

DESCRIPTION

Title of Invention: FOREIGN OBJECT REMOVAL APPARATUS AND PANEL TREATMENT APPARATUS

Technical Field

[0001]

The present disclosure relates to a foreign object removal apparatus and a panel treatment apparatus used for removing foreign objects from fragments including a glass layer separated from a plate-shaped member.

Background Art

[0002]

Hitherto, a glass layer included in a solar panel, a liquid crystal panel, or the like (hereinafter, referred to as "solar panel or the like") is a target of recycling and therefore is peeled off when the solar panel or the like is discarded. In the solar panel, the glass layer is bonded to a backsheet on which battery cells are stacked with the interposition of a sealant, and four sides are reinforced with a frame material. A connector to which a power transmission cable is connected is attached to the back surface of the solar panel. Therefore, when the solar panel is disassembled, the frame material and the connector are first removed, and subsequently the glass layer is ripped off from the backsheet.

[0003]

For recovering only glass from the glass layer, foreign objects such as electric wires are required to be removed. For example, according to an invention described in the following PTL 1 (hereinafter, referred to as literature public knowledge 1 invention), the foreign objects are removed through a sieving step, a wind power selection step, an air table selection step, and the like.

Citation List

Patent Literature

[0004]

PTL 1: Japanese Unexamined Patent Application Publication No. 2023-89446

Summary of Invention

Technical Problem

[0005]

However, as described above, in literature public knowledge 1 invention, a specific configuration of the sieving step is not clear. Further, the removal of the foreign objects is executed through the wind power selection step, the air table selection step, and the like. Thus, literature public knowledge 1 invention cannot easily remove the foreign objects.

[0006]

The present disclosure is proposed in view of the above-described actual circumstance, and an object thereof is to provide a foreign object removal apparatus and a panel treatment apparatus that can remove foreign objects by a simple configuration.

Solution to Problem

[0007]

In order to achieve the above-described object, a foreign object removal apparatus according to the present disclosure includes a hopper portion into which fragments generated through crushing and separation of a glass layer from a plate-shaped member having the glass layer and an applied layer to which the glass layer is applied are input, an input amount adjuster that is disposed on a

downstream side of the hopper portion and adjusts the amount of transport of the fragments toward the downstream side, a chute portion disposed on the downstream side of the input amount adjuster, and a sieving section that is disposed on the downstream side of the chute portion and sieves the fragments into glass pieces and foreign objects other than the glass pieces.

[0008]

In the foreign object removal apparatus according to the present disclosure, the sieving section has a belt portion wound around a pair of rollers and a plurality of protrusions that protrudes from a surface of the belt portion.

[0009]

In the foreign object removal apparatus according to the present disclosure, the sieving section has a vibrator that vibrates the belt portion.

[0010]

In the foreign object removal apparatus according to the present disclosure, the sieving section inclines due to disposing of the pair of rollers at positions different in an up-down direction, and the belt portion moves from the roller disposed lower toward the roller disposed higher. Among the fragments put on the belt portion, the glass pieces move downward against the movement of the belt portion and the foreign objects are transported in the movement direction of the belt portion.

[0011]

In a panel treatment apparatus according to the present disclosure, the above-described foreign object removal apparatus is set on the downstream side of a glass separation apparatus that crushes and separates the glass layer from the plate-shaped member. The glass separation apparatus has a transport

section that transports the plate-shaped member and a rotational hitting portion that is disposed downstream of the transport section to face an end of the plate-shaped member in a transport direction and rotates in a direction from an upper surface of the glass layer toward a lower side to separate the glass layer from the plate-shaped member. A hitting member having a joint is disposed on an outer surface of the rotational hitting portion. A support pedestal that supports the plate-shaped member in a state in which the plate-shaped member is bent downward is disposed on the downstream side of the transport section. The glass layer on the side bending with respect to the side of the transport section in the plate-shaped member that bends is separated from a bending place in the plate-shaped member through hitting of the hitting member on the bending place at a position at which the plate-shaped member on the support pedestal is aligned with an extended line of the hitting member in which the joint stretches through rotation of the rotational hitting portion. The fragments are transported to the foreign object removal apparatus.

Advantageous Effects of Invention

[0012]

The foreign object removal apparatus according to the present disclosure includes the hopper portion into which the fragments generated through crushing and separation of the glass layer from the plate-shaped member having the glass layer and the applied layer to which the glass layer is applied are input, the input amount adjuster that is disposed on the downstream side of the hopper portion and adjusts the amount of transport of the fragments toward the downstream side, the chute portion disposed on the downstream side of the input amount adjuster, and the sieving section that is disposed on the downstream side of the chute

portion and sieves the fragments into the glass pieces and the foreign objects other than the glass pieces. For the fragments input into the hopper portion, the amount of transport to the chute portion is adjusted in the input amount adjuster. Then, the fragments are evened out by the chute portion. In other words, transport of a large amount of fragments to the sieving section and piling of the fragments in a heap on the sieving section do not occur. Although the glass pieces and the foreign objects are mixed in the fragments, the glass pieces and the foreign objects are properly sieved in the sieving section. Therefore, the foreign objects can be removed by a simple configuration, and only the glass pieces can be extracted.

Brief Description of Drawings

[0013]

Fig. 1 is a plan view of a glass separation apparatus of a panel treatment apparatus according to a first embodiment of the present disclosure.

Fig. 2 is a side view of the glass separation apparatus of the panel treatment apparatus according to the first embodiment of the present disclosure.

Fig. 3 is an enlarged plan view of a major part of the glass separation apparatus of the panel treatment apparatus according to the first embodiment of the present disclosure.

Fig. 4 is an enlarged side view of the major part of the glass separation apparatus of the panel treatment apparatus according to the first embodiment of the present disclosure.

