

[54] DEVICE FOR VACUUM COATING

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118/500-503; 117/107.1

[56] References Cited

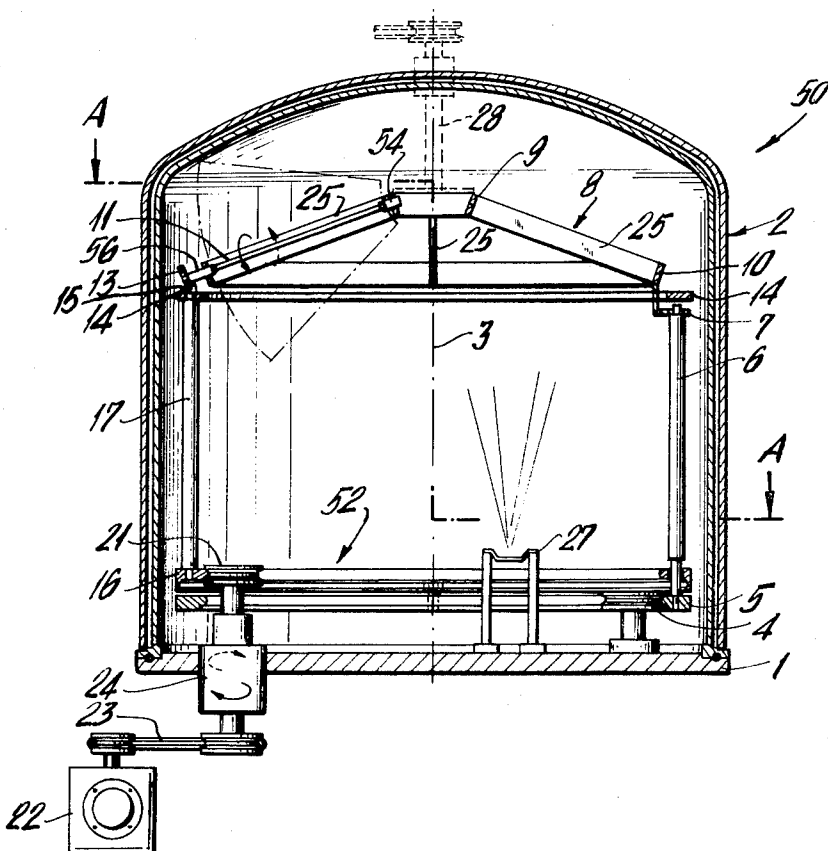
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[57] ABSTRACT

A device for vacuum coating comprises a vessel which is adapted to be evacuated and a structure therein which includes a rotary holding structure upon which is mounted a plurality of supporting plates. The supporting plates are mounted for rotation about an axis parallel to the plate surface. The rotary holding structure is driven by a drive ring which during the initial portion of its rotation is effective to rotate the plates to a position at which they will be oriented in a coating position and thereafter to rotate the whole holding ring structure with the plates. The apparatus advantageously includes means for the electronic sputtering within the vessel to generate ionized gases carrying the coating substance and/or means are provided for evaporating substances to produce the coating material.

