

SLEWING TYPE PROTECTING AND GUIDING DEVICE FOR CABLES

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a slewing type protecting and guiding device for cables for protecting and guiding cables, hoses, and/or tubes (hereinafter referred to also as "cables").

Description of the Related Art

A semiconductor manufacturing apparatus, in general, incorporates a large amount of cables for supplying electric power or a fluid (air or water, etc.) to a treatment unit that performs a predetermined treatment on an object to be treated. In addition, in the semiconductor manufacturing apparatus, at least a part of the treatment unit may often be rotated at the time of treating the object to be treated.

When at least a part of the treatment unit is rotated, the cables connected to the treatment unit may be entangled. As a device for preventing the generation of such a problem, a slewing type protecting and guiding device for cables has been known (see Japanese Patent Laid-Open No. 2009-44809, for example).

The known slewing type protecting and guiding

device for cables includes a cables protecting and guiding member for protecting and guiding the cables. One end portion of the cables protecting and guiding member is connected to a circular inside wall surface of an outer circumferential side guide drum member fixed to a disposing surface, and the other end portion is connected to a circular outside wall surface of an inner circumferential side guide drum member. Note that these wall surfaces are concentrically provided.

In addition, the inner circumferential side guide drum member is rotatable around a straight line which passes through the center of the circular outside wall surface and which is perpendicular to the disposing surface. In this device, by rotation of the inner circumferential side guide drum member, the cables protecting and guiding member is wound around the wall surface of the inner circumferential side guide drum member, and, by loosening the cables protecting and guiding member wound around the wall surface, the probability of entangling of the cables is reduced.

Further, this device is provided with a guide frame (guide) for stabilizing a curved track (bent track) of the cables protecting and guiding member in an annular space between the wall surface of the outer

circumferential side guide drum member and the wall surface of the inner circumferential side guide drum member. The guide frame has an arcuate wall surface provided concentrically with the wall surface of the outer circumferential side guide drum member and the like, and guides the cables protecting and guiding member by the arcuate wall surface.

SUMMARY OF THE INVENTION

In the above-mentioned slewing type protecting and guiding device for cables, the guide frame is provided in the annular space in which the cables protecting and guiding member is disposed, and therefore, the device is enlarged in outside diameter. When the outside diameter of the device is thus enlarged, the disposing area necessary for mounting the device is also enlarged. For example, in the case where this device is mounted on a semiconductor manufacturing apparatus, the semiconductor manufacturing apparatus itself must also be enlarged.

The semiconductor manufacturing apparatus, in general, is installed in a clean room. Therefore, in order to install the large semiconductor manufacturing apparatus, it is necessary to prepare a large clean room or apportion the most part of the clean room to the

semiconductor manufacturing apparatus. In this case, a production cost and a maintenance cost of the clean room may be increased, and convenience thereof may be lowered.

In consideration of this point, it is an object of the present invention to provide a small-type slewing type protecting and guiding device for cables that can stabilize a track of a cables protecting and guiding member in an annular space in which the cables protecting and guiding member is disposed.

In accordance with an aspect of the present invention, there is provided a slewing type protecting and guiding device for cables. The slewing type protecting and guiding device for cables includes an outer circumferential section facing an outside surface of an annular space, an inner circumferential section facing an inside surface of the annular space, and a cables protecting and guiding member including a movable end movable along a circumferential direction in the annular space and a fixed end disposed at a predetermined position in the annular space. A columnar track guide roller extending in a direction of a rotational axis perpendicular to the circumferential direction is disposed in the annular space, and the track guide roller is rotated in contact with the cables protecting and

guiding member by movement of the movable end.

Preferably, the outer circumferential section has a plurality of columnar outside slide improving rollers extending in the direction of the rotational axis and facing the outside surface of the annular space, and the outside slide improving rollers are rotated in contact with the cables protecting and guiding member by movement of the movable end.

Preferably, the inner circumferential section has a plurality of columnar inside slide improving rollers extending in the direction of the rotational axis and facing the inside surface of the annular space, and the inside slide improving rollers are rotated in contact with the cables protecting and guiding member by movement of the movable end.

In the present invention, the track guide roller which is rotated in contact with the cables protecting and guiding member by movement of the movable end of the cables protecting and guiding member and which is a columnar structure extending in the direction of the rotational axis perpendicular to the circumferential direction of the annular space.

When the cables protecting and guiding member is moved in the annular space and makes contact with the

track guide roller, the track guide roller is rotated to thereby smoothen the movement of the cables protecting and guiding member. Therefore, in the present invention, the cables protecting and guiding member can be guided by the track guide roller to thereby stabilize the track of the cables protecting and guiding member.

In addition, the disposing area of such a track guide roller is smaller than the disposing area of the guide frame having an arcuate wall surface provided in a conventional slewing type protecting and guiding device for cables. Therefore, in the present invention, it is possible to provide a smaller slewing type protecting and guiding device for cables as compared to the conventional slewing type protecting and guiding device for cables.

