

TITLE OF THE INVENTION

VISION INSPECTION APPARATUS

5 BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a vision inspection apparatus, and particularly, to a vision inspection apparatus capable of inspecting external
10 appearance of an electronic component loaded in a tray.

2. Background of the Invention

An electronic component such as a semiconductor package undergoes various tests such as electric test and external test, during
15 manufacturing processes or before being distributed into the market, so as to enhance yield and increase reliability of the products.

For example, semiconductor packages are manufactured through various processes including fabricating process on a wafer, cutting process, and packing process. If subsequent processes are unnecessarily performed in
20 spite of inferiority in the semiconductor device, the entire fabrication costs may be increased. In order to prevent this problem, the above tests are performed before main processes thus to select good electronic components. Then, these selected good electronic components undergo subsequent processes.

Most of electronic components undergo each kind of tests before
25 being distributed into the market. Accordingly, only good electronic

components are presented on the market, thereby enhancing reliability of the products.

The vision inspection apparatus performs vision inspection as a tray loaded with electronic components thereon is up-down moved along a guide rail, and a camera is moved in right and left directions so as to inspect the electronic components loaded in the tray. Since the inspection is performed while the tray loaded with the electronic components thereon is transferred, the positions of the electronic components loaded in the tray are changed due to a tolerance between the electronic component inside an accommodation groove of the tray. As a result, inferiority may occur when measuring the positions of the electronic components. This will be explained in more detail.

FIG. 1 is a plane view showing an example of a vision inspection apparatus in accordance with the prior art.

As shown in FIG. 1, the prior vision inspection apparatus for inspecting external appearance of an electronic component includes a tray loading unit 1 for loading a tray 5 loaded with electronic components thereon along a guide rail 1a, a camera 2 for vision-inspecting the electronic components having been transferred by a picker 6, a picker 7 for transferring the electronic components so as to sort the electronic components having completely undergone the vision inspection, a tray transfer device (not shown) for transferring the tray 5, a sorting unit 4 for automatically transferring the tray 5 along a guide rail 4a, etc.

However, the prior vision inspection apparatus has to be provided with the tray transfer device for automatically transferring the tray, and the tray loading unit 1 and the sorting unit 4 have to be provided with the guide rails 1a

and 4a, respectively. And, a sorting device such as the sorting unit 4 including the additional picker 7 after the vision inspection has to be additionally provided. This may cause the entire structure to be complicated, and the fabrication costs to be expensive.

5 In case of massively producing electronic components, the prior vision inspection apparatus may be used. However, when the expensive vision inspection apparatus is used in case of producing a small number of electronic components, the entire fabrication costs are increased to lower the productivity.

10 Furthermore, the prior vision inspection apparatus occupies a relatively larger installation space due to its complicated structure and larger size.

 In order to enhance reliability of processes for electronic components, the vision inspection apparatus is installed in a clean room where occurrence
15 of dust, etc. is minimized. If the size of the vision inspection apparatus is increased, larger area inside the clean room is occupied. This may lower productivity of the electronic components based on a unit area.

 The prior vision inspection apparatus performs vision inspection by obtaining images of the electronic components loaded in the tray 5, and then
20 by analyzing the obtained images. Here, the images of the electronic components are obtained by moving the tray 5 in up and down directions in FIG. 1 along the guide rail, and by moving the camera 2 in right and left directions.

 While the tray 5 is transferred, the electronic components are minutely
25 moved due to a tolerance between the electronic component inside an

accommodating groove of the tray 5. This may change the positions of the electronic components, resulting in errors in measuring precise positions of the electronic components, or causing precise images of the electronic components not to be measured. As a result, reliability of the vision inspection
5 may be lowered, or the vision inspection may not be smoothly performed.

SUMMARY OF THE INVENTION

Therefore, an object of the present invention is to provide a vision
10 inspection apparatus capable of reducing an occupation area by simplifying the entire structure, and capable of reducing the fabrication costs.

Another object of the present invention is to provide a vision inspection apparatus capable of greatly reducing fabrication costs and size by minimizing configurations for transferring trays and electronic components.

15 To achieve these and other advantages and in accordance with the purpose of the present invention, as embodied and broadly described herein, there is provided a vision inspection apparatus, comprising: two or more trays loaded with electronic components thereon; a vision inspection unit for vision-inspecting the electronic components loaded in the trays; and a dumping unit
20 for exchanging good products and bad products with each other between the trays according to a result of the vision inspection, wherein the dumping unit places good electronic component in one or more trays, and places bad electronic component in the remained one or more trays.

