



Device for cleaning the surface of lift-out rollers of a float plant for producing a floated glass ribbon

The invention relates to a device for cleaning the surface of lift-out rollers of a float plant for producing a floated glass ribbon, the lift-out rollers drawing out the glass ribbon at the end of the float bath from the surface of the tin bath and transporting it further on its upper side. The glass ribbon is thereby drawn out in a lifting box by means of 2 or 3 lift-out rollers from the tin surface of the float bath. The glass ribbon has therefore tin and oxides of tin (SnO , SnO_2) on the underside. During contact of the underside of the glass ribbon with the surface of the lift-out rollers, the result is contamination of the lift-out rollers with the tin and the tin oxides (dross).

Normally the roller body of the lift-out roller is formed from heat-resistant steel. Particles of tin and/or tin oxides (dross) remain adhering to the surface of the roller bodies due to adhesion forces. Alloys are formed from the components of the roller body (iron, chrome, nickel) and from the adherent tin and/or tin oxides. This alloy formation occurs all the faster the higher are the temperatures in the lifting box.

The tin adhesion, the alloy formation and the oxidation lead to deposits and local corrosion of the surface of the roller body. These defects on the surface of the roller body of the lift-out roller lead to glass defects, such as scratches, roller imprints, microcracks etc.

An attempt is usually made to remove these deposits on the roller body from the surface of the lift-out roller by means of wire brushes. However, this is generally not very effective. If the glass defects on the underside of the glass ribbon increase due to contamination by tin and tin oxides, the lift-out rollers must be replaced.



An improvement in the quality of the floated glass ribbon can be achieved by using lift-out rollers with a roller body made of ceramic. In particular slip cast and sintered fused silica ceramic is thereby used. This fused silica ceramic is inert to tin and tin oxides so that no alloy formation takes place. In addition, the fused silica ceramic does not react with sulphur and sulphur compounds. Lift-out rollers of this type with a roller body made of fused silica ceramic and with a continuous roller axle made of heat-resistant steel are known from JP 07-069657 A and JP 07-069658 A.

As JP 2000-154028 A shows, lift-out rollers are also known in which the roller body formed from fused silica ceramic bears a coating of an inorganic, non-metallic substance.

One disadvantage of the lift-out rollers formed from a ceramic roller body is the low mechanical resistance to cleaning appliances (mechanical brushes, scrapers, shavers, etc.). The surface of lift-out rollers of this type is therefore normally cleaned continuously of adherent foreign particles by means of blocks made of graphite being pressed thereon. The graphite blocks are pressed against the lift-out rollers from below by means of a resilient force. The disadvantage of graphite is the inadequate thermal resistance in an oxidising atmosphere. The oxidation of carbon begins from 600°C. The graphite "burns". Temperatures > 700°C on the lift-out rollers are required in particular when floating special glasses with a high strain point. The service life of the graphite cleaning blocks is very low. The low oxidation resistance of the graphite also does not permit use of "carbon" for the roller bodies, as is proposed in JP 11-302029 A.

It is the object of the invention to produce a device of the initially mentioned type which permits continuous cleaning of the surface of the lift-out rollers but which does not thereby mechanically damage the roller surface. In addition, it is intended to be ensured that no damaging residues are left behind on the roller surface and on the underside of the glass ribbon and that a temperature resistance > 600 to 800°C is given.

This object is achieved according to the invention in that cleaning blocks are supported on the undersides of the lift-out rollers, which cleaning blocks are formed from a mixture of hexagonal BN with finely ground hard materials, such as SiC, ZrO₂ and/or Al₂O₃.

The hexagonal BN (boron nitride) has graphite structure and is similar in its mechanical and thermal properties to graphite. The maximum usage temperature of hexagonal BN in air is 1000°C. BN is not included in hard materials due to the relatively low hardness (2300 according to Knoop, Vickers hardness approximately 20). Boron nitride (BN) can therefore not damage the surface of the lift-out rollers which are formed from special steel or fused silica ceramic. Because of the low hardness of BN, the cleaning effect is admittedly smaller than with graphite. A material is therefore required which has the thermal properties of hexagonal BN and the mechanical properties of graphite. Such an optimised material for the cleaning blocks is found in the mixture of hexagonal BN with finely ground hard materials, such as SiC, ZrO₂ and/or Al₂O₃.

