

DESCRIPTION

The invention relates to a process for coating the inner faces of meander-shaped single-tube glass vessels with a suspension and to an apparatus for carrying out the process.

- 5 By "meander-shaped" and "in meander shape" is meant in the sense of the invention: folded U-shaped in continuous connection.

Low pressure fluorescent lights, more particularly fluorescent lamps, are used on a wide scale for electric
10 light production. Compared with light bulbs they produce a high light output and a long service life.

Producing light by low pressure fluorescent lamps takes place by the process of a gas discharge in a discharge vessel; Electrons accelerated in an electrical field excite
15 by shocks gas atoms which discharge the absorbed excitation energy again after a short time in the form of UV-light quanta which in turn are converted in a luminous substance applied to the inner walls of the discharge vessel into visible light.

20 Processes for coating the insides of known discharge vessels, approximately rod-shaped or U-shaped glass tubes, with luminous substance are known. The processes follow the principle of "filling and drying" or "filling, up-ending and drying". A suspension is cast, sprayed or
25 pneumatically pressed into a discharge vessel. This process

is called elutriating the discharge vessel. Then the excess suspension, possibly after turning the discharge vessel upside down, runs naturally out of the discharge vessel again. A drying process follows.

- 5 This type of procedure is satisfactory in the case of discharge vessels having a simple geometric shape.

Fluorescent lamps which as opposed to the conventional tubular fluorescent lamps are characterised by a folded discharge vessel and thus have small dimensions are called
10 compact lamps.

The discharge vessel is with the known compact lamps formed by placing two or more U-shaped together in a row wherein two U-tubes are connected together through a hole-type connecting area on each of their arms. Such discharge
15 vessels cannot be elutriated as a whole on the "filling, up-ending and drying" principle. Instead the individual U-shaped tubes are elutriated before they are combined into the discharge vessel. The hole-type connecting areas of the U-tubes which are only formed after elutriation are
20 therefore by necessity not or only minimally coated with luminous substance. Such a condition must be regarded as unsatisfactory.

Single tube glass vessels in meander shape are the subject of German Patent Application P 41 19 852.2 "Process and
25 apparatus for producing single-tube glass vessels in meander shape" as well as German Patent Application P 42 14 542.2

"Multiple-folded single tube glass vessels as well as apparatus and process for manufacturing same" belonging to the applicant. These relate to multiple folded single tube glass vessels with at least four straight parts arranged in parallel with each other and connected together by U-shaped sections and whose two open tube ends lie next to one another.

Vessels of this kind are particularly suitable as discharge vessels for compact lamps. They are characterised compared to the known discharge vessels for compact lamps by substantially constant wall thickness and a substantially continuously constant diameter, ie they have no narrow restrictions and no dead spaces.

Processes for evenly coating the inner walls of single tube glass vessels in meander shape with suspension are not known. There is no relevant prior art.

Single tube glass vessels in meander shape cannot be coated evenly fault-free according to the principle of "filling, up-ending and drying". Thus as the suspension is filled into the single tube glass vessel and as it runs out from same it would eddy in the bends and arms of the tube so that damaging air bubbles would arise. Suspensions are very difficult to handle owing to their chemical and physical properties; they tend easily to form bubbles and streaks. Uniform coating requires a continuous eddy-free elutriation.

Also excess suspension would not run evenly out from the

single tube glass vessel when the latter is turned upside down but would collect unevenly in the bends and arms of the vessel.

The object of the invention is to provide a process and
5 apparatus for evenly coating the inner faces of meander-shaped single tube glass vessels with a suspension.

According to the invention this is achieved by the characterizing parts of claims 1 and 9.

According to the invention a meander-shaped single tube
10 glass vessel after the addition of a measured amount of suspension into one of the two open arms carries out a horizontal and up and down movement. At the same time the single tube glass vessel rotates axially parallel to a longitudinal axis defined by the straight parts of the
15 meander-shaped single tube glass vessel. The arms of the single tube glass vessel occupy a horizontal position between the change-over points between the up and down movement. After the end of the movement the single tube glass vessel is dried with the open tube ends pointing
20 downwards.

As opposed to the known processes, the process according to the invention allows even internal coating of meander-shaped single tube glass vessels with a suspension.

A longitudinal axis is defined by the straight parts of the
25 meander-shaped single tube glass vessel. An axial rotation

of a meander-shaped single tube glass vessel in the sense of the invention is a rotation about an axis which runs parallel to the straight parts of the single tube glass vessel and more particularly through the centre of gravity
5 of same.

