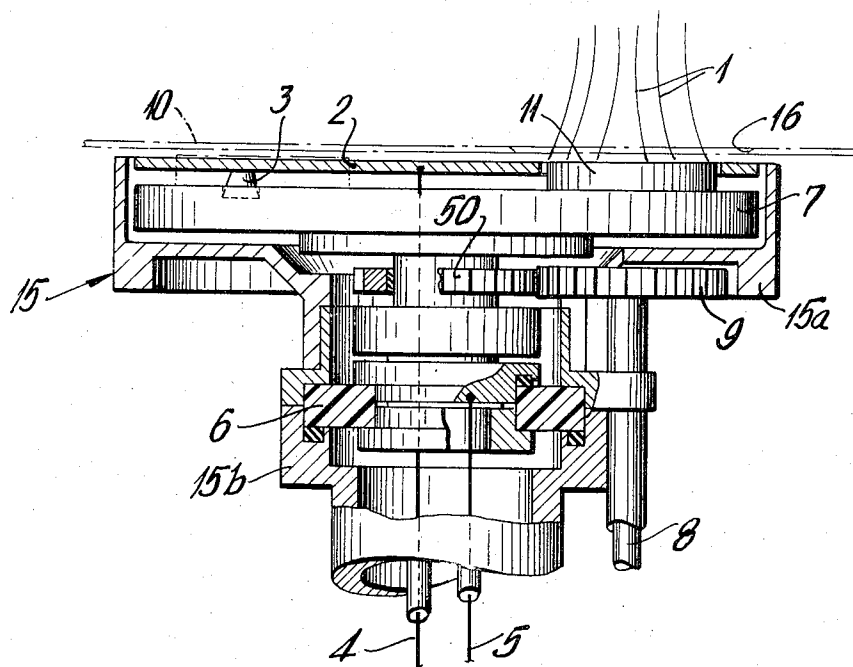


FIG.1a

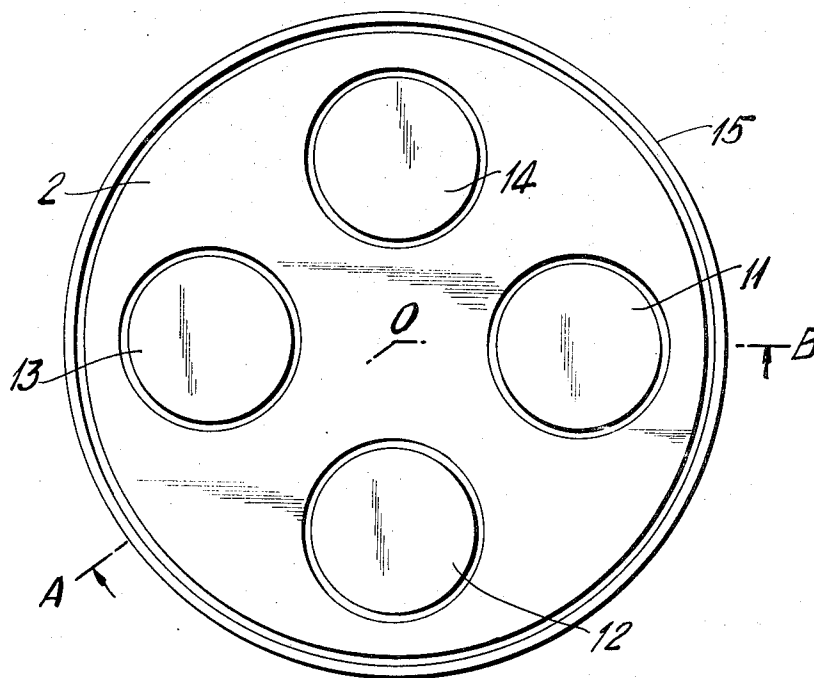


FIG. 1b

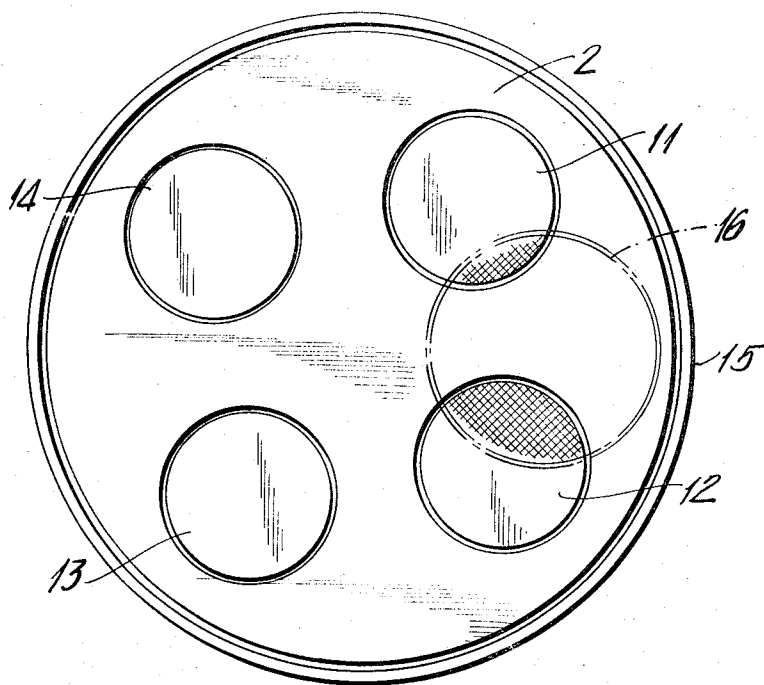


FIG. 2

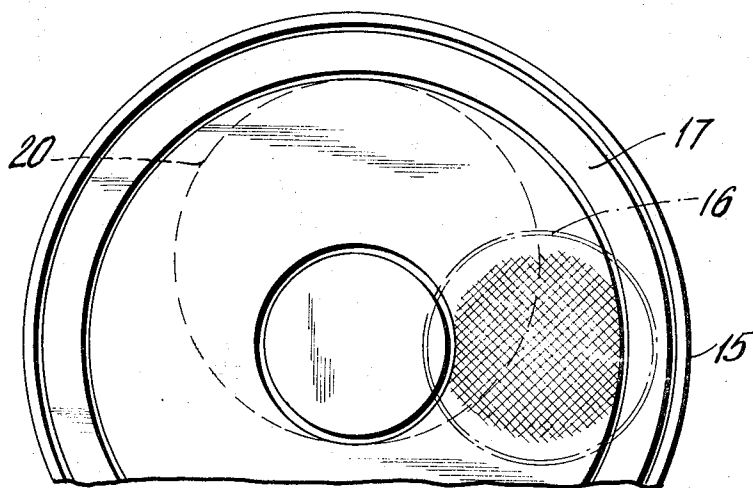


FIG. 3

# TARGET CHANGER FOR SPUTTERING BY IONIC BOMBARDMENT

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

This invention relates in general to apparatus for exposing substances to sputtering by ionic bombardment and, in particular, to a new and useful target changer for positioning targets which are to be subjected to electronic sputtering by ions.

### 2. Description of the Prior Art

Many devices are known for sputtering substances by ionic bombardment. In general, they comprise a working chamber capable of being evacuated in which an ion beam generated by an ionic source and concentrated to a greater or lesser degree is directed against the surface of a substance to be sputtered, called a target. The particles of the sputtered substance, in general precipitate on so-called substrate, i.e., a glass plate which is intended to be coated with a corresponding layer. When it is intended to sputter different substances several different targets composed of respective materials were necessary. In order to have the possibility of submitting these targets to sputtering consecutively, so-called target changers have been used. Such changers usually include a rotatable support, for example a turntable or a drum on which a plurality of targets are arranged and in each case one of them is brought into the path of the sputtering ion beam. In order to protect the other targets against undesired simultaneous sputtering while the particular target is being acted upon, a fixed mask is commonly used which has an aperture for exposing the respective target to sputtering.

The known target changers have the disadvantage that during the changing, the sputtering ion beams of the accelerating voltage must be cut off in order to prevent an undesirable sputtering of the changer parts such as the parts supporting the target, for example, which during the change are temporarily below the exposure opening and could, therefore, be exposed to the action of the ion beam. The necessity for repeated switching off and on, however, affects the reliability of operation of the device. In addition, in certain industrial production processes, for example in the multi-layer coating processes with twenty or more layers, the switching time of several seconds needed for the operation of the usual high voltage supply devices is a great economical cost. A longer interruption of the coating process may also bring technological disadvantages insofar as the substrate and the targets may become covered in the interruption time by molecules of the residual gas. This would result in a deterioration of the quality of the product, for example causing a poor adhesion of the applied layers or change the electrical or optical properties of the layers. On the other hand, high speed, high voltage switches which would be necessary to diminish the disadvantages in the switching operation are very expensive.

