



GLASS PLATE CLEAVING MECHANISM AND A TRIMMING DEVICE

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a glass plate cleaving mechanism and a trimming device. More specifically, the invention concerns a glass plate trimming mechanism for separating narrow marginal strips (ears) of glass from a glass plate along preliminarily formed score lines by applying bending forces to glass edges. The invention also concerns a trimming device equipped with the aforementioned cleaving mechanism.

Description Of the Related Art

A glass plate trimming device is known and is described, e.g., in Japanese Unexamined Patent Publication No. 8(1996)-253336. The aforementioned trimming device is provided with upper and lower pressure members for applying a pressure to a glass plate on both sides from the score line. In the case of trimming a glass plate shown in Fig. 10A, the lower pressure members apply pressure forces acting upward from the side of the glass inward with respect to the trimming score lines La and Lb, whereas the upper pressure members apply pressure forces acting downward from the side of the glass G outward with respect to the score lines La and Lb (i.e., from the sides of so-called ears), so that bending forces are developed on both sides of the score lines La and Lb. The ears E separated along the score lines La and Lb, fall down. As



as a result, the main glass body B, which is formed after separation of the ears E (Fig. 10B), is transported to the next treatment position with predetermined dimensions defined by the positions of the score lines.

In the known trimming device the ears separated by trimming fall down into the device and may crush inside the device. In particular, since the separated ears fall under the glass plate transportation path, the device needs a space and a container for collecting the falling debris.

SUMMARY OF THE INVENTION

The present invention is aimed at the solution of the above problems and provides a glass plate cleaving mechanism and a trimming device which perform trimming by separating the peripheral portions and remove the separated ears as waste glass.

A glass plate cleaving mechanism of the present invention comprises:

cleaving members and supporting members for cleaving by applying a pressure to a glass plate in mutually opposite directions and on both sides from the score line, the mechanism being characterized by the fact that:

the cleaving members have pressure elements for applying pressure to the glass plate and first end faces which intersect the pressure elements, the cleaving members can be driven vertically in upward and downward directions;

the supporting members are installed in parallel with said first end faces of the cleaving members, have edges spaced in

the horizontal direction from the first end faces, and can be driven vertically in upward and downward directions;

the first end faces of the cleaving members having first glass suction means opposite to the supporting members.

Since, in the aforementioned construction, the debris of glass formed as a result of cleaving is supported by suction action of the first glass suction means, the glass debris does not fall down on the glass plate transportation path. For example, if the lower surface of the treated glass plate, which rests on the supporting member, is coated with a film and trimming is performed by lowering the cleaving member and separating a marginal piece of glass along a pre-scored line by applying to the upper surface of the glass a downwardly directed force for developing a bending moment, the piece separated by cleaving will remain attached to the film. The aforementioned suspended portion of the separated piece of glass will be supported by the suction action of the first glass plate suction means. This glass debris can be later discarded, e.g., after moving the cleaving member to a predetermined position.

In the cleaving member of the device of the invention the first glass plate suction means is made in the form of a plurality of suction ports which are suctioned to the glass plate under the effect of a negative pressure. The glass debris can be easily separated from the suction means as it can be freely connected to and disconnected from the source vacuum. Provision of a plurality of suction elements facilitates supporting of

narrow elongated glass strips formed as a result of trimming.

The pressure element of the aforementioned cleaving member has a substantially horizontal surface, a glass supporting element that intersects the supporting member via the glass edge, and a second end face. The cleaving mechanism has a glass supporting element with a substantially horizontal surface, so that when the glass plate is transported, e.g., by a belt conveyor, the glass is maintained in a horizontal position with the use of the aforementioned glass supporting element. Since glass debris separated by cleaving from a film-coated glass plate can also be arranged along the second end face, position of the glass debris can be stabilized, and the debris can be more reliably supported, suspended, and held by vacuum action of the first glass suction means. Although the second end face normally has vertical orientation, it can also be inclined.

It is recommended that in the cleaving mechanism of the present invention at least the cleaving members or the supporting members can reciprocate for moving towards each other or away from each other in mutually opposite directions, so that the aforementioned first suction means can approach the separated glass debris suspended from the film. More specifically, when under initial conditions the cleaving member is located closer to the supporting member, there is a higher risk of interference with the separated glass debris. Therefore, under this condition it is recommended to move both members apart, while after cleaving it is recommended to bring the first suction

element toward the glass debris, so that the debris holding conditions can be improved.