Fig. 5 is a side view of a foreign object removal apparatus of the panel treatment apparatus according to the first embodiment of the present disclosure.

Fig. 6 is a front view of the foreign object removal apparatus of the panel

treatment apparatus according to the first embodiment of the present disclosure.

Fig. 7 is a plan view of the glass separation apparatus and a panel inversion apparatus of a panel treatment apparatus according to a second embodiment of the present disclosure.

Fig. 8 is a plan view of the panel inversion apparatus of the panel treatment apparatus according to the second embodiment of the present disclosure.

Fig. 9 is a side view of the panel inversion apparatus of the panel treatment apparatus according to the second embodiment of the present disclosure.

Fig. 10 is a front view of the panel inversion apparatus of the panel treatment apparatus according to the second embodiment of the present disclosure.

Fig. 11 is an enlarged view of a major part of the panel inversion apparatus of the panel treatment apparatus according to the second embodiment of the present disclosure.

Fig. 12 is a first process operation explanatory diagram in which a first process of operation of the panel inversion apparatus of the panel treatment apparatus according to the second embodiment of the present disclosure is depicted.

Fig. 13 is a second process operation explanatory diagram in which a second process of the operation of the panel inversion apparatus of the panel treatment apparatus according to the second embodiment of the present disclosure is depicted.

Description of Embodiments

[0014]

In a foreign object removal apparatus according to the present disclosure, a

sieving section has a belt portion wound around a pair of rollers and a plurality of protrusions that protrudes from a surface of the belt portion. Among fragments transported to the sieving section, comparatively small glass pieces pass between the protrusions. Meanwhile, comparatively large foreign objects get caught on the protrusions. Therefore, the foreign objects can be removed by a simple configuration, and only the glass pieces can be extracted.

[0015]

In the foreign object removal apparatus according to the present disclosure, the sieving section has a vibrator that vibrates the belt portion. Vibrations of the belt portion by the vibrator promote the sieving. Therefore, the foreign objects can be removed by a simple configuration, and only the glass pieces can be extracted.

[0016]

In the foreign object removal apparatus according to the present disclosure, the sieving section inclines due to disposing of the pair of rollers at positions different in the up-down direction, and the belt portion moves from the roller disposed lower toward the roller disposed higher. Among the fragments put on the belt portion, the glass pieces move downward against the movement of the belt portion and the foreign objects are transported in the movement direction of the belt portion. Among the fragments transported to the sieving section, the comparatively small glass pieces pass between the protrusions and move downward on the inclination. Meanwhile, the comparatively large foreign objects get caught on the protrusions, and are transported by the belt portion to move upward. Therefore, the foreign objects can be removed by a simple configuration, and only the glass pieces can be extracted.

[0017]

In a panel treatment apparatus according to the present disclosure, the above-described foreign object removal apparatus is set on the downstream side of a glass separation apparatus that crushes and separates a glass layer from a plate-shaped member. The glass separation apparatus has a transport section that transports the plate-shaped member and a rotational hitting portion that is disposed downstream of the transport section to face an end of the plate-shaped member in a transport direction and rotates in a direction from an upper surface of the glass layer toward a lower side to separate the glass layer from the plate-shaped member. A hitting member having a joint is disposed on an outer surface of the rotational hitting portion. A support pedestal that supports the plate-shaped member in a state in which the plate-shaped member is bent downward is disposed on the downstream side of the transport section. The glass layer on the side bending with respect to the side of the transport section in the plate-shaped member that bends is separated from a bending place in the plate-shaped member through hitting of the hitting member on the bending place at a position at which the plate-shaped member on the support pedestal is aligned with an extended line of the hitting member in which the joint stretches through rotation of the rotational hitting portion. The fragments are transported to the foreign object removal apparatus. Therefore, the glass layer can surely be separated from the plate-shaped member, and only the glass pieces can be extracted from the fragments.

[0018]

The following is a description of a foreign object removal apparatus and a panel treatment apparatus according to a first embodiment of the present

disclosure. In Figs. 1 and 2, a glass separation apparatus 10 of a panel treatment apparatus 100 according to the present first embodiment is depicted. In Figs. 3 and 4, a major part of the glass separation apparatus 10 is enlarged and a state of treatment is depicted. In the description of the glass separation apparatus 10, as depicted in Figs. 1 and 2, an upstream side or a downstream side is defined on the basis of a direction in which a plate-shaped member 1 is transported, and the thickness direction of the plate-shaped member 1 is regarded as an upward direction or a downward direction. Further, the direction that is parallel to the plate-shaped member 1 and is orthogonal to the transport direction is employed as the rotation axis direction of a rotational hitting portion 26, and is regarded as left and right lateral directions.

[0019]

In Fig. 1, the panel treatment apparatus 100 is an apparatus that disassembles a solar panel as the plate-shaped member 1, and has at least the glass separation apparatus 10 and a foreign object removal apparatus 40 disposed on the downstream side of the glass separation apparatus 10. The respective apparatuses 10 and 40 are disposed on the same line. Therefore, in the panel treatment apparatus 100, treatment for the plate-shaped member 1 is executed sequentially through the glass separation apparatus 10 and the foreign object removal apparatus 40.

[0020]

The plate-shaped member 1 has a glass layer and an applied layer to which this glass layer is applied (depiction of the details is omitted). The applied layer is a component obtained by bonding a backsheet to the back surface of a battery layer by a sealant, and the glass layer is bonded to the front surface by the

sealant. A connector is attached to the back surface of the backsheet. Four sides of the layer-stacking body of the glass layer and the applied layer are surrounded by a frame. The frame and the connector are separated from the plate-shaped member 1 in advance by a frame disassembly apparatus (depiction is omitted).