8 Claims, 3 Drawing Figures



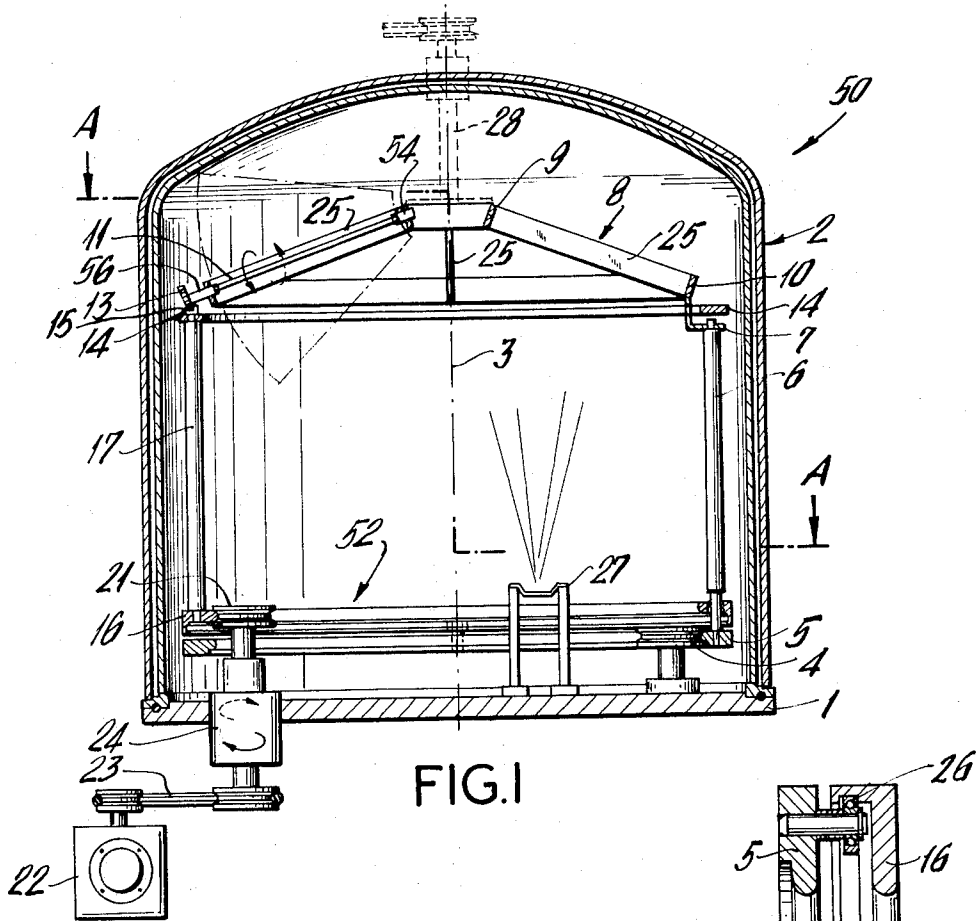


FIG. 1

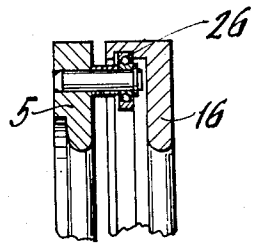


FIG. 3

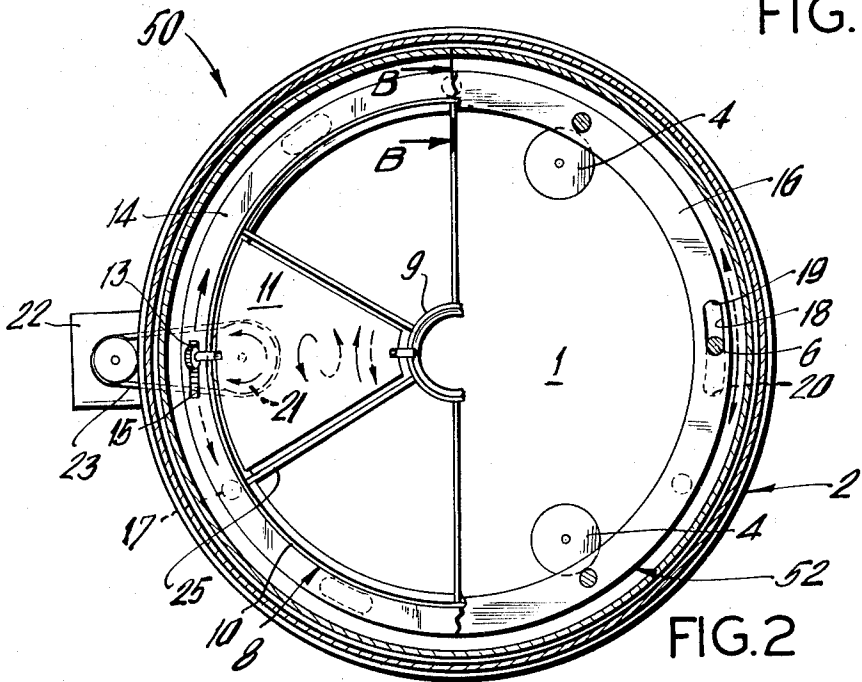


FIG. 2

## DEVICE FOR VACUUM COATING

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

This invention relates in general to vacuum coating devices and in particular to a new and useful vacuum coating device in which materials to be coated are arranged within a chamber which may be evacuated and which includes a rotary structure carrying a plurality of support plates with means for rotating the plates into a position in which the articles thereon are exposed for evaporation coating and for thereafter rotating them with the rotatable structure.