The vision inspection unit and the dumping unit may be independently
25 driven, or may be interworked with each other by being fixed to at least one

shaft.

The dumping unit may include a plurality of pickers for picking and placing the electronic components.

According to another aspect of the present invention, there is
5 provided a vision inspection apparatus, comprising: a plurality of first tray mounting units for mounting trays loaded with electronic components thereon, respectively; one or more second tray mounting units for mounting empty trays; a vision inspection unit for vision-inspecting the electronic components loaded in the trays; and a dumping unit for sorting good and bad electronic
10 components to at least one of the first and the second mounting units according to a result of the vision inspection.

The dumping unit may be configured to place good electronic components on one or more trays of the first tray mounting units, and to place bad electronic components on the empty tray of the second tray mounting unit.

15 The dumping unit may be configured to place bad electronic components on one or more trays of the first tray mounting units, and to place good electronic components on the empty tray of the second tray mounting unit.

The dumping unit may be configured to place good electronic
20 components on one or more one trays of the first tray mounting units, and to place bad electronic components on the remained one or more trays of the first tray mounting units.

The dumping unit may be configured to place good electronic components on one or more one empty trays of the second tray mounting unit,
25 and to place bad electronic components on the remained one or more empty

trays of the second tray mounting unit.

The vision inspection apparatus may further comprise one or more first tray stack units for stacking thereon the trays loaded with the electronic components thereon; one or more second tray stack units for stacking the empty trays thereon; one or more good tray stack units for stacking trays loaded with good electronic components thereon; one or more reject tray stack units for stacking trays loaded with bad electronic components thereon; and a tray transfer unit for transferring the trays among the first tray mounting units, the second tray mounting unit, the first tray stack units, the second tray stack units, the good tray stack units, and the reject tray stack units.

According to still another aspect of the present invention, there is provided a vision inspection apparatus, comprising: one or more first tray mounting units for mounting one or more trays loaded with electronic components thereon for vision inspection; a first inspection unit including a first vision inspection unit for performing first vision inspection with respect to the electronic components loaded in the trays of the first tray mounting units; an inversion unit for receiving the trays having completely undergone the first vision inspection, and inverting the electronic components loaded in the trays; two or more second tray mounting units for mounting the trays inverted by the inversion unit; a second vision inspection unit for performing second vision inspection with respect to the electronic components loaded in the trays of the second tray mounting units; a second inspection unit including a dumping unit for sorting the electronic components loaded in the trays of the second tray mounting units into good and bad electronic products according to results of the first and the second vision inspections after the second vision inspection;

and a tray transfer unit for transferring the trays among the first inspection unit, the inversion unit, and the second inspection unit.

The inversion unit may include a tray pickup unit for picking up the inversed tray before inverting the tray; and an inversion device for overlapping
5 the tray transferred by the tray transfer unit with the tray picked-up by the tray pickup unit, and then turning the overlapped one pair of trays upside down, thereby inverting the electronic components loaded in the tray.

The second tray mounting unit of the second inspection unit may include one or more first sub-tray mounting units for performing second vision
10 inspection after receiving the trays from the inversion unit; and one or more second sub-tray mounting units for sorting the electronic components by the dumping unit according to results of the first and the second vision inspections, after receiving the trays having undergone the second vision inspection from the first sub-tray mounting units.

15 The first sub-tray mounting unit may be disposed between the first inspection unit and the second sub-tray mounting unit by being adjacent to the first inspection unit.

Each of the first and the second tray mounting units may be disposed in plurality in number in a direction perpendicular to an arrangement direction
20 of the first and the second inspection units.

The second tray mounting unit may be configured such that the electronic components are sorted by the dumping unit after the second vision inspection, according to results of the first and the second vision inspections.

The vision inspection apparatus according to the present invention
25 may further comprise a tray stack unit for supplying trays to the first tray

mounting unit or the second tray mounting unit, or stacking trays thereon.

The tray stack unit may include a first tray stack unit for supplying trays to the first tray mounting unit; a second tray stack unit for stacking empty trays thereon; and a third tray stack unit for stacking thereon trays having
5 undergone the second vision inspection.

The tray stack unit may be positioned below the first and the second tray mounting units, and the tray transfer unit may include an X-Z direction robot or an X-Y-Z robot.