## SUMMARY OF THE INVENTION

The present invention provides a device for changing targets which are to be sputtered by ionic bombardment and which is constructed as a mobile support of a plurality of targets and includes a fixed mask having an aperture for exposing a target to be sputtered so that it does not have the disadvantages of the prior art. The

target changer is constructed with a cover designed as an ion shielding electrode which is connected to and moves with the movable support but is electrically insulated from the support and capable of being charged to a potential which is positive with respect to the target. The result of such a construction is that the targets can be changed without cutting off the operational voltage. In addition, because the cover moves with the target, a sputtering of the supporting parts particularly the target support itself, is avoided. The construction is such that only the targets themselves can be sputtered as long as they remain within the range of the ion beam action. On the other hand, a sputtering of the cover is not possible because during the operation the cover is provided with a positive potential equal or approximately equal to the anode potential so that relative to positive ions the cover acts as a shielding electrode. The simplest arrangement is to connect the cover electrically with the anode and to apply the anode potential thereto. It is also possible, however, to insulate the cover electrically from the other parts of the device so that during operation within a short time the positively charged ions initially striking the cover charge the cover positively until it reaches a potential sufficient to shield away the positive ions.

Another advantage of the device constructed in accordance with the invention, is that it may be designed to permit a continuous transition from the sputtering of a first target to the sputtering of a second target and thereby produce, for example coatings with a smooth change of components from layer to layer in a direction perpendicular to the surface. Because of the fact that during the target change the high voltage need not be cut off, the sputtering with the device according to the invention is particularly suited for automatic sputtering units producing thin coatings.

Accordingly it is an object of the invention to provide a target changer for positioning targets which are to be subjected to electronic sputtering by ions which comprises a movable support for carrying a target and with a cover overlaying the support but exposing a portion of the target thereon and insulated from the support, and wherein the cover comprises an ion shielding electrode capable of being charged with a positive potential relative to the target.

A further object of the invention is to provide a target changer for positioning targets for electronic sputtering by ions which is simple in design, rugged in construction and economical to manufacture.

For an understanding of the principles of the invention, reference is made to the following description of typical embodiments thereof as illustrated in the accompanying drawing.

## BRIEF DESCRIPTION OF THE DRAWINGS

### In the Drawings

FIG. 1a is a partial elevational and partial sectional view of a target changer constructed in accordance with the invention and taken along the line A-O-B of FIG. 1b;

FIG. 1b is a top plan view of the target changer shown in FIG. 1a;

FIG. 2 is a view similar to FIG. 1b of another embodiment of the invention; and

FIG. 3 is a view similar to FIG. 1b of still another embodiment of the invention.

### GENERAL DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings in particular, the invention embodied therein in FIGS. 1a and 1b comprises a target changer for use in sputtering objects by ionic bombardment. The ionic bombardment is produced by a beam of positively charged ions indicated at 1 which is incident on a target 11 which is supported on a carrier or rotary support 7.

In accordance with the invention, the target changer includes a cover 2 which is supported on the carrier 7 by means of electrical insulators 3 which hold the cover in spaced location above the carrier surface and secure it to the carrier for movement therewith. A feature of the construction is that the cover is capable of being charged with a positive potential relative to the target 11 which is to be subjected to sputtering to produce ionic bombardment. For this purpose the cover 2 is connected to a voltage lead 4 which is brought to a positive potential relative to the support 7 and the targets which are carried thereby. In the embodiment shown the support 7 carries four separate targets 11, 12, 13 and 14 which are connected to a high voltage lead 5.

In the construction shown, the support 7 forms a turntable which is rotated by a shaft 8 driving through a gear 9 which drives a gear 50 affixed to the turntable support 7. The turntable is supported for rotation on an insulator ring 6.

A fixed mask 10 which has an aperture 16 is advantageously located above the cover 2 and the aperture 16 is located to expose the respective target which is to be sputtered in a particular operation. In FIG. 1b it is shown that four targets 11, 12, 13 and 14 can be arranged on the turntable so that in each case only one of them is aligned with the aperture 16 of the mask 10. In this way only one target is sputtered at a time. The fixed mask 10 is needed particularly when sputtering is effected under higher gas pressures, for example, in a cathode sputtering unit only when there is a danger that the other targets arranged on the rotary support might be sputtered at the same time as the one which is exposed. It is also recommendable to use the fixed mask 10 in order to avoid any risk during the operation that particles of the bombarded target reach and thereby contaminate the surface of another target because of the straying of the residual gas present in the sputtering chamber.