#### 2. Description of the Prior Art

The present invention relates in particular to devices for vacuum coating which comprises a vessel which is evacuated and which holds articles to be coated while they are subjected to evaporation or cathode sputtering apparatus. In devices of this kind it is known to provide a rotary support for moving the articles which are to be coated and generally such supports are designed as rotatable cages. The rotation is carried out in order to produce a more uniform coating. There are also known holding structures which comprise supporting plates which may be inverted so that the objects to be coated can be turned over without interrupting the vacuum within the vessel. This possibility is advantageous because both sides of the supporting plates may be used as holding surfaces for the objects for example such as lenses which may be fixed in recesses of the supporting plate and which therefore may be coated on both sides in one operation. Such an arrangement permits the more economical use of the devices. Devices which are capable of holding the articles to be coated and for inverting them without opening the evacuated vessel are known. Devices which include both rotary motion and movement for the turning over of the plates which carry the objects it is usual to employ separate driving mechanisms for both types of movement and consequently in most cases two separate sealed bushings must be provided for the transmissions in each case. Some of the known devices however require very large space owing to their complicated transmission mechanism and therefore they are not suitable for most installations and they are very susceptible to disturbances.

### SUMMARY OF THE INVENTION

The present invention provides a device for supporting articles which are to be coated in an evacuated chamber and which includes a simple means for both inverting the article and for rotating it during the coating process. The device includes a rotary holding structure arranged within a vessel which may be evacuated and which includes a plurality of supporting plates for the objects to be coated. Appropriate devices for coating the objects such as an evaporation or cathode sputtering equipment are provided in the vessel. A drive mechanism drives the holding structure to produce rotary motion of the objects to be coated during the coating process and the movement is preferably about a vertical axis. The drive mechanism also includes means permitting the turning of the supporting plates to bring them into selected coating positions which is advantageously carried out prior to the rotary movement of the plates. The construction includes a drive ring which is provided with rotatable shaft elements which drive the

plates to rotate them for arranging the plate surfaces in a proper coating position after subsequently fixing the drive ring in respect to the holding structure so that continued rotation of the drive ring causes rotation of the holding structure.

Accordingly it is an object of the invention to provide an improved device for holding objects to be coated in an evacuation plant which includes a support structure including a rotatable holding structure having at least one plate thereon and drive means connected to said holding structure and to said plate for rotating said plate to position said plate in a desired coating position and thereafter to rotate said holding structure to rotate the plate while it is held in the coating position.

A further object of the invention is to provide an apparatus for coating articles in a reduced pressure atmosphere within a vessel which includes means for both rotating and inverting the position of articles to be coated arranged within the vessel.

A further object of the invention is to provide a coating device 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 embodiment thereof as illustrated in the accompanying drawing.

### BRIEF DESCRIPTION OF THE DRAWING

In the Drawing:

FIG. 1 is a transverse sectional view of a vacuum coating apparatus constructed in accordance with the invention;

FIG. 2 is a section taken along the line A—A of FIG. 1; and

FIG. 3 is a section taken along the line B—B of FIG. 2.

### GENERAL DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings in particular, the invention embodied therein comprises a vacuum coating unit which comprises a vessel generally designated 50 having a bottom or base portion 1 and a double walled bell or top portion 2.