It is particularly advantageous if the meander-shaped single tube glass vessel is located in a vertical still position during the drying of the suspension.

It is within the scope of the invention that the meander-
10 shaped single tube glass vessel after being coated with a suspension enters a drying station with its tube ends pointing downwards. Any excess suspension thereby drips off and uniform drying of the suspension takes place. Drying of the suspension thereby begins at the U-bends of the meander-
15 shaped single tube glass vessel which now lie at the top.

In a preferred embodiment the suspension is dried by means of dry hot air or heat radiation.

It is particularly advantageous if the suspension runs through the meander-shaped single tube glass vessel several
20 times during the coating process, preferably two to four times, forwards and backwards.

It is also advantageous if the dosed amount of suspension which is added to one of the open arms of the meander-shaped single tube glass vessel corresponds to the amount required
25 for coating.

It is within the scope of the invention that meander-shaped single tube glass vessels with pipe diameters of more than 8 mm are coated.

It is particularly advantageous to use the process according to the invention to coat the inner faces of meander-shape single tube glass vessels which are used as discharge vessels for the production of compact lamps. A suspension of fluorescent substance is particularly used as a suspension in this case.

10 An apparatus for carrying out the process consists of a chain conveyor, glass vessel holders, rotation devices, a dosing device and a drying station. According to the invention the glass vessel holders are fixed with an integrated cam disc at regular intervals on an endless chain drive through an articulated joint with a degree of vertical freedom. Rotation devices are mounted in front of the drying path in order to move the glass vessel holders in succession in opposite rotation during simultaneous tilting movement.

20 The rotation devices run parallel to the chain drive. Furthermore they lie in the plane defined by the chain drive. The path of movement according to the invention of a glass vessel holder and thus of the glass vessel itself is produced through the drive element of a coupling of the integrated cam disc with the rotation devices. The rotational speed and direction of a glass vessel holder thereby follows from the relative speed between the chain

drive and rotation device.

A dosing device which is mounted in front of the rotation devices fills one of the open arms of the glass vessel with suspension. The corresponding glass vessel holder with
5 integrated cam disc is moved by means of the chain drive and rotation devices so that the glass vessel is uniformly coated with suspension. After passing the rotation devices the glass vessel holder is guided over rails downwards so that the open ends of the glass vessel point downwards. In
10 this position the vessel holder enters the drying path. After passing the drying path the glass vessel is removed from the glass vessel holder.

It is particularly advantageous if the glass vessel holders are ball-mounted on a joint. The rotation devices are
15 preferably designed as rotary direction belts.

In a preferred embodiment the drying path is designed as a hot air or radiation tunnel.

In an advantageous design the relative speed between chain drive and rotation device is selected so that a glass vessel
20 holder rotates several times, more particularly three to five times about its own axis along a rotation device.

The integrated cam disc has advantageously an oval shape so that the tilting movement of the vessel holder is carried out sinusoidally.

It is within the scope of the invention that the integrated cam discs are moved through a friction coupling of the rotation devices.

Advantageously several rotation devices, more particularly
5 two to four are mounted in succession.

The invention will now be explained in further detail with reference to an embodiment shown in the accompanying drawings in which:

- Figure 1 is a diagrammatic illustration of an apparatus for
10 carrying out the process and
Figure 2 is a diagrammatic illustration of the path of movement of the single tube glass vessel in a meander shape.

A glass vessel holder 1 with integrated cam disc 2 is fixed
15 by a vertically movable joint 3 on a chain 6 which is driven by chain wheels 7. The chain 6 and chain wheels 7 form an endless chain drive. The glass vessel holder is ball mounted on a ball bearing 5 so that it can rotate about its own axis.

20 The glass vessel 4 is taken up by the glass vessel holder. A dosing device 8 fills one of the open arms of the glass vessel with suspension. This arm is thereby located in an inclined upright position.

After the dosing device two rotary direction belts 9 and 10

are mounted in succession parallel to the chain drive. The rotary speed of the rotary direction belts is with one of the two belts greater than the speed of the chain drive and with the other belt less than the speed of the chain drive so that two relative speeds of opposite directions are produced.

