The invention relates to apparatus for holding and turning lenses, in particular for spectacle lenses to be coated in a high-vacuum metallising or cathode sputtering installation, having ring pairs which carry the lenses to be held and are tiltably mounted with a substrate support, which is held in the processing chamber of the high-vacuum installation.

A vacuum coating installation is known for the cathode sputtering of anti-reflective coatings on to optical substrates (DE-OS 37 15 831), such as plastics spectacle lenses, which are mountable over nebulising sources on support means revolving in a receptacle capable of being evacuated, wherein the support means have a plurality of flat support plates having at least the approximate shape of a segment of a circle, which are supported in the form of a lune on a common axis of rotation so as to be each capable of turning through 180° relative to one another, wherein each support plate has in the aperture regions a plurality of substrate supports provided with at least one holding spring, at least one of the substrate supports being freely tiltable to either side out of the support plate plane by a specified angle.

Each freely tiltable substrate support has a mounting which partly encompasses the substrate to be held and is fixed to the support plate via a tilting shaft, so as to be freely tiltable to either side, and in which the substrate is under the action of the holding spring.

Furthermore, a lens holding device is known, in particular a holding device for glass spectacle lenses to be cleaned and then coated (EP-A-0 215 261), which is formed as a ring carrying on its inside forks for receiving the lenses to be held, wherein the ring is resiliently deformable and the

forks are disposed on two mutually opposite sections of the inside of the ring.

The object of the present invention is to create an apparatus for holding and turning lenses which is suitable for circular shell-shaped or screen-shaped substrate supports or in which it is possible to place a plurality of lenses on a substrate support so formed, and which permits rapid turning of the lenses relative to the coating source, wherein the outer face of the lens respectively facing the source is to have the same distance from and position relative to the source as the respectively other outer face of the lens after turning.

This object is achieved according to the invention in that the screen-like or half-shell-shaped sheet-metal part forming the substrate support is covered at least partly by a sickle-shaped sheet-metal blank or profile element forming a slide or rake, and the edge of the rake associated with the substrate support is held at a short distance from the outer face of the substrate support by a slide member or articulated arm located in the processing chamber, and in this position the rake is movable relative to the upper side of the substrate support about the vertical axis of rotation of the substrate support or in the direction of the axis of rotation, and the prongs located on the lower edge of the rake associated with the substrate support enter into at least temporary engagement with the pinions, gearwheels or links of the lugs of the rings mounted in bearing blocks or bearing forks located on the substrate support.

In a preferred embodiment, the sickle-shaped rake is held and guided by an articulated arm, slide member, lifting ring or collar displaceable in the direction of the axis of rotation and by the lifting member of a lifting device, for example a lifting motor, fixed to the wall of the processing chamber or receptacle.

Advantageously, the slide or rake has a plurality of lugs or prongs extending approximately perpendicular to the outer face of the substrate support and into the vicinity of the pinions, gearwheels or links of the respective rings.

Advantageously, the rake extending in a to the axis of rotation of the substrate support is coupled by one end to a lifting ring and is connected by the other end to a coupling ring surrounding the substrate support and provided in a plane transverse to the axis of rotation, and the coupling ring communicates with the wall of the receptacle via a lifting member, for example the piston rod of a lifting motor, and is movable in the longitudinal direction of the axis of rotation by said lifting motor.

In an alternative embodiment,the prongs are movably coupled to the rake, so that when said prongs run on to a slope of a locked or non-rotatable link in the direction of the rake, they are deflected.

In order to ensure even pivoting of the ring pairs, the prongs coupled to the rake are advantageously fork-shaped or comb-shaped or are formed as tooth segments at their free ends cooperating with the links, and the individual prong ends or teeth, when engaged with the link, together effect the pivoting movement of the link or of the respectively associated ring pair.