[0021]

The plate-shaped member 1 from which the frame and the connector have been removed is transported from the frame disassembly apparatus to a panel inversion apparatus (details are described later) in a posture in which the glass layer is oriented downward, and is made into a posture in which the glass layer is oriented upward in the panel inversion apparatus. Subsequently, the plate-shaped member 1 is transported to the glass separation apparatus 10.

[0022]

The glass separation apparatus 10 is an apparatus for crushing and separating the glass layer from the plate-shaped member 1, and is disposed on the downstream side of the panel inversion apparatus. The glass separation apparatus 10 breaks down and rips off a glass layer 2 by the rotational hitting portion 26 while transporting the plate-shaped member 1.

[0023]

As depicted in Figs. 1 and 2, the glass separation apparatus 10 has a transport section 11 that transports the plate-shaped member 1 (see Fig. 4) and a glass separation section 15 disposed on the downstream side of the transport section 11. The transport section 11 has a transport-side base frame portion 12, a rail portion 13 mounted on the transport-side base frame portion 12, and a heater 14 disposed on the downstream side of the rail portion 13 and over the rail

portion 13. The heater 14 is, for example, an infrared heater or the like, and faces the rail portion 13 with a space therebetween.

[0024]

The glass separation section 15 has a separation-side base frame portion 16, a transport support portion 17 and the rotational hitting portion 26 mounted on the separation-side base frame portion 16, and a recovery portion 37 that exists between the transport support portion 17 and the rotational hitting portion 26 and is attached to a lower portion of the separation-side base frame portion 16. The glass separation section 15 also has a first drive portion 38 that operates the transport support portion 17 and a second drive portion 39 that operates the rotational hitting portion 26. The respective drive portions 38 and 39 are, for example, motors or the like.

[0025]

The transport support portion 17 is disposed downstream of the downstream end of the transport section 11. The transport support portion 17 has support rollers 18 at upper and lower two stages, a first pulley 21 coupled to the right end of these support rollers 18, and a support pedestal 25 disposed downstream of the support rollers 18. In the support rollers 18, a plurality of rollers is arranged on the same axis toward the left and right lateral sides, and upper rollers 19 and lower rollers 20 face each other with a space therebetween in the up-down direction. The first pulley 21 is coaxially coupled to the right end of the upper rollers 19. The first pulley 21 operates in conjunction with the first drive portion 38 through a first belt 23. The support pedestal 25 has a flat plate shape elongated toward the left and right lateral sides, and is fixed in a substantially horizontal state. The rotational hitting portion 26 is disposed on the

downstream side of the transport support portion 17. The rotational hitting portion 26 is elongated toward the left and right lateral sides, and a second pulley 22 is coupled to the left end thereof. The second pulley 22 operates in conjunction with the second drive portion 39 through a second belt 24. The recovery portion 37 is a box with an open upper side.

[0026]

Here, the transport support portion 17 and the rotational hitting portion 26 are described in detail on the basis of drawings.

[0027]

As depicted in Figs. 3 and 4, the rotational hitting portion 26 has a rotating shaft portion 27 that is a rotating shaft, a plurality of support main portions 28 that is attached to the rotating shaft portion 27 and is arranged in the rotation axis direction, and a plurality of hitting members 31 coupled to the outer surfaces of these support main portions 28. In the support main portions 28, the rotating shaft portion 27 is made to pass through the center, and three places at the outer periphery project outward. In other words, valley portions 30 are formed between the respective projecting portions 29. The three projecting portions 29 are disposed at equal intervals at the outer periphery of the support main portion 28, and the hitting member 31 is coupled to each of them.

[0028]

The hitting member 31 has a coupled portion 34 and a hitting main portion 35. The coupled portion 34 is coupled to the projecting portion 29 of the support main portion 28 through a first joint 32. The hitting main portion 35 is coupled to the coupled portion 34 through a second joint 33. This configuration allows the hitting members 31 to freely bend at the respective joints 32 and 33 like a chain.

The coupled portion 34 is a flat-plate shaped link composed of a pair of pieces. The hitting main portion 35 has a head portion 36 formed to have a tip projecting toward the left and right lateral sides.

[0029]

The support main portions 28 adjacent to each other are fixed to the rotating shaft portion 27 while being shifted in a staggered manner. Specifically, each support main portion 28 is disposed to be shifted from the adjacent support main portion 28 in the rotation direction by, for example, approximately 60 degrees so that the projecting portions 29 of the adjacent support main portion 28 may be disposed in the valley portions 30 of the support main portion 28. Therefore, in the respective support main portions 28, the hitting members 31 adjacent in the rotation axis direction are disposed to be shifted in the rotation direction. In addition, the left and right ends of the head portions 36 of the hitting members 31 overlap with each other as viewed in a direction orthogonal to the rotation axis direction (see Fig. 3).

[0030]

The rotational hitting portion 26 is disposed with the interposition of a gap X from the downstream end of the support pedestal 25 in the transport support portion 17. Specifically, the gap X is made between the tips of the head portions 36 of the hitting main portions 35 in a state in which the rotational hitting portion 26 rotates and the tip of the support pedestal 25. The gap X is substantially the same as the thickness of the plate-shaped member 1, and is adjusted depending on the kind of plate-shaped member 1. The recovery portion 37 is disposed under the gap X (see Fig. 2).

[0031]

In the glass separation apparatus 10 configured in the above-described manner, the plate-shaped member 1 is placed on the rail portion 13 of the transport section 11 in a state in which the glass layer 2 is oriented upward. For the plate-shaped member 1 transported by the transport section 11, the glass layer 2 is heated by the heater 14 as required. Whether or not to execute the heating and the degree of heating differ depending on the plate-shaped member 1. The plate-shaped member 1 is transported while being pinched by the support rollers 18 from the upper and lower sides, and is placed on the support pedestal 25. The downstream end of the plate-shaped member 1 disposed on the support pedestal 25 faces the outer peripheral surface of the rotational hitting portion 26.

