DESCRIPTION

TITLE OF INVENTION:

Cutting Device and Method for Manufacturing Separately Cut Articles

TECHNICAL FIELD

[0001] The present disclosure relates to a cutting device and a method for manufacturing separately cut articles.

BACKGROUND ART

[0002] Japanese Patent Laid-Open No. 2023-076250 (PTL 1) discloses an invention related to a cutting device. The cutting device cuts a target object (package substrate) into a plurality of separately cut articles (electronic components). The cutting device is separately provided with an inspection mechanism that inspects a lower surface of an electronic component and an inspection mechanism that inspects an upper surface of the electronic component. More specifically, a first optical inspection camera is disposed on the upstream side in the transporting direction of the electronic components, and a second optical inspection camera is disposed on the downstream side thereof.

[0003] According to the cutting device, after a mold surface of an electronic component is inspected by the first optical inspection camera, a ball/lead surface of the electronic component is inspected by the second optical inspection camera. Each inspection mechanism is typically provided with a lighting unit suitable for inspecting the target object. In the cutting device mentioned above, a lighting unit suitable for inspecting the mold surface is provided as the lighting unit for the first optical inspection camera, and a lighting unit suitable for inspecting the ball/lead surface is provided as the lighting unit for the second optical inspection camera.

CITATION LIST

PATENT LITERATURE

[0004] PTL 1: Japanese Patent Laid-Open No. 2023-076250

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0005] In recent years, there are various needs for cutting devices. For example, it is desirable to efficiently cut more kinds of target objects and efficiently inspect separately cut articles obtained by cutting. For example, one surface of a target object may be a mold surface entirely sealed with resin, and the other surface of the target object may be a ball/lead surface partially sealed with resin. Suppose that a cutting device disclosed in PTL 1 (Japanese Patent Laid-Open No. 2023-076250) is used to obtain a plurality of separately cut articles from such a target object.

[0006] In order to appropriately cut the target object using the cutting device mentioned above, the target object is fixed on a processing table with the mold surface of the target object facing upward, and a blade is brought close to the target object from the mold surface side to cut the target object. Thereafter, if the cutting device with the configuration as described in PTL 1 is used without any modification, the ball/lead surface of the target object is inspected by the first optical inspection camera disposed on the upstream side, and the mold surface is inspected by the second optical inspection camera disposed on the downstream side.

[0007] The lighting unit is not suitable for the inspection target. In order to appropriately perform the inspection, it is necessary to replace the lighting unit to be used together with the first optical inspection camera with the lighting unit suitable for inspecting the ball/lead surface, replace the lighting unit to be used together with the second optical inspection camera with the lighting unit suitable for inspecting the mold surface, and perform adjustments such as alignment and focusing of each inspection mechanism. Such replacement and adjustment will require time and labor.

[0008] An object of the present disclosure is to provide a cutting device capable of performing cutting and inspection with high productivity, and a method for manufacturing separately cut articles.

SOLUTION TO PROBLEM

[0009] A cutting device of the present disclosure includes:

a processing table that holds a target object;

a cutting mechanism that cuts the target object held on the processing table into a plurality of separately cut articles;

a first transport mechanism that holds and transports the plurality of separately cut articles;

a second transport mechanism that holds and transports the plurality of separately cut articles;

a first inspection mechanism that inspects a first surface of the plurality of separately cut articles when the plurality of separately cut articles are disposed at a first inspection position; and

a second inspection mechanism that inspects a second surface of the plurality of separately cut articles when the plurality of separately cut articles are disposed at a second inspection position,

the first transport mechanism is configured to be capable of transporting the plurality of separately cut articles to both the first inspection position and the second inspection position, and

the second transport mechanism is also configured to be capable of transporting the plurality of separately cut articles to both the first inspection position and the second inspection position.

[0010] A method for manufacturing separately cut articles according to the present disclosure uses the cutting device mentioned above and includes the steps of:

cutting the target object held on the processing table into the plurality of separately cut articles;

inspecting the second surface of the plurality of separately cut articles by using the second inspection mechanism when the plurality of separately cut articles are disposed at the second inspection position by the first transport mechanism;

transferring the plurality of separately cut articles from the first transport mechanism to the second transport mechanism; and

inspecting the first surface of the plurality of separately cut articles by using the first inspection mechanism when the plurality of separately cut articles are disposed at

the first inspection position by the second transport mechanism.

[0011] A method for manufacturing separately cut articles according to the present disclosure uses the cutting device mentioned above and includes the steps of:

cutting the target object held on the processing table into the plurality of separately cut articles;

inspecting the first surface of the plurality of separately cut articles by using the first inspection mechanism when the plurality of separately cut articles are disposed at the first inspection position by the first transport mechanism;

transferring the plurality of separately cut articles from the first transport mechanism to the second transport mechanism; and

inspecting the second surface of the plurality of separately cut articles by using the second inspection mechanism when the plurality of separately cut articles are disposed at the second inspection position by the second transport mechanism.