The above and other objects, features and advantages of the present invention and the manner of realizing them will become more apparent, and the invention itself will best be understood from a study of the following description and appended claims with reference to the attached drawings showing some preferred embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A is a side view schematically depicting an

example of a protecting and guiding device for cables;

FIG. 1B is a plan view schematically depicting the example of the protecting and guiding device for cables;

FIG. 2A is a plan view schematically depicting an example of the protecting and guiding device for cables in a state in which a movable end of a cables protecting and guiding member is moved;

FIG. 2B is a plan view schematically depicting an example of the protecting and guiding device for cables in a state in which the movable end of the cables protecting and guiding member is moved;

FIG. 3 is a block diagram schematically depicting an example of constituent elements of a semiconductor manufacturing apparatus;

FIG. 4 is a perspective view schematically depicting a workpiece unit including a workpiece;

FIG. 5 is a sectional view schematically depicting an expansion unit, a hot air jetting unit, and a cooling table; and

FIG. 6 is a block diagram schematically depicting connection relations of the cooling table, a dry gas supply unit, a lifting unit, a cooling unit, and a suction unit.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiments of the present invention will be described below referring to the attached drawings. FIG. 1A is a side view schematically depicting an example of a protecting and guiding device for cables, and FIG. 1B is a plan view schematically depicting an example of the protecting and guiding device for cables. Note that, in FIG. 1A, for convenience' sake, constituent elements concerning the protecting and guiding device for cables are depicted in blocks.

The protecting and guiding device for cables 2 depicted in FIGS. 1A and 1B includes a disk-shaped first plate (upper plate) 4 having one surface (upper surface) and the other surface (lower surface) substantially parallel to each other. In a central region of the first plate 4, a substantially circular opening 4a penetrating from the one surface to the other surface is provided. In addition, the first plate 4 is provided with an arcuate (C-shaped) opening 4b penetrating from the one surface to the other surface along a periphery thereof.

One end parts of a plurality of rollers (outside slide improving rollers) 6 are connected to a region (a region on the outer side than the opening 4b as viewed from the center of the first plate 4) in the vicinity of

an outer edge of the first plate 4. The plurality of rollers 6 are each connected to the first plate 4 in the manner of being independently rotatable, and each have a columnar shape extending in the direction perpendicular to the one surface and the other surface of the first plate 4.

In addition, the plurality of rollers 6 are disposed at substantially regular intervals along a circumferential direction of the first plate 4. Note that, in FIG. 1A, for convenience' sake, some of the plurality of rollers 6 (specifically, five rollers located on the front side in side view, of twelve rollers 6) are omitted.

One end parts of a plurality of rollers (inside slide improving rollers) 8 are connected to a region in the vicinity of the opening 4a of the first plate 4. The plurality of rollers 8 are each connected to the first plate 4 in the manner of being independently rotatable, and each have a columnar shape extending in the direction perpendicular to the one surface and the other surface of the first plate 4.

Besides, the plurality of rollers 8 are disposed at substantially regular intervals along a circumferential direction of the opening 4a. In addition, a height (a

length in the direction perpendicular to the one surface and the other surface of the first plate 4) of the rollers 8 is substantially equal to a height of the rollers 6, and their width (the length in a direction parallel to the one surface and the other surface of the first plate 4) is, for example, smaller than a width of the rollers 6.

One end part of a roller (track guide roller) 10 is connected to a region between the opening 4a and the opening 4b of the first plate 4. The roller 10 is connected to the first plate 4 in the manner of being independently rotatable and has a columnar shape extending in the direction perpendicular to the one surface and the other surface of the first plate 4. In addition, the height of the roller 10 is substantially equal to the height of the rollers 6 and 8, and its width is, for example, larger than the widths of the rollers 6 and 8.

A disk-shaped second plate (lower plate) 12 having one surface (upper surface) and the other surface (lower surface) substantially parallel to the one surface and the other surface of the first plate 4 is connected to the other end parts of the plurality of rollers 6, the other end parts of the plurality of rollers 8, and the

other end part of the roller 10. Note that the plurality of rollers 6, the plurality of rollers 8, and the roller 10 are each connected to the second plate 12 in the manner of being independently rotatable.

In a central region of the second plate 12, a substantially circular opening 12a penetrating from the one surface to the other surface of the second plate 12 is provided. The profile of the opening 12a substantially overlaps with the profile of the opening 4a of the first plate 4 in plan view.

In addition, in a region on the outer side than the plurality of rollers 8 of the second plate 12, an opening 12b penetrating from the one surface to the other surface of the second plate 12 is provided. The opening 12b is provided on the inner side than the opening 4b of the first plate 4 in plan view. More specifically, in plan view, the opening 12b is provided between an intermediate portion of the C-shaped opening 4b and the openings 4a and 12a and at a position nearer to the openings 4a and 12a than to the opening 4b.

In the protecting and guiding device for cables 2, an annular space A is surrounded by the first plate 4, the plurality of rollers 6, the plurality of rollers 8, and the second plate 12. Specifically, the first plate 4

and the second plate 12 faces respectively an upper surface and an lower surface of the annular space A, the plurality of rollers 6 face an outside surface of the annular space A, and the plurality of rollers 8 face an inside surface of an annular space A.

In the annular space A, a cables protecting and guiding member 14 is disposed. The cables protecting and guiding member 14 accommodates cables 14a curved along the circumferential direction B of the annular space A. Note that the circumferential direction B is a direction parallel to the upper surface and the lower surface of the first plate 4 and the upper surface and the lower surface of the second plate 12. In addition, the cables protecting and guiding member 14 includes a movable end 14b and a fixed end 14c including a housing for directing the thus curved cables 14a in the manner of bending to a direction perpendicular to the circumferential direction B of the annular space A.