[0032]

The rotational hitting portion 26 rotates in a direction from the upper surface of the glass layer 2 of the plate-shaped member 1 toward the lower side (counterclockwise direction in Fig. 4). When the rotational hitting portion 26 does not rotate, the hitting members 31 bend at the respective joints 32 and 33 due to their own weight. Through rotation of the rotational hitting portion 26, the respective joints 32 and 33 stretch due to a centrifugal force, and the hitting members 31 become such a state as to be tense outward from the rotation axis.

[0033]

When being further transported, the plate-shaped member 1 is disposed in the gap X between the support pedestal 25 and the rotational hitting portion 26. When the hitting main portions 35 of the hitting members 31 hit the downstream end of the plate-shaped member 1 at a position at which the plate-shaped member 1 on the support pedestal 25 is aligned with an extended line of the

hitting member 31 in which the respective joints 32 and 33 stretch, the plate-shaped member 1 is supported by the support pedestal 25 in such a state as to bend downward by approximately 90 degrees. Simultaneously, the glass layer 2 is broken down, and cracks in the glass layer 2 are formed at the place where the plate-shaped member 1 bends. Due to the hitting on the place where the plate-shaped member 1 bends (cracks in the glass layer 2) by the hitting members 31, the glass layer 2 on the side bending with respect to the side of the transport section 11 is ripped off from a battery layer 4, with the bending place being the boundary. At this time, the respective joints 32 and 33 bend and the hitting members 31 warp due to shock of the hitting on the glass layer 2. The hitting members 31 that warp in this manner are swung down onto the upper end of the glass layer 2 on the bending side at the cracks in the glass layer 2 at the bending place. This causes the glass layer 2 to be ripped off from the battery layer 4 and become glass pieces 3 to fall. Through repetition of this operation, the glass layer 2 is crushed while the plate-shaped member 1 is transported, and the glass pieces 3 are accumulated in the recovery portion 37.

[0034]

The glass separation apparatus 10 operates in the above-described manner. Next, effects of the glass separation apparatus 10 are described.

[0035]

The glass separation apparatus 10 has, at the downstream end of the transport section 11, the support pedestal 25 that supports the plate-shaped member 1 in the state in which the plate-shaped member 1 bends downward by approximately 90 degrees and at a position with which the hitting members 31 hit the bending place. That is, the plate-shaped member 1 placed on the support

pedestal 25 bends at the tip of the support pedestal 25, and becomes a state in which the downstream side thereof droops from the tip of the support pedestal 25. Simultaneously, the glass layer 2 is broken down, and cracks in the glass layer 2 are formed at the bending place. Due to the hitting on the bending place (cracks in the glass layer 2) in the glass layer 2 by the hitting members 31, the glass layer 2 on the side bending with respect to the side of the transport section 11 is ripped off from the battery layer 4, with the bending place being the boundary.

Therefore, crushing and separation of the glass layer 2 can be simultaneously executed. Further, the glass layer 2 can be smoothly ripped off from the battery layer 4.

[0036]

Moreover, the glass layer 2 is ripped off in the direction in which the plate-shaped member 1 is discharged downward, and thus the glass layer 2 can be smoothly ripped off without applying an excessive load.

[0037]

The hitting member 31 of the glass separation apparatus 10 has the coupled portion 34 and the hitting main portion 35. The coupled portion 34 is coupled to the projecting portion 29 of the support main portion 28 through the first joint 32. The hitting main portion 35 is coupled to the coupled portion 34 through the second joint 33. This configuration allows the hitting members 31 to freely bend at the respective joints 32 and 33 like a chain. Through rotation of the rotational hitting portion 26, the respective joints 32 and 33 stretch due to a centrifugal force, and the hitting members 31 become such a state as to be tense outward from the rotation axis. When the hitting main portions 35 of the hitting members 31 hit the downstream end of the plate-shaped member 1 in this state,

the respective joints 32 and 33 bend and the hitting members 31 warp due to shock. The glass layer 2 is ripped off from the battery layer 4 by the hitting members 31 that warp, and becomes the glass pieces 3 to fall. Therefore, the glass layer 2 can surely be ripped off from the battery layer 4.

[0038]

In the glass separation apparatus 10, the support main portions 28 adjacent to each other are fixed to the rotating shaft portion 27 while being shifted in a staggered manner in the rotation axis direction. Therefore, in the respective support main portions 28, the hitting members 31 adjacent in the rotation axis direction are disposed to be shifted in the rotation direction. In addition, the left and right ends of the head portions 36 of the hitting members 31 overlap with each other as viewed in a direction orthogonal to the rotation axis direction (see Fig. 3). That is, for example, as viewed from the upper side, the left and right ends of the head portions 36 overlap with each other without a gap. Thus, the glass layer 2 can be ripped off from the battery layer 4 without unevenness in the rotation axis direction.

[0039]

In the glass separation apparatus 10, the heater 14 that heats the glass layer 2 faces the rail portion 13 of the transport section 11 (see Fig. 2). Due to heating of the glass layer 2 by the heater 14, it becomes easier to rip off the glass layer 2 from the plate-shaped member 1.

[0040]

Next, the foreign object removal apparatus 40 is described on the basis of drawings. In Figs. 5 and 6, the foreign object removal apparatus 40 according to the first embodiment is depicted.

[0041]

In the recovery portion 37 of the glass separation apparatus 10, not only the glass pieces 3 but also foreign objects such as electric wires (depiction is omitted) exist in a mixed manner as fragments generated through crushing and separation of the glass layer 2 from the plate-shaped member 1. Therefore, the fragments are sucked by a vacuum portion or the like (depiction is omitted) and are transported to the foreign object removal apparatus 40 to be sieved by the foreign object removal apparatus 40. In the description of the foreign object removal apparatus 40, as depicted in Figs. 5 and 6, the vertical direction is regarded as an upward direction or a downward direction. Further, the movement direction of a belt portion 64 is regarded as a forward direction, and the opposite direction to the movement direction of the belt portion 64 is regarded as a rearward direction. Moreover, the rotation axis direction of rollers that move the belt portion 64 is regarded as left and right lateral directions. In addition, the position of the fragments on a transport path is defined as an upstream side and a downstream side.