Furthermore, the cleaving mechanism of the invention is provided with a glass-receiving means which is located under the edge of the aforementioned supporting member and has a substantially horizontal surface for receiving the glass debris separated by cleaving. The pressure element of the cleaving member has second glass suction means located opposite to the aforementioned glass-receiving element. Such suction means may be required for cleaving glass plates which do not have coating films. If the glass plate is not coated with the film, the debris will fall directly into the glass-receiving means. Furthermore, location of the second suction means in the pressure element of the cleaving member on the side opposite to the glass receiving means facilitates supporting of the glass debris by the suction action.

The aforementioned second suction means formed in the cleaving mechanism for holding the glass plate by suction under effect of a negative pressure can be made in the form of a plurality of elongated suction openings in the surface of the pressure member on the side facing the glass-receiving element. As these suction openings are arranged in longitudinal direction, they prevent misalignment during application of pressure to the glass plate. Irrespective of whether the suction means are made in the form of a single elongated suction opening or of a plurality of longitudinally-arranged suction openings, the suction

action developed under the effect of a negative pressure will reliably hold even a very long and narrow glass strip.

As the cleaving member of the cleaving mechanism of the invention can reciprocate in the longitudinal direction of the first end face, i.e., in the direction parallel to the surface of the elongated glass debris, the latter can be reliably transported to the discarding position without interference with other parts of the mechanism.

Furthermore, in order to improve reliability of supporting of the glass plate with the supporting element, it is preferable to provide the cleaving mechanism of the invention with third glass-holding suction means formed in the aforementioned supporting element.

A glass plate trimming device of the invention comprises:
a transportation device for transporting the glass plate in a horizontal direction;

one of the aforementioned glass plate cleaving mechanisms located near the front end and the rear end of the transportation device;

a front edge detection device for detecting the front edge of the glass plate, the aforementioned front edge detection device being located near the front end of the aforementioned transportation device; and

a rear edge detection device for detecting the rear edge of the glass plate, the aforementioned rear edge detection device being located near the rear end of the aforementioned

transportation device.

The use of the mechanisms described above makes it possible to facilitate trimming of both front and rear ends of the glass plate and to discard the glass debris, formed as a result of cleaving, smoothly and without crushing. If it is necessary also to trim left and right sides of the glass plate, the plate can either be hold by suction and turned by 90° by rotating the suction device, or attached to a turn-table on the aforementioned transportation device and turned by 90° with the use of the turn-table for subsequent trimming on the left and right edges.

According to another embodiment, the glass plate trimming device of the invention comprises:

a transportation device for transporting the glass plate in a horizontal direction;

glass plate cleaving mechanisms of one of the aforementioned types located near both ends of the transportation device;

devices for positioning said glass plate in the width direction located at both sides of the transportation device;

the aforementioned devices for positioning said glass plate in the width direction being able of applying a pressure toward both edges of the glass plate in a direction perpendicular to the transportation direction.

The use of the mechanisms described above makes it possible to facilitate trimming of both left and right ends of the glass

plate and to discard the glass debris, formed as a result of cleaving, smoothly and without crushing. If it is also necessary to trim front and rear sides of the glass plate, the plate can either be held by suction and turned by 90° by rotating the suction device, or attached to a turn-table on the aforementioned transportation device and turned by 90° with the use of the turn-table for subsequent trimming on the front and rear edges.

According to still another embodiment, the glass plate trimming device of the invention comprises:

- a transportation device for transporting the glass plate in a horizontal direction;

- glass plate cleaving mechanisms of one of the aforementioned types located near both sides and near front and rear ends of the transportation device;

- devices for positioning said glass plate in the width direction located at both sides of the transportation device;

- a device for detecting a front edge of the glass plate located near the front end of the transportation device; and

- a device for detecting a rear edge of the glass plate located near the rear end of the transportation device;

the aforementioned devices for positioning said glass plate in the width direction can apply a pressure toward both edges of the glass plate in a direction perpendicular to the transportation direction.

