Dec. 15, 1942. F. B. WALDRON ET AL 2,304,974

APPARATUS FOR PRODUCING A GROUND OR POLISHED CONTINUOUS STRIP OF GLASS

Filed Oct. 25, 1941 2 Sheets-Sheet 1

FIG. 1.

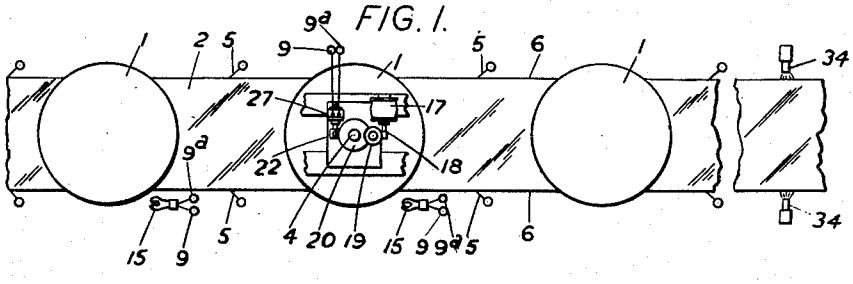

FIG. 2.

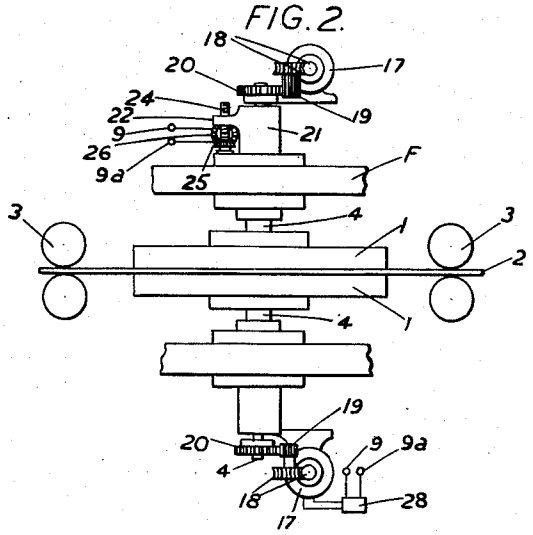

FIG. 3.

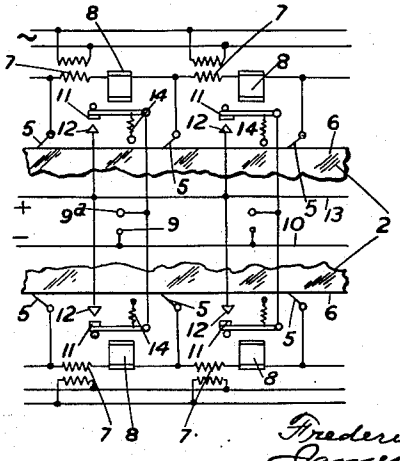

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FIG. 4.

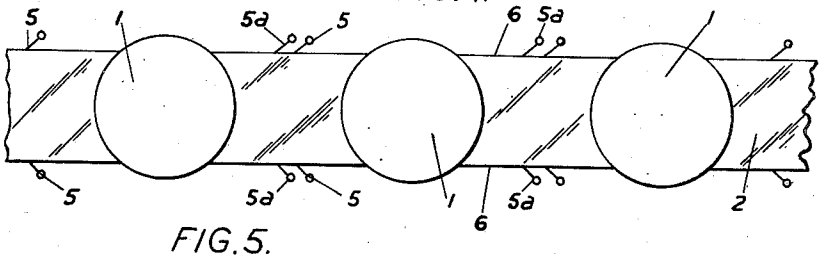


FIG. 5.

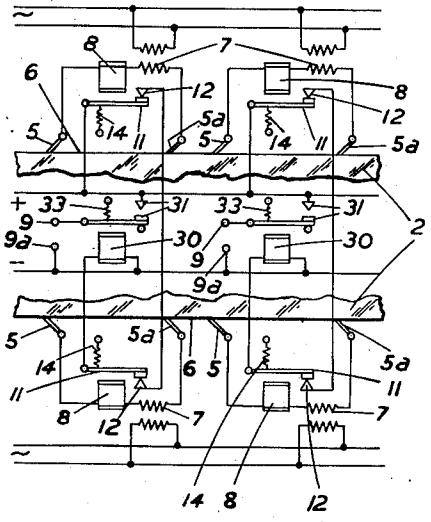


FIG. 7.