According to the type and proportion of the finely ground hard materials, the resistance to wear and tear of the lift-out rollers can be set in a defined manner. The resistance to wear and tear of the cleaning blocks must thereby be smaller than that of the roller bodies but large enough to achieve an adequate cleaning of the surface of the roller bodies.

In order to maintain the cleaning uniformly, a development of the invention provides that the cleaning blocks abut against the underside of the lift-out rollers under the tension of a pressure spring. It can thereby be provided in addition in order to achieve a sufficiently large cleaning surface that the abutting face of the cleaning blocks is adapted to the curved circumferential face of the lift-out rollers.

The construction of the cleaning blocks is advantageously such that they comprise a graphite basic body and an insert made of hexagonal BN with the hard materials, which is inserted into the graphite basic body orientated towards the lift-out roller.

Insert and basic body are consequently combined into a cleaning block in that the insert is connected to the graphite basic body by means of a tongue and groove joint, in particular a dovetail joint, the joint being aligned in the axial direction of the lift-out rollers.

Since the width of the glass ribbon can indeed be significantly large, it is provided for production reasons that a plurality of cleaning blocks is disposed next to each other in the axial direction of the lift-out rollers.

A particularly suitable mixture for the inserts of the cleaning blocks comprises 50% by weight hexagonal BN, 10% by weight SiC and 40% by weight ZrO_2 and is produced into a shaped body by hot pressing or high-temperature isostatic pressing.

It is provided according to a development of the invention that the cleaning blocks are supported in a mounting by means of pressure springs and that the mounting with the cleaning block is adjustable and lockable vertically in the direction of the underside of the lift-out roller by means of an adjustment device, then the cleaning blocks can be re-adjusted correspondingly after use. The lift-out rollers still comprise a roller body placed upon a steel roller axle, which roller body is made of heat-resistant steel or ceramic, such as slip cast and sintered fused silica ceramic.

The device according to the invention with cleaning blocks comprising a mixture of hexagonal BN with finely ground hard materials, such as SiC, ZrO_2 and/or Al_2O_3 has substantial advantages relative to a cleaning block made of graphite. On the one hand, an oxidation resistance up to 1000°C

and a greater resistance to wear and tear is achieved. The cleaning effect on the surface of the lift-out rollers is improved without however fear of damage to the surface of the roller body so that glass defects due to defects in the surface of the roller body are avoided.

In addition a thin film made of the materials of the cleaning block, i.e. of the insert with the new material mixture, is formed on the surface of the lift-out rollers. This film is not wetted by the glass melt and therefore acts as protective layer for the lift-out rollers, i.e. their roller bodies.

The invention is described in more detail with reference to an embodiment illustrated in the drawing which shows:

Fig. 1 a partial view which extends in the region of a lift-out roller over a part of the width of the float bath,

Fig. 2 a partial longitudinal section through the transition region from the float bath to the lift-out device,

Fig. 3 a cleaning block with an insert made of a material mixture according to the invention which is connected to a basic body made of graphite,

Fig. 4 and 5 in two views rotated by 90°, an assembled cleaning block in which the insert is connected to the basic body made of graphite via a dovetail joint.

In the production of float glass according to the float method, it is normal to melt the glass in a glass melt bath, to refine it and to supply it to the float bath in a feeding channel with adjustable adjustment slides (Tweel) via a spout lip, the glass melt proceeding towards the upper side of a tin bath.

A lift-out device with lift-out rollers 10, 10.1, 10.2 and 10.3 (Fig. 1 and 2) adjoins the float bath, said lift-out rollers drawing out the floated glass ribbon from the surface 31 of the tin bath and transporting it further via its upper sides. A lift-out roller 10, 10.1, 10.2 and 10.3 can thereby have a roller axle 11 made of steel which are set in rotational movements via their ends 12. The roller axle 11 carries a roller body, formed from heat-resistant steel, for example special steel or ceramic, for example slip cast and sintered fused silica ceramic.

The lift-out device has, as Fig. 2 shows, three lift-out rollers 10.1, 10.2 and 10.3, the upper side of which is adjusted above the surface 31 of the tin bath. A cleaning device is disposed thereby underneath each lift-out roller and comprises a plurality of cleaning blocks 20 combined together in the axial direction of the lift-out roller. These cleaning blocks 20 are retained by means of pressure springs 25 under tension on the underside of the lift-out rollers 10.1, 10.2 and 10.3 in order to obtain an adequate cleaning effect. The cleaning blocks 20 are thereby fixed in a mounting 13 on which the pressure springs 25 are supported. The mounting 13 with the cleaning blocks 20 can be adjusted vertically and readjusted via an adjustment device 14, 15. The cleaned item can thereby be collected and taken away.