[0042]

As depicted in Figs. 5 and 6, the foreign object removal apparatus 40 is an apparatus in which a hopper portion 42, an input amount adjuster 45, a chute portion 50, and a sieving section 55 are attached sequentially from the upper side between removal-side base frame portions 41 that are a pair of left and right portions and face each other. The fragments are input into the hopper portion 42, and sequentially go through the input amount adjuster 45, the chute portion 50, and the sieving section 55 to be sieved. The hopper portion 42 is attached to upper portions of the removal-side base frame portions 41. The input amount

adjuster 45 is disposed on the downstream side of the hopper portion 42 on the transport path by being coupled to a lower portion of the hopper portion 42. The chute portion 50 is disposed on the downstream side of the input amount adjuster 45 with respect to the transport path by being disposed under the input amount adjuster 45. The sieving section 55 is disposed on the downstream side of the sieving section 55 with respect to the transport path by being disposed under the chute portion 50.

[0043]

In the hopper portion 42, an input port 43 at the upper end is formed to be wide in the forward-rearward direction, and a discharge port 44 at the lower end is formed to be smaller than the input port 43 in the forward-rearward direction. Thus, the hopper portion 42 is formed into a funnel shape. The hopper portion 42 is formed to have a wide width in the left-right direction. The input amount adjuster 45 is disposed directly under the discharge port 44. The input amount adjuster 45 is a unit obtained by forming a plurality of protruding wall portions 47 on the outer circumferential surface of a rotating member 46 for adjustment with a circular column shape. The protruding wall portions 47 protrude outward from the outer circumferential surface of the rotating member 46 for adjustment, and extend leftward and rightward. The protruding wall portions 47 are disposed at equal intervals in the circumferential direction of the rotating member 46 for adjustment. Therefore, grooves 48 extending leftward and rightward are formed between the protruding wall portions 47. The number, length, and interval of the protruding wall portion 47 are any values. A motor as a drive portion 49 for adjustment is coupled to the rotating member 46 for adjustment.

[0044]

The chute portion 50 is a component in which side wall pieces 52 are connected to left and right ends of a chute main piece 51 with a thin plate shape. The side wall pieces 52 extend upward. A chute vibrator 53 is attached to the lower surface of the chute main piece 51. The chute vibrator 53 is disposed at the center of the chute main piece 51. The chute portion 50 inclines obliquely downward from the rear side toward the front side. The front end of the chute portion 50 is a discharge end portion 54.

[0045]

The sieving section 55 has a box-shaped frame 56 with a substantially box shape, a sieving main portion 57 disposed inside the box-shaped frame 56, and a sieving vibrator 58 disposed under the sieving main portion 57. In the box-shaped frame 56, the upper end is opened, and front and rear two places at the lower end are opened. A housing port 59 that is the opened upper end is formed to be wider than the discharge end portion 54 of the chute portion 50. A rear-side sieving port 60 and a front-side sieving port 61 that are the opened lower ends extend downward and are both narrowed, and are formed to be narrower than the lateral width of the box-shaped frame 56.

[0046]

The sieving main portion 57 has a rear-side belt roller 62 and a front-side belt roller 63 that are a pair of front and rear rollers, and the belt portion 64 wound around these rear-side belt roller 62 and front-side belt roller 63. The rear-side belt roller 62 and the front-side belt roller 63 are disposed at positions different in the up-down direction. Therefore, the sieving section 55 inclines obliquely upward from the rear side toward the front side as a whole. A motor as a drive portion 65 for sieving is coupled to a rotating shaft of the front-side belt roller 63.

A plurality of protrusions 66 is formed on the surface of the belt portion 64. The protrusions 66 protrude outward from the surface of the belt portion 64. The protrusions 66 have, for example, a bar shape like a nail, and are formed across the whole surface of the belt portion 64. The thickness, length, interval, number, and the like of the protrusions 66 are any values. The interval between the protrusions 66 is at such a degree that a glass piece can pass therebetween.

[0047]

The sieving vibrator 58 is disposed inside the box-shaped frame 56, and is attached to the box-shaped frame 56. The sieving vibrator 58 is disposed under and at the center of the sieving main portion 57. That is, the position of the sieving vibrator 58 exists between the rear-side belt roller 62 and the front-side belt roller 63 and at the center of the belt portion 64 wound around the rear-side belt roller 62 and the front-side belt roller 63.

[0048]

The foreign object removal apparatus 40 is configured as described above. Next, operation and effects of the foreign object removal apparatus 40 are described.

[0049]

When the drive portion 49 for adjustment for the input amount adjuster 45 operates, the rotating member 46 for adjustment rotates. When being input into the hopper portion 42, fragments enter the grooves 48 of the rotating member 46 for adjustment from the discharge port 44, and are transported in small batches to be sent out to the chute portion 50. Therefore, the amount of fragments transported to the chute portion 50 is adjusted. Here, the rotation direction of the rotating member 46 for adjustment is such a direction that the fragments that have

entered the grooves 48 fall onto a position closer to the rear end on the chute portion 50 (counterclockwise direction in Fig. 5, arrow A₁). Therefore, on the chute portion 50, the fragments slide across a long distance from the rear end toward the discharge end portion 54 at the front end and thus spread on the whole surface of the chute main piece 51 to be evened out.