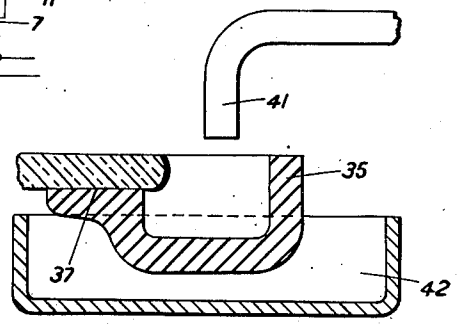
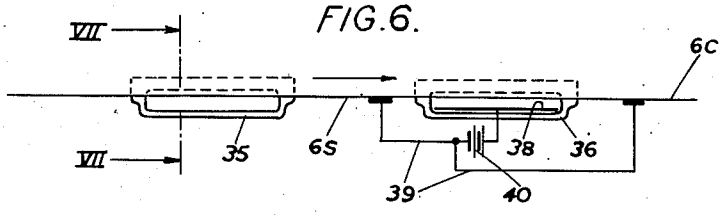


FIG. 6.



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APPARATUS FOR PRODUCING GROUND OR POLISHED CONTINUOUS STRIPS OF GLASS

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In Great Britain November 27, 1940

15 Claims. (Cl. 51—112)

This invention relates to apparatus for producing a continuous strip of ground or ground and polished glass.

In the type of apparatus to which the invention is applicable, a strip of glass is formed from molten glass in a tank, is passed through a lehr and then through a grinding apparatus followed, if the strip is to be polished, by a polishing apparatus. In the grinding and polishing apparatus the tools are in pairs, the two tools of each pair operating opposite to each other on the upper and lower surfaces of the strip. The lower tools are usually adjusted in height so that the series of tools form a plane surface on which the strip rests, while the upper tools are adapted to be raised from and let down on to the strip, with means for adjusting the yielding pressure they exert on the strip.

The strip is normally continuous from the forming apparatus to the further end of the grinding or grinding and polishing apparatus, but from time to time the strip cracks across in its passage through the apparatus. The fact of the strip being non-continuous by reason of such a crack does not per se interrupt the continuous operation of the apparatus, because the strip is driven through the apparatus by pairs of rollers between each pair of tools, and the two lengths of strip are driven independently through the apparatus. A crack in the glass generally results in the glass being broken into pieces and the pieces are flung about violently. In the use of a polishing tool the broken pieces damage the felts and splinters of glass become embedded in the felts and have to be removed before the operation of the tool is continued.

In practice it is found that cracks in the glass usually take place under the grinding or polishing tools, and the main object of the present invention is to enable an upper operating tool to be raised in the shortest possible time after a crack has started. Another object is to stop the rotation of the lower tool, when the upper tool is raised and another object is to raise successive upper tools and stop the corresponding lower tools as the crack approaches them.

According to the present invention a method of controlling machinery used in grinding or polishing simultaneously the two surfaces of glass in continuous strip form consists in applying an electrical conductor to the glass and utilising the discontinuity in the conductor caused by a crack in the glass strip to control electrical means for giving immediately an indication of the existence of the crack.

The present invention also involves a novel principle of control of the machinery used in treating the surface of the glass, which consists in applying an electrical conductor to the glass and utilising the discontinuity in the conductor due to the crack in the travelling glass to control electrically means for raising the upper tool operating on the glass.

Accordingly the invention comprises an installation for grinding or polishing glass wherein a continuous strip travels past rotary operating tools operating on the two surfaces of the strip comprising in combination a sensing means disposed to cooperate with an electrical conductor applied to an edge of the strip for the purpose of detecting any break in the continuity of said conductor, said sensing means comprising a plurality of electrical contact members placed along the path of the edge of the strip and means operative under the control of the sensing means to give an indication of a break in the continuity of the length of conductor between any two adjacent contact members.

In one form of the invention the electrical contacts may be in the form of brushes, each tool having a brush located on either side of it so as to cooperate with the electrical conductor and complete therewith an electrical circuit, the said circuits serving to control means for indicating a break in the continuity of the conductor.