The vision inspection apparatus according to the present invention
10 may have the following advantages.

Firstly, vision inspection is performed in a state that the two or more trays loaded with a plurality of electronic components thereon are fixed, and then good and bad electronic components are sorted to each tray according to a result of the vision inspection. This may simplify the entire structure and
15 minimize the vision inspection apparatus.

Secondly, the fabrication costs are reduced due to smaller size of the vision inspection apparatus, and an installation space is also reduced. Accordingly, the entire space for production of the electronic components may be effectively utilized.

20 Thirdly, since the vision inspection apparatus has smaller size, productivity of the electronic components based on a unit area may be greatly enhanced.

Fourthly, since vision inspection is performed by moving only a camera of the vision inspection unit without moving the electronic components
25 to be vision-inspected, the electronic components may be stably maintained

and vision inspection may be smoothly performed. This may enhance reliability of the vision inspection, and allow the vision inspection to be more smoothly performed.

5 The foregoing and other objects, features, aspects and advantages of the present invention will become more apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

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The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles of the invention.

15 In the drawings:

FIG. 1 is a plane view of a vision inspection apparatus in accordance with the prior art;

FIG. 2 is a perspective view of a vision inspection apparatus according to a first embodiment of the present invention;

20 FIGS. 3A to 3C are plane views showing an operation of the vision inspection apparatus of FIG. 2;

FIG. 4 is a perspective view of a vision inspection apparatus according to a second embodiment of the present invention;

25 FIGS. 5A to 5D are plane views showing an operation of the vision inspection apparatus of FIG. 4;

FIG. 6 is a partial perspective view of a tray stack unit of the vision inspection apparatus of FIG. 4;

FIG. 7 is a perspective view of a vision inspection apparatus according to a third embodiment of the present invention;

5 FIG. 8 is a front view showing a part of the vision inspection apparatus of FIG. 7;

FIG. 9 is a plane view of the vision inspection apparatus of FIG. 7; and

FIGS. 10A to 10C are partial front views showing an operation of an inversion device of the vision inspection apparatus of FIG. 7.

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DETAILED DESCRIPTION OF THE INVENTION

Description will now be given in detail of the present invention, with reference to the accompanying drawings.

15 Hereinafter, a vision inspection apparatus according to the present invention will be explained in more detail with reference to the attached drawings.

FIG. 2 is a perspective view of a vision inspection apparatus according to a first embodiment of the present invention, and FIGS. 3A to 3C are plane
20 views showing an operation of the vision inspection apparatus of FIG. 2.

As shown in FIG. 2, the vision inspection apparatus according to a first embodiment of the present invention comprises a body 100; two or more trays
20 mounted to tray mounting units 110 fixedly installed in the body 100, and loaded with electronic components 10 thereon so as to be vision-inspected; a
25 vision inspection unit 300 for vision-inspecting the electronic components 10

loaded in the trays 20; and a dumping unit 200 for exchanging good and bad electronic components 10 with each other between the trays 20.

The electronic components 10 to be vision-inspected may include all types of objects requiring vision inspection, for example, semiconductor
5 packages such as IC chips including PGA, BGA, etc., application chips such as DDI, PCBs, etc.

The trays 20 serve to load thereon the plurality of electronic components 10, and to carry the electronic components 10. The trays 20 may have various sizes and structures according to a type of the electronic
10 components 10, and may have accommodation grooves in horizontal and vertical directions, the accommodation grooves for accommodating the electronic components therein.

The body 100 provided with each component installed therein may include an upper plate portion 101 for forming an upper surface, and a
15 supporting portion 102 for supporting the upper plate portion 101. And, the body 100 may have various structures including a frame structure.

As shown in FIG. 2, the tray mounting units 110 may include a plurality of guide members 111 fixedly installed on the upper plate portion 101 of the body 100, and configured to support the trays 20 in a lateral direction. Here,
20 the trays 20 of the tray mounting units 110 may be replaced by other trays 20 by an operator's manual processes after vision inspection.

The vision inspection unit 300 is an apparatus for performing vision inspection with respect to the electronic components 10 by obtaining an external image for a top surface, a bottom surface, etc. of the electronic
25 components 10, and by inspecting external appearance of the electronic

components 10 based on analysis result of the obtained image. The vision inspection unit 300 may include an image obtaining device (not shown) such as a camera, and an image analyzing device (not shown).