[0050]

The fragments discharged from the discharge end portion 54 pass through the housing port 59 of the box-shaped frame 56 of the sieving section 55, and fall onto the belt portion 64 of the sieving main portion 57. When the drive portion 65 for sieving operates, the front-side belt roller 63 rotates (clockwise direction in Fig. 5, arrow A₂). Thus, the belt portion 64 moves forward from the rear-side belt roller 62 toward the front-side belt roller 63, and the rear-side belt roller 62 operates in conjunction with the front-side belt roller 63. Comparatively small glass pieces among the fragments pass between the protrusions 66, and move downward on the inclination to be transported rearward (arrow A₃ in Fig. 5) against the movement of the belt portion 64. Meanwhile, comparatively large foreign objects get caught on the protrusions 66, and are transported by the belt portion 64 to move upward and forward (in Fig. 5, arrow A₄). When the sieving vibrator 58 operates, vibrations are propagated to the whole of the belt portion 64 through the box-shaped frame 56, the rear-side belt roller 62, and the front-side belt roller 63. Thus, the sieving is promoted.

[0051]

The glass pieces are discharged from the rear-side sieving port 60 of the sieving section 55 (in Fig. 5, arrow A₅). Meanwhile, the foreign objects are discharged from the front-side sieving port 61 of the sieving section 55 (in Fig. 5,

arrow A₆). In this manner, the glass pieces and the foreign objects are properly sieved. Therefore, the foreign objects can be removed by a simple configuration, and only the glass pieces can be extracted.

[0052]

The following is a description of a panel treatment apparatus according to a second embodiment of the present disclosure. In Fig. 7, a panel treatment apparatus 200 according to the second embodiment is depicted. In Figs. 8 to 13, a panel inversion apparatus 207 included in the panel treatment apparatus 200 is depicted.

[0053]

In Fig. 7, the panel treatment apparatus 200 has at least the panel inversion apparatus 207 and the glass separation apparatus 10 disposed on the downstream side of the panel inversion apparatus 207. The respective apparatuses 10 and 207 are disposed on the same line. In the panel treatment apparatus 200, the frame disassembly apparatus is disposed on the upstream side of the panel inversion apparatus 207. Therefore, in the panel treatment apparatus 200, treatment for the plate-shaped member 1 is executed sequentially through the frame disassembly apparatus, the panel inversion apparatus 207, the glass separation apparatus 10, and the foreign object removal apparatus 40.

[0054]

The posture of the plate-shaped member 1 from which the frame and the connector have been removed by the frame disassembly apparatus is inverted by the panel inversion apparatus 207. That is, the plate-shaped member 1 is transported from the frame disassembly apparatus to the panel inversion apparatus 207 in a posture in which the glass layer is oriented downward, and is

made into a posture in which the glass layer is oriented upward in the panel inversion apparatus 207 (details are described later). Subsequently, the plate-shaped member 1 is transported to the glass separation apparatus 10. The configuration of the glass separation apparatus 10 is as described in the first embodiment.

[0055]

Next, the panel inversion apparatus 207 is described on the basis of drawings. In Figs. 8 to 10, the panel inversion apparatus 207 is depicted. In Fig. 11, a state of operation of a suction portion 216 is depicted. In the description of the panel inversion apparatus 207, as depicted in Fig. 8, the transport direction of the plate-shaped member 1 is regarded as a forward direction or a rearward direction, and the inversion direction is regarded as a left lateral direction or a right lateral direction.

[0056]

As depicted in Figs. 8 to 10, the panel inversion apparatus 207 has a stage portion 208 on which the plate-shaped member 1 is mounted in a posture in which the glass layer is oriented downward, and an inversion section 210 installed adjacent to the right lateral side of the stage portion 208. The stage portion 208 is formed of a frame made of a metal, and has a flat mounting table 209 in the upper surface. The inversion section 210 has a substantially plate shape, and is disposed over a base portion 211 formed of a frame made of a metal. The inversion section 210 is coupled to an inversion rotating shaft 217 that exists on the right lateral side of the stage portion 208 and is coupled to the base portion 211. The axial center of the inversion rotating shaft 217 is oriented in the forward-rearward direction. An inversion drive portion 218 such as a motor is

connected to the inversion rotating shaft 217 through a chain belt or the like. The inversion drive portion 218 is driven by a control signal from a control section (depiction is omitted) and the inversion rotating shaft 217 rotates. This changes the posture of the inversion section 210. Specifically, the inversion section 210 rotates in a range from a position disposed over the base portion 211 (hereinafter, referred to as "transport preparation position P₁", see Fig. 10) to a position that faces the mounting table 209 of the stage portion 208 (hereinafter, referred to as "suction preparation position P₂", see Fig. 10).

[0057]

The inversion section 210 has a support frame 212 coupled to the inversion rotating shaft 217, a pair of transport portions 214 coupled to the support frame 212, and a movable frame 213 that is coupled to the support frame 212 and is displaced relative to the support frame 212. The inversion section 210 also has the suction portions 216 coupled to the movable frame 213 and an elongated guide portion 215 fixed to an end of the transport portion 214. The guide portion 215 is fixed to the end on the side of the inversion rotating shaft 217 in the transport portions 214, and protrudes from a flat surface of the transport portion 214.

[0058]

The transport portions 214 are flat belts elongated in the forward-rearward direction. The belts are wound around a roller (depiction is omitted), and are fed forward by rotation of the roller. The suction portions 216 and the movable frame 213 are disposed at the center of the inversion section 210 and between the transport portions 214. The suction portions 216 are, for example, a plurality of vacuum portions made of rubber or silicone, and are arranged in the forward-

rearward direction. A cylinder or the like displaces the movable frame 213 by a control signal from the control section. This changes the degree of protrusion of the suction portion 216 relative to the transport portions 214. Specifically, as depicted in Fig. 11, the suction portions 216 move in a range from a position on the same plane as the flat surfaces of the transport portions 214 or a sunken position relative to the flat surfaces of the transport portions 214 (hereinafter, referred to as "standby position P₃") to a position arising from the flat surfaces of the transport portions 214 (hereinafter, referred to as "suction position P₄").