In an installation for grinding or polishing glass constructed according to the present invention, wherein a continuous strip travels between a plurality of pairs of operating tools operating simultaneously on the two surfaces of the strip, and wherein automatic means are provided for raising each of the upper tools from the glass, each tool may have an electrical brush located on either side of it so as to cooperate with the electrical conductor on the glass edge and complete therewith an electrical circuit for controlling the associated tool, each of said circuits incorporating means responsive to a break in the circuit for setting into operation the automatic means for raising the upper tool operating on the length of strip between the two associated brushes.

In order that the invention may be more fully understood two embodiments thereof will now be described by way of example with reference to the accompanying diagrammatic drawings.

In the drawings:

Figure 1 illustrates in plan one form of polishing installation according to the invention;

Figure 2 shows in elevation and to a larger scale one pair of tools and driving mechanism therefor;

Figure 3 is a diagram of the electrical control circuit employed in the installation shown in Figure 1;

Figure 4 illustrates in plan an installation similar to that of Figure 1 but having a modified form of control;

Figure 5 is a diagram of the modified electrical

control circuit of the installation shown in Figure 4; and

Figures 6 and 7 show a means of depositing electrolytically an electrical conducting layer on an edge of the glass, Figure 7 being a view in section on the line VII—VII of Figure 6.

In the drawings like references designate the same or similar parts.

In the construction shown in Figures 1 to 3 the installation comprises a plurality of equally spaced-coaxial pairs of polishing tools 1 of known form of which three pairs are shown in Figure 1 and one pair only in Figure 2, between which pairs of tools the horizontal strip of glass 2 is driven by rollers 3 (Figure 2). Only the upper tool 1 of each pair is visible in Figure 1, the lower tool being on the lower side of the strip 2 immediately below the upper tool.

Each tool 1 is rotated by a vertical shaft 4 and the shafts of the two tools of a pair are in line.

Spaced along the path of the edge of the glass strip 2 is a plurality of electrical brushes 5, there being one brush located in contact with an electrical conducting strip 6 applied to each edge of the glass strip, between each two adjacent pairs of tools 1 as shown in Figure 1.

Connected in series with each two adjacent brushes 5 is the secondary winding 7 of a transformer (Figure 3) and a relay 8 serving to control the supply of current to a pair of terminals 9, 9a, across which may be connected an electrical device for giving an indication of the presence of a crack in the glass strip 2.

The two brushes 5 with winding 7 and relay 8 constitute a sensing means for detecting a break of continuity in the length of conducting strip 6 between the two brushes.

Where, as shown in Figure 2, brushes 5 are provided to sense each edge of the strip 2, a separate circuit is provided for each pair of adjacent brushes on both sides of the strip.

The terminal 9 (see Figure 3) is connected to one supply line 10 while the other terminal 9a is connected to the movable contacts 11 of both the relays 8 and the fixed contacts 12 of these relays are both connected to the other line 13 of the supply. A spring 14 tends to close the relay contacts 11, 12, but as long as the conducting strip 6 remains uninterrupted the circuit through the transformer secondary 7, relay 8, brushes 5 and conducting strip 6 remains unbroken and the relay 8 remains energised thereby maintaining its contacts 11, 12 open. Should a crack develop, however, in either edge of the glass then the conducting strip 6 will be interrupted and the aforesaid circuit will be broken, resulting in de-energisation of the appropriate relay 8. Thereupon the spring 14 closes the contacts 11, 12, thus energising the circuit containing the terminals 9, 9a.

The electrical device which is connected across the terminals 9, 9a, may be a lamp 15 as shown in Figure 1 for giving a visual indication of the presence of the crack, or it may be a device for giving an audible indication. Thereby the operator is advised of the position of a crack as soon as it occurs and is able quickly to raise the upper tool operating on the length of glass in which the crack is, and to stop the operation of the lower tool. Similarly an operator can, on hearing or seeing a signal, relive the pressure applied to the glass by the top rollers of a driving pair disposed between the operating tools.

Preferably, however, as also shown in Figure 1, the relays 8 in addition to or instead of controlling a signal, for example the lamp 15, serves to control automatic means for raising the upper tool from the glass strip 2.