The invention permits a wide variety of possible embodiments. One of these is illustrated diagrammatically in more detail in the attached drawings, in which:

Fig. 1 shows a high-vacuum cathode sputtering installation, partly in section,

Fig. 2, the motor-driven substrate support curved into a lune shape according to Fig. 1, but on a larger scale, and without the ring pairs insertable into each of their apertures,

Figs. 3 and 4 the two rings for holding the glass spectacle lenses, viewed in perspective,

Fig. 5, the two interconnected rings according to Figures 3 and 4 and their mounting on the substrate support,

Fig. 6, the partial longitudinal section through the two rings according to Figure 5, with a glass spectacle lens inserted,

Fig 7, a side view of a rake and the substrate support in partial section, and

Fig. 8, a partial view in perspective of a rake with movably mounted prongs and a ring pair, whose first ring is equipped with a link of a special configuration, the substrate support not being shown further in the drawing.

The high-vacuum cathode sputtering installation shown in Figure 1 consists essentially of a receptacle 3 with a nebulising source disposed therein, but not shown in more detail, a substrate support 4 curved into a lune shape and composed of a sheet-metal blank provided with a plurality of apertures 5, 5', ..., a drive unit 8 consisting of a motor 6 with a transmission 7, a slide or rake 9 rotatable about a vertical axis and mounted above the substrate support 4 with a lifting motor 10, a fore pump set 11, a diffusion pump 12, and a vacuum valve 13.

The apertures 5, 5′, ... in the substrate support shown in Figure 2 are for receiving ring pairs 14, 15, which are connected together by means of wire springs 16, 17 and are insertable via lugs 18, 19 in bearing forks 20, 21, which are located in pairs at the edges of the apertures 5, 5′, ... of the substrate support 4 (but are not drawn in more detail in Figure 2 for the sake of clarity). In Figures 3 and 5, the first of the two rings 14 is provided on its radially outer surface 22 with the two diametrically opposite lugs 18, 19, and the longitudinal axis 24, 24′ or the axis of rotation of the two rings extends approximately in the plane of contact of these two rings 14, 15.

In order to insert the glass spectacle lens 25 into the rings 14, 15 and then to be able to connect same together, the glass spectacle lens 25 is laid on the correspondingly dimensioned chamfer or flange-shaped step 26 of the second ring 15 in a first stage of the operation, and then in a second stage of the operation the first ring 15 is laid from above on the second ring 15 so that the axes of rotation 27, 27′ of the two rings 14, 15 are flush or coincide; in a third stage of the operation the first ring 14 is rotated relative to the second ring 15 in the direction of the arrow A (Figure 3), in particular until the bow-shaped resilient ends 16′, 17′ of the wire springs 16, 17 slide into the two grooves 28, 29 cut diametrically opposite one another into the radially outer surface 22 of the first ring 14. In this rotary movement, the bow-shaped ends 16′, 17′ slide along the slopes 30, 31 of the grooves 28, 29 until they rest on the upper side 32 of the first ring 14 and thus hold the two rings 14, 15 with the interposed glass spectacle lens 25 together (see Figure 5).

The lugs 18, 19 of the two rings 14, 15 clipped together are then inserted in the direction of the arrow B into the two fork-shaped or U-shaped bearing forks 20, 21, which are