The above construction makes it possible to trim the glass

plate over the entire periphery without the use of mechanisms for turning the glass plate by 90°.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a three-dimensional view of a glass plate trimming device in accordance with one embodiment of the invention.

Fig. 2 is a side view of the device of Fig. 1.

Fig. 3 is a top view of the device of Fig. 2.

Fig. 4 is a right-hand view of the device of Fig. 2.

Fig. 5 is a side view on an essential part of the trimming machine of Fig. 2.

Fig. 6A is a partially sectional side view on an essential part of the trimming machine of Fig. 2 with illustration of the front cleaving mechanism; Fig. 6B is a sectional view along line VI-VI in the direction of the arrows.

Figs. 7A to 7F are schematic side views illustrating operation of the rear and front cleaving mechanisms shown in Fig. 6.

Fig. 8 is a side view on an essential part of the trimming device of Fig. 2, illustrating the film-removing mechanism. Fig. 8A shows the condition prior to removal of the film, and Fig. 8B shows the condition during removal of the film.

Fig. 9 is a partial sectional side view on an essential part of the trimming device of Fig. 2, the view illustrating an alternative method of using the front cleaving mechanisms.

Fig. 10A is a top view of an object of trimming in the form of a glass plate with score lines. Fig. 10B is a top view

of the glass plate after trimming.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Practical examples of the glass plate cleaving mechanism and a trimming device of the invention will be further described with reference to the attached drawings.

Fig. 1 is a three-dimensional view of a glass plate trimming device in accordance with one embodiment of the invention. Fig. 2 is a side view of the device of Fig. 1, and Fig. 3 is a top view of the device of Fig. 2. Fig. 4 is a right-hand view of the device of Fig. 2. The following description will be made with references to Figs. 1 through 4.

A glass plate transportation mechanism used in a trimming device 1 of the invention consists of horizontal belt conveyors 2. A glass plate G placed onto the belt conveyors 2 is transported in the direction of arrow A. The direction shown by this arrow will be called a forward direction, and the direction opposite to this arrow will be called a backward direction. Directions perpendicular to transportation (forward and backward) directions in a horizontal plane will be called transverse or width directions or leftward-rightward directions. Arranged in front and behind, as well as on the left and on the right sides of the conveyors 2, are respective cleaving and supporting members for trimming the glass plate by cleaving and separating ears from plate margins. The cleaving and supporting members form a glass plate cleaving mechanisms. These mechanisms are the following: a front

cleaving mechanism formed by a front cleaving member 3 and a front supporting member 7; a rear cleaving mechanism formed by a rear cleaving member 4 and a rear supporting member 8; a left cleaving mechanism formed by a left cleaving member 5 and a left supporting member 9; and a right cleaving mechanism formed by a right cleaving member 6 and a right supporting member 10.

The aforementioned supporting members 7, 8, 9, 10 can be lifted by means of an air cylinder 11, whereas the aforementioned cleaving members 3, 4, 5, and 6 can be lifted by means of an electrically-driven servo cylinder 12. The speed of the stroke and a stopping position of the servo cylinder 12 can be adjusted with the use of a micro-adjustment mechanism. The glass plate G has score lines preliminarily formed in its surface for breaking the glass along these lines by applying forces to the glass plate acting in mutually opposite vertical directions from the supporting and cleaving members which squeeze the glass plate on both sides of the scoring lines. More specifically, the supporting members support the glass plate G from below, while the cleaving members press on the glass plate G in the downward direction from the marginal (ear E) side of the score line, where downward-directed bending forces are developed.

As shown in Figs. 2 to 4, the front cleaving member 3 and the rear cleaving member 4 can reciprocate in the leftward and rightward directions by means of so-called rodless cylinders

13 used for mechanical joint. As will be described later, such reciprocation is needed for transporting and discarding the separated glass plate ears E toward the side of the device 1. Although, in the illustrated embodiment, the rodless cylinders 13 are located above the glass G transportation path and extend to the left, if necessary, they can extend to the right.

The left and right cleaving members 5 and 6 and left and the right supporting members 9 and 10 are constructed so that they can be moved in the leftward and rightward directions with respect to the left and right score lines of the glass plate G, in accordance with left and right positioning of the glass plate G by below-described left-hand and right-hand positioning members 25 and 26.