The whole of the movable end 14b overlaps with the opening 4b of the first plate 4 in plan view. In other words, the movable end 14b is wholly exposed from the first plate 4 through the opening 4b. Besides, a bracket 16a is fixed to a side portion of the housing of the movable end 14b.

The bracket 16a has an L-shaped shape including a long section extending in the direction perpendicular to the upper surface and the lower surface of the first plate 4, and a short section that has one end portion connected to one end portion of the long section and extends in a direction parallel to the upper surface and the lower surface of the first plate 4. The long section of the bracket 16a is fixed to the side portion of the housing of the movable end 14b.

In addition, the long section of the bracket 16a extends to above the first plate 4 by passing through the opening 4b, while the short section of the bracket 16a is fixed to a rotated body 18 present in the outside of the protecting and guiding device for cables 2. Note that the rotated body 18 is a rotatable constituent element included in a treatment unit that performs a desired treatment on an object to be treated. Therefore, when the rotated body 18 is rotated, the movable end 14b fixed to the rotated body 18 is also moved through the bracket 16a, whereby relative positions of the first plate 4 and the movable end 14b are varied.

At least a part of the fixed end 14c overlaps with the opening 12b of the second plate 12 in plan view. In other words, at least a part of the fixed end 14c is

exposed from the second plate 12 through the second opening 12b. In addition, a bracket 16b is fixed to a side portion of the housing of the fixed end 14c.

The bracket 16b has an L-shaped shape including a long section extending in the direction perpendicular to the upper surface and the lower surface of the second plate 12, and a short section that has one end portion connected to one end portion of the long section and extends in a direction parallel to the upper surface and the lower surface of the second plate 12. The long section of the bracket 16b is fixed to the side portion of the housing of the fixed end 14c.

Besides, the long section of the bracket 16b extends from the side portion of the housing of the fixed end 14c to the upper surface of the second plate 12, while the short section of the bracket 16b is fixed to the second plate 12. Therefore, relative positions of the second plate 12 and the fixed end 14c are not varied.

Note that the cables 14a bent at the movable end 14b pass through the opening 4b of the first plate 4 and are connected to terminals of the treatment unit including the rotated body 18. In addition, the cables 14a bent at the fixed end 14c pass through the opening 12b of the second plate 12 and are connected to terminals

of power sources (a power source and a fluid (air, water, or the like) supply source) 20.

Besides, a rotary shaft 22 for rotating the rotated body 18 included in the treatment unit is inserted in the opening 4a of the first plate 4 and the opening 12a of the second plate 12. One end portion of the rotary shaft 22 is fixed to a central portion of the rotated body 18, and the other end portion of the rotary shaft 22 is connected to a rotational drive source 24 including a motor or the like.

Note that the protecting and guiding device for cables 2 is, for example, supported by a support section (not illustrated) connected to at least one of the first plate 4 and the second plate 12. Alternatively, the protecting and guiding device for cables 2 may be supported by the rotary shaft 22 through a bearing (not illustrated) provided between at least one of the first plate 4 and the second plate 12 and the rotary shaft 22.

In the protecting and guiding device for cables 2, the short section of the bracket 16a fixed to the rotated body 18 is provided at a position spaced from the rotary shaft 22. Therefore, when the rotational drive source 24 rotates the rotary shaft 22, the movable end 14b is moved so as to rotate around the rotary shaft 22.

In this instance, the cables 14a disposed in the annular space A is also moved following the movable end 14b. Therefore, with the protecting and guiding device for cables 2 provided between the power sources 20 and the treatment unit including the rotated body 18, the rotated body 18 can be rotated while keeping the state in which the cables 14a are connected to the treatment unit.

Specifically, the rotational drive source 24 can rotate the rotary shaft 22 by 180° along the circumferential direction B of the annular space A. When the rotational drive source 24 thus rotates the rotary shaft 22, the movable end 14b fixed to the treatment unit through the bracket 16a is moved together with the rotated body 18 along the circumferential direction B of the annular space A.

FIG. 2A is a plan view schematically depicting an example of the protecting and guiding device for cables 2 in a state in which the movable end 14b is moved such as to rotate by 90° around the rotary shaft 22, and FIG. 2B is a plan view schematically depicting an example of the protecting and guiding device for cables 2 in a state in which the movable end 14b is moved such as to rotate by 180° around the rotary shaft 22.

When the movable end 14b is moved such as to rotate

by 90° around the rotary shaft 22 (see FIG. 2A), the curvature of the curved cables protecting and guiding member 14 is enlarged. In addition, when the movable end 14b is moved, the cables protecting and guiding member 14 can make contact with the rollers 6. In this instance, the rollers 6 are rotated by influence of frictional forces generated due to the contact with the rotating cables protecting and guiding member 14.

When the movable end 14b is moved such as to rotate by 180° around the rotary shaft 22 (see FIG. 2B), the curvature of the curved cables protecting and guiding member 14 is further enlarged. In addition, when the movable end 14b is moved, the cables protecting and guiding member 14 can make contact with the rollers 8 and 10. In this instance, the rollers 8 and 10 are rotated by the influence of frictional forces generated due to contact with the rotating cables protecting and guiding member 14.

Besides, the rotational drive source 24 can rotate the rotary shaft 22 by 180° along the direction opposite to the circumferential direction B of the annular space A, such as to be returned from the state depicted in FIG. 2B to the state depicted in FIG. 1B.