Each shaft 4 carrying the upper and lower tools is, in the example shown, driven in the usual manner from an independent motor 17 through worm gearing 18, a pinion 19 and a spur wheel 20 secured to the associated driving shaft 4 (see Figures 1 and 2).

The upper tool is provided in the known manner with automatic means for raising it clear of the glass, and a motor driven form of automatic means is shown diagrammatically in Figures 1 and 2 wherein the shaft 4 for the upper tool is mounted in a sleeve 21 which is disposed to slide vertically on the fixed frame F and carries a lateral extension 22 having an internally screw threaded bore with which engages a screw threaded spindle 24 of which the lower end bears on the frame F. Secured to the spindle 24 is a bevel wheel 25 meshing with a bevel wheel 26 secured to the shaft of a motor 27 (Figure 1).

In order to operate the raising means automatically immediately a crack is detected by the brushes 5, the motor 27 is connected in series with the terminals 9, 9a, so that when the contacts 11, 12 of either relay 8 close due to a crack in the glass, the motor 27 revolves so as to rotate the spindle 24 in a direction to raise the sleeve 21 and therefore the upper tool 1 clear of the glass strip 2.

The usual safety switch is provided in the motor circuit which is opened when the sleeve 21 reaches the limit of its travel.

The terminals 9, 9a may also be connected to a contactor switch 28 (Figure 2) serving to control the current supply to the driving motor 17 for the lower tool in such a way as to stop the rotation of the lower tool by cutting off the current supply to its motor when the circuit of the terminals 9, 9a is interrupted.

Figures 4 and 5 illustrate a modified arrangement in which the brushes are arranged in separate pairs, there being one pair of brushes 5, 5a at each side of the glass strip for each pair of tools 1.

Each pair of brushes 5 and 5a is connected in series with a relay coil 8 and with the secondary winding 7 of an independent transformer. The contacts 11, 12 of the two relays 8 are connected in series with a third relay coil 30 of which the contacts 31 are connected in series with the terminals 9, 9a.

As long as the circuit through both relay coils 8 remains uninterrupted these relays maintain their contacts open against the action of their springs 14 but when a crack passes between the brushes 5 and 5a of a pair the circuit through one or other relay 8 is interrupted, thereby de-energising the corresponding relay, whereupon the associated spring 14 opens the contacts 11, 12 of this relay thereby de-energising relay 30. A spring 33 then closes the contacts 31 to complete the circuit through the apparatus which is connected across the terminals 9 and 9a, so as to light the signal lamp 15, and operate the motor 27 for raising the upper tool and the contactor switch 28 for stopping the motor 17 driving the lower tool in the manner described with reference to Figures 1 to 3.

In operation, when a crack occurs, the upper tool operating on the length in which the crack is, is lifted and the lower tool stopped. The two lengths of strip continue their travel and, when the crack passes under a brush and enters the

next length, the upper tool in this length is raised before the crack reaches the tool, the lower tool also being stopped. The operator can then re-start the lower tool in the first length and lower the upper tool on to the strip. Continuing, each upper tool is raised and each lower tool stopped automatically before the crack reaches it, and the two lengths of strip, separated by the crack, travel through the whole apparatus without damage and without interruption of the process.

The conducting strips **6** applied to the edges of the glass may be constituted by metal, for example aluminium, sprayed on to the edge of the strip by spray nozzles **34** disposed to direct the spray on to the edge of the strip before the latter reaches the surfacing tools, as indicated diagrammatically in Figure 1.

Any other form of electrically conducting surface may be applied to the extreme edge of the strip, provided that it breaks when the glass cracks. Thus, the edge may be electroplated after preliminary silvering, or a ribbon of metal foil may be applied to the edge by adhesive, or a wire may be run along the edge and attached at intervals to the glass when this is plastic immediately after formation of the strip.

As an example, a method of providing an electrically conducting surface to the glass may consist in disposing open baths under the edge of the glass, one bath **35** in the form of a moulded rubber trough for a silvering solution and a similar bath **36** for a coppering solution (Figure 6), the inner wall of each bath terminating at the upper part in a ledge **37** (Figure 7) which lies against the underside of the glass as a sealing face, and the other walls having a height at least equal to the height of the inner wall and the thickness of the glass so that the glass forms part of the inner wall of the bath and the edge of the glass is submerged in the respective coating solution.