As shown in Figs. 3 and 4, the left cleaving member 5 and the right cleaving member 6 can reciprocate in the leftward and rightward directions by means of a screw-type feeding mechanism consisting of a screw shaft 14 and a nut (not shown). As will be described later, these reciprocation motions are needed for defining dimensions of the scored glass plate, more specifically, positions of the score lines La (Fig. 10A). The screw shaft 14 is divided into left and right parts by a joint unit 15 which interconnects both parts of the screw. The left part 14a of the screw has a left-hand thread, while the right part 14b of the screw has a right-hand thread. The screw shaft 14 is driven into rotation by a motor 16 via a chain 16a so that both cleaving members 5 and 6 can synchronously approach

toward each other or away from each other in mutually opposite directions.

It can be seen from Fig. 4 that the left supporting member 9 and the right supporting member 10 can reciprocate in the leftward and rightward directions by means of a screw-type feeding mechanism consisting of a screw shaft 17 and a nut (not shown). As will be described later, these reciprocation motions are needed to displace both aforementioned members in the same direction for compliance with the leftward and rightward movements of the aforementioned left and right cleaving members 5 and 6. The screw shaft 17 is divided into left and right parts by a joint unit 18 which interconnects both parts of the screw. The left part 17a of the screw has a left-hand thread, while the right part 17b of the screw has a right-hand thread. The screw shaft 17 is driven into rotation by a motor 19 so that both supporting members 9 and 10 can synchronously approach toward each other or away from each other in mutually opposite directions.

In Figs. 2 to 4, reference numerals 20 designate guide rods for guiding the front, rear, left, and right cleaving members 3, 4, 5, and 6 during their upward and downward movements. Similarly, reference numerals 21 designate guide rods for guiding the front, rear, left, and right supporting members 7, 8, 9, and 10 during their upward and downward movements, whereas reference numerals 22 designate guide rods for left and right cleaving members 5 and 6 during their movements in

the leftward and rightward directions. The guide rods for guiding the left and right supporting members 9 and 10 are not shown in the drawings. It is assumed, however, that they are present as well.

The trimming device 1 is equipped with a front positioning device 23 and a rear positioning device 24 for positioning the glass plate G during its movement in the front and backward directions, as well as with a left positioning device 25 and a right positioning device 26 for positioning the glass plate G during its movement in the leftward and rightward directions. The aforementioned positioning devices 23, 24, 25, and 26 displace the glass plate G into a position, in which the score lines of the glass are located between respective cleaving and supporting members.

Fig. 5 illustrates construction of the front positioning device 23. Since the rear positioning device 24 is identical, only the front positioning device will be described. The front positioning device 23 is provided with optical sensors 29, which are attached to a support 28 moveable horizontally in forward and backward directions. These optical sensors can be positioned so as to stop the glass plate G in predetermined positions. The optical sensors 29 are illuminated by a light transmitted via optical fibers, and are capable of detecting a light reflected from the glass plate G being transported. The invention is not limited to the use only of optical sensors, and sensors of any other type can be used for the same purpose.

As shown in Figs. 1 to 4, the left and right positioning devices 25 and 26 are provided with cylinders 30 for displacing the left and right margins of the glass plate G toward the center of the trimming device. It is recommended that several such positioning devices be installed on the left and on the right sides. A pressure pad 30 is attached to the end of the rod of each cylinder 30. Initial positions of the cylinders 30 can be adjusted by means of holders 30b which hold the cylinder 30 and can be shifted in leftward and rightward directions. The adjustment mechanism can be realized in the form of a rack and a pinion (not shown) with rotation of the pinion controlled via a dial 30c. Several floating pads (not shown in the drawings) can be installed between the conveyor belts 2 for maintaining the glass plate G in a floating state. Leftward and rightward positioning of the glass plate with the use of the left and right positioning devices 25 and 26 can be accomplished due to the use of the aforementioned floating pads which maintain the glass plate in a floating condition during operation of the aforementioned positioning devices. The floating condition of the glass plate facilitates its displacement in the leftward and rightward directions and protects the glass plate surface from damaging. If necessary, operation of the left and right positioning devices 25 and 26 can be performed synchronously with operation of the aforementioned left and right cleaving members 5, 6 and left and right supporting members 9, 10. The following explanation will relate to the cleaving and

supporting members. The respective cleaving members 3, 4, 5, and 6 have their lower ends located above the transportation path of the glass plate G and can be shifted downward to the level below the aforementioned transportation path by means of the servo cylinders 12. The aforementioned downward movement is accompanied by application of pressure to the ears E of the glass plate G. On the other hand, the supporting members 7, 8, 9, and 10 are located under the transportation path of the glass plate G and can be shifted upward to the aforementioned transportation path by means of the air cylinders 11 for supporting the glass plate G from underneath.