In the protecting and guiding device for cables 2,

the roller (track guide roller) 10 which is rotated in contact with the cables protecting and guiding member 14 by movement of the movable end 14b of the cables protecting and guiding member 14 and which is a columnar structure extending in the direction perpendicular to the circumferential direction B of the annular space A (namely, in the direction of a rotational axis in which the rotary shaft 22 extends) is disposed in the annular space A.

When the cables protecting and guiding member 14 is moved in the annular space A and makes contact with the roller 10, the roller 10 is rotated, whereby movement of the cables protecting and guiding member 14 is smoothened. Therefore, in the protecting and guiding device for cables 2, it is possible to guide the cables protecting and guiding member 14 by the roller 10, and to stabilize the track of the cables protecting and guiding member 14.

In addition, the disposing area of the roller 10 is smaller than the disposing area of a guide frame having an arcuate wall surface like the one provided in the conventional slewing type protecting and guiding device for cables. Therefore, the protecting and guiding device for cables 2 is a device which can be reduced in size as

compared to the conventional slewing type protecting and guiding device for cables.

Note that the protecting and guiding device for cables 2 is one mode of the present invention, and the technical scope of the present invention includes a device provided with characteristics different from those of the protecting and guiding device for cables 2. For example, in the present invention, the plurality of rollers 6 may be replaced by an outer wall, and/or the plurality of rollers 8 may be replaced by an inner wall.

Specifically, in the protecting and guiding device for cables of the present invention, the outer circumferential section facing the outside surface of the annular space A may include an outer wall, and/or the inner circumferential section facing the inside surface of the annular space A may include an inner wall.

It is to be noted that, however, as above-mentioned, the plurality of rollers (outside slide improving rollers) 6 and the plurality of rollers (inside slide preventing rollers) 8 are rotated in contact with the cables protecting and guiding member 14 by movement of the movable end 14b. In this case, of the frictional forces generated due to the contact between the rollers 6 and 8 and the cables protecting and guiding member 14,

the proportion of the frictional force that acts as a resistance against movement of the cables protecting and guiding member 14 is reduced.

In other words, in the case where the rollers 6 and 8 are present, movement of the cables protecting and guiding member 14 attendant on the movement of the movable end 14b is little restrained. Therefore, in the present invention, it is preferable that the plurality of rollers 6 face the outside surface of the annular space A and/or the plurality of rollers 8 face the inside surface of the annular space A.

In addition, in the protecting and guiding device for cables 2, the opening 4b is provided in an arcuate shape with a center angle of approximately 180° . Therefore, the movable end 14b of the cables protecting and guiding member 14 can only be moved such as to rotate by 180° around the rotary shaft 22, but, in the protecting and guiding device for cables of the present invention, the moving range of the movable end 14b is not limited to this.

Specifically, in the protecting and guiding device for cables of the present invention, the moving range of the movable end of the cables protecting and guiding member may be widened by enlarging the center angle of

the opening 4b provided in the arcuate shape. In such a case, a plurality of rollers (track guide rollers) 10 may be disposed in the annular space A, for stabilizing the track of the cables protecting and guiding member.

This case is preferable in the point that the use of the protecting and guiding device for cables is enlarged. On the other hand, the case where the movable end 14b can be moved such as to rotate only 180° around the rotary shaft 22 as in the protecting and guiding device for cables 2 is preferable in the point that the probability of entangling of the cables 14a can be reduced.

Besides, in the protecting and guiding device for cables 2, the movable end 14b of the cables protecting and guiding member 14 is provided at a position farther from the rotary shaft 22 than the fixed end 14c, but, in the protecting and guiding device for cables of the present invention, the movable end of the cables protecting and guiding member may be provided at a position nearer to the rotary shaft 22 than the fixed end.

In addition, in the protecting and guiding device for cables 2, the rollers 6, 8, and 10 are connected to the first plate 4 and the second plate 12 in a rotatable

manner, but, in the protecting and guiding device for cables of the present invention, a plurality of shafts fixed to the first plate 4 and the second plate 12 may be provided, and the rollers 6, 8, and 10 may be connected in the manner of being rotatable around the shafts.

Besides, in FIG. 1A, the protecting and guiding device for cables 2 is disposed on the lower side of the treatment unit including the rotated body 18, but the protecting and guiding device for cables 2 may be disposed on the upper side of the treatment unit. Specifically, the protecting and guiding device for cables 2 may be disposed on the upper side of the treatment unit such that the first plate 4 is on the lower side and the second plate 12 is on the upper side. Note that, in this case, the rotary shaft fixed to an upper portion of the rotated body included in the treatment unit is inserted in the opening 4a of the first plate 4 and the opening 12a of the second plate 12.

FIG. 3 is a block diagram schematically depicting an example of constituent elements of a semiconductor manufacturing apparatus including the protecting and guiding device for cables 2. Specifically, the semiconductor manufacturing apparatus 30 depicted in FIG. 3 is an expanding apparatus that exerts an external force

on a workpiece unit 1 including a workpiece formed with semiconductor devices on a front surface thereof to divide the workpiece, thereby manufacturing semiconductor device chips. Hereinafter, first, an example of the workpiece unit 1 will be described, and thereafter, constituent elements of the semiconductor manufacturing apparatus 30 will be described.