The vision inspection unit 300 is installed in the body 100 so as to
5 capture image of the electronic components 10 loaded in the trays 20 while moving above the tray mounting units 110. As shown in FIG. 2, the vision inspection unit 300 may be installed in an X-Y robot 320 so as to be movable in X and Y directions.

In the body 100, installed is the dumping unit 200 for picking up the
10 electronic components 10 and transferring the picked-up electronic components 10 to other tray 20 after vision inspection, and exchanging good and bad electronic components 10 with each other between the trays 20.

The dumping unit 200 may have any configuration to pick and place the electronic components 10. For instance, the dumping unit 200 may include
15 a dumping unit 210 having a suction head (not shown) for picking up the electronic components 10 by forming vacuum pressure, and an up-down driving device for up-down moving the suction head.

The dumping unit 210 has to perform a pick-up function for picking-up the electronic components 10 from one tray 20, and a place function for
20 placing the picked-up electronic components 10 to another tray 20. Therefore, the dumping units 210 have to be provided with two or more pickers 211. However, it is preferable to install two pickers 211 with consideration of the fabrication costs and simplified structure.

One of the two pickers 211 of the dumping unit 210 picks up the
25 electronic component 10 from one tray 20, and then moves to another tray 20

on which the electronic component 10 to be replaced is loaded. Next, the other picker 211 of the dumping unit 210 picks up the electronic components 10 to be replaced, and then places the firstly picked-up electronic components 10 onto another tray 20. These operations are repeatedly performed.

5 Like the vision inspection unit 300, the dumping unit 210 is installed in the body 100 so as to transfer the electronic components 10 loaded in the trays 20 while moving above the tray mounting units 110. As shown in FIG. 2, the dumping unit 210 may be installed in an X-Y robot 320 so as to be movable in X and Y directions.

10 The vision inspection unit 300 and the dumping unit 210 may be fixed to one shaft, and may be interworked with each other or independently operated.

 Preferably, the tray mounting units 110 are installed in two or more in number for vision inspection and "sorting of the electronic components 10
15 determined as bad products". The tray mounting units 110 may have various configurations according to operation methods.

 As shown in FIG. 3A, each of the tray mounting units 110 mounts the tray 20 loaded with the electronic components 10 thereon for vision inspection. As shown in FIGG. 3B and 3C, in order to sort good electronic components 10
20 ("G" in FIGS. 3A to 3C) and bad electronic components 10 ("R" in FIGS. 3A to 3C) after vision inspection by exchanges of the electronic components 10 between the trays 20, only good electronic components 10 (G) may be loaded in trays 20 of the tray mounting units 110, and only bad electronic components 10 (R) may be loaded in the remained trays 20 of the remained tray mounting
25 units 110.

For instance, as shown in FIGS. 2 to 3C, two tray mounting units 110 are arranged. And, it may be configured that only good electronic components 10 (G) are loaded in the left tray 20 whereas only bad electronic components 10 (R) are loaded in the right tray 20 through exchanging processes by the
5 dumping unit 210 after vision inspection.

That is, the tray mounting units 110 may include one or more first tray mounting units (left) for mounting the trays 20 loaded with the electronic components 10 thereon for vision inspection, and one or more second tray mounting units (right) for exchanging good and bad electronic components 10
10 from the trays 20 of first tray mounting units 110, with each other by the dumping unit 210 after vision inspection.

Since the positions of the first and the second tray mounting units are set for convenience, they may be variable according to an operation method.

The number of the bad electronic components 10 is relatively small.
15 Accordingly, as shown in FIG. 3B, when the tray 20 of the left tray mounting unit 110 has been filled with only good electronic components 10, the tray 20 of the left tray mounting unit 110 is repeatedly replaced.

As shown in FIG. 3C, when the tray 20 of the right tray mounting unit 110 has been filled with only bad electronic components 10, the operator
20 replaces the tray 20 by another tray 20 loaded with the electronic components 10 to be vision-inspected thereon.

The tray 20 of the tray mounting unit 110 is not replaced by a new one by the operator every time. Rather, after a predetermined number of trays 20 have been stacked, each tray 20 of the stacked trays 20 may be automatically
25 supplied to each tray mounting unit 110.

FIG. 4 is a perspective view of a vision inspection apparatus according to a second embodiment of the present invention, FIGS. 5A to 5D are plane views showing an operation of the vision inspection apparatus of FIG. 4, and FIG. 6 is a partial perspective view of a tray stack unit of the vision inspection
5 apparatus of FIG. 4.