ADVANTAGEOUS EFFECTS OF INVENTION

[0012] According to the present disclosure, it is possible to obtain a cutting device capable of performing cutting and inspection with high productivity, and a method for manufacturing separately cut articles.

BRIEF DESCRIPTION OF DRAWINGS

[0013] Fig. 1 is a plan view schematically illustrating a cutting device 1.

Fig. 2 is a front view schematically illustrating a portion between a processing table 5M and a placement table 14 in cutting device 1 and illustrating a state SA1 in which a first transport mechanism 7 is disposed at a pick-up position T1 and is suction-holding a separately cut article S1 placed on processing table 5M from above.

Fig. 3 illustrates a state SA2 in which separately cut article S1 is disposed at a first inspection position Q1 by first transport mechanism 7.

Fig. 4 illustrates a state SA3 in which a second transport mechanism 11 positioned at a reception position U1 receives separately cut article S1 held by first transport mechanism 7 from first transport mechanism 7 and holds the same.

Fig. 5 illustrates a state SA4 in which separately cut article S1 is disposed at a

second inspection position Q2 by second transport mechanism 11.

Fig. 6 illustrates a state SA5 in which second transport mechanism 11 is disposed at a placement position U2 to place separately cut article S1 on placement table 14.

Fig. 7 illustrates a state SB1 in which first transport mechanism 7 is disposed at pick-up position T1 suction-holding separately cut article S1 placed on processing table 5M from above.

Fig. 8 illustrates a state SB2 in which separately cut article S1 is disposed at second inspection position Q2 by first transport mechanism 7.

Fig. 9 illustrates a state SB3 in which second transport mechanism 11 disposed at reception position U1 receives separately cut article S1 held by first transport mechanism 7 from first transport mechanism 7 and holds the same.

Fig. 10 illustrates a state SB4 in which separately cut article S1 is disposed at first inspection position Q1 by second transport mechanism 11.

Fig. 11 illustrates a state SB5 in which second transport mechanism 11 places separately cut article S1 on placement table 14 at placement position U2.

Fig. 12 illustrates a state SC5 in which first transport mechanism 7 receives separately cut article S1 held by second transport mechanism 11 from second transport mechanism 11 and holds the same.

Fig. 13 illustrates a state SC6 in which first transport mechanism 7 is disposed at placement position U2 to place separately cut article S1 on placement table 14.

DESCRIPTION OF EMBODIMENTS

[0014] Hereinafter, embodiments of the present disclosure will be described. In the embodiments described below, when a reference is made to a number, an amount or the like, the scope of the present disclosure is not necessarily limited to the number, the amount or the like unless otherwise specified. Each element is not necessarily essential to the present disclosure unless otherwise specified. The same or corresponding parts will be denoted by the same reference numerals, and the description thereof may not be repeated.

[0015] (Cutting Device 1)

Fig. 1 is a plan view schematically illustrating a cutting device 1. Cutting device 1 includes a cutting module A1 (Fig. 1) and an inspection/storage module B1. Cutting device 1 includes a monitor 20 and a computer 50 and operates in accordance with various input commands. In Fig. 1, monitor 20 and computer 50 are provided in inspection/storage module B1, but may be provided in cutting module A1. Cutting device 1 cuts a target object (package substrate) to singulate it into a plurality of separately cut articles (package components). Hereinafter, the details of cutting device 1 and a method for manufacturing separately cut articles S1 using cutting device 1 will be described.

[0016] (Target Object P1)

In the case of a package substrate, for example, a substrate or a lead frame on which a semiconductor chip is mounted is sealed with resin. Examples of the package substrate include a BGA (Ball Grid Array) package substrate, an LGA (Land Grid Array) package substrate, a CSP (Chip Size Package) package substrate, an LED (Light Emitting Diode) package substrate, and a QFN (Quad Flat No-leaded) package substrate.

[0017] Cutting device 1 further inspects each of the separately cut articles (electronic components). An image of each separately cut article is captured, and each separately cut article is inspected based on the image. Inspection data is generated based on the inspection, and each separately cut article is classified as a "non-defective product" or a "defective product".

[0018] Here, a package substrate is used as a target object P1 (Fig. 1), and target object P1 is cut into a plurality of separately cut articles S1 (Fig. 2) by cutting device 1. In the following description, a resin-sealed surface of two surfaces of target object P1 or a separately cut article S1 is referred to as a mold surface F1 (Fig. 2), and a surface opposite to mold surface F1 is referred to as a ball/lead surface F2 (Fig. 2).