FIG. 4 is a perspective view schematically depicting the workpiece unit 1 including the workpiece to be divided by the semiconductor manufacturing apparatus 30. The workpiece unit 1 depicted in FIG. 4 includes a workpiece 11 having a disk-like shape. The workpiece 11 is, for example, a wafer including a semiconductor material such as silicon (Si).

A front surface 11a side of the workpiece 11 is partitioned by a plurality of intersecting streets 13 into a plurality of regions, and a semiconductor device 15 such as an integrated circuit (IC) and large scale integration (LSI) is formed in each of the regions.

Note that a material, a shape, a structure, a size, and the like of the workpiece 11 are not limited. For example, a substrate including a material such as other semiconductor, ceramic, resin, or metal can be used as the workpiece 11. Similarly, a kind, a number, a shape, a

structure, a size, layout, and the like of the semiconductor device 15 are not limited.

In addition, in the inside of the workpiece 11, modified layers 17 are formed along the streets 13. The modified layers 17 are formed, for example, by applying a laser beam of such a wavelength as to be transmitted through the workpiece 11 to the workpiece 11 along the streets 13, with the focal point of the laser beam positioned inside the workpiece 11.

To a back surface 11b of the workpiece 11, an expanding sheet 23 is attached through an adhesive film 21. The adhesive film 21 is typically a film-shaped adhesive called die attach film (DAF), and generally, has a disk-like shape larger than the workpiece 11 in diameter.

The adhesive film 21 is formed, for example, by use of a resin or the like which is cured by heat or light, and has a function of fixing the chips obtained by dividing the workpiece 11 to an optional object (for example, another chip or a substrate).

The expanding sheet 23 attached to the back surface 11b of the workpiece 11 through the adhesive film 21 is a resin-made film which expands when a force is exerted thereon, and, for example, has a disk-like shape larger

than the adhesive film 21 in diameter. Further, a peripheral portion of the expanding sheet 23 is attached to an annular frame 25 having an inside diameter larger than the diameters of the workpiece 11 and the adhesive film 21.

In the workpiece unit 1 depicted in FIG. 4, the adhesive film 21 and the expanding sheet 23 are laid over and attached to the workpiece 11 such that the adhesive film 21 makes contact with the back surface 11b of the workpiece 11. Further, a peripheral portion of the expanding sheet 23 is attached to the frame 25, to close an opening of the frame 25. As a result, the workpiece 11 is put into the state of being supported by the frame 25 through the adhesive film 21 and the expanding sheet 23.

Next, the constituent elements of the semiconductor manufacturing apparatus 30 will be described. The semiconductor manufacturing apparatus 30 has an expanding unit 32 and a hot air jetting unit 44 as treatment units for directly treating the workpiece unit 1 (see FIG. 3). Note that the treatments of the workpiece unit 1 by the expanding unit 32 and the hot air jetting unit 44 are conducted in a state in which the workpiece unit 1 is held by a cooling table 64.

In other words, the expanding unit 32 expands the

expanding sheet 23 of the workpiece unit 1 to divide the workpiece 11 and the adhesive film 21 along the streets 13. In addition, the hot air jetting unit 44 jets hot air to the expanded expanding sheet 23, to contract the expanding sheet 23.

The hot air jetting unit 44 includes a rotatable heater plate, and is connected to the power sources 20 through the protecting and guiding device for cables 2. In the semiconductor manufacturing apparatus 30, the heater plate of the hot air jetting unit 44 corresponds to the rotated body 18 depicted in FIG. 1A.

FIG. 5 is a sectional view schematically depicting the expanding unit 32, the hot air jetting unit 44, and the cooling table 64 included in the semiconductor manufacturing apparatus 30. Note that, in FIG. 5, for convenience' sake, the protecting and guiding device for cables 2 is depicted in a block.

The expanding units 32 has a plurality of (for example, four) cylinder cases 34 fixed to a housing (not illustrated) of the semiconductor manufacturing apparatus 30. Lower end portion of piston rod 36 is inserted in the upper side of the cylinder case 34.

Note that, in FIG. 5, the piston rods 36 in the state of being positioned in a conveying-in position

where the workpiece unit 1 can be conveyed into the semiconductor manufacturing apparatus 30 are depicted. In addition, the piston rods 36 can be moved upward from the conveying-in positions.

An annular support table 38 capable of supporting the frame 25 of the workpiece unit 1 depicted in FIG. 4 is fixed to an upper end portion of the piston rod 36. Further, on the upper side of the support table 38, an annular fixed plate 40 is disposed.

The fixed plate 40 is supported by the housing of the semiconductor manufacturing apparatus 30 such that it can be moved upward. Specifically, the fixed plate 40 is supported by the housing of the semiconductor manufacturing apparatus 30 such that the piston rod 36 in a state of being located in the conveying-in position is spaced from the support table 38.

When the piston rod 36 is moved upward in a state in which the frame 25 of the workpiece unit 1 is supported by the support table 38, the fixed plate 40 makes contact with the frame 25 to fix the frame 25 on the support table 38. When the piston rod 36 is moved further upward, the fixed plate 40 is moved upward together with the support table 38 and the frame 25.

On the inside of the fixed plate 40, a cylindrical

drum 42 fixed to the housing of the semiconductor manufacturing apparatus 30 is provided. A lower end of the drum 42 is, for example, located substantially at the same height as a lower surface of the fixed plate 40 in a state in which the piston rod 36 is located at the conveying-in position.

