

The invention relates to a device for the heat treatment and transport of substrates in vacuum-coating plants having several stations, with substrate holders of roughly plate-shaped, flat, parallelepipedic configuration which in vertical position are capable of being moved - along a predetermined transport path - through the stations and with pairs of roller bodies, slide blocks or rollers which in combination with rails hold and guide the substrate holders and which are each provided in the region of their base part below the substrates that are capable of being attached to the substrate holders, whereby the substrate holder exhibits a shaft-like recess which extends from above into the region of its base part and which runs parallel to the rails and into which there projects, when passing through the station, a flat heating element extending vertically downwards and arranged above the substrate holder on the upper part of the wall.

The substrate holders finding application are either plates with cut-outs shaped to correspond to the substrates or frames with struts to which the substrates are attached. In general one substrate holder serves to accommodate a plurality of substrates.

From US-PS 4,042,128 a transport device of the type described in the introduction is known, in which plate-shaped substrate holders are guided in the vertical location of their principal plane along their upper and lower longitudinal edges between rollers which are capable of rotating about perpendicular axes. Along their lower edges the substrate holders additionally rest on support rollers having a horizontal axis of rotation. The lower guide rollers are, however, incapable of holding and transporting the substrate holders in precisely vertical position on their own, so that stable positioning is only possible with the aid of the upper guide rollers.

Also known is a transport device for vacuum-coating plants (EP 0 254 145 B1) with several stations and with roller systems for the guidance and feed of essentially two-dimensional substrate holders in vertical position along a predetermined transport path through the stations, whereby in the region of the lower edge of the substrate holders there are arranged in pairs guide rollers which accommodate the substrate holder between themselves and which are capable of rotating about vertical axes, whereby the substrate holders are guided exclusively in the region of their lower edge by the roller systems and the guide rollers are provided with running surfaces which are arranged on at least one guide roller of a roller pair on both the lower and the upper ends, whereby in each case the other guide roller of the same roller pair exhibits at least one running surface and whereby the at least three running surfaces of a roller pair constitute, in relation to the substrate holder, a non-tilting clamping system.

Furthermore it is known (DE 3 107 914) to pretreat thermally the substrates to be coated in a special sluice chamber with a heating device. It is also known to equip the substrate holder in the case of a transport device for a vacuum-coating plant with a base part which glides on fixed rails (EP 0 346,815).

Lastly, a device has already been proposed (EP-A-0 476,219) having several stations, with substrate holders of roughly plate-shaped configuration which in vertical position are capable of being moved along a predetermined transport path and which interact with rails which in each case are provided in the region of their base part below the substrates that are capable of being attached to the substrate holders, whereby the base part of the substrate holder is provided with a pair of parallel rails, the longitudinal grooves of which correspond with rollers which are supported in fixed manner on the bottom part of the device and which in each case are

provided spaced in relation to one another in rows corresponding to the course of the grooves in vertical planes lying above one another, whereby the substrate holder exhibits a shaft-like recess which extends from above and which runs parallel to the rails and into which there projects, when passing through the station, a flat heating element extending vertically downwards and arranged above the substrate holder on the upper part of the wall.

The object underlying this prior transport device was to create a substrate retaining system for several substrates and to design said substrate retaining system in such a way that the substrates are capable of being tempered jointly by a single heating source simultaneously and with the same intensity.

The object particularly underlying the present invention is to create a device of the type under discussion that is suitable for improving the electrical and the optical layer characteristics on non-heat-resistant substrates by tempering and in particular to design the device in such a way that the temperature in the environment of the substrates is kept comparatively low.

This object is achieved according to the invention in that the finger-shaped or plate-shaped heating element formed from a magnetic material exhibits at least one conductor loop with current passing through it, said conductor loop interacting with plates consisting of electrically conductive material arranged appropriately on the lateral faces of the substrates facing away from the heating element and constituting together with said electrically conductive material an induction heating element.

The substrate holder preferably exhibits two side parts of frame-shaped design and arranged in parallel planes which between themselves form the shaft-like recess and into the

window-type openings of which the substrates are capable of being placed, whereby the side parts are designed in one piece or are riveted or screwed or connected via joints to the base part and whereby the plates consisting of electrically conductive material have external dimensions such that they are capable of being inserted into the window-type recesses and secured in position therein.

Further preferred embodiments are disclosed in the dependent Claims 2 and 3.

The invention permits the most varied embodiment options; one of these is represented schematically in greater detail in the attached drawing, which shows the section through a device.

As the drawing shows, the device consists of the rollers 7, 8 mounted rotatably on the arms 5, 6 and extending horizontally in the coating chamber 3 on one side wall 4a of the casing 4, the two cathodes 9, 10 arranged rigidly on the side walls 4a, 4b, the plate-shaped element 11 which is held on the upper part 4c of the wall or on the insulator 12 and which is surrounded by a conductor loop 29, the base part 15 provided with rails 13, 14 of the substrate holder 16 of U-shaped cross-section, the two frame-shaped side parts 16a, 16b of the substrate holder 16 holding the substrates 22, 23 and the plates 27, 28, and the two cathodes 19, 20 rigidly arranged on the side walls 4a, 4b with their cathode diaphragms 17, 18, and lastly the extractor socket 21 of a turbomolecular pump which is not shown in any detail.