Figs. 6 and 8 illustrate construction of the front cleaving member 3 and of the front supporting member 7. Since the rear cleaving member 4 and the rear supporting member 8, the left cleaving member 5 and the left supporting member 9, and the right cleaving member 6 with the right supporting member 10 have constructions identical to those of the front cleaving member 3 and of the front supporting member 7, respectively, only the latter members 3 and 7 will be described in detail. As shown in Fig. 6A, the supporting member 7 has an elongated trim-receiving bar 31 which extends along the edge of the glass plate G. The trim-receiving bar 31 has a third suction member 32 for suction to the surface of the glass plate. The aforementioned third suction member 32 is connected via a pipe 32a to suction means such as, e.g., an ejector (not shown in the drawings), and can be easily put under negative-pressure

condition or released from the negative-pressure condition. The trim-receiving bar 31 has a substantially L-shaped cross section. The upper horizontal surface of the bar 31 forms the glass supporting portion 31c which is coplanar to suction surface of the third suction member 32. During cleaving of the ear E of the glass plate E the third suction member 32 secures the glass plate G to the supporting member 7. The aforementioned cleaving member 3 is lowered into the angular space formed by mutually perpendicular legs of the L-shaped profile of the trim-receiving bar 31. Descending of the cleaving member 3 breaks the glass plate G along the score line and pushes the separate part down. One surface that defines the aforementioned angular space of the L-shaped trim-receiving bar is the inner vertical surface 31a. When the glass G is coated with a film, the part of the glass, which has been separated by cleaving, will hang down on the film and come into contact with the surface 31a. In view of the above, the surface 31a can be coated with a damping plate made from rubber or soft synthetic plastic.

Another surface that defines the aforementioned angular space of the L-shaped trim-receiving bar forms a glass surface 31b. Lines of intersection of the support portions 31c with the inner vertical surfaces 31a form cutting edges of the supporting members 7, 8, 9, and 10. These cutting edges function as fulcrums for bending moments developed during cleaving of the glass plate G along the score lines.

The cleaving members 3 are parallel to the aforementioned trim-receiving bars 31 and have cleaving bars 33 capable of performing slight movements in the horizontal direction. The cleaving bars 33 are located on the outer sides with respect to the trim-receiving bars 31. The cleaving bars 33 have rectangular cross sections and can be shifted by a cylinder 34 closer to the supporting member 7. Furthermore, on its side facing the cleaving bar 33, the supporting member 7 has a vertical surface 33a which is parallel to the inner vertical surface 31a of the trim-receiving bar 31. The vertical surface 33a forms a respective first end-face surface. This first end-face surface 33a supports a plurality of first suction elements 35 arranged in the longitudinal direction of the cleaving bar 33 and facing the second end-face surface 31a. The first suction elements 35 comprise bell-shaped elements made from a soft material and projecting from the first end-face surface 33a. A suction port 35a is formed in the center of each bell-shaped element. The suction port 35a is connected via a tube 35b to suction means, such as an ejector (not shown in the drawings). The suction port can be freely connected to or disconnected from the suction means.

In the illustrated embodiment, the device is constructed so that the cleaving bar 33 is moveable towards the supporting member 7. However, the invention is not limited to such a construction, and, if necessary, the supporting member 7 can be moveable with respect to the cleaving bar 33.

Furthermore, in the aforementioned embodiment, the first end face 33a and the second end face 31a are substantially vertical. This feature should not be construed as limiting the invention, and the aforementioned end faces can be inclined forward or rearward.