located in respective pairs at each aperture 5, 5′, ... of the substrate support 4. The outer diameter of the two rings 14, 15 or the inner diameter of the apertures 5, 5′, ... respectively is in this case so dimensioned that the two rings 14, 15 clipped together, which together form a ring pair, can be rotated in the direction of the arrow C or D about the longitudinal axis 24, 24′ (arrow direction C, D in Figure 5). This rotary or pivotal movement can be carried out when the processing chamber 34 is closed by means of a rake 9 mounted in the receptacle 3. The rakes 9, 9′, which are formed as semicircular sheet-metal blanks with prongs 43, 43′ formed thereon and brush over the upper face of the substrate support 4 like a comb when the substrate support 4 is rotated about its axis 33, 33′, thus come into contact with the teeth of gearwheels 35, 35′ mounted non-rotatably on a respective lug 18 of the respective first ring 14 and carry said gearwheels with it until the ring pairs 14, 15 have respectively completed a pivoting motion through 180° about their longitudinal axes 24, 24′. A finger 36 provided on the lug 18 is thus laid on the upper face of the substrate support 4 and prevents further rotation or is held in this position by one of the magnets 39, 39′, which are rigidly mounted spaced apart in the region of the finger 36, 36′, ... on the upper face of the substrate support 4. The two magnets 39, 39′ therefore ensure that the associated ring pair 14, 15 does not remain in an intermediate or unstable position during turning and that it does not pivot back into such a position after turning. The rakes 9, 9′, ... engaging in the gearwheels 35 of the respective ring pairs 14, 15 therefore permit a pivoting motion of the individual ring pairs or the glass spectacle lenses 25 inserted therein during the current coating operation, i.e. when the receptacle 3 is closed. For this, separate lifting motors 10 with lifting members 41 and hinges 37 are provided, and are coupled for this purpose to a coupling ring 38 connecting a plurality of rakes 9, 9′ together. The rakes 9, 9′ are

furthermore connected together via a lifting ring 40 held and guided displaceably on the bearing tube 42 of the drive unit 8.

If the lifting motors 10 (of which only one is shown in Figures 1 and 7) are actuated, the rakes 9, 9′, ... move together with the coupling ring 38 in the direction of the arrow F out of the lower position shown in Figure 7 into an upper position, in which the individual prongs 43, 43′, ... of the rakes 9, 9′, ... are disengaged from the associated gearwheels 35, 35′, ..., so that the substrate support 4 can then rotate freely and the ring pairs 14, 15 and 14′, 15′ and 14", 15" and 14"′, 15"′ respectively remain in their rest position.

It should be also mentioned that the screen-like or half-shell-shaped substrate support is provided on its lower circular edge with a reinforcing ring 44, which forms a reliable guide face for the coupling ring 38 movable in the direction of the arrow F. Since, in the embodiment shown in the drawings, three respective rakes 9 are braced between the lifting ring 40 and the coupling ring 38, all three rakes 9 can be raised like a closed hood in the direction of the arrow F, so that the numerous prongs 43, 43′, ... are disengaged from the gearwheels 35, 35′, ... at the same time.

In the embodiment of the apparatus according to Figure 8, prongs 48 which are fork-shaped are coupled to the rake 47, i.e. the part of the prongs 48 engaging with the link 49 is in this case provided with three respective prong ends 48a, 48b, 48c, so that the rotation of the link 49, which is respectively equipped with a plurality of teeth 52a, 52b, 52c, 52d, takes place particularly smoothly and easily. Each link 49 is additionally provided with slopes 51, which prevent locking of the apparatus if, for example, rotation

has already taken place and the ring pair 45, 46 is prevented from rotating due to the resting of the finger 53 on the substrate support 4. In such a case, the prong 48 runs up the respective slope 51 and is pushed up thereby, so that by pivoting in the direction of the arrow K the prong ends 48a, 48b, 48c are disengaged. As the drawing shows, the prong 48 is fixed to a pivot arm 54, which is in turn coupled to a bolt 55 on the rake 47.