In the course of operation of the coating station represented schematically in the drawing, the substrates 22, 23 are moved in a direction perpendicular to the intersecting plane until they are located opposite the cathodes 19, 20, as can be seen from the drawing.

After the coating of the outer surfaces 22a, 23a of the substrates 22, 23 the latter are moved on in the same direction (perpendicular to the plane of the drawing) as far as the next processing station. The disc-shaped substrates 22, 23 and also the plates consisting of electrically conductive material 27, 28 are held by the side parts 16a, 16b of the substrate holder 16 surrounding them in the shape of a frame, said substrate holder in turn being rigidly connected to the base part 15 or designed in one piece with the latter. The base part 15 is screwed or welded to a pair of rails 13, 14 which in turn exhibit longitudinal grooves 13a, 14a in which run rollers 7 and 8 respectively which are rotatably supported on arms 5 and 6 respectively, spaced one behind the other in two rows. The spacing which the rows of rollers 5 and 6 exhibit in relation to one another is chosen in such a way that the base part 15 is held and guided on the latter in non-tilting manner.

In order to ensure that the substrates 22, 23 exhibit the temperature necessary for the coating process, on the upper part 4c of the wall of the casing 4 there is attached on an insulator 12 a plate-shaped element 11 which is surrounded by a conductor loop with current passing through it or by a wire-wound coil 29 and which projects into the shaft-like groove 24 and is so dimensioned that the substrates 22, 23 are heated uniformly from their one lateral face as a consequence of induction. In order to keep radiation losses as low as possible and to keep the tempering of both substrates 22, 23 at the same level, the gaps remaining in each case between the heating element 11 and the substrates 22, 23 are equal and as small as possible.

It is clear that the conductor loop 29 interacts not only together with metal plates 27, 28 arranged on the back of the substrates 22, 23 in the sense of an induction heating element, but also with layers applied to the front or back of the substrates and consisting of electrically conductive

material. Likewise, metal foils can be pasted onto the substrates which together with the conductor loop 29 constitute an induction heater.

A substantial advantage consists, in particular, in that the heat to be employed is only generated at the moment when the substrate is located immediately in front of the heater 11, 29, so that the plant itself is not heated any further and the heat - limited locally - can be particularly well controlled.

List of Reference Numbers

3	coating chamber
4	casing
4a	side wall of casing
4b	side wall of casing
4c	upper part of wall of casing
5	arm
6	arm
7	roller
8	roller
9	cathode
10	cathode
11	plate-shaped element, winding body
12	insulator
13	rail
13a	longitudinal groove
14	rail
14a	longitudinal groove
15	base part
16	substrate holder
16a	side part of substrate holder
16b	side part of substrate holder
17	cathode diaphragm
18	cathode diaphragm
19	cathode
20	cathode
21	extractor socket
22	substrate
22a	outer surface of substrate
23	substrate
23a	outer surface of substrate
24	shaft-like groove
25	window-shaped recess
26	window-shaped recess
27	metal plate

28

metal plate

29

conductor loop



Claims

1. Device for the transport of substrates in vacuum-coating plants having several stations, with substrate holders (16) of roughly plate-shaped, flat, parallelepipedic configuration which in vertical position are capable of being moved through the stations along a predetermined transport path and which interact with rails (13, 14) which are each provided in the region of their base part (15) below the substrates (22, 23) that are capable of being attached to the substrate holders (16), whereby the substrate holder (16) exhibits a shaft-like recess (24) which extends from above into the region of its base part (15) and which runs parallel to the rails (13, 14) and into which there projects, when passing through the station, a flat element (11) extending vertically downwards and arranged above the substrate holder (16) on the upper part (4c) of the wall, characterised in that the finger-shaped or plate-shaped element (11) formed from a magnetic material exhibits at least one conductor loop (29) through which electric current passes, whereby said conductor loop interacts with plates, foils or layers consisting of electrically conductive material (27, 28) which are arranged on the lateral faces of the substrates (22, 23) facing away from the element (11) or which are rigidly connected to the substrates and said conductor loop together with said conductive material constitutes an induction heating element.
2. Device according to Claim 1, characterised in that the substrate holder (16) exhibits two frame-shaped side parts (16a, 16b) arranged in parallel planes, whereby said side parts form between themselves the shaft-like recess (24) and the substrates (22, 23) are capable of being placed into the window-type openings (25, 26) of said side parts,

whereby the side parts (16a, 16b) are formed in one piece or are riveted or screwed together or connected via joints to the base part (15) and whereby the plates or foils (27, 28) consisting of electrically conductive material have external dimensions such that they are capable of being inserted into the window-type openings (25, 26) and secured in position therein.

3. Device according to Claim 1, characterised in that the plates (27, 28) are formed in one piece with the substrates (22, 23) from electrically conductive material and are arranged as a layer on the back of the substrates (22, 23) or on the lateral face thereof facing the cathodes (19, 20).