[0059]

The panel inversion apparatus 207 is configured as described above. Next, operation and effects of the panel inversion apparatus 207 are described on the basis of drawings. In Figs. 12 and 13, a process of operation of the panel inversion apparatus 207 according to the present embodiment is depicted. In these diagrams, only a schematic major part is depicted and the other part is omitted.

[0060]

In Fig. 12, the plate-shaped member 1 is mounted on the mounting table 209 of the panel inversion apparatus 207 in a posture in which the glass layer is oriented downward. At first, the inversion section 210 exists at the transport preparation position P₁, and the suction portions 216 exist at the standby position P₃. The frame and the connector have been removed from the plate-shaped member 1 in advance by the frame disassembly apparatus.

[0061]

The inversion section 210 of the panel inversion apparatus 207 rotates together with the inversion rotating shaft 217 (rotates in the counterclockwise

direction in Fig. 12), and reaches the suction preparation position P₂.

Thereupon, the suction portions 216 move from the standby position P₃ to the suction position P₄. The inversion section 210 existing at the suction preparation position P₂ faces the applied layer of the plate-shaped member 1 on the mounting table 209 (hereinafter, referred to as "facing posture P₅"), and the suction portions 216 are brought into contact with and pressed against the applied layer to suck the applied layer. This causes suction adhesion of the plate-shaped member 1. With the facing posture P₅, the suction portions 216 existing at the suction position P₄ protrude toward the plate-shaped member 1 relative to the transport portions 214. Thus, the suction portions 216 surely get contact with the applied layer of the plate-shaped member 1 and cause the suction adhesion of the plate-shaped member 1.

[0062]

Even if the glass layer has broken, the glass is applied to the applied layer and is oriented downward. Thus, when the plate-shaped member 1 is sucked upward, the glass layer remains applied to the applied layer and is not displaced, and the posture thereof is hardly lost. Thus, the orientation of the glass layer of the plate-shaped member 1 can be easily inverted, with the flat posture of the glass layer kept.

[0063]

As depicted in Fig. 13, with the facing posture P₅, the suction portions 216 that have caused the suction adhesion of the plate-shaped member 1 move from the suction position P₄ to the standby position P₃. Thereupon, the applied layer of the plate-shaped member 1 gets contact with the flat surfaces of the transport portions 214. Due to the contact of the transport portions 214 with the applied

layer, the plate-shaped member 1 is supported by the transport portions 214.

The inversion section 210 rotates in this state, and thus the plate-shaped member 1 is inverted without distorting.

[0064]

The inversion section 210 rotates together with the inversion rotating shaft 217 (rotates in the clockwise direction in Fig. 13). The suction portions 216 release the plate-shaped member 1 in a period until the inversion section 210 moves from the suction preparation position P_2 to the transport preparation position P_1 and when a posture in which the glass layer of the plate-shaped member 1 is oriented upward is made. Specifically, the suction portions 216 stop the suction when the inversion section 210 exists at a position resulting from rotation from the suction preparation position P_2 by at least 90 degrees. The plate-shaped member 1 slides on the inversion section 210 toward the end on the side of the inversion rotating shaft 217 due to its own weight (see arrow D in Fig. 13), and impinges on the guide portion 215 at a reaching point of the sliding-down. The plate-shaped member 1 that has impinged on the guide portion 215 is adjusted to a posture along the guide portion 215. That is, the posture of the plate-shaped member 1 is automatically corrected to a proper posture. Thus, the posture of the plate-shaped member 1 becomes the proper posture in terms of treatment in the glass separation apparatus 10 in the next step. In addition, the trouble of correcting the posture is avoided and thus a contribution to labor saving is also obtained.

[0065]

The "posture in which the glass layer of the plate-shaped member 1 is oriented upward" in the present embodiment means such a posture that the glass

layer can be visually recognized in plan view. Thus, this posture is not limited to a posture when the glass layer is horizontal.

[0066]

The inversion section 210 existing at the transport preparation position P_1 supports the plate-shaped member 1 in such a posture that the glass layer is oriented upward (hereinafter, referred to as "support posture P_6 "). In the support posture P_6 , the transport portions 214 are in contact with the applied layer. Thus, the plate-shaped member 1 is transported through operation of the transport portions 214 and feeding of the belts. The belts are single-sheet belts and therefore a fragment of glass does not get stuck in the belt in the middle of the transport. Further, with the support posture P_6 , the suction portions 216 existing at the standby position P_3 do not protrude from the flat surfaces of the transport portions 214 and thus do not interfere with the transport.

[0067]

As described above, the inversion section 210 inverts the plate-shaped member 1 by sucking the plate-shaped member 1 by the suction portions 216 and rotating to change to the facing posture P_5 and the support posture P_6 . Thus, the orientation of the glass layer of the plate-shaped member 1 can be easily inverted.

[0068]

<Supplementary Notes>

A panel inversion apparatus has a stage portion on which a plate-shaped member having a glass layer and an applied layer to which the glass layer is applied is mounted in a posture in which the glass layer is oriented downward, and

an inversion section that inverts the plate-shaped member by changing to a

facing posture with which the inversion section faces the applied layer over the stage portion and a support posture with which the inversion section supports the plate-shaped member in such a posture that the glass layer is oriented upward through rotation of an inversion rotating shaft disposed on a lateral side of the stage portion, wherein

the inversion section has

a suction portion that causes suction adhesion of the plate-shaped member by sucking the applied layer in the facing posture, and

a transport portion that transports the plate-shaped member in the support posture.

[0069]

In the panel inversion apparatus, the suction portion in the facing posture protrudes toward the plate-shaped member relative to the transport portion and gets contact with the applied layer.