List of individual parts

3	receptacle
4	substrate support
5, 5′, ..	aperture
6	motor
7	transmission
8	drive unit
9, 9′, ...	rake
10	lifting motor
11	fore pump set
12	diffusion pump
13	vacuum valve
14	first ring
15	second ring
16, 16′	wire spring
17, 17′	wire spring
18	lug
19	lug
20	bearing fork
21	bearing fork
22	radially outer surface
23	radially outer surface
24, 24′	longitudinal axis
25	glass spectacle lens
26	flange-shaped step
27, 27′	axis of rotation
28	groove
29	groove
30	slope
31	slope
32	ring upper side
33	axis of rotation
34	processing chamber
35, 35′, ...	gearwheel
36	finger

37	hinge
38	coupling ring
39, 39′	magnet
40	lifting ring, slide member
41	lifting member
42	bearing tube
43, 43′, ...	lug, prong
44	reinforcing ring
45	first ring
46	second ring
47	rake
48, 48a, 48b, 48c	prong
49	link
50	lug
51, 51′	slope
52a, 52b, 52c, 52d	tooth
53	finger
54	pivot arm
55	bolt

Claims

1. Apparatus for holding and turning lenses (25), in particular for spectacle lenses to be coated in a high-vacuum metallising or cathode sputtering installation, having ring pairs (14, 14′ ... 15, 15′ ...) which carry the lenses (25) to be held and are tiltable on the substrate support (4), which is held in the processing chamber (3) of the high-vacuum installation, characterised in that the screen-like or half-shell-shaped sheet-metal part forming the substrate support (4) is at least partly covered by a sickle-shaped sheet-metal blank or profile element forming a slide or rake (9, 9′...), and the edge of the rake (9, 9′..., 47) associated with the substrate support (4) is held at a short distance from the outer face of the substrate support (4) by a slide member (40) or articulated arm located in the processing chamber (1), and in this position the rake (9, 9′...) is movable relative to the upper side of the substrate support (4) about the vertical axis of rotation (33′) of the substrate support or in the direction of the axis of rotation, and the prongs (43, 43′... and 48 respectively) located on the lower edge of the rake (9, 9..., 47) associated with the substrate support (4) enter into at least temporary engagement with the pinions, gearwheels (35, 35′...) or links (49) of the lugs (18, 19 and 18′, 19′ and 50 respectively) of the rings (14, 14′...) mounted in bearing blocks or bearing forks (20, 21) located on the substrate support (4).

2. Apparatus for holding and turning lenses according to claim 1, characterised in that the sickle-shaped rake (9 and 47 respectively) is held and guided by an articulated arm, slide member, lifting ring or collar (40) displaceable in the direction of the axis of

rotation (33, 33′) and by the lifting member (41) of a lifting device, for example a lifting motor (10), fixed to the wall of the processing chamber (34) or receptacle (3).

3. Apparatus according to claim 2, characterised in that the slide or rake (9, 9;,... and 47 respectively) has a plurality of lugs or prongs (43, 43′, ... and 48 respectively) extending approximately perpendicular to the outer face of the substrate support (4) and into the vicinity of the pinions, gearwheels (35, 35′,...) or links (49) of the respective rings (14, 14′,... and 45, 46 respectively).

4. Apparatus according to claims 2 and 3, characterised in that the rake (9, 9′,... and 47 respectively) extending in a to the axis of rotation (33, 33′) of the substrate support (4) is coupled by one end to a lifting ring (40) and is connected by the other end to a coupling ring (38) surrounding the substrate support (4) and provided in a plane transverse to the axis of rotation (33, 33′), and the coupling ring (38) communicates with the wall of the receptacle (3) via a lifting member (41), for example the piston rod of a lifting motor (10), and is movable in the longitudinal direction of the axis of rotation (33, 33′) by said lifting motor (10) (arrow direction F).

5. Apparatus according to one or more of the preceding claims, characterised in that the prongs (48) are movably coupled to the rake (47) and, when said prongs run on to a slope (51) of a locked or non-rotatable link (49) in the direction of the rake (47), they are deflected (arrow direction K) and jump over the link (49).

6. Apparatus according to claim 5, characterised in that the prongs (48) coupled to the rake (47) are fork-shaped or comb-shaped or are formed as tooth segments at their free ends cooperating with the links (49), and the individual prong ends (48a, 48b, 48c) or teeth together effect the pivoting movement of the link (49) or of the respectively associated ring pair (45, 46).