The lower surface of the cleaving bar 33 is also horizontal and has a pressure portion 36 for pressing on the ear E of the glass plate G. The pressure portion 36 has a plurality of second suction elements 37, which are arranged along the cleaving bar 33 and face the aforementioned glass receiving surface 31b. The second suction element has an oval-shaped suction port connected via a tube 37a to suction means, such as an ejector (not shown). The suction port can be freely connected to or disconnected from the suction means. Since the second suction element 37 is formed inside the pressure portion 36 and does not extend beyond the surface of the latter, it does not interfere with the glass plate G during contact of the pressure portion with the glass.

As shown in Fig. 6B, the oval-shaped second suction elements 37 have long axes of the ovals oriented in the longitudinal direction of the cleaving bar 33 and are arranged in a staggered manner. If necessary, however, they can be arranged in line. The linear arrangement of the suction elements is preferable, e.g., for reliable suction and attachment to narrow and long ears E.

The trimming device 1 described above operates as follows:

After the film-coated glass G is placed onto the conveyor 2 of the device 1 for transportation, it will be supported on the conveyor in a floating state by means of floating pads which are not shown in the drawings but can be positioned in spaces between the conveyor belts 2. At the same time, the glass plate G is shifted to the left or to the right to predetermined positions by means of left-right positioning devices 25 and 26. Positioning operation is accomplished when the left and right margins of the glass plate G assume the aforementioned positions. After the floating pads descend, the conveyor 2 is reversed, and the glass plate G returns. The rear positioning device 24 is then activated, and after the rear edge of the glass plate G is detected, the conveyor 2 is stopped. At this moment, the score line Lb (Fig. 10A) of the glass plate G is arranged parallel to and between the first end face 33a of the rear cleaving member 4 and the second end face 31a of the rear supporting element 8. Thus, the rear positioning device 24 is set in a required position. The above action provides positioning of the rear edge.

Then, as shown in Fig. 7A, the rear supporting element 8 is raised by the air cylinder 11 (Fig. 2) until the score line Lb (Fig. 10A) on the edge of the glass plate G is supported from below and from the opposite side of the glass plate 2a and secured by suction of the third suction means 32 (Fig. 6) to the lower surface of the glass plate G.

As shown in Fig 7B, simultaneously with the action

described above, the rear cleaving member 4 is lowered by means of the servo cylinder 12 (Figs. 3 and 4), so that its pressure element 36 applies a downward force to the ear E of the glass plate G. Following this, the glass plate G is cleaved along the score line, whereby the separated ear E is suspended by the film F and comes into contact with the second end face 31a of the trim-receiving bar 31.

Fig. 7C shows the rear cleaving member 4 in the lower position in which its first suction element 35 is in contact with the ear E. This action sets the stroke of the servo cylinder 12.

As shown in Fig. 7D, the cleaving bar 33 of the rear cleaving member 4 is moved by the cylinder 34 (Fig. 6) closer to the second end face 31a of the trim-receiving bar 31. The first suction means 35 is activated and is attached to the ear E.

Fig. 7E illustrates a condition of the cleaving bar 33 of the rear cleaving member 4 in which the first suction means 35 is moved away from the trim-receiving bar 31 by the cylinder 34, while remaining attached to the ear E. Thus the mechanisms are preset to conditions in which the respective parts can be raised without interference with other components.

Fig. 7F shows a condition in which the rear cleaving member 4 is returned to its upper position by means of the servo cylinder 12, while remaining attached by suction to the ear E. The film is peeled off the ear E so that only the latter (i.e., the ear E or glass debris) remains attached to the first suction element

35.

Finally, the rodless cylinder 13 is activated (Figs. 2 through 4), and the rear cleaving member 4 is shifted up (to the left) in Fig. 4. At a point outside the transportation path of the glass plate G, operation of the first suction element 35 is discontinued, and the ear E is discarded into a glass debris collecting container (not shown), which is located underneath.

When the above-described trimming of the rear edge of the glass plate is completed, the glass plate is subjected to trimming of the front edge. For this purpose, the conveyor 2 is activated, the glass plate is moved forward, and the front positioning device is stopped when the front edge of the glass plate G is detected. In the stopped condition, the front score line Lb of the glass plate G (Fig. 10A) is located between the first end face 33a of the front cleaving member 3 and the second end face 31a of the front supporting member 7. The operation described above sets the front positioning device 23.