[0019] [First Embodiment]

(Cutting Module A1)

Cutting module A1 manufactures a plurality of separately cut articles S1 (Fig. 2) by cutting target object P1 (Fig. 1). Inspection/storage module B1 inspects each of the plurality of separately cut articles S1, and thereafter stores the plurality of separately cut articles S1 in a tray. Each component in cutting device 1 is detachable and replaceable with respect to other components.

[0020] Cutting module A1 includes a substrate supply unit 3, a positioning unit 4, a processing table 5M, a processing table 5N, a cutting mechanism 6, and a first transport mechanism 7. Substrate supply unit 3 pushes out target object P1 one by one from a magazine M1 to supply target object P1 one by one to positioning unit 4. Target object P1 is disposed with ball/lead surface F2 (Fig. 2) facing upward.

[0021] Positioning unit 4 places target object P1 pushed out from substrate supply unit 3 on a rail unit 4a and positions target object P1. Cutting device 1 has a twin cut table configuration that includes two processing tables 5M and 5N. Positioning unit 4 transports target object P1 to processing tables 5M and 5N, and processing tables 5M and 5N hold target object P1.

[0022] Each of processing tables 5M and 5N includes a holding member 5a, a rotating mechanism 5b, and a moving mechanism 5c. Holding member 5a holds target object P1 by applying suction to target object P1 transported from positioning unit 4 from below. Rotating mechanism 5b rotates holding member 5a in a direction indicated by θ1 in Fig. 1 (in other words, rotates holding member 5a in the XY plane in Fig. 1). Moving mechanism 5c moves holding member 5a along the Y axis in the drawing.

[0023] For example, after target object P1 is suction-held on processing table 5M, target object P1 is imaged by first position confirmation camera 5d, and the position of target object P1 is confirmed. The confirmation using first position confirmation camera 5d is, for example, to confirm the position of a mark provided on target object P1. The mark is, for example, provided for determining a cutting position of target object P1.

[0024] Thereafter, processing table 5M is moved toward cutting mechanism 6 along the Y axis in the drawing. After processing table 5M is moved below cutting

mechanism 6, alignment is performed, and thereafter processing table 5M and cutting mechanism 6 are relatively moved to cut target object P1. Cutting mechanism 6 uses a blade 6a to cut target object P1 into a plurality of separately cut articles S1.

[0025] Every time target object P1 is cut by blade 6a of cutting mechanism 6, target object P1 (separately cut article S1) is imaged and confirmed by a second position confirmation camera 6b provided in cutting mechanism 6. The confirmation using second position confirmation camera 6b is, for example, to confirm the cut position and the cut width of target object P1.

[0026] After the cutting of target object P1 is completed, processing table 5M, on which a plurality of separately cut articles S1 are suction-held, is moved in a direction away from cutting mechanism 6 along the Y axis in the drawing. During the moving process, the upper surface (ball/lead surface F2 (Fig. 2)) of each separately cut article S1 is cleaned and dried by a first cleaner 5e.

[0027] Fig. 2 is a front view schematically illustrating a portion between processing table 5M and placement table 14 in cutting device 1. First transport mechanism 7 includes a main body 7a and a moving shaft 7b and can transport separately cut articles S1 along moving shaft 7b while separately cut articles S1 are being held by main body 7a.

[0028] After the cleaning and drying by first cleaner 5e (Fig. 1) are completed, as illustrated in Fig. 2, when first transport mechanism 7 is disposed at a pick-up position T1, first transport mechanism 7 suction-holds separately cut article S1 placed on processing table 5M from above. Fig. 2 illustrates a state SA1 in which first transport mechanism 7 is positioned at pick-up position T1 to suction-hold separately cut article S1 placed on processing table 5M from above. After picking up separately cut article S1 from processing table 5M, first transport mechanism 7 transports separately cut article S1 toward a first inspection mechanism 8 and a second inspection mechanism 9 of inspection/storage module B1.

[0029] As illustrated in Fig. 3, separately cut article S1 is transported upward (as indicated by an arrow AR1), and is moved to face a cleaning nozzle 10a (as indicated

by an arrow AR2) and a drying nozzle 10b of a second cleaner 10 (as indicated by an arrow AR3), and thereby, the lower surface (mold surface F1) of separately cut article S1 is cleaned and dried. Thereafter, separately cut article S1 is further transported by first transport mechanism 7 to a position (first inspection position Q1) facing first inspection mechanism 8 (as indicated by an arrow AR4). Fig. 3 illustrates a state SA2 in which separately cut article S1 is disposed at first inspection position Q1 by first transport mechanism 7.

[0030] (Inspection/Storage Module B1)

With reference to Figs. 1 and 3, inspection/storage module B1 (Fig. 1) includes a first inspection mechanism 8, a second inspection mechanism 9, a second transport mechanism 11, a placement table 14, and an extraction unit 15. First inspection mechanism 8 includes a first optical inspection camera 12 and a first lighting unit 16. First lighting unit 16 is provided above first optical inspection camera 12, and first lighting unit 16 is configured to emit light to separately cut article S1 during the inspection by first optical inspection camera 12.