In accordance with the invention a device generally designated 52 for supporting objects to be coated so that they may be rotated during the coating process and so that they may be changed in position for example inverted for subsequent coating, is mounted within the bell 2 over the base 1. The holding structure 52 includes a base ring 5 which is mounted so as to be rotated by individual rollers 4 which are arranged to rotate the ring 5 about a vertical axis 3. A first cage portion of the structure 52 includes the ring 5 which has upright rods 6 thereon which support a top structure generally designated 8. The top structure 8 includes an inner ring 9 and an outer ring 10. A plurality of radially extending arms arranged around the circumference interconnect the two rings 9 and 10. In accordance with a feature of the invention supporting plates 11 for carrying objects to be coated or mounted for rotation about an axis extending parallel to the plane of the plate on journals 54 which are rotatably supported on the inner plate 9 and journals 56 which are rotatably supported on the outer plate 10. The journal 56 carries a small gear 13 which rides in meshing engagement with a rack 15 which is carried on a ring 14 of a second

rotary cage construction. The upper drive ring is also rotatable about the axis 3 and it is supported on vertically extending rods 17 which are carried on a lower drive ring 16. Thus, a first rotary cage structure which includes the drive ring 5, the vertically extending rod 6 and the inner and outer rings 9 and 10 which are supported on brackets 7 on the rod 6 may be rotated separately by the drive rollers 4 or it may be rotated after rotation of a second rotary cage assembly which includes the lower drive ring 16, the vertical rod 17 and the upper ring 14 which carries the rack 15. When the first rotatable cage rotates in respect to the second rotatable cage the gear 13 moves on the rack 15 to cause rotation of the individual plates 11 and this movement may continue until the two rotary cages are coupled together at which time the plates 11 will move into a position in which they hold the articles at a proper position for coating. Thus for the coating process the objects to be coated are fixed to the supporting plate 11 for example by means of clamps or screws (not shown).

The special equipment for the coating itself particularly the evaporation source as well as devices for the cathode sputtering or for producing layers in an electric glow discharge for example in an atmosphere of an organic or inorganic vapor, is only schematically indicated at 27. Such equipment is well known however and does not form an essential part of the invention.

The rods 6 of the first rotary cage pass through arched oblong slots 18 of the lower drive ring 16 of the second rotary cage. The slots 18 are of such a dimension that a relative movement between the two cages may take place to permit the gear 13 to run over the rack 14 and cause rotation or turning over of the supporting plates 11.

In the embodiment shown the drive ring 16 is driven by a drive roller 21 which is in frictional engagement therewith and which in turn is driven by a motor 22 through a V-belt transmission 23 which is connected through a sealed bushing 24 in the bottom 1. During the initial movement of the ring 16 the plates 11 are turned until they are oriented in a desired position for coating and this may be determined when they abut against a stop which defines the coating position. If rotation proceeds in an opposite direction the supporting plates are rotated in an opposite direction until they are stopped in a second coating position. The stops advantageously comprise connecting arms 25 and the plates are advantageously constructed so that they hit the arms in each end position. In some cases it is desirable to provide additional stops on the top structure 8 and to make them adjustable to define predetermined coating positions of the plates 11. The slots 18 are advantageously dimensioned so that the rods 6 abut at the ends 19 or 20 at the end positions of rotatable movement of the plates 11.

The operation of the device is as follows:

After the objects to be coated have been fixed to the supporting plates 11 and the coating equipment prepared for service, the bell 2 is closed and the vessel is evacuated down to the operation pressure. The second rotary cage which includes the bottom ring 16 the rods 17 and the upper ring 14 is driven by the motor 22 and during the initial stages of its rotation it turns the supporting plates 11 by driving through the rack 15 and the gear 13. The movement continues until the coating position of the plates 11 is attained as determined by the location at which it hits a stop. When this occurs no

further relative motion is possible between the first and second rotary cages so that the first rotary cage bearing the top structure 8 is driven along with the second rotary cage and the whole structure including the supporting plates 11 which are held within a coating position is continuously rotated. During this time the coating on one side of the supporting plates 11 is carried out. As soon as the coating of this side of the objects is finished the rotation is reversed for example by reversing the motor 22 and during this initial portion of reverse rotary movement the support plates 11 are again turned over to a second coating position. After they reach the second coating position the whole structure then rotates together during the next coating operation.