In Figs. 1 and 2, only the parts which are of importance for explaining the device according to the invention are provided with reference numbers. The design and arrangement of the remaining parts of the float plant are undertaken in the known manner.

The cleaning block 20 can be assembled from a basic body 22 made of graphite and from an insert 21 produced from the new material mixture, as Fig. 3 shows. The combination of the insert 21 with the basic body 22 can thereby be effected by a tongue and groove joint 23, the joining direction of which (insertion) is directed parallel to the roller axle 11 of the lift-out roller 10, 10.1, 10.2 or 10.3.

As the two views according to Fig. 4 and 5 show, the insert 21 can also be connected to the basic body 22 via a dovetail joint 24. In each case, the insert 21 cannot be detached from the basic body 22 due to the choice of connection direction, if the lift-out roller 10, 10.1, 10.2 or 10.3 exerts a tensile force counter to the direction of the moved glass ribbon on the inserts 21.

The entire cleaning block does not therefore require to be produced completely from the new material mixture. A fraction of the total volume suffices, as the inserts of the lift-out rollers 10.1, 10.2 and 10.3, which are orientated towards the undersides of the roller bodies, show.

What is crucial in the new device is the material choice for the inserts 21 of the cleaning blocks 20. It should thereby be mentioned also that also only cleaning blocks 20 which are then produced from the new material mixture can be used in the size and shape of the inserts 21. A material mixture comprising 50% by weight hexagonal boron nitride (BN) with finely ground hard materials, such as SiC, ZrO₂ and/or Al₂O₃, in particular 10% by weight SiC and 40% by weight ZrO₂, has proved to be particularly suitable, said material mixture being hot pressed into a shaped body.

Claims

1. Device for cleaning the surface of lift-out rollers of a float plant for producing a floated glass ribbon by means of cleaning blocks, the lift-out rollers drawing out the floated glass ribbon at the end of the float bath from the surface of the tin bath and transporting it further on its upper side,
characterised in that
cleaning blocks (20) are supported on the undersides of the lift-out rollers (10, 10.1, 10.2, 10.3), said cleaning blocks comprising a mixture of hexagonal BN with finely ground hard materials, such as SiC, ZrO₂ and/or Al₂O₃.
2. Device according to claim 1,
characterised in that
the cleaning blocks (20) abut against the underside of the lift-out rollers (10, 10.1, 10.2, 10.3) under the tension of a pressure spring (25).
3. Device according to claim 1 or 2,
characterised in that
the abutting face of the cleaning blocks (20) is adapted to the curved circumferential face of the lift-out rollers (10, 10.1, 10.2, 10.3).
4. Device according to one of the claims 1 to 3,
characterised in that
the cleaning blocks (20) comprise a graphite basic body (22) and an insert (21) made of hexagonal BN with the hard materials, which is inserted into the graphite basic body (2) orientated towards the lift-out roller (10, 10.1, 10.2, 10.3).
5. Device according to claim 4,
characterised in that

the insert (21) is connected to the graphite basic body (22) by means of a tongue and groove joint (23), in particular a dovetail joint (24), the joint being aligned in the axial direction of the lift-out rollers (10, 10.1, 10.2, 10.3).

6. Device according to one of the claims 1 to 5, characterised in that a plurality of cleaning blocks (20) is disposed next to each other in the axial direction of the lift-out rollers (10, 10.1, 10.2, 10.3).
7. Device according to one of the claims 1 to 6, characterised in that the inserts (21) of the cleaning blocks (20) are produced from a mixture comprising 50% by weight hexagonal BN, 10% by weight SiC and 40% by weight ZrO₂ by hot pressing or high-temperature isostatic pressing.
8. Device according to one of the claims 1 to 7, characterised in that the cleaning blocks (20) are supported in a mounting (13) by means of pressure springs and in that the mounting (13) with the cleaning block (20) is adjustable and lockable vertically in the direction of the underside of the lift-out roller (10, 10.1, 10.2, 10.3) by means of an adjustment device (14, 15).
9. Device according to one of the claims 1 to 8, characterised in that the lift-out rollers (10, 10.1, 10.2, 10.3) have a roller body placed upon a steel roller axle (11), which roller body is made of heat-resistant steel or ceramic, such as slip cast and sintered fused silica ceramic.