[0031] As illustrated in Fig. 3, when separately cut article S1 is disposed at first inspection position Q1 by first transport mechanism 7, first optical inspection camera 12 images mold surface F1 (first surface) of separately cut article S1. First optical inspection camera 12 is disposed in the vicinity of separately cut article S1 disposed at first inspection position Q1 to image upward.

[0032] With reference to Fig. 4, after the imaging by first optical inspection camera 12, first transport mechanism 7 is moved together with separately cut article S1 (as indicated by an arrow AR5) to a position facing second transport mechanism 11 to place separately cut article S1 on a main body 11a of second transport mechanism 11.

[0033] Second transport mechanism 11 has a main body 11a and a moving shaft 11b and can transport separately cut article S1 along moving shaft 11b while separately cut article S1 is being held by main body 11a. Second transport mechanism 11 illustrated in Fig. 4 is positioned at a reception position U1. When second transport mechanism 11 is positioned at reception position U1, it receives separately cut article S1 held by

first transport mechanism 7 from first transport mechanism 7 and holds the same. Fig. 4 illustrates a state SA3 in which second transport mechanism 11 positioned at reception position U1 receives separately cut article S1 held by first transport mechanism 7 from first transport mechanism 7 and holds the same.

[0034] As illustrated in Fig. 5, main body 11a of second transport mechanism 11 in a state of holding separately cut article S1 is flipped vertically. Separately cut article S1 is disposed at a position (second inspection position Q2) facing second inspection mechanism 9 by second transport mechanism 11. Fig. 5 illustrates a state SA4 in which separately cut article S1 is disposed at second inspection position Q2 by second transport mechanism 11.

[0035] Second inspection mechanism 9 includes a second optical inspection camera 13 and a second lighting unit 17. Second lighting unit 17 is provided above second optical inspection camera 13, and second lighting unit 17 is configured to emit light to separately cut article S1 during the inspection by second optical inspection camera 13. When separately cut article S1 is disposed at second inspection position Q2 by second transport mechanism 11, second optical inspection camera 13 images ball/lead surface F2 (second surface) of separately cut article S1. Second optical inspection camera 13 is disposed in the vicinity of separately cut article S1 disposed at second inspection position Q2 to image upward.

[0036] With reference to Fig. 6, after the imaging by second optical inspection camera 13, second transport mechanism 11 is moved together with separately cut article S1 to a position facing placement table 14 to place separately cut article S1 on placement table 14. Second transport mechanism 11 illustrated in Fig. 6 is positioned at a placement position U2. Fig. 6 illustrates a state SA5 in which second transport mechanism 11 is disposed at placement position U2 to place separately cut article S1 on placement table 14.

[0037] In the present embodiment, when a reference direction (X direction) extending linearly is defined, the positions in the reference direction are pick-up position T1 (Fig. 2), first inspection position Q1 (Fig. 3), second inspection position Q2 (Fig. 5), and

placement position U2 (Fig. 6) in this order from the left in the drawing.

[0038] With reference to Fig. 1 again, the inspected separately cut article S1 is placed on placement table 14. Placement table 14 is movable along the Y axis in the drawing. Extraction unit 15 transfers separately cut article S1 placed on placement table 14 to a tray. Separately cut article S1 is classified into a "non-defective product" or a "defective product" based on the inspection results by first optical inspection camera 12 and second optical inspection camera 13. Extraction unit 15 transfers each separately cut article S1 to a non-defective product tray 15a or a defective product tray 15b based on the classification result.

[0039] [Second Embodiment]

In the first embodiment described above, after the cutting of target object P1 is completed, separately cut articles S1 are disposed with ball/lead surface F2 (Fig. 2) facing upward. On the other hand, even in the case where separately cut articles S1 are disposed with mold surface F1 (Fig. 2) facing upward after the cutting of target object P1 is completed, in other words, even in the case where target object P1 is disposed with mold surface F1 facing upward when target object P1 is supplied from magazine M1 (Fig. 1) to positioning unit 4, cutting device 1 can efficiently perform the inspection.

[0040] As illustrated in Fig. 7, when first transport mechanism 7 is disposed at pick-up position T1, first transport mechanism 7 suction-holds separately cut article S1 placed on processing table 5M from above. Fig. 7 illustrates a state SB1 in which first transport mechanism 7 is disposed at pick-up position T1 to suction-hold separately cut article S1 placed on processing table 5M from above. After picking up separately cut article S1 from processing table 5M, first transport mechanism 7 transports separately cut article S1 toward first inspection mechanism 8 and second inspection mechanism 9 of inspection/storage module B1.