It is also possible to use a base ring 5 instead of the drive ring 16 as the driving mechanism since it is only the relative motion between the two cages that determines the rotatable movement of the article support plates 11. In such a case in the beginning of rotation first the one coating position corresponding to this rotational direction is adjusted and after attaining this position the top structure is then put into rotation. When the ring 5 is driven in the opposite direction first the supporting plates are brought into their second coating position and thereupon the whole structure turns together.

As is easily seen from the drawings instead of using whole rotary cages it is possible to establish the same motion transmission through two rotatable ring structures which rotate about a common axis and with one of them carrying the top structure and the other being capable of executing a limited movement in respect to the one carrying the top structure. These rings may be supported and rotatably mounted on the inner surface of the bell 2 instead of being supported by means of the rod 6 or 17 and the rings 5 or 16 shown in FIG. 1. As is shown in FIG. 1 in dashed lines the ring could also be driven by means of a transmission including the drive shaft 28 from a connection through the bell at the top thereof.

FIG. 3 indicates the mounting of the rings 5 and 16 so that they can be rotated relative to each other about the common axis 3. The rings are supported on ball bearings 26.

While a specific embodiment of the invention has 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 device for vacuum coating, comprising a vessel adapted to be evacuated, a holding structure arranged within said vessel having an outer periphery orbital about a central axis, a supporting plate for the objects to be coated mounted on the outer periphery of said holding structure and being rotatable about an axis of said plate, means in said vessel for coating the objects, drive means operable during the coating process to put said holding structure into orbital motion and initially to invert the supporting plate about said axis of said plate thereby to bring it into a coating position and said drive means further including means to thereafter stop plate movement about said plate axis and, to hold it in said coating position during further orbiting of said holding structure and said support plate.

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2. A device according to claim 1 wherein said means to invert the supporting plate and to stop movement about the plate axis includes a drive ring connected to rotate said plate to turn them and coupling means coupling said drive ring to said rotatable holding structure to simultaneously rotate said drive ring and said holding structure and to stop turning said supporting plate.

3. A device according to claim 2 wherein said holding structure comprises a rotary cage including at least one said supporting plate which is rotatable thereon and adapted to be rotated 180°.

4. A device according to claim 1 wherein said drive means comprises an orbital cage, said holding structure including inner and outer plate support rings, said plates being journalled for rotation in said plate support rings.

5. A device according to claim 1 wherein said holding structure and said drive means comprise separate orbital cages interengaged and concentrically arranged each having vertically extending rods and one having a drive ring with an elongated arcuate slot therethrough through which the rods of the other extend.

6. A device according to claim 5 wherein said drive ring has a toothed rim said plates having a gear affixed to the axis thereof which is engaged with the toothed rim of said drive ring.

7. A device for vacuum coating comprising a vessel having a base portion and a bell portion covering said base portion, said vessel being adapted to be evacuated to reduce the pressure therein, means in said vessel for

coating objects, a first structure orbital about a central axis and having at least one article receiving plate thereon for articles to be coated, means on said holding structure for mounting said plates for rotation about an axis extending at an angle to the orbit axis, a second orbital structure connected to said first structure, drive gear means defined between said first and second orbital structures to rotate said plate upon relative rotation of said first and second orbital structures and coupling means coupling said first and second orbital structures together for orbiting together and permitting initial independent orbital movement of said first structure relative to said second structure for driving said plates to a rotated position at which they will be disposed during the coating process and which is thereafter effective to orbit both said structures together to hold said plate in a coating position during the coating process.

8. An apparatus according to claim 7 wherein said drive means includes a first drive ring connected to said first structure, and motor means connected to said drive ring to rotate said drive ring, said coupling means including a ring on said second structure having an elongated arcuate slot and a rod on said first drive ring extending through said slot and permitting relative movement between said first drive ring and said second drive ring to the end of travel of said slot and then combined movement of said drive means thereafter.

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