The glass vessel holder 1 is guided by the chain 6 onto the rotary direction belt 9. Rotation as well as a tilting movement of the glass vessel holder 1 are produced through the drive element of a friction coupling of the integrated cam disc 2 with the rotary direction belt 9. Owing to the relative speed between the cam disc 2 and the rotary direction belt 9 the cam disc 2 and thus the glass vessel 4 are set in rotation. In addition to the rotational movement the glass vessel holder 2 also carries out a tilting movement which is determined by the shape of the cam disc 2. In the embodiment the integrated cam disc 2 has an oval shape so that the tilting movement of the cam disc 2 takes place sinusoidally (Figure 2).

The relative speed between the chain drive 6 and rotary direction belts 9 and 10 is selected so that the glass vessel holder rotates three to five times about its own axis along the rotary direction belts. It is thereby ensured that the suspension is evenly distributed over the inner wall of the glass vessel.

When the glass vessel holder 1 reaches the end of the rotary direction belt 9 through the continuous movement of

the chain the suspension still remaining collects in the open arm which had not previously been filled with the suspension.

5 The glass vessel holder 1 is guided further onto the rotary direction belt 10. Through the coupling of the integrated cam disc 2 on the rotary direction belt 10 the glass vessel holder 1 is moved in the previously described way but, owing to a different relative speed between chain 6 and rotary direction belt 10, the rotation of the glass vessel holder 10 1 takes place in the reverse direction, compared with the movement with the rotary direction belt 9.

After passing the rotary direction belt 10 the glass vessel holder is guided down over rails so that the open ends of the glass vessel point downwards. In this position the 15 glass vessel holder enters the drying path which consists of several hot air stations 11. After the drying path the glass vessel is removed from the glass vessel holder.



PATENT CLAIMS:

1. Process for coating the inner faces of a meander-shaped single tube glass vessel with suspensions, more particularly fluorescent suspensions, characterised in that the single
5 tube glass vessel after the addition of a dosed amount of suspension in one of the open arms carries out a horizontal and tilting movement rotating axially parallel to a longitudinal axis defined by the straight parts of the meander-shaped single tube glass vessel wherein the arms of
10 the single tube glass vessel between the reversal points of the tilting movement occupy a horizontal position and then the single tube glass vessel is dried with the open tube ends facing downwards.
2. Process according to claim 1 characterised in that the
15 single tube glass vessel is located in a vertical still position during drying of the suspension.
3. Process according to claim 1 or 2 characterised in that the single tube glass vessel after coating with a suspension with the open tube ends facing downwards enters a drying
20 path in which excess suspension drips off and even drying of the suspension is carried out.
4. Process according to at least one of claims 1 to 3 characterised in that drying begins at the U-bends of the single tube glass vessel which lie at the top.
- 25 5. Process according to at least one of claims 1 to 4



characterised in that drying is carried out by means of dry hot air or heat radiation.

6. Process according to at least one of claims 1 to 5 characterised in that the suspension runs forwards and
5 backwards through the single tube glass vessel several times, preferably two to four times, during the coating process.

7. Process according to at least one of claims 1 to 6 characterised in that the dosed amount of suspension
10 corresponds to the amount required for coating.

8. Process according to at least one of claims 1 to 7 characterised in that single tube glass vessels with pipe diameters of more than 8 mm are coated.

9. Apparatus for carrying out the process according to at
15 least one of claims 1 to 8 comprising a chain conveyor, glass vessel holders, rotation devices, a dosing apparatus and a drying path,
characterised in that the glass vessel holders (1) are mounted with integrated cam discs (2) on an endless chain
20 drive and that rotation devices are mounted in front of the drying path in order to move the glass vessel holders (1) in succession in opposite rotation during simultaneous tilting movement.

10. Apparatus according to claim 9 characterised in that
25 the glass vessel holders (1) are ball-mounted on a joint.



11. Apparatus according to claim 9 or 10 characterised in that the rotation devices are designed as rotary direction belts (9,10).
12. Apparatus according to at least one of claims 9 to 11
5 characterised in that the drying path is designed as a hot air or radiation tunnel.
13. Apparatus according to at least one of claims 9 to 12 characterised in that a glass vessel holder rotates along a rotation device three to five times about its own axis.
- 10 14. Apparatus according to at least one of claims 9 to 13 characterised in that an integrated cam disc (2) is shaped so that the tilting movement of a glass holder (1) is carried out sinusoidally.
- 15 15. Apparatus according to at least one of claims 9 to 14 characterised in that an integrated cam disc (2) is moved through a friction coupling of the rotation devices.
16. Apparatus according to at least one of claims 9 to 15 characterised in that more particularly two to four rotation devices are mounted in front of the drying path.