

DESCRIPTION

BLADE COVER, CUTTING APPARATUS, AND METHOD OF MANUFACTURING A CUT PRODUCT

5 Technical Field

[0001] The present invention relates to a blade cover, a cutting apparatus, and a method of manufacturing a cut product.

Background Art

- 10 [0002] JP2019-145583A (Patent Literature 1) discloses a cutting apparatus. This cutting apparatus includes a chuck table for holding a workpiece, a cutting unit with a cutting blade, and a cooling nozzle for supplying cutting water. In this cutting apparatus, two cooling nozzles are provided, with the cutting edge of the cutting blade positioned between the two cooling nozzles. Each cooling nozzle supplies cutting water toward the
- 15 cutting blade (see Patent Literature 1).

Citation List

Patent Literature

[0003] Patent Literature 1: JP 2019-145583A

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Summary of Invention

Technical Problem

- [0004] The cutting apparatus disclosed in Patent Literature 1 cited above has a plurality of cooling nozzles. With this configuration, when the positions, orientations, and the
- 25 like of the respective cooling nozzles are not sufficiently adjusted, there is the risk of a drop in cutting quality for the object to be cut.

[0005] The present invention was conceived to solve the problem described above, and it

is an object of the present invention to provide a blade cover, a cutting apparatus, and a method of manufacturing a cut product capable of reducing a drop in cutting quality for the object to be cut.

5 Solution to Problem

[0006] A blade cover according to an aspect of the present invention is provided in a cutting mechanism including a blade for cutting an object to be cut that has been resin molded, and is configured to cover part of the blade. The blade has an outer peripheral portion, a first side surface portion, and a second side surface portion. The blade cover is equipped with a slit portion, a discharge port, and a supplying unit. The slit portion faces each of the outer peripheral portion, the first side surface portion, and the second side surface portion. The discharge port is formed at a position facing the outer peripheral portion, out of inner surfaces of the slit portion, and is configured to discharge machining fluid. The supplying unit supplies the machining fluid to the discharge port.

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[0007] A cutting apparatus according to another aspect of the present invention is equipped with the blade cover described above.

[0008] A method of manufacturing a cut product according to another aspect of the present invention includes: preparing the cutting apparatus described above; and manufacturing a plurality of cut products by cutting a resin-molded object to be cut using the cutting apparatus.

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Advantageous Effects of Invention

[0009] According to the present invention, it is possible to provide a blade cover, a cutting apparatus, and a method of manufacturing cut products capable of reducing a drop in cutting quality for an object to be cut.

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Brief Description of Drawings

[0010] FIG. 1 schematically depicts part of a top view of a cutting apparatus.

FIG. 2 is a perspective view schematically depicting part of a cutting mechanism.

5 FIG. 3 is a side view schematically depicting part of the cutting mechanism.

FIG. 4 is a perspective view schematically depicting a blade cover.

FIG. 5 is a side view schematically depicting the blade cover.

FIG. 6 is a front view schematically depicting the blade cover.

FIG. 7 is a plan view schematically depicting the blade cover.

10 FIG. 8 schematically depicts a direction in which machining fluid is dispersed.

FIG. 9 schematically depicts one example of an automatic replacement mechanism.

FIG. 10 schematically depicts part of a side surface of a blade cover according to a modification.

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Description of Embodiments

[0011] Hereinafter, an embodiment according to one aspect of the present invention (hereinafter, also referred to as “the present embodiment”) will be described in detail with reference to the accompanying drawings. Note that identical or corresponding parts in the drawings have been assigned the same reference numerals and description thereof is not repeated. Note also that the drawings have been schematically drawn by omitting or exaggerating configurations as appropriate for ease of understanding. Also, the directions indicated by the arrows in the respective drawings are common across the drawings.

25 [0012] 1. Configuration of Cutting Apparatus

FIG. 1 is a diagram schematically depicting part of a top view of a cutting apparatus 10 according to the present embodiment. As depicted in FIG. 1, the cutting

apparatus 10 includes a cutting table 30 and a cutting mechanism 40.