Following this, trimming of the front edge is completed in accordance with the above-described operation of the front cleaving member 3 and the front supporting member 7 (Figs. 7A to 7F), and the front cleaving member 3 drops the front glass ear E to the glass debris collecting container which is located outside the glass plate transportation path.

The left and right edges are trimmed at the same time.

More specifically, left and right cleaving members 5 and 6 and left and right supporting members 9 and 10 are positioned with respect to the scoring lines L on the glass plate G by means of respective screw bars 14 and 17. More specifically, the glass plate is squeezed between the first end faces 33a of the cleaving members 5 and 6 positioned outside the score lines L (on the sides of the ears E) and the second end faces 31a of the supporting members 9 and 10 located on the inner sides of the glass with respect to the score lines. Movements for positioning the aforementioned left and right cleaving members 5 and 6 and left and right supporting members 9 and 10 can be carried out simultaneously with above-described positioning of the glass plate G in the leftward and rightward directions.

The next step is the leftward and rightward trimming, which is carried out simultaneously with the above-described operation of the left and right cleaving members 5 and 6 and left and right supporting members 9 and 10. In this step, the left and right cleaving members 5 and 6 are withdrawn together with the glass ears E which remain attached by suction for shifting to a position outside the transportation path of the glass plate G, and the ears E are then discarded to the glass debris collecting container.

Upon completion of trimming of the glass plate G over its entire periphery, the conveyor 2 moves the glass plate G forward.

As shown in Fig. 8, the trimming device 1 of the present

invention is provided with a film-removing device 38 located near the front end of the conveyor 2 and intended for removing the film from the film-coated glass plate G after completion of the trimming operation. The aforementioned film-removing device 38 grasps the film remaining on the area corresponding to the ear E after removal of the ear E from the front edge of the glass plate, so that during further transportation of the glass G the entire film is peeled off the glass body B.

More detailed construction of the film-removing device 38 is shown in Fig. 8. This device can perform swinging motions in a space between adjacent conveyors 2. It has a gripper device 39 for gripping the film and a pressure cylinder 40 located at the front end of the conveyor 2. The gripper device 39 consists of a swinging arm 41 and a film chuck 42 attached to the end of the swinging arm 41. Normally, the swinging arm 41 is maintained in a position inclined with respect to the front end of the conveyor 2, so that a pair of gripping claws 42a installed on the film chuck 42 is opened and faces the front end of the conveyor (Fig. 8A).

After the front glass ear is cleaved and disconnected from the glass plate G, and the trim-receiving bar 31 of the front supporting member is lowered, the swinging arm 41 performs a swinging motion and raises the film chuck 42. As a result, the gripping claw 42a grasps the portion F of the film that corresponded to the position of the ear E suspended from the front edge of the glass plate G. As shown in Fig. 8B), the

grasped film swinging arm 41 swings downward and backward and pulls the film synchronously with transportation of the plate glass G. Then the rod 40a of the aforementioned pressure cylinder 40 is extended, and the film portion F is squeezed between a roller 40b on the end of the piston rod and the conveyor pulley 2a. Under this condition, continuing transportation of the glass G will peel the entire film off from the surface of the glass plate G.

Fig. 9 illustrates an alternative method for using the cleaving mechanism of the invention. More specifically, this drawing illustrates trimming of a glass plate G which is not coated with a film. When it is necessary to cleave ear E from a glass plate G which is not coated with a film, the cleaved ear E will not be attached to the film and therefore will fall down. In view of the above, glass receiving portions 31b of the trim-receiving bars 31 in respective supporting members 7, 8, 9, and 10 are provided with supporting blocks 43. The surfaces of the supporting blocks 43 are coated with damping plates 44 made from rubber or a soft synthetic resin. When the cleaving member 3 descends, the pressure element 36 pushes the ear E of the glass plate G down. As a result, the film-free glass plate G is cleaved along the score line, and the separated ear E is placed in a horizontal state onto the damping plate 44 of the supporting block 43. The cleaving bar 33 is then lowered and is stopped in a position close to the ear E. This action sets the stroke of the servo cylinder 12. The second

suction device is then activated and is attached to the ear E, as shown in the drawing.