The second embodiment of the present invention is different from the first embodiment in that the tray mounting units 110 are differently arranged, and in that a tray transfer unit for automatically transferring the trays 20 is additionally implemented. Accordingly, only differentiated configurations of
10 the second embodiment will be explained for convenience.

The tray mounting unit 400 according to the second embodiment may include one or more first tray mounting units 410 for mounting the trays 20 loaded with the electronic components 10 thereon for vision inspection, and one or more second tray mounting units 420 for mounting empty trays 20.

15 As shown in FIGS. 4 and 5A to 5D, two or more first tray mounting units 410 may be installed. On empty regions of the tray 20 of one first tray mounting unit 410, may be placed with good electronic components 10 loaded in the tray 20 of another first tray mounting unit 410. Here, the empty regions are regions where the bad electronic components 10 are picked up and
20 transferred to the tray 20 of the second tray mounting unit 420.

The first and the second tray mounting units 410 and 420 may have various configurations according to a sorting result by the dumping unit 210, and may be configured to place thereon good and bad electronic components, or bad and good electronic components, respectively.

25 In case of mounting a plurality of trays 20, each of the first and the

second tray mounting units 410 and 420 may include the tray 20 loaded with only good electronic components thereon, and the tray 20 loaded with only bad electronic components thereon.

To the second tray mounting unit 420, an empty tray 20 is firstly
5 mounted. And, the empty tray 20 is filled with bad electronic components 10 loaded in the tray 20 of the first tray mounting unit 410. The tray 20 loaded with the electronic components to be vision-inspected may be also mounted to the second tray mounting unit 420.

In the body 100, may be further provided with a tray stack unit 500 for
10 stacking thereon the trays 20 to be mounted to the tray mounting unit 400 so that the trays 20 can be automatically transferred, and a tray transfer unit 580 for transferring the trays 20 between the tray stack unit 500 and the tray mounting unit 400.

As shown in FIGS. 4 and 6, the tray stack unit 500 may have a
15 configuration to stack thereon a plurality of trays 20, and to supply or withdraw the trays 20 to and from the tray mounting unit 400. And, the tray stack unit 500 may include a first tray stack unit 510 for stacking thereon the trays 20 to be vision-inspected and supplying the trays 20 to the first tray mounting unit 410, a second tray stack unit 520 for stacking empty trays, and a third tray
20 stack unit 530 for stacking thereon the trays 20 having completely undergone vision inspection and sorting processes.

The first tray stack unit 510 is configured to be stacked with a tray 20 loaded with the electronic components 10 thereon to be vision-inspected and sorted, and may be installed in one or more in number.

25 The second tray stack unit 520 is configured to be stacked with empty

trays 20 which the electronic components 10 are not loaded or removed therefrom, or to provide the empty tray 20 to the second tray mounting unit 420 after finishing placing bad electronic components 10 on the former empty tray 20.

5 The third tray stack unit 530 is configured to be stacked with the trays 20 after sorting the electronic components 10 according to a result of vision inspection. And, the third tray stack unit 530 may include one or more good tray stack units 531 for stacking thereon the trays 20 filled with good electronic components 10, and one or more reject tray stack units 532 for stacking
10 thereon the trays 20 filled with bad electronic components 10.

 The tray stack unit 500 is installed below the tray mounting unit 400 inside the body 100. And, the tray stack unit 500 may include a bottom portion 501 for forming a bottom surface so as to stack the trays 20 thereon, and guide members 502 for guiding each edge(apex) of the trays 20 so as to
15 stably stack the trays 20 thereon.

 Differently from the first embodiment, the tray mounting unit 400 is configured in the form of a window disposed in an upper surface 101 of the body 100 so that the trays 20 can be smoothly supplied by the tray transfer unit 580. And, the tray mounting unit 400 may include a tray fixing unit 401 for
20 fixing the tray 20 having been supplied by the tray transfer unit 580.

 The tray stack unit 500 is installed so as to be accommodated in the body 100 without being exposed to the outside. And, the tray stack unit 500 may be slidably installed in the body 100 so that the operator can withdraw the trays 20 by holding a handgrip 503, etc.

25 The tray transfer unit 580 is configured to transfer the trays 20

between the tray stack unit 500 and the tray mounting unit 400. And, the tray transfer unit 580 may have any configurations to transfer the trays 20.