[0041] As illustrated in Fig. 8, separately cut article S1 is transported upward (as indicated by an arrow AR1), and is moved to face a cleaning nozzle 10a (as indicated by an arrow AR2) and a drying nozzle 10b of a second cleaner 10 (as indicated by an

arrow AR3), and thereby, the lower surface (ball/lead surface F2) of separately cut article S1 is cleaned and dried.

[0042] Thereafter, separately cut article S1 is further transported by first transport mechanism 7 to a position (second inspection position Q2) facing second inspection mechanism 9 (as indicated by an arrow AR4). Fig. 8 illustrates a state SB2 in which separately cut article S1 is disposed at second inspection position Q2 by first transport mechanism 7. When separately cut article S1 is disposed at second inspection position Q2 by first transport mechanism 7, second optical inspection camera 13 images ball/lead surface F2 (second surface) of separately cut article S1.

[0043] With reference to Fig. 9, after the imaging by second optical inspection camera 13, first transport mechanism 7 is moved together with separately cut article S1 (as indicated by an arrow AR5) to a position facing second transport mechanism 11 to place separately cut article S1 on main body 11a of second transport mechanism 11.

[0044] Second transport mechanism 11 illustrated in Fig. 9 is positioned at reception position U1. When second transport mechanism 11 is positioned at reception position U1, it receives separately cut article S1 held by first transport mechanism 7 from first transport mechanism 7 and holds the same. Fig. 9 illustrates a state SB3 in which second transport mechanism 11 positioned at reception position U1 receives separately cut article S1 held by first transport mechanism 7 from first transport mechanism 7 and holds the same.

[0045] As illustrated in Fig. 10, main body 11a of second transport mechanism 11 that holds separately cut article S1 is flipped vertically. Separately cut article S1 is disposed at a position (first inspection position Q1) facing first inspection mechanism 8 by second transport mechanism 11. Fig. 10 illustrates a state SB4 in which separately cut article S1 is disposed at first inspection position Q1 by second transport mechanism 11. When separately cut article S1 is disposed at first inspection position Q1 by second transport mechanism 11, first optical inspection camera 12 images mold surface F1 (first surface) of separately cut article S1.

[0046] With reference to Fig. 11, after the imaging by first optical inspection camera

12, second transport mechanism 11 is moved together with separately cut article S1 to a position facing placement table 14 to place separately cut article S1 on placement table 14. Second transport mechanism 11 illustrated in Fig. 11 is positioned at placement position U2. Fig. 11 illustrates a state SB5 in which second transport mechanism 11 places separately cut article S1 on placement table 14 at placement position U2.

[0047] Thereafter, as described in the first embodiment, extraction unit 15 classifies separately cut article S1 into a "non-defective product" or a "defective product" based on the inspection results by first optical inspection camera 12 and second optical inspection camera 13.

[0048] (Effects)

As described above in the first embodiment and the second embodiment, in cutting device 1, first transport mechanism 7 is configured to be capable of transporting separately cut article S1 to both first inspection position Q1 (Fig. 3) and second inspection position Q2 (Fig. 8), and second transport mechanism 11 is also configured to be capable of transporting separately cut article S1 to both first inspection position Q1 (Fig. 10) and second inspection position Q2 (Fig. 5).

[0049] Therefore, even when separately cut article S1 is disposed with ball/lead surface F2 (Fig. 2) facing upward or separately cut article S1 is disposed with mold surface F1 (Fig. 7) facing upward after the cutting of target object P1 is completed, the inspection can be performed without performing operations such as the replacement of lighting units and the adjustment of first inspection mechanism 8 and second inspection mechanism 9 for inspection (optimization of inspection). In addition, in the cutting device provided with two inspection mechanisms, it is possible to obtain high versatility as a cutting device in terms of an increase in the number of inspection sequences. Therefore, according to cutting device 1, it is possible to obtain high versatility as a cutting device, and it is possible to perform cutting and inspection with high productivity.

[0050] [Modification of Second Embodiment]

In the second embodiment described above, after the inspection is performed by

first inspection mechanism 8, separately cut article S1 is placed on placement table 14 with mold surface F1 facing downward. As a modification thereof, as illustrated in Fig. 12, after the inspection is performed by first inspection mechanism 8, main body 11a of second transport mechanism 11 that holds separately cut article S1 may be flipped vertically.

[0051] First transport mechanism 7 receives separately cut article S1 held by second transport mechanism 11 from second transport mechanism 11 and holds the same. Fig. 12 illustrates a state SC5 in which first transport mechanism 7 receives separately cut article S1 held by second transport mechanism 11 from second transport mechanism 11 and holds the same.