In the expanding unit 32 depicted in FIG. 5, the piston rod 36 can be moved upward, in a state in which the frame 25 of the workpiece unit 1 is fixed between the support table 38 and the fixed plate 40. In addition, the expanding unit 32 can also maintain the position of the piston rod 36 when the cooling table 64 is lowered.

In other words, the expanding unit 32 can relatively move the frame 25 of the workpiece unit 1 and the cooling table 64. Then, by moving the cooling table 64 and the frame 25 making contact with the fixed plate 40 such as to space away from each other, the expanding sheet 23 of the workpiece unit 1 is expanded.

Besides, on the inside of the support table 38, the hot air jetting unit 44 is provided. As above-mentioned, the hot air jetting unit 44 has the heater plate 46. The heater plate 46 has a disk-like shape and is disposed on the inside of the support table 38. In addition, an upper surface of the heater plate 46 is disposed below a lower

surface of the support table 38.

Further, an upper end portion of the rotary shaft 22 passing through the opening 4a of the first plate 4 and the opening 12a of the second plate 12 of the protecting and guiding device for cables 2 and the bracket 16a of the protecting and guiding device for cables 2 (see FIGS. 1A and 1B) are fixed to a lower surface side of the heater plate 46. In addition, a lower end portion of the rotary shaft 22 is connected to the rotational drive source (heater plate rotating motor) 24. Therefore, when the rotational drive source 24 is operated, the heater plate 46 is rotated together with the rotary shaft 22.

On an upper surface of the heater plate 46, a plurality of (for example, four) hot air jetting sections 48 is provided. The hot air jetting sections 48 faces a region of the expanding sheet 23 which is provided between a peripheral edge of the workpiece 11 of the workpiece unit 1 and an inner circumferential edge of the frame 25, and jets hot air to this region of the expanding sheet 23. Specifically, the hot air jetting sections 48 are provided at substantially regular intervals in the circumferential direction at a peripheral portion of the upper surface of the heater

plate 46.

The hot air jetting section 48 includes a bottomed tubular jetting section main body 50 opened at an upper portion, and a coil heater 52 accommodated in the jetting section main body 50. Further, the hot air jetting section 48 has a terminal connected to cables for supplying air into the jetting section main body 50, and a terminal connected to the cables for supplying electric power to the coil heater 52. In other words, these terminals are connected to the cables 14a (see FIG. 1A) bent at the movable end 14b of the cables protecting and guiding member 14 of the protecting and guiding device for cables 2.

On the upper side of the hot air jetting sections 48, a shutter plate 54 is provided. The shutter plate 54 has a disk-like shape whose diameter is slightly shorter than the inside diameter of the support table 38, and the shutter plate 54 is disposed on the inside of the support table 38. In addition, an upper end portion of a rotary shaft 56 is fixed to a lower surface side of the shutter plate 54.

Besides, a lower end portion of the rotary shaft 56 is connected to a rotational drive source (shutter plate rotating motor) 58. Therefore, when the rotational drive

source 58 is operated, the shutter plate 54 is also rotated together with the rotary shaft 56. In addition, a peripheral portion of the shutter plate 54 is provided with an opening 60 through which the hot air jetting sections 48 can be exposed.

Besides, on the inside of the drum 42, a cylindrical support rod 62 formed from a metal or the like is disposed. As will be described later, the support rod 62 is supported on the housing of the semiconductor manufacturing apparatus 30 in the manner of being lifted upward and downward. Further, a lower end portion of the support rod 62 is fixed to an upper portion of the cooling table 64. As will be described later, the support rod 62 also functions as a medium that absorbs heat from the cooling table 64 to cool the cooling table 64.

The cooling table 64 is formed from a metal (for example, aluminum (Al)), and has a disk-like shape. In the cooling table 64, a lower surface is a contact surface (lower surface) 64a making contact with that region of the expanding sheet 23 which is attached to the workpiece 11 through the adhesive film 21.

Further, the contact surface (lower surface) 64a is formed with a plurality of through-holes 66. The plurality of through-holes 66 each penetrate from a back

surface 64b on the back side of the contact surface 64a of the cooling table 64 to the contact surface 64a. Note that the plurality of through-holes 66 function as supply routes for supplying a dry gas to the contact surface 64a or suction routes for generating a negative pressure at the contact surface 64a.

Besides, a cover member 68 formed of a resin or the like is fixed to the cooling table 64. The cover member 68 has a disk-shaped back surface cover section 68a having a circular lower surface. The lower surface of the back surface cover section 68a faces the back surface 64b of the cooling table 64 through a gap 70. In a central region of the back surface cover section 68a, an opening 68b penetrating the back surface cover section 68a in the thickness direction is provided, and the support rod 62 is inserted in the opening 68b.

A plurality of regions of the back surface cover section 68a located directly above the plurality of through-holes 66 of the cooling table 64 are provided with joint holes penetrating the back surface cover section 68a in the thickness direction. Cylindrical joints 72 are inserted into the joint holes, and the inside of the joints 72 communicates with the through-holes 66.

Further, the cover member 68 has a cylindrical outer circumferential surface cover section 68c extending downward from a peripheral edge of the back surface cover section 68a. An inner circumferential surface of the outer circumferential surface cover section 68c faces an outer circumferential surface 64c between the contact surface 64a and the back surface 64b of the cooling table 64.

In addition, the cover member 68 has a tubular joint insertion section 68d extending upward from an inner circumferential edge of the back surface cover section 68a. An upper portion of the joint insertion section 68d is fixed to the support rod 62 such as to close the gap 70. Besides, the joint insertion section 68d is provided with a joint hole penetrating the joint insertion section 68d in the radial direction. A tubular joint 74 is inserted in the joint hole, and the inside of the joint 74 communicates with the gap 70.

The cooling table 64 is connected to a dry gas supply unit 76, a lifting unit 78, a cooling unit 80 and a suction unit 82 (see FIG. 3). FIG. 6 is a block diagram schematically depicting connection relations of the cooling table 64, the dry gas supply unit 76, the lifting unit 78, the cooling unit 80, and the suction unit 82.

The dry gas supply unit 76 is connected to a valve 84 and the joints 72 through the cables. Therefore, by setting the valve 84 into an open state, the dry gas supply unit 76 can provide a dry gas to the contact surface 64a of the cooling table 64 through the valve 84, the joints 72, and the through-holes 66.

Besides, the dry gas supply unit 76 is connected to a valve 86 and the joint 74 through the cables. Therefore, by setting the valve 86 into an open state, the dry gas supply unit 76 can provide a dry gas to the back surface 64b and the outer circumferential surface 64c of the cooling table 64 through the valve 86, the joint 74, and the gap 70.

The dry gas is adjusted such that its dew point is lower than the temperature of the cooling table 64 when the expanding sheet 23 of the workpiece unit 1 held by the contact surface 64a of the cooling table 64 is expanded by the expanding unit 32 to break the adhesive film 21, and that its temperature is higher than the dew point of the atmosphere. Note that the dry gas supply unit 76 includes a gas cylinder incorporating the dry gas and a compressor for adjusting the pressure of the dry gas and the like.

The lifting unit 78 is connected to the cooling

table 64 through the support rod 62. The lifting unit 78, for example, by lowering the cooling table 64 through the support rod 62, can bring the contact surface 64a of the cooling table 64 into contact with the expanding sheet 23 of the workpiece unit 1. Note that the lifting unit 78 includes, for example, a motor, a ball screw driven by the motor, and the like.

The cooling unit 80 is connected to the cooling table 64 through the support rod 62. The cooling unit 80, for example, by absorbing heat from the support rod 62 in a state in which the workpiece unit 1 is held by the contact surface 64a of the cooling table 64 to cool the cooling table 64, can cool the adhesive film 21 through the expanding sheet 23. Note that the cooling unit 80 includes, for example, a piston cooler or the like.

The suction unit 82 is connected to a valve 88 and the joints 72 through the cables. Therefore, by setting the valve 88 into an open state, the suction unit 82 can generate a negative pressure at the contact surface 64a of the cooling table 64 through the valve 88, the joints 72, and the through-holes 66. Note that the suction unit 82 includes, for example, an ejector or the like.

Operations of the expanding unit 32, the hot air jetting unit 44, the dry gas supply unit 76, the lifting

unit 78, the cooling unit 80, and the suction unit 82 are controlled by a control unit 90 (see FIG. 3). The control unit 90 includes, for example, a processing section 92 that generates signals for controlling the constituent elements of the semiconductor manufacturing apparatus 30, and a storage section 94 that stores various kinds of information (data and programs, etc.) to be used in the processing section 92.

A function of the processing section 92 is embodied by a central processing unit (CPU) or the like that reads and executes the programs stored in the storage section 94. In addition, a function of the storage section 94 is embodied by at least one of a semiconductor memory such as a dynamic random access memory (DRAM), a static random access memory (SRAM), and a Not AND (NAND) type flash memory, and a magnetic storage device such as a hard disk drive (HDD).

The control unit 90 controls the operations of the constituent elements included in the semiconductor manufacturing apparatus 30, according to signals inputted from an input unit 96. Note that the input unit 96 includes, for example, at least one of a touch panel, a keyboard, a mouse, buttons, a microphone, and the like.

The input unit 96 can, for example, input to the

control unit 90 a signal designating a control for restraining generation of dewing, according to an operator's operation performed before the workpiece unit 1 is put into contact with the contact surface 64a of the cooling table 64.

When this signal is inputted, the control unit 90 sets the valve 84 and the valve 86 into an open state. Then, the control unit 90 controls the dry gas supply unit 76 such that the dry gas is supplied to the cooling table 64.

In this case, the dry gas supplied from the dry gas supply unit 76 is supplied to the contact surface 64a of the cooling table 64 through the valve 84, the joints 72, and the through-holes 66, and is supplied to the back surface 64b and the outer circumferential surface 64c of the cooling table 64 through the valve 86, the joint 74, and the gap 70.

Further, the input unit 96 can input to the control unit 90 a signal designating expansion of the expanding sheet 23 by holding the workpiece unit 1 on the contact surface 64a of the cooling table 64, according to an operator's operation.

When this signal is inputted, the control unit 90 controls the lifting unit 78 such that the contact

surface 64a of the cooling table 64 comes into contact with the expanding sheet 23 of the workpiece unit 1. Next, the control unit 90 controls the cooling unit 80 to cool the cooling table 64. As a result, a circular region of the expanding sheet 23 that makes contact with the contact surface 64a of the cooling table 64 is cooled.