As shown in FIG. 1a the turntable 7 is supported in a protective housing 15 which comprises an upper part 15a and a lower part 15b with the insulator ring 6 held therebetween at flanged extensions of the upper and lower parts. The housing provides a support for the voltage leads 4 and 5 as shown.

In the arrangement shown in FIG. 2, targets 11 to 14 are arranged in respect to an aperture 16 of a mask 10 so that two targets 11 and 12 are partially exposed in the case where it is desired to simultaneously sputter two different targets. The ratio of the two sputtered portions of the targets is determined by the surface ratio of the two target surfaces which are in the exposed position below the aperture 16. By appropriately positioning the turntable, there is the possibility to adjust to any desired surface ratio.

In the arrangement shown in FIG. 3 an annular target 17 can be sputtered continuously when it is rotated uniformly or gradually about the ring axis. In choosing the

right dimensions of the exposure aperture 16, it is possible on the one hand, to provide a source of sputtered particles having a relative small surface which is desired in some cases for optico-geometrical reasons in order to cover substrates with thin layers; and on the other hand, to obtain a long operational time without target renewal because the annular target represents a large reserve of the substance to be sputtered. The annular target may also be provided for a simultaneous sputtering of two different substances in any desired mixture ratio. If, for example, a portion of the annular target within the dotted circle 20, indicated in FIG. 3, consists of a first substance and the rest of the annular surface of another substance, any desired ratio of the portions to be sputtered which comprises different substances may be adjusted as is evident by the respective positioning of the annular target with respect to the aperture 16. It would also be possible to provide different segments of the ring half or quarter segments, for example, which contain different substances and thus to obtain a possibility of changing from the sputtering of one substance to the sputtering of another.

In the examples represented, a turntable such as the turntable carrier 7 is provided as the rotary support of the targets. However, it is evident that instead of a turntable, a drum supporting the targets may be provided or even a slide, which may be moved together with the cover which is capable of being charged to a positive potential. The arrangement may be operated with or without a mask 10 as the requirements dictate so that only the desired targets are submitted to sputtering.

The target changer of the invention can be used in any known arrangements for sputtering but ionic bombardment, for example in the known cathodic sputtering units. Its utilization has been proved particular in so-called triode sputtering units where the surface to be sputtered is placed in an electric arc discharge between a hot cathode and an anode and the sputtering ions are attracted from the plasma of the arc column by means of a negative high voltage applied to the targets. The fixed mask of the target changer according to the invention, can serve as an anode for the low voltage discharge while the rotating cover can be connected to the anode or kept at a floating potential (electrically insulated from all of the other parts) and thus be charged by itself positively during the operation.

While specific embodiments of the invention have been shown and described in detail to illustrate the application of the principles of the invention, it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. A target changer for positioning targets which are to be subjected to cathode sputtering by ions, comprising a movable support for carrying a target, a cover comprising an ion shielding electrode, means adapted to supply a positive potential to said cover relative to the target said cover overlying said support but exposing at least a portion of the target thereon, electrical insulation means supporting said cover on said support, and mounting means for supporting said support for movement.

2. A target changer according to claim 1, wherein said movable support comprises a rotary table, means for rotating said table and a voltage lead connected to said cover.

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3. A target changer according to claim 2, including a housing with an upper part surrounding said table and said cover and a lower skirt portion, an insulating ring disposed between said upper part of said housing and said lower skirt portion and rotatably supporting said table for movement, and a high voltage terminal connected to said rotary table and the target thereon.

4. A target changer according to claim 1, wherein said movable support is a rotatable turntable.

5. A target changer according to claim 1, wherein said movable support comprises a rotatable drum.

6. A target changer according to claim 1, including

a fixed mask mounted over said cover having an opening for exposing a particular target.

7. A target changer for sputtering by means of ions, comprising a rotatable support for several targets, a cover overlying said support and provided with at least one opening for exposing a target to sputtering, said cover being an ion-shielding electrode movable with said support, but electrically insulated therefrom and including means adapted to apply a positive potential thereto relative to said targets.

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