As shown in FIG. 6, the tray transfer unit 580 may include a tray pickup unit 581 for picking up the trays 20, and a pickup driving unit 582 for transferring the trays 20 picked-up by the tray pickup unit 581 between the tray stack unit 500 and the tray mounting unit 400.

The pickup driving unit 582 is configured to move the tray pickup unit 581 in an X-Z direction, and may be implemented as an X-Z robot. The pickup driving unit 582 may include an X-Y-Z robot according to arrangements of the trays 20.

The operation of the vision inspection apparatus according to the present invention will be explained in more detail.

Firstly, the trays 20 to be vision-inspected are stacked on the first tray stack unit 510, and a predetermined number of empty trays 20 are stacked on the second tray stack unit 520.

Upon completion of the stack of the trays 20 on the first tray stack unit 510, the tray transfer unit 580 supplies the trays 20 loaded with the electronic components 10 to be vision-inspected, to the first tray mounting unit 410 from the first tray stack unit 510. And, the tray transfer unit 580 supplies the empty trays 20 to the second tray mounting unit 420.

Upon completion of the supply of the trays 20, the vision inspection unit 300 and the dumping unit 210 perform vision inspection and sorting process with respect to the electronic components 10 loaded in the trays 20.

The tray mounting unit 400 may have various configurations according to an operation method. As aforementioned, the tray mounting unit

400 may include one or more first tray mounting units 410, and one or more second tray mounting units 420. For instance, as shown in FIGS. 4 to 5D, the tray mounting unit 400 may include two first tray mounting units 410, and one second tray mounting unit 420.

5 As shown in FIG. 5A, the trays 20 to be vision-inspected are mounted to each of the two first tray mounting units 410, and the empty trays 20 are mounted to the second tray mounting unit 420.

 Upon completion of the mounting of the trays 20, the vision inspection unit 300 performs vision inspection with respect to the electronic components
10 10 loaded in the trays 20 of the first tray mounting units 410 by moving the X-Y robot 320.

 Upon completion of the vision inspection by the vision inspection unit 300, as shown in FIG. 5A, bad electronic components 10 of the electronic components 10 loaded in the trays 20 of the first tray mounting units 410 are
15 transferred to the tray 20 of the second tray mounting unit 420.

 As shown in FIG. 5B, the dumping unit 210 transfers the bad electronic components 10 to the second tray mounting unit 420, and transfers good electronic components 10 loaded in the tray 20 of the right of the two first tray mounting units 410, to the tray 20 of the left of the two first tray
20 mounting units 410.

 As shown in FIG. 5B, when the tray 20 of the left first tray mounting unit 410 has been completely filled with the good electronic components 10, the tray 20 is transferred to the good tray stack unit 531, and a new tray 20 is supplied to the left first tray mounting unit 410 from the first tray stack unit 510.

25 As shown in FIG. 5C, when the tray 20 of the right first tray mounting

unit 410 to which the good electronic components 10 have been completely transferred is made to be empty, the empty tray 20 is stacked on the second tray stack unit 520, and a new tray 20 is supplied to the right first tray mounting unit 410 from the first tray stack unit 510.

5 As shown in FIG. 5D, when the tray 20 of the second tray mounting unit 420 has been completely filled with the bad electronic components 10, the tray 20 is transferred to the reject tray stack unit 532 of the third tray stack unit 530. And, a new empty tray 20 is supplied to the second tray mounting unit 420 from the second tray stack unit 520.

10 The vision inspection apparatus according to the present invention may be configured to inspect both surfaces, i.e., a bottom surface and a top surface of the electronic components 10 when necessary.

FIG. 7 is a perspective view of a vision inspection apparatus according to a third embodiment of the present invention, FIG. 8 is a front view showing a part of the vision inspection apparatus of FIG. 7, FIG. 9 is a plane view of the vision inspection apparatus of FIG. 7, and FIGS. 10A to 10C are partial front views showing an operation of an inversion device of the vision inspection apparatus of FIG. 7.

20 The vision inspection apparatus according to a third embodiment of the present invention is configured to firstly perform vision inspection (first vision inspection), and then secondly perform vision inspection (second vision inspection) after inverting the electronic components 10. The second vision inspection is performed in a similar manner to that of the second embodiment. Therefore, similar components to those of the second embodiment will be provided with the same reference numerals, and their detailed explanations

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will be omitted.