[0070]

In the panel inversion apparatus, the transport portion in the facing posture gets contact with the applied layer of the plate-shaped member subjected to the suction adhesion by the suction portion through movement of the suction portion that has gotten contact with the applied layer in the facing posture from such a position as to protrude relative to the transport portion to such a position as not to protrude.

[0071]

In the panel inversion apparatus, the inversion section has

a guide portion that adjusts the posture of the plate-shaped member through impingement of an end portion of the plate-shaped member on the guide

portion.

[0072]

In the panel inversion apparatus, the suction portion releases the plate-shaped member with such a posture that the glass layer is oriented upward in the middle of change from the facing posture to the support posture, and the plate-shaped member impinges on the guide portion at a reaching point of sliding-down on the inversion section.

[0073]

In the panel inversion apparatus, the transport portion is a belt fed in the axial direction of the inversion rotating shaft.

[0074]

In another embodiment of the present disclosure, the sieving section does not have the sieving vibrator.

In still another embodiment, the chute portion does not have the chute vibrator.

[0075]

Although the embodiments of the present disclosure have been described in detail above, the present disclosure is not limited to the above-described embodiments. Further, various design changes can be carried out for the present disclosure without departing from matters set forth in the scope of claims.

Reference Signs List

[0076]

- 1 plate-shaped member
- 2 glass layer
- 3 glass piece

- 4 battery layer
- 10 glass separation apparatus
- 11 transport section
- 12 transport-side base frame portion
- 13 rail portion
- 14 heater
- 15 glass separation section
- 16 separation-side base frame portion
- 17 transport support portion
- 18 support roller
- 19 upper roller
- 20 lower roller
- 21 first pulley
- 22 second pulley
- 23 first belt
- 24 second belt
- 25 support pedestal
- 26 rotational hitting portion
- 27 rotating shaft portion
- 28 support main portion
- 29 projecting portion
- 30 valley portion
- 31 hitting member
- 32 first joint
- 33 second joint

- 34 coupled portion
- 35 hitting main portion
- 36 head portion
- 37 recovery portion
- 38 first drive portion
- 39 second drive portion
- 40 foreign object removal apparatus
- 41 removal-side base frame portion
- 42 hopper portion
- 43 input port
- 44 discharge port
- 45 input amount adjuster
- 46 rotating member for adjustment
- 47 protruding wall portion
- 48 groove
- 49 drive portion for adjustment
- 50 chute portion
- 51 chute main piece
- 52 side wall piece
- 53 chute vibrator
- 54 discharge end portion
- 55 sieving section
- 56 box-shaped frame
- 57 sieving main portion
- 58 sieving vibrator

- 59 housing port
- 60 rear-side sieving port
- 61 front-side sieving port
- 62 rear-side belt roller
- 63 front-side belt roller
- 64 belt portion
- 65 drive portion for sieving
- 66 protrusion
- A₁ arrow
- A₂ arrow
- A₃ arrow
- A₄ arrow
- A₅ arrow
- A₆ arrow
- X gap
- 100, 200 panel treatment apparatus
- 207 panel inversion apparatus
- 208 stage portion
- 209 mounting table
- 210 inversion section
- 211 base portion
- 212 support frame
- 213 movable frame
- 214 transport portion
- 215 guide portion

216 suction portion

217 inversion rotating shaft

218 inversion drive portion

P₁ transport preparation position

P₂ suction preparation position

P₃ standby position

P₄ suction position

P₅ facing posture

P₆ support posture

CLAIMS

[Claim 1]

A foreign object removal apparatus comprising:

a hopper portion into which fragments generated through crushing and separation of a glass layer from a plate-shaped member having the glass layer and an applied layer to which the glass layer is applied are input;

an input amount adjuster that is disposed on a downstream side of the hopper portion and adjusts an amount of transport of the fragments toward the downstream side;

a chute portion disposed on the downstream side of the input amount adjuster; and

a sieving section that is disposed on the downstream side of the chute portion and sieves the fragments into glass pieces and foreign objects other than the glass pieces.

[Claim 2]

The foreign object removal apparatus according to Claim 1, wherein the sieving section has

a belt portion wound around a pair of rollers, and

a plurality of protrusions that protrudes from a surface of the belt portion.

[Claim 3]

The foreign object removal apparatus according to Claim 2, wherein the sieving section has a vibrator that vibrates the belt portion.

[Claim 4]

The foreign object removal apparatus according to Claim 2 or Claim 3, wherein

the sieving section inclines due to disposing of the pair of rollers at positions different in an up-down direction, and the belt portion moves from the roller disposed lower toward the roller disposed higher, and

among the fragments put on the belt portion, the glass pieces move downward against the movement of the belt portion and the foreign objects are transported in a movement direction of the belt portion.

[Claim 5]

A panel treatment apparatus, wherein

the foreign object removal apparatus according to Claim 4 is set on the downstream side of a glass separation apparatus that crushes and separates the glass layer from the plate-shaped member,

the glass separation apparatus has

a transport section that transports the plate-shaped member, and

a rotational hitting portion that is disposed downstream of the transport section to face an end of the plate-shaped member in a transport direction and rotates in a direction from an upper surface of the glass layer toward a lower side to separate the glass layer from the plate-shaped member,

a hitting member having a joint is disposed on an outer surface of the rotational hitting portion,

a support pedestal that supports the plate-shaped member in a state in which the plate-shaped member is bent downward is disposed on the downstream side of the transport section,

the glass layer on a side bending with respect to a side of the transport section in the plate-shaped member that bends is separated from a bending place in the plate-shaped member through hitting of the hitting member on the bending

place at a position at which the plate-shaped member on the support pedestal is aligned with an extended line of the hitting member in which the joint stretches through rotation of the rotational hitting portion, and

the fragments are transported to the foreign object removal apparatus.