[0052] First transport mechanism 7 is moved together with separately cut article S1 to a position facing placement table 14 to place separately cut article S1 on placement table 14. First transport mechanism 7 illustrated in Fig. 13 is positioned at placement position U2. Fig. 13 illustrates a state SC6 in which first transport mechanism 7 is disposed at placement position U2 to place separately cut article S1 on placement table 14.

[0053] Here, first transport mechanism 7 is configured to be movable to a pick-up position T1 for picking up and holding a plurality of separately cut articles S1 on processing table 5M and to a placement position U2 for placing the plurality of separately cut articles S1 on placement table 14. According to the configuration described above, separately cut article S1 can be placed on placement table 14 with ball/lead surface F2 facing downward.

[0054] [Aspects]

Although the embodiments of the present disclosure have been described above, the contents of the embodiments of the present disclosure can be summarized in the following aspects.

[0055] [Aspect 1]

A cutting device comprising:

a processing table that holds a target object;

a cutting mechanism that cuts the target object held on the processing table into a plurality of separately cut articles;

a first transport mechanism that holds and transports the plurality of separately cut articles;

a second transport mechanism that holds and transports the plurality of separately cut articles;

a first inspection mechanism that inspects a first surface of the plurality of separately cut articles when the plurality of separately cut articles are disposed at a first inspection position; and

a second inspection mechanism that inspects a second surface of the plurality of separately cut articles when the plurality of separately cut articles are disposed at a second inspection position,

the first transport mechanism being configured to be capable of transporting the plurality of separately cut articles to both the first inspection position and the second inspection position, and

the second transport mechanism being also configured to be capable of transporting the plurality of separately cut articles to both the first inspection position and the second inspection position.

[0056] According to the configuration described in aspect 1, each of the first transport mechanism and the second transport mechanism is configured to be capable of transporting a plurality of separately cut articles to both the first inspection position and the second inspection position. Therefore, at the time of starting the inspection, for example, even if the first surface of the separately cut article faces downward (for example, the first surface faces the inspection mechanism) or even if the second surface of the separately cut article faces downward, it is possible to flexibly perform the inspection on the separately cut article. For example, as compared with a case where the first transport mechanism is configured to be capable of transporting a plurality of separately cut articles only to the first inspection position and the second transport mechanism is configured to be capable of transporting a plurality of separately cut

articles only to the second inspection position, the configuration described in aspect 1 makes it easier to set the inspection order relatively freely, such as inspecting the first surface earlier than the second surface or inspecting the second surface earlier than the first surface, and thereby, it is possible to perform the cutting and inspection with high productivity.

[0057] [Aspect 2]

The cutting device described in aspect 1, further comprising:

a placement table capable of placing the plurality of separately cut articles thereon, wherein

the second transport mechanism is configured to be movable between a reception position for receiving the plurality of separately cut articles held by the first transport mechanism from the first transport mechanism and holding the same and a placement position for placing the plurality of separately cut articles on the placement table.

[0058] According to the configuration described in aspect 2, after the second transport mechanism receives the plurality of separately cut articles from the first transport mechanism at the reception position and holds the same, the second transport mechanism can be moved to the placement position to place the plurality of separately cut articles on the placement table.

[0059] [Aspect 3]

The cutting device described in aspect 2, wherein

the first transport mechanism is configured to be movable between a pick-up position for picking up the plurality of separately cut articles on the processing table and holding the same and the placement position for placing the plurality of separately cut articles on the placement table.

[0060] According to the configuration described in aspect 3, for example, it is possible to realize an operation in which the first transport mechanism transports the plurality of separately cut articles to one of the first inspection position and the second inspection position to perform the inspection on the plurality of separately cut articles, the second

transport mechanism transports the plurality of separately cut articles to the other of the first inspection position and the second inspection position to perform the inspection on the plurality of separately cut articles, the first transport mechanism further receives the plurality of separately cut articles from the second transport mechanism and holds the same, and then the first transport mechanism is moved to the placement position to place the plurality of separately cut articles on the placement table. Thus, it is possible to select the state of a separately cut article when storing it in the non-defective product tray 15a or the defective product tray 15b (whether to cause the first surface to face downward or the second surface to face downward).

[0061] [Aspect 4]

The cutting device described in aspect 3, wherein

the first transport mechanism receives the plurality of separately cut articles held by the second transport mechanism from the second transport mechanism and holds the same, and

the first transport mechanism is moved together with the plurality of separately cut articles to a position facing the placement table to place the plurality of separately cut articles on the placement table.

[0062] According to the configuration described in aspect 4, for example, the first transport mechanism transports the plurality of separately cut articles to one of the first inspection position and the second inspection position to perform the inspection on the plurality of separately cut articles, the second transport mechanism transports the plurality of separately cut articles to the other of the first inspection position and the second inspection position to perform the inspection on the plurality of separately cut articles, the first transport mechanism further receives the plurality of separately cut articles from the second transport mechanism and holds the same, and then the first transport mechanism is moved to the placement position to place the plurality of separately cut articles on the placement table.