As shown in FIGS. 7 to 9, the vision inspection apparatus according to a third embodiment of the present invention may comprise: a body 100; a first inspection unit installed in the body 100, for performing first vision inspection;
5 an inversion unit 700 installed in the body 100, for receiving the trays 20 having completely undergone the first vision inspection by the first inspection unit, and inverting the electronic components 10 loaded in the trays 20; a second inspection unit installed in the body 100, for performing second vision inspection and sorting processes; and one or more tray transfer units 780,
10 580 for transferring the trays 20.

The tray transfer units 780, 580 may have various configurations for transferring the trays 20 between first tray mounting units 810 of the first inspection unit and second tray mounting units 820 of the second inspection unit, and between the inversion unit 700 and the tray stack unit 500. And, the
15 tray transfer units 780, 580 may have the same or similar configuration as/to that of the third embodiment. Reference numeral 781 indicates a tray pickup unit for picking up the trays 20.

As shown in FIG. 7, with considering that the trays 20 are transferred to both the first inspection unit and the second inspection unit, the tray
20 transfer units 780, 580 may be individually installed in each of the first and the second inspection units for smooth processes.

In a case that a plurality of first tray mounting units 810 are arranged in horizontal and vertical directions, the tray transfer units 780, 580 may include an X-Z direction robot or an X-Y-Z robot which can move to X-Z
25 directions or X-Y-Z directions according to the arrangement of the first tray

mounting units 810.

The first vision inspection unit may include one or more first tray mounting units 810 fixedly installed in the body 100, for mounting the trays 20 loaded with the electronic components 10 for first vision inspection; and a first vision inspection unit 630 for performing first vision inspection with respect to the electronic components 10 loaded in the trays 20 of the first tray mounting unit 810 while moving above the first tray mounting units 810.

The first tray mounting units 810 have a similar configuration to second tray mounting units 820 of the second inspection unit which will be later explained. For smooth first vision inspection, the first tray mounting units 810 are preferably in two or more in number. In the case that the first tray mounting units 810 are implemented in plurality in number, the first tray mounting units 810 may be disposed in a horizontal direction or a vertical direction. In an assumption that the arrangement direction of the first and the second inspection units is a horizontal direction (X-axis direction) with consideration of a size of the apparatus, the first tray mounting units 810 are preferably arranged in a direction perpendicular to the X-axis direction, i.e., in a vertical direction (Y-axis direction).

The first vision inspection unit 630 has a similar configuration to the vision inspection units of the first and the second embodiments, and is an apparatus for performing vision inspection with respect to the electronic components 10 by obtaining external image of the electronic components 10, and by inspecting external appearance of the electronic components 10 based on analysis result of the obtained image. The first vision inspection unit 630 may include an image obtaining device (not shown) such as a camera,

and an image analyzing device (not shown).

The first vision inspection unit may be installed in the body 100 so as to obtaining external image of the electronic components 10 loaded in the trays 10 while moving above the first tray mounting units 810. And, as shown
5 in FIG. 7, the first vision inspection unit 630 may be installed to in X-Y robot 620 so as to move in X and Y directions.

As aforementioned, the second inspection unit has a similar configuration to that of the third preferred embodiment. And, the second inspection unit includes two or more second tray mounting units 820 fixedly
10 installed in the body 100, for mounting the trays 20 inverted by the inversion unit 700; a second vision inspection unit 300 for performing second vision inspection with respect to the electronic components 10 loaded in the trays 20 of the second tray mounting units 820 while moving above the second tray mounting units 820; and a dumping unit 210 for transferring the electronic
15 components 10 loaded in one tray 20 of the second tray mounting units 820 to another tray 20 of the second tray mounting units 820 while moving above the second tray mounting units 820.

The second inspection unit has a similar configuration to that of the third preferred embodiment, and thus its detailed explanations will be omitted.
20 Here, the arrangements of the second tray mounting units 820 may become different so that sorting processes can be performed according to results of the first and the second vision inspections, since the sorting processes are performed according to results by the second inspection unit.

For instance, the second tray mounting units 820 may include one or
25 more first sub-tray mounting units 821 for mounting the trays 20 loaded with

the electronic components 10 to be vision-inspected; and a plurality of second sub-tray mounting units 822 for receiving the trays 20 having been vision-inspected from the first sub-tray mounting units 821, and sorting good and bad electronic components 10 from each other by the dumping unit 210.

5 The first sub-tray mounting units 821 may be configured to perform both second vision inspection and sorting processes, or may be configured to perform only second vision inspection as shown in FIGS. 7 to 9. And, the first sub-tray mounting units 821 may have a similar configuration to the first tray mounting units 810 of the first inspection unit.