In such an arrangement the silver coat indicated at **6***s* in Figure 6 forms the negative electrode for the coppering bath **36**, while the positive electrode is a copper plate **38** in the bath **36**, circuits indicated at **39** and including a source of current **40** being provided for the coppering bath **36** to cause a deposit **6***c* of the metal to be formed electrolytically on the just previously formed silver surface **6***s*. By this means a conducting surface on the extreme edge of the glass is formed which will be ruptured immediately a crack reaches the glass edge, so that the control device for the tool under which the crack has occurred will be immediately operated. Of course, if the crack should occur between two adjacent pairs of tools the control device for the next pair having regard to the direction of travel of the glass will be operated.

A feed pipe **41** for the silvering solution is provided for the bath **35** and each bath may be provided with an overflow tank shown at **42** in Figure 7 in respect of the silvering tank.

Instead of silvering the edge of the glass, the edge may be coated with graphite as a preliminary to electroplating as will be well understood in the art of electroplating.

Both edges of the strip are provided with an electrically conducting surface when, as in the example shown, brushes are applied to both edges, the control device being operated when either or both surfaces are broken. This provides for the case of a portion of glass at one side only of the strip being broken.

A conducting surface and brushes may, however, be applied to one edge only of the strip, to provide only for the more usual case of a crack extending across the strip.

By the present invention simple and effective means are provided which are particularly useful in preventing a cracked glass sheet from being broken up into small pieces as it passes through the polishers. Accordingly the invention eliminates damage to the polishing felts, protects operators from the effects of broken pieces being flung to the side of the installation by the polishers, and obviates interruption of production from the installation due to splinters of glass becoming embedded in the felts.

It will be understood from the foregoing description that the occurrence of a crack anywhere along the strip will result in the immediate operation of the indicating means and/or the means for raising the upper tool which is in the vicinity of the crack even if the crack develops immediately under a tool, since any break in the electrical conductor on the glass edge will immediately call into operation the control devices for the tools associated with the length of conductor in which the break occurs.

Moreover as the crack approaches each successive pair of tools in its travel through the apparatus, each upper tool will be raised and the corresponding lower tool will be stopped so that the crack may pass between the tools with safety.

We claim:

1. A method of controlling machinery used in surfacing simultaneously the two surfaces of glass in continuous strip form, consisting in applying an electrical conductor to the glass and utilising the discontinuity in the conductor caused by a crack in the glass strip to control electrical means for giving immediately an indication of the existence of the crack.

2. A method of controlling machinery used in surfacing simultaneously the two surfaces of glass in continuous strip form, consisting in applying an electrical conductor to the glass and utilising the discontinuity in the conductor caused by a crack in the glass strip to control electrically means for raising the upper tool operating on the glass in the vicinity of the crack.

3. An insulation for surfacing glass of the kind wherein a continuous strip of glass travels between a plurality of pairs of rotary tools operating simultaneously on the two surfaces of the strip, and comprising a sensing means disposed to cooperate with an electrical conductor applied to an edge of the strip for the purpose of detecting any break in the continuity of said conductor, said sensing means comprising a plurality of electrical contact members placed along the path of the edge of the strip and means operative under the control of the sensing means to give an indication of a break in the continuity of the length of conductor between any two adjacent contact members.

4. An installation for surfacing glass of the kind wherein a continuous strip of glass travels between a plurality of pairs of rotary tools operating simultaneously on the two surfaces of the strip, and comprising a plurality of electrical brushes, one located on each side of each tool so as to cooperate with an electrical conductor applied to an edge of the glass strip, a plurality of electrical circuits each including two brushes and the portion of the conductor between them, means for indicating a break in the continuity

of the conductor, and means in each of said circuits for controlling said indicating means.

5. An installation for surfacing glass of the kind wherein a continuous strip of glass travels between a plurality of pairs of rotary tools operating simultaneously on the two surfaces of the strip and including power driven means for raising each upper tool from the glass, the said installation also including in combination an electrical brush located on either side of each tool so as to cooperate with an electrical conductor applied to an edge of the glass strip, and complete therewith an electrical circuit for controlling the associated tool, and means in each circuit, responsive to a break in said circuit, for setting into operation the power driven means for raising the upper tool operating on the length of strip between the two brushes associated with said tool.