[0063] [Aspect 5]

The cutting device according to any one of aspects 1 to 4, wherein

the second transport mechanism is configured to be capable of flipping the orientation of the plurality of separately cut articles while holding the plurality of separately cut articles.

[0064] According to the configuration described in aspect 5, for example, when performing an inspection, it is easy to switch between the first surface and the second surface of a separately cut article which serves as an inspection target, and when placing a separately cut article, it is easy to set the first surface and the second surface of the separately cut article to face upward or downward.

[0065] [Aspect 6]

A method for manufacturing separately cut articles using the cutting device according to any one of aspects 1 to 5, the method comprising:

cutting the target object held on the processing table into the plurality of separately cut articles;

inspecting the second surface of the plurality of separately cut articles by using the second inspection mechanism when the plurality of separately cut articles are disposed at the second inspection position by the first transport mechanism;

transferring the plurality of separately cut articles from the first transport mechanism to the second transport mechanism; and

inspecting the first surface of the plurality of separately cut articles by using the first inspection mechanism when the plurality of separately cut articles are disposed at the first inspection position by the second transport mechanism.

[0066] According to the configuration described in aspect 6, since each of the first transport mechanism and the second transport mechanism is configured to be capable of transporting a plurality of separately cut articles to both the first inspection position and the second inspection position, it is possible to inspect the second surface earlier than the first surface, for example, as compared with a case where the first transport mechanism is configured to be capable of transporting a plurality of separately cut articles to only the first inspection position and the second transport mechanism is configured to be capable of transporting a plurality of separately cut articles to only the

second inspection position, and thereby, it is possible to perform the cutting and inspection with high productivity.

[0067] [Aspect 7]

A method for manufacturing separately cut articles using the cutting device according to any one of aspects 1 to 5, the method comprising:

cutting the target object held on the processing table into the plurality of separately cut articles;

inspecting the first surface of the plurality of separately cut articles by using the first inspection mechanism when the plurality of separately cut articles are disposed at the first inspection position by the first transport mechanism;

transferring the plurality of separately cut articles from the first transport mechanism to the second transport mechanism; and

inspecting the second surface of the plurality of separately cut articles by using the second inspection mechanism when the plurality of separately cut articles are disposed at the second inspection position by the second transport mechanism.

[0068] According to the configuration described in aspect 7, since each of the first transport mechanism and the second transport mechanism is configured to be capable of transporting a plurality of separately cut articles to both the first inspection position and the second inspection position, it is possible to inspect the first surface earlier than the second surface, for example, as compared with a case where the first transport mechanism is configured to be capable of transporting a plurality of separately cut articles to only the first inspection position and the second transport mechanism is configured to be capable of transporting a plurality of separately cut articles to only the second inspection position, and thereby, it is possible to perform the cutting and inspection with high productivity.

[0069] [Aspect 8]

A method for manufacturing separately cut articles using the cutting device according to aspect 3 or 4, the method comprising:

cutting the target object held on the processing table into the plurality of

separately cut articles;

inspecting the second surface of the plurality of separately cut articles by using the second inspection mechanism when the plurality of separately cut articles are disposed at the second inspection position by the first transport mechanism;

transferring the plurality of separately cut articles from the first transport mechanism to the second transport mechanism;

inspecting the first surface of the plurality of separately cut articles by using the first inspection mechanism when the plurality of separately cut articles are disposed at the first inspection position by the second transport mechanism;

transferring the plurality of separately cut articles from the second transport mechanism to the first transport mechanism; and

placing the plurality of separately cut articles on the placement table by using the first transport mechanism.

[0070] According to the configuration described in aspect 8, for example, by transferring the separately cut article from the first transport mechanism to the second transport mechanism, it is possible to change the posture of the separately cut article from a posture for inspecting the second surface to a posture for inspecting the first surface. Further, by transferring the separately cut article from the second transport mechanism to the first transport mechanism, it is possible to change the posture from a posture for inspecting the first surface to a posture suitable for the first transport mechanism to place the separately cut article on the placement table. Furthermore, it is possible to select how to place a separately cut article in the non-defective product tray 15a or the defective product tray 15b (whether to allow the first surface to face downward or the second surface to face downward).

[0071] While the embodiments of the present disclosure have been described above, it should be understood that the embodiments disclosed herein are illustrative and non-restrictive in all respects. The scope of the present disclosure is defined by the claims, and is intended to include all modifications within the meaning and scope equivalent to the claims.