10 With considering that the trays 20 are transferred after undergoing first vision inspection and inversion, the first sub-tray mounting units 821 are preferably arranged so as to be adjacent to the first inspection unit. That is, the first sub-tray mounting units 821 may be disposed between the first inspection unit and the second sub-tray mounting units 822.

15 The second sub-tray mounting units 822 may be configured so that the electronic components 10 can be sorted as bad products (R1) after first vision inspection, as bad products (R2) after second vision inspection, etc. according to results of the first and the second inspections. The second sub-tray mounting units 822 may have various configurations, i.e., a configuration
20 for fixing a part of the trays according to a sorting method. And, the second sub-tray mounting units 822 are implemented in plurality in number so as to sort good and bad electronic components 10.

For instance, as shown in FIGS. 7 and 9, the second sub-tray mounting units 822 include one or more 2-1 to 2-3 sub-tray mounting units
25 822a, 822b, 822c for receiving the trays 20 from the first sub-tray mounting

units 821. By the dumping unit 210, good electronic components 10 may be placed in one or more first sub-tray mounting portions 822a, bad electronic components 10 (R1) resulting from first vision inspection may be placed in the second sub-tray mounting portion 822b, and bad electronic components 10
5 (R2) resulting from second inspection by the second inspection unit may be placed in the third sub-tray mounting portion 822c.

The second sub-tray mounting units 822 may further include a buffer tray unit 424 for temporarily loading the electronic components 10 for initialization, or in preparation for mal-operation of the apparatus.

10 In case that the second tray mounting units 820 are implemented in plurality in a similar manner to the first tray mounting units 810 of the first inspection unit, they may be arranged in a horizontal direction or a vertical direction. In an assumption that the arrangement direction of the first and the second inspection units is a horizontal direction (X-axis direction) with
15 consideration of a size of the apparatus, the second tray mounting units 820 are preferably arranged in a vertical direction (Y-axis direction).

The vision inspection unit 300 and the dumping unit 210 may have the same configurations as those of the second embodiment according to configurations and arrangements of the first and the second tray mounting
20 units 810, 820. In case that the second tray mounting units 820 include the first sub-tray mounting units 821 and the second sub-tray mounting units 822, the dumping unit 210 and the vision inspection unit 300 may be configured so as to be independently operated from each other by additional X-Y robots 620, 640.

25 The second vision inspection unit 300 may have various

configurations, i.e., a similar configuration to a first vision inspection unit 610, or a similar configuration to that of the second embodiment, etc. As shown in FIGS. 7 to 9, the second vision inspection unit 300 may be installed to the X-Y robot 640 so as to be movable in X and Y directions. The X-Y robot 620 for moving the first vision inspection unit 610, and the X-Y robot 640 for moving the second vision inspection unit 300 may share guide rails 650 along which their motions are guided.

Like in the second embodiment, the dumping unit 210 is installed in the body 100 so as to transfer the electronic components 10 loaded in the trays 20 while moving above the second sub-tray mounting units 822. As shown in FIGS. 7 to 9, the dumping unit 210 may be installed to the X-Y robot 320 so as to be movable in X and Y directions.

Like in the second embodiment, a tray stack unit 500 for stacking thereon the trays 20 to be mounted to the first and the second mounting units 810, 820 may be further installed in the body 100 so as to automatically transfer the trays 20.

The tray stack unit 500 may have a similar configuration to that of the second embodiment, and have a configuration to supply or withdraw the trays 20 to and from the first tray mounting units 810 of the first inspection unit. And, the tray stack unit 500 may include a first tray stack unit 510 for stacking thereon the trays 20 to be vision-inspected and supplying the trays 20 to the first tray mounting units 810 of the first inspection unit, a second tray stack unit 520 for stacking empty trays, and a third tray stack unit 530 for stacking thereon the trays 20 having completely undergone vision inspection and sorting processes.

With considering that vision inspection consists of first and the second vision inspections, the third tray stack unit 530 may include a good tray stack unit 531 for stacking thereon the trays 20 loaded with good electronic components, a first reject tray stack unit 532 for stacking thereon the trays 20 loaded with bad electronic components 10 (R1) resulting from first vision inspection, and a second reject tray stack unit 533 for stacking thereon the trays 20 loaded with bad electronic components 10 resulting from second vision inspection.

The tray stack unit