6. An installation according to claim 5, including means for stopping the rotation of the lower tool of each pair, and means operative under the control of each control circuit to render effective the stopping mechanism for the lower tool of the pair of tools operating on the length of strip between the two brushes associated with said pair of tools, when the upper tool of said pair is raised.

7. An installation for surfacing glass of the kind wherein a continuous strip of glass travels between a plurality of pairs of tools operating simultaneously on the two surfaces of the strip, comprising driving means for rotating each tool, means for raising each upper tool from the glass, an electrical conductor applied to an edge of the strip, sensing means disposed to cooperate with the electrical conductor to detect any break in the continuity of the conductor, said sensing means comprising a plurality of electrical contact members adapted to make contact with the conductor and spaced along the edge of the strip, a plurality of electrical circuits each including two of the contact members and the portion of the conductor between them, and means under the control of the sensing means for operating an electrical device when a break occurs in the continuity of the portion of conductor in any one of the electrical circuits.

8. An installation for surfacing glass of the kind wherein a continuous strip of glass travels between a plurality of pairs of tools operating simultaneously on the two surfaces of the strip, comprising driving means for rotating each tool, power driven means for raising each upper tool from the glass, an electrical conductor applied to an edge of the strip, sensing means disposed to cooperate with the electrical conductor to detect any break in the continuity of the conductor, said sensing means comprising a pair of electrical contact members adapted to make contact with the conductor, the two members of the pair being located at the two sides respectively of each upper tool, an electrical circuit associated with each upper tool including each pair of contact members and the portion of the conductor between the members of the pair, and an electrical device in each circuit, responsive to a break in the circuit, for setting into operation the power driven means for raising the upper tool operating on the length of strip between the two contact members associated with said tool.

9. An installation for surfacing glass of the kind wherein a continuous strip of glass travels between a plurality of pairs of tools operating simultaneously on the two surfaces of the strip, comprising driving means for rotating each tool, power driven means for raising each upper tool from the glass, an electrical conductor applied to an edge of the strip, sensing means disposed to cooperate with the electrical conductor to detect any break in the continuity of the conductor, said sensing means comprising a pair of electrical contact members adapted to make contact with the conductor, the two members of the pair being located at the two sides respectively of each upper tool, an electrical circuit associated with each upper tool including each pair of contact members and the portion of the conductor between the members of the pair, an electrical device in each circuit, responsive to a break in the circuit, for setting into operation the power driven means for raising the upper tool operating on the length of strip between the two contact members associated with said tool, and means operative under the control of the electrical circuit associated with each upper tool to stop the driving means for rotating the lower tool of the pair of tools when the upper tool is raised.

10. An installation according to claim 7 in which the electrical conductor is a layer of metal sprayed on to the edge of the glass strip.

11. An installation according to claim 8 in which the electrical conductor is a layer of metal sprayed on to the edge of the glass strip.

12. An installation according to claim 9, in which the electrical conductor is a layer of metal sprayed on to the edge of the glass strip.

13. An installation according to claim 7 including electroplating baths for depositing the conductor on the edge of the glass strip, each bath including an inner wall terminating at the upper part in a ledge disposed to lie against the underside of the glass so as to constitute a sealing face, while the other walls of each bath have a height at least equal to the height of the inner wall and the thickness of the glass so that the glass forms part of the inner wall of the bath and the edge of the glass is submerged in the electrodeposition liquid contained therein.

14. An installation according to claim 8 including electroplating baths for depositing the conductor on the edge of the glass strip, each bath including an inner wall terminating at the upper part in a ledge disposed to lie against the underside of the glass so as to constitute a sealing face, while the other walls of each bath have a height at least equal to the height of the inner wall and the thickness of the glass, so that the glass forms part of the inner wall of the bath and the edge of the glass is submerged in the electrodeposition liquid contained therein.

15. An installation according to claim 9 including electroplating baths for depositing the conductor on the edge of the glass strip, each bath including an inner wall terminating at the upper part in a ledge disposed to lie against the underside of the glass so as to constitute a sealing face, while the other walls of each bath have a height at least equal to the height of the inner wall and the thickness of the glass so that the glass forms part of the inner wall of the bath and the edge of the glass is submerged in the electrodeposition liquid contained therein.

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