The cleaning bar 33 of the cleaving member 4 is then raised together with the attached ear E to the original level by means of the servo cylinder 12. Similar to the above action, the rodless cylinder 13 (Figs. 2 through 4) is activated, whereby the cleaving member 3 pushes the glass plate G to a position outside the transportation path of the glass plate G, and the ear E is discarded to the glass debris collecting container.

The trimming device 1 described above is provided with front and rear cleaving mechanisms as well as with left and right cleaving mechanisms. However, the invention is not limited only to such arrangements. For example, the device may have only the front and rear cleaving mechanisms, or only the left and right cleaving mechanisms. In these cases, a rotatable suction device capable of changing positions of the glass plate by rotating it by 90° can be installed on the upper side of the trimming device. Alternatively, a turntable can be installed on the conveyor. Thus, after trimming of the glass plate on opposite sides with the use of a pair of oppositely located cleaving devices, the other pair of opposite sides of the glass plate can be trimmed by rotating the plate by 90°.

The invention makes it possible to treat a glass plate over the entire periphery, i.e., to remove the marginal edges by trimming, and to discard the removed glass ears. In the device of the invention, the removed glass ears do not fall

onto the path of transportation of the glass plate and are not crushed.

What is claimed is:

1. A glass plate cleaving mechanism comprising cleaving members and supporting members, wherein cleaving is carried out by applying a pressure to a glass plate in mutually opposite directions and on both sides from a score line, the mechanism being characterized by the fact that:

said cleaving members have pressure elements for applying pressure to said glass plate and first end faces which intersect said pressure elements, wherein said cleaving members can be driven vertically in upward and downward directions;

said supporting members are installed in parallel with said first end faces of said cleaving members, have edges spaced in the horizontal direction from said first end faces, and can be driven vertically in upward and downward directions; and

said first end faces of said cleaving members have first glass suction means opposite to said supporting members.

2. The glass plate cleaving mechanism of Claim 1, wherein said first glass suction means comprise a plurality of suction ports which are suctioned to the glass plate under effect of a negative pressure.

3. The glass plate cleaving mechanism of Claim 1, wherein each of said pressure elements of said cleaving members comprises: a substantially horizontal surface, a glass supporting element which intersects said supporting member via said edges, and a second end face; said glass supporting element

having a substantially horizontal surface.

4. The glass plate cleaving mechanism of Claim 1, wherein at least said cleaving members or said supporting members are capable of moving toward each other or away from each other in mutually opposite directions.

5. The glass plate cleaving mechanism of Claim 1, further comprising glass receiving means located under the edge of said supporting member and having a substantially horizontal surface for receiving glass debris formed as a result of cleaving.

6. The glass plate cleaving mechanism of Claim 5, further comprising second suction means in the form of a plurality of longitudinally arranged elongated suction ports formed in said pressure element in the surface that faces said glass receiving means, wherein said suction ports can be suctioned to said glass plate under effect of a negative pressure.

7. The glass plate cleaving mechanism of Claim 1, wherein said cleaving members can reciprocate in the longitudinal direction of said first end faces.

8. The glass plate cleaving mechanism of Claim 1, wherein third glass suction elements for suction to said glass plate are formed in said supporting members.

9. A glass plate trimming device comprising:

a transportation device for transporting said glass plate in a horizontal direction;

glass plate cleaving mechanisms, according to any of aforementioned Claims 1 through 8, located near the front and rear ends of said transportation device;

a front edge detection device located near the front end of said transportation device for detecting the front edge of said glass plate; and

a rear edge detection device located near the rear end of said transportation device for detecting the rear edge of said glass plate.

10. A glass plate trimming device comprising:

a transportation device for transporting said glass plate in a horizontal direction;

glass plate cleaving mechanisms, according to any of aforementioned Claims 1 through 8, located near both ends of said transportation device; and devices for positioning said glass plate in the width direction located at both sides of said transportation device;

said devices for positioning said glass plate in the width direction can apply a pressure toward both edges of said glass plate in a direction perpendicular to the transportation direction.

11. The glass plate trimming device of Claim 9 comprising:

glass plate cleaving mechanisms, according to any of aforementioned Claims 1 through 8, located near both ends of said transportation device; and devices for positioning said

glass plate in the width direction located at both sides of said transportation device;

said devices for positioning said glass plate in the width direction can apply a pressure toward both edges of said glass plate in a direction perpendicular to the transportation direction.