REFERENCE SIGNS LIST

[0072] 1: cutting device; 3: substrate supply unit; 4: positioning unit; 4a: rail unit; 5M, 5N: processing table; 5a: holding member; 5b: rotating mechanism; 5c: moving mechanism; 5d: first position confirmation camera; 5e: first cleaner; 6: cutting mechanism; 6a: blade; 6b: second position confirmation camera; 7: first transport mechanism; 7a, 11a: main body; 7b, 11b: moving shaft; 8: first inspection mechanism; 9: second inspection mechanism; 10: second cleaner; 10a: cleaning nozzle; 10b: drying nozzle; 11: second transport mechanism; 12: first optical inspection camera; 13: second optical inspection camera; 14: placement table; 15: extraction unit; 15a: non-defective product tray; 15b: defective product tray; 16: first lighting unit; 17: second lighting unit; 20: monitor; 50: computer; A1: cutting module; B1: inspection/storage module; F1: mold surface (first surface); F2: lead surface (second surface); M1: magazine; P1: target object; Q1: first inspection position; Q2: second inspection position; S1: separately cut article; T1: pick-up position; U1: reception position; U2: placement position.

CLAIMS

[Claim 1] A cutting device comprising:

a processing table that holds a target object;

a cutting mechanism that cuts the target object held on the processing table into a plurality of separately cut articles;

a first transport mechanism that holds and transports the plurality of separately cut articles;

a second transport mechanism that holds and transports the plurality of separately cut articles;

a first inspection mechanism that inspects a first surface of the plurality of separately cut articles when the plurality of separately cut articles are disposed at a first inspection position; and

a second inspection mechanism that inspects a second surface of the plurality of separately cut articles when the plurality of separately cut articles are disposed at a second inspection position,

the first transport mechanism being configured to be capable of transporting the plurality of separately cut articles to both the first inspection position and the second inspection position, and

the second transport mechanism being also configured to be capable of transporting the plurality of separately cut articles to both the first inspection position and the second inspection position.

[Claim 2] The cutting device according to claim 1, further comprising:

a placement table capable of placing the plurality of separately cut articles thereon, wherein

the second transport mechanism is configured to be movable between a reception position for receiving the plurality of separately cut articles held by the first transport mechanism from the first transport mechanism and holding the same and a

placement position for placing the plurality of separately cut articles on the placement table.

[Claim 3] The cutting device according to claim 2, wherein

the first transport mechanism is configured to be movable between a pick-up position for picking up the plurality of separately cut articles on the processing table and holding the same and the placement position for placing the plurality of separately cut articles on the placement table.

[Claim 4] The cutting device according to claim 3, wherein

the first transport mechanism receives the plurality of separately cut articles held by the second transport mechanism from the second transport mechanism and holds the same, and

the first transport mechanism is moved together with the plurality of separately cut articles to a position facing the placement table to place the plurality of separately cut articles on the placement table.

[Claim 5] The cutting device according to any one of claims 1 to 4, wherein

the second transport mechanism is configured to be capable of flipping the orientation of the plurality of separately cut articles while holding the plurality of separately cut articles.

[Claim 6] A method for manufacturing separately cut articles using the cutting device according to any one of claims 1 to 5, the method comprising:

cutting the target object held on the processing table into the plurality of separately cut articles;

inspecting the second surface of the plurality of separately cut articles by using the second inspection mechanism when the plurality of separately cut articles are disposed at the second inspection position by the first transport mechanism;

transferring the plurality of separately cut articles from the first transport mechanism to the second transport mechanism; and

inspecting the first surface of the plurality of separately cut articles by using the first inspection mechanism when the plurality of separately cut articles are disposed at the first inspection position by the second transport mechanism.

[Claim 7] A method for manufacturing separately cut articles using the cutting device according to any one of claims 1 to 5, the method comprising:

cutting the target object held on the processing table into the plurality of separately cut articles;

inspecting the first surface of the plurality of separately cut articles by using the first inspection mechanism when the plurality of separately cut articles are disposed at the first inspection position by the first transport mechanism;

transferring the plurality of separately cut articles from the first transport mechanism to the second transport mechanism; and

inspecting the second surface of the plurality of separately cut articles by using the second inspection mechanism when the plurality of separately cut articles are disposed at the second inspection position by the second transport mechanism.

[Claim 8] A method for manufacturing separately cut articles using the cutting device according to claim 3 or 4, the method comprising:

cutting the target object held on the processing table into the plurality of separately cut articles;

inspecting the second surface of the plurality of separately cut articles by using the second inspection mechanism when the plurality of separately cut articles are disposed at the second inspection position by the first transport mechanism;

transferring the plurality of separately cut articles from the first transport mechanism to the second transport mechanism;

inspecting the first surface of the plurality of separately cut articles by using the

first inspection mechanism when the plurality of separately cut articles are disposed at the first inspection position by the second transport mechanism;

transferring the plurality of separately cut articles from the second transport mechanism to the first transport mechanism; and

placing the plurality of separately cut articles on the placement table by using the first transport mechanism.