[0013] The cutting table 30 holds a package substrate 20 to be cut. The cutting table 30 includes a holding member 31, a rotating mechanism 32, and a moving mechanism 33. The holding member 31 holds the package substrate 20 by suction clamping the package substrate 20 from below. The rotating mechanism 32 is capable of rotating the holding member 31 in the θ direction in the drawing. The moving mechanism 33 is capable of moving the holding member 31 along the Y axis in the drawing. Note that in the package substrate 20, substrates or lead frames on which a semiconductor chip are mounted, are encapsulated in resin. As examples, a QFN (Quad Flat No-leaded) package substrate, a BGA (Ball Grid Array) package substrate, an LGA (Land Grid Array) package substrate, a CSP (Chip Size Package) substrate, or an LED (Light Emitting Diode) package substrate is used as the package substrate 20.

[0014] The cutting mechanism 40 includes a blade 41. The cutting mechanism 40 cuts the package substrate 20 with the blade 41 to singulate the package substrate 20 into a plurality of semiconductor packages. The cutting mechanism 40 is movable along the X-axis and the Z-axis in the drawing. Note that the cutting apparatus 10 may have a twin-spindle configuration with two cutting mechanisms 40 or a single-spindle configuration with one cutting mechanism 40.

[0015] FIG. 2 is a perspective view schematically depicting part of the cutting mechanism 40. FIG. 3 is a side view schematically depicting part of the cutting mechanism 40. As depicted in FIGS. 2 and 3, the cutting mechanism 40 includes the blade 41, a spindle portion 46, a support member 44, a rotating member 45, a blade cover 50, and a supply pipe 60. Note that during cutting of the package substrate 20, the cutting table 30 moves from the front toward the rear.

[0016] The blade 41 is a circular cutting blade. The blade 41 has an outer peripheral portion 43 formed on the outer peripheral surface and side surface portions 42 formed on each of two side surfaces.

[0017] The spindle portion 46 is configured to rotate the blade 41. The blade 41 is detachably attached to an end portion of the spindle portion 46 in the X-axis direction. The spindle portion 46 includes a motor for rotating the blade 41. Note that the blade 41 rotates in the counterclockwise direction in FIG. 3.

5 [0018] The support member 44 is a metal member and is fixed to an end portion of the spindle portion 46 in the X-axis direction. The support member 44 faces part of the outer peripheral portion 43 of the blade 41.

[0019] The rotating member 45 is a metal member and is rotatably attached to the support member 44. The rotating member 45 is rotatable around a rotational shaft J1. The
10 rotating member 45 contacts the support member 44 at a position P1. The rotating member 45 rotates in the counterclockwise direction only to a position where the rotating member 45 contacts the support member 44 at the position P1. At the position P1, the rotating member 45 faces part of the outer peripheral portion 43 of the blade 41 in a state where the rotating member 45 contacts the support member 44.

15 [0020] The blade cover 50 is a metal member that is substantially L-shaped. The blade cover 50 is attached by screws 71 and 72 to an end portion of the rotating member 45 in the Y-axis direction. A flow path through which machining fluid passes is formed inside the blade cover 50, and machining fluid that has passed through the flow path is sprayed toward the blade 41. The blade cover 50 will be described in detail later.

20 [0021] The supply pipe 60 is a resin or metal pipe, and is connected at a front end of the blade cover 50 to a flow path (or "supplying unit 500", described later) formed inside the blade cover 50. The supply pipe 60 is configured to supply machining fluid received from a machining fluid supplying source (not illustrated) via a tube or the like (not illustrated) to the flow path inside the blade cover 50.

25 [0022] 2. Configuration of Blade Cover

FIG. 4 is a perspective view schematically depicting the blade cover 50. FIG. 5 is a side view schematically depicting the blade cover 50. FIG. 6 is a front view

schematically depicting the blade cover 50. FIG. 7 is a plan view schematically depicting the blade cover 50.

[0023] As depicted in FIGS. 4, 5, 6 and 7, the blade cover 50 includes a lower surface portion 510, a first upper surface portion 560, a second upper surface portion 561, a first rear end surface 540, a second rear end surface 541, and a front end surface 550. That is, the lower surface portion 510, the first upper surface portion 560, the second upper surface portion 561, the first rear end surface 540, the second rear end surface 541, and the front end surface 550 are formed around the perimeters of two side surfaces of the blade cover 50.