Note that, in the semiconductor manufacturing apparatus 30, as above-mentioned, by supplying the dry gas to the contact surface 64a, the back surface 64b, and the outer circumferential surface 64c of the cooling table 64 prior to cooling of the cooling table 64, it is possible to reduce the probability of generation of dewing in the semiconductor manufacturing apparatus 30.

Next, the control unit 90 controls the expanding units 32 and/or the lifting unit 78 such as to expand the expanding sheet 23 of the workpiece unit 1. Specifically, the control unit 90 controls the expanding units 32 and/or the lifting unit 78 such as to move the piston rods 36 of the expanding units 32 upward and/or to lower the cooling table 64. As a result, the workpiece 11 and the adhesive film 21 of the workpiece unit 1 are divided along the streets 13.

Note that, in the semiconductor manufacturing apparatus 30, as above-mentioned, that circular region of

the expanding sheet 23 which makes contact with the contact surface 64a of the cooling table 64 is cooled prior to the expansion of the expanding sheet 23, and deformation of the adhesive film 21, when the expanding sheet 23 is expanded, can be restrained. As a result, division of the workpiece 11 is facilitated.

Next, the control unit 90 sets the valve 84 into a closed state and sets the valve 88 into an open state. Then, the control unit 90 controls the suction unit 82 such that a negative pressure is generated at the contact surface 64a of the cooling table 64. As a result, the circular region of the expanding sheet 23 held by the contact surface 64a of the cooling table 64 is sucked at the contact surface 64a.

Subsequently, the control unit 90 controls the hot air jetting unit 44 such as to mitigate the slackening generated in an annular region of the expanding sheet 23 surrounding the circular region by the expansion of the expanding sheet 23. Specifically, the hot air jetting unit 44 is operated in the following sequence.

First, the rotational drive source 58 rotates the shutter plate 54 such that the opening 60 of the shutter plate 54 is located directly above the hot air jetting section 48. Subsequently, air is supplied from the power

sources 20 connected to the hot air jetting section 48 to the jetting section main body 50 and electric power is supplied to the coil heater 52, through the cables 14a (see FIG. 1A and the like) accommodated in the cables protecting and guiding member 14 of the protecting and guiding device for cables 2.

In this instance, the air supplied into the jetting section main body 50 is heated to be hot air by the coil heater 52 energized and is jetted upward through the opening 60 of the shutter plate 54. As a result, the hot air is jetted to the region of the expanding sheet 23 that is located between the peripheral edge of the workpiece 11 and the inner circumferential edge of the frame 25 of the workpiece unit 1, and on the upper side of the opening 60.

Next, the rotational drive source 24 rotates the heater plate 46 through the rotary shaft 22 and the rotational drive source 58 rotates the shutter plate 54 through the rotary shaft 56 such that the hot air is jetted along the circumferential direction of the expanding sheet 23. As a result, the annular region of the expanding sheet 23 to which the hot air is jetted is heated and contracted. In other words, the slackening generated due to the expansion of the expanding sheet 23

by the expanding unit 32 is mitigated.

In the semiconductor manufacturing apparatus 30, the supply of air to the jetting section main body 50 and the supply of electric power to the coil heater 52 are conducted through the cables 14a accommodated in the cables protecting and guiding member 14 of the protecting and guiding device for cables 2. Therefore, in the semiconductor manufacturing apparatus 30, the track of the cables protecting and guiding member 14 can be stabilized without enlarging the apparatus.

Note that the semiconductor manufacturing apparatus 30 is an example of the semiconductor manufacturing apparatus including the protecting and guiding device for cables of the present invention, and the semiconductor manufacturing apparatus including the protecting and guiding device for cables of the present invention is not limited to the semiconductor manufacturing apparatus 30.

Other than the above-mentioned, the structures and the methods and the like concerning the embodiments and modifications described above can be modified, as required, in carrying out the present invention insofar as the modifications do not depart from the scope of the object of the present invention.

The present invention is not limited to the details

of the above described preferred embodiments. The scope of the invention is defined by the appended claims and all changes and modifications as fall within the equivalence of the scope of the claims are therefore to be embraced by the invention.

WHAT IS CLAIMED IS:

1. A slewing type protecting and guiding device for cables comprising:

an outer circumferential section facing an outside surface of an annular space,

an inner circumferential section facing an inside surface of the annular space,

and a cables protecting and guiding member including a movable end movable along a circumferential direction in the annular space and a fixed end disposed at a predetermined position in the annular space, wherein

a columnar track guide roller extending in a direction of a rotational axis perpendicular to the circumferential direction is disposed in the annular space, and

the track guide roller is rotated in contact with the cables protecting and guiding member by movement of the movable end.

2. The slewing type protecting and guiding device for cables according to claim 1, wherein

the outer circumferential section has a plurality of columnar outside slide improving rollers extending in the direction of the rotational axis and facing the outside surface of the annular space, and

the outside slide improving rollers are rotated in contact with the cables protecting and guiding member by movement of the movable end.

3. The slewing type protecting and guiding device for cables according to claim 1 or 2, wherein

the inner circumferential section has a plurality of columnar inside slide improving rollers extending in the direction of the rotational axis and facing the inside surface of the annular space, and

the inside slide improving rollers are rotated in contact with the cables protecting and guiding member by movement of the movable end.