[0024] The lower surface portion 510 is a surface located at the lower end in the Z-axis direction. The first upper surface portion 560 is a surface located at the upper end of a part of the blade cover 50 that extends along the Y-axis direction. The second upper surface portion 561 is a surface located at the upper end of a part of the blade cover 50 that extends along the Z-axis direction. The second upper surface portion 561 is at a higher position than the first upper surface portion 560 in the Z-axis direction. The first rear end surface 540 is a surface located at the rear end of the part of the blade cover 50 that extends along the Y-axis direction. The second rear end surface 541 is a surface located at the rear end of the part of the blade cover 50 that extends along the Z-axis direction. The first rear end surface 540 is at a position to the rear of the second rear end surface 541 in the Y-axis direction. The front end surface 550 is a surface located at the front end of the blade cover 50.

[0025] In the blade cover 50, holes H2 and H3 are formed near the upper end in the Z-axis direction of the front end surface 550. The holes H2 and H3 both pass through from the front end surface 550 to the second rear end surface 541. The blade cover 50 is attached to the rotating member 45 by passing the screws 71 and 72 (see FIG. 3) through the holes H2 and H3, respectively.

[0026] In the blade cover 50, the first rear end surface 540 is inclined at an acute angle

with respect to the lower surface portion 510. A slit portion 520 is formed in the first rear end surface 540. The slit portion 520 is a channel that is recessed toward the front in the Y-axis direction from the first rear end surface 540. The slit portion 520 is formed from the first upper surface portion 560 to the lower surface portion 510. The width of the slit portion 520 in the X-axis direction is 0.5 mm or more and 10 mm or less, for example. As more specific examples, the width may be set at 1 mm, 1.5 mm, 2 mm, 2.5 mm, 3 mm, 3.5 mm, 4 mm, 4.5 mm, 5 mm, 5.5 mm, 6 mm, 6.5 mm, 7 mm, 8 mm, or 9 mm.

[0027] The slit portion 520 covers part of the blade 41. The slit portion 520 faces each of the side surface portions 42 formed on the respective side surfaces of the blade 41 and the outer peripheral portion 43 of the blade 41.

[0028] A slope portion 530 is formed at a deepest portion in the Y-axis direction of the slit portion 520. The slope portion 530 faces the outer peripheral portion 43 of the blade 41. The slope portion 530 is inclined at an acute angle with respect to the lower surface portion 510. The angle A1 formed by the slope portion 530 and the lower surface portion 510 is, 10° or more and less than 90°, for example. As more specific examples, the angle may be set at 15°, 20°, 25°, 30°, 35°, 40°, 45°, 50°, 55°, 60°, 70° or 80°.

A discharge port H1 is formed in the slope portion 530.

[0029] The supplying unit 500 is formed inside the part of the blade cover 50 that extends along the Y-axis direction. The supplying unit 500 is a hole that communicates with the discharge port H1 and the front end surface 550. The supplying unit 500 extends linearly along the Y axis. The machining fluid supplied from the supply pipe 60 through the supplying unit 500 is sprayed from the discharge port H1 toward the outer peripheral portion 43 of the blade 41. By doing so, the machining fluid is supplied to the blade 41 during cutting of the package substrate 20.

[0030] The discharge port H1 faces the outer peripheral portion 43 of the blade 41 in a region that is below the blade 41 in the Z-axis direction and in front of the blade 41 in the

Y-axis direction. During rotation of the blade 41, the region of the outer peripheral portion 43 that faces the discharge port H1 has a vector component that points downward in the Z-axis direction and a vector component that points rearward in the Y-axis direction.

[0031] During the rotation of the blade 41, since the region of the outer peripheral portion 43 facing the discharge port H1 has a vector component that points rearward in the Y-axis direction, when looking from above, the direction of rotation of the blade 41 is rearward in the Y-axis direction. On the other hand, since the supplying unit 500 extends in the Y-axis direction and the machining fluid is supplied from the front toward the rear in the Y-axis direction, the direction in which the machining fluid is sprayed by the discharge port H1 is rearward in the Y-axis direction. Accordingly, when looking from above, the direction of rotation of the region of the outer peripheral portion 43 that faces the discharge port H1 and the direction in which the machining fluid is sprayed by the discharge port H1 are substantially identical.

[0032] Referring back to FIG. 3, when looking from the side, the blade cover 50 overlaps a part of the blade 41. In order to replace the blade 41 in the cutting mechanism 40, it is necessary to move the blade 41 toward the front in the X-axis direction. When the blade cover 50 and the blade 41 overlap each other when looking from the side, the blade cover 50 will obstruct replacement of the blade.

[0033] As mentioned earlier, in the cutting apparatus 10, the rotating member 45 is rotatable around the rotational shaft J1. By rotating the rotating member 45 clockwise around the rotational shaft J1, the blade cover 50 moves to a position away from the blade 41. As a result, the blade cover 50 and the blade 41 will no longer overlap each other when looking from the side. That is, the cutting apparatus 10 includes a retracting mechanism for the blade cover 50 including the rotating member 45 and the rotational shaft J1. This retracting mechanism is configured to retract the blade cover 50 to a position where the blade 41 is not overlapped. According to the cutting apparatus 10, replacement of the blade 41 can be easily performed by retracting the blade cover 50.

[0034] 3. Effects Obtained by Provision of the Blade Cover

As mentioned earlier, the cutting mechanism 40 includes the blade cover 50. The effects obtained by providing the blade cover 50 are described below.

[0035] With the blade cover 50, the machining fluid that has passed through the supplying
5 unit 500 is discharged from the discharge port H1. Some of the machining fluid discharged from the discharge port H1 hits the outer peripheral portion 43 of the blade 41. Some of the machining fluid discharged from the discharge port H1 advances toward the rear in the Y-axis direction along the side surface portions 42 of the blade 41. Since the discharge port H1 and the outer peripheral portion 43 are close to each other and the width
10 of the slit portion 520 is narrow, if the discharge port H1 continuously discharges the machining fluid, the slit portion 520 will become filled with the machining fluid. Once this state has been produced, the machining fluid will hit the outer peripheral portion 43 and each of the side surface portions 42 of the blade 41, which achieves an equivalent effect to spraying the machining fluid toward the outer peripheral portion 43 and each of
15 the side surface portions 42 of the blade 41. This achieves the effects of cooling the point of machining and preventing clogging of the blade 41.

[0036] To spray the machining fluid toward the outer peripheral portion 43 and each of the side surface portions 42 without providing the blade cover 50, a plurality of nozzles would be required. However, when a plurality of nozzles are provided, a high cost and
20 a long time would be required to adjust the bending angle, orientation, and height position of each nozzle. If the bending angle, orientation, and height position of each nozzle are not sufficiently adjusted, the cutting quality and cutting accuracy for the package substrate 20 will fall.

[0037] Also, when a plurality of nozzles are provided without the blade cover 50 being
25 provided, the distance between the nozzles and the blade 41 will be longer than when the blade cover 50 is provided. This means that it would be necessary to increase the pressure of the machining fluid to apply the machining fluid onto the blade 41 with

sufficient force. When the pressure of the machining fluid is high, splash back and the like of the machining fluid becomes likely, increasing the likelihood of the inside of the cutting apparatus 10 becoming dirty.

[0038] In the cutting apparatus 10 according to the present embodiment, the supplying unit 500 connected to the discharge port H1 facing the outer peripheral portion 43 of the blade 41 is formed inside the blade cover 50. Accordingly, the positional relationship between the discharge port H1 and the blade 41 is determined by merely attaching the blade cover 50 to the rotating member 45. That is, complicated adjustment, such as adjustment of the bending angle, orientation, and height position of each nozzle, which is required when a plurality of nozzles are provided, is not necessary. This means that according to the cutting apparatus 10, since the positioning of the discharge port H1 is simple, it is possible to suppress a drop in the cutting quality of the package substrate 20 due to a positioning failure for the discharge port H1.

[0039] Also, in the cutting apparatus 10, the length between the outer peripheral portion 43 of the blade 41 and the discharge port H1 is short. Accordingly, it is possible to apply the machining fluid onto the blade 41 with sufficient force even when the pressure of the machining fluid is low. As a result, according to the cutting apparatus 10, it is possible to suppress splashing back and the like of the machining fluid, which makes it possible to suppress the extent to which the inside of the cutting apparatus 10 becomes dirty due to operation of the cutting apparatus 10. It is also possible to suppress the consumed amount of machining fluid.

[0040] Also, in the cutting apparatus 10, the slope portion 530 of the blade cover 50 is inclined at an acute angle with respect to the lower surface portion 510. Accordingly, machining fluid that is repelled by the blade 41 becomes dispersed in a direction along the slope portion 530.

[0041] FIG. 8 is a diagram schematically depicting the directions in which the machining fluid is dispersed. As depicted in FIG. 8, in the cutting apparatus 10, the machining fluid

is collectively blown diagonally downward along the inclination of the slope portion 530. Accordingly, with the cutting apparatus 10, it is possible to suppress dispersion of the machining fluid in all different directions, and possible to suppress the dispersion of cutting chips, fragments, and the like caused by dispersion of the machining fluid. As a result, it is possible to suppress the extent to which the cutting apparatus 10 becomes dirty.

[0042] 4. Manufacturing Method of Cut Products

With the cutting apparatus 10, in a state where the position of the cutting mechanism 40 in the X-axis and Z-axis directions has been determined, rotation of the blade 41 and the discharging of the machining fluid from the discharge port H1 are commenced. In this state where the rotation of the blade 41 and the discharging of the machining fluid from the discharge port H1 have been commenced, the cutting table 30 moves from the front toward the rear in the Y-axis direction. By doing so, the package substrate 20 disposed on the cutting table 30 is cut by the blade 41. By cutting the package substrate 20, a plurality of cut products are manufactured.

[0043] 5. Features

As described above, the blade cover 50 according to the present embodiment is provided on the cutting mechanism 40 including the blade 41 for cutting the package substrate 20 that has been resin-molded, and is configured to cover part of the blade 41. The blade 41 has the outer peripheral portion 43 and the side surface portions 42. The blade cover 50 includes the slit portion 520, the discharge port H1, and the supplying unit 500. The slit portion 520 faces the outer peripheral portion 43 and each of the side surface portions 42. The discharge port H1 is formed in the slope portion 530, which faces the outer peripheral portion 43, of the inner surface of the slit portion 520 and is configured to discharge the machining fluid. The supplying unit 500 supplies the machining fluid to the discharge port H1.

[0044]

As described above, the supplying unit 500 connected to the discharge port H1

facing the outer peripheral portion 43 of the blade 41 is formed inside the blade cover 50. Accordingly, the positional relationship between the discharge port H1 and the blade 41 is determined by merely attaching the blade cover 50. That is, complicated adjustments, such as adjustment of the bending angle, orientation, and height position of each nozzle which is required when a plurality of nozzles are provided, are not necessary. Accordingly, with the blade cover 50, since the positioning of the discharge port H1 is simple, it is possible to reduce a drop in the cutting quality of the package substrate 20 due to a positioning failure for the discharge port H1.

[0045] 6. Other Embodiments

The concept of the above embodiment is not limited to the embodiment described above. Another example embodiment to which the concept of the above embodiment can be applied is described below.

[0046] As one example, the cutting apparatus 10 may be equipped with an automatic replacement mechanism configured to automatically perform replacement of the blade 41.

[0047] FIG. 9 is a diagram schematically depicting an example of an automatic replacement mechanism. In the example in FIG. 9, the cutting apparatus has a twin spindle configuration, and the cutting apparatus includes cutting mechanisms 40 and 85. As depicted in FIG. 9, this automatic replacement mechanism includes a suction-clamping arm 80 and a moving mechanism 90. The suction-clamping arm 80 includes a suction-clamping unit 81 and an arm portion 82. The moving mechanism 90 includes slide mechanisms 91 and 92.

[0048] The suction-clamping unit 81 is configured to suction-clamp the blade 41 or the like included in the cutting mechanism 40. The arm portion 82 is configured to adjust the position of the suction-clamping unit 81. One end of the arm portion 82 is connected to the suction-clamping unit 81, and another end of the arm portion 82 is connected to the slide mechanism 92. The slide mechanism 92 is configured to slide the arm portion 82 in the height direction. The slide mechanism 92 is connected to the slide mechanism 91.

The slide mechanism 91 is configured to slide the slide mechanism 92 in the horizontal direction.

[0049] This automatic replacement mechanism releases the locking of the blade 41 in the cutting mechanism 40 and removes the blade 41 from the cutting mechanism 40 in a state
5 where the blade 41 and the like have been suction clamped onto the suction clamping unit 81. The automatic replacement mechanism then attaches another blade 41 to the cutting mechanism 40. By performing this procedure, the blade 41 is automatically replaced.

[0050] In the above embodiment, the slope portion 530 of the blade cover 50 is flat. However, it is not necessary for the slope portion 530 to be flat. The slope portion 530
10 may be curved, for example.

[0051] FIG. 10 is a diagram schematically depicting part of a side surface of a blade cover 50X according to a modification. As depicted in FIG. 10, a supplying unit 500X is formed inside the blade cover 50X. A slit portion 520X is formed on a first rear end surface 540X. A slope portion 530X is formed at a deepest portion of the slit portion
15 520X. The slope portion 530X is curved. The slope portion 530X is inclined at an acute angle with respect to a lower surface portion 510X. Here, the expression "the slope portion 530X is inclined at an acute angle with respect to the lower surface portion 510X" refers to a state where an angle A2 formed by a tangent line L1 of the slope portion 530X and the lower surface portion 510X at a point where the slope portion 530X and the
20 lower surface portion 510X intersect is an acute angle.

[0052] Embodiments of the present invention have been exemplified above. That is, detailed description and accompanying drawings have been provided for illustrative purposes. Accordingly, the components indicated in the detailed description and the accompanying drawings may include components that are not essential for solving the
25 problem. Although such non-essential components have been indicated in the detailed description and the accompanying drawings, this should not be directly interpreted as signifying that such non-essential components are essential.

[0053] Note that the embodiments given above are exemplary of the present invention in all aspects. Various changes and modifications can be made to the embodiments without departing from the scope of the invention. When implementing the present invention, it is possible to use an appropriate specific configuration in keeping with the application.

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List of Reference Numerals

10	[0054] 10	Cutting apparatus
	20	Package substrate
	30	Cutting table
	31	Holding member
	32	Rotating mechanism
	33, 90	Moving mechanism
	40, 85	Cutting mechanism
	41	Blade
	42	Side surface portion
	43	Outer peripheral portion
15	44	Support member
	45	Rotating member
	46	Spindle portion
	50, 50X	Blade cover
	60	Supply pipe
20	71, 72	Screw
	80	Suction-clamping arm
	81	Suction-clamping unit
	82	Arm portion
	91, 92	Slide mechanism
25	500, 500X	Supplying unit

	510, 510X	Lower surface portion
	520, 520X	Slit portion
	530, 530X	Slope portion
	540, 540X	First rear end surface
5	541	Second rear end surface
	550	Front end surface
	560	First upper surface portion
	561	Second upper surface portion
	H1	Discharge port
10	H2, H3	Hole
	J1	Rotational shaft
	L1	Tangent line
	P1	Position

CLAIMS

1. A blade cover provided in a cutting mechanism including a blade for cutting an object to be cut that has been resin molded, the blade cover being configured to cover
5 part of the blade,

wherein the blade has an outer peripheral portion, a first side surface portion, and a second side surface portion, and

the blade cover comprises:

a slit portion that faces each of the outer peripheral portion, the first side
10 surface portion, and the second side surface portion;

a discharge port that is formed at a position facing the outer peripheral portion, out of inner surfaces of the slit portion, and is configured to discharge machining fluid; and

a supplying unit for supplying the machining fluid to the discharge port.
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2. The blade cover according to claim 1,

wherein a surface, out of the inner surfaces of the slit portion, where the discharge port is formed is inclined at an acute angle with respect to a lower surface of the blade cover.

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3. The blade cover according to claim 1 or claim 2, wherein when looking from above, a direction of rotation of the blade at a position where the machining fluid hits the blade and a direction in which the machining fluid is discharged by the discharge port are substantially identical.

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4. The blade cover according to any one of claim 1 to claim 3, wherein a width of the slit portion is 10 mm or less.

5. A cutting apparatus comprising a cutting mechanism provided with the blade cover according to any one of claim 1 to claim 4.
- 5 6. The cutting apparatus according to claim 5, further comprising a retracting mechanism configured to retract the blade cover to a position where the blade cover does not overlap the blade when looking from a side.
7. The cutting apparatus according to claim 6,
- 10 further comprising an automatic replacement mechanism configured to perform automatic replacement of the blade.
8. A method of manufacturing a cut product comprising:
- 15 preparing the cutting apparatus according to any one of claim 5 to claim 7; and manufacturing a plurality of cut products by cutting a resin-molded object to be cut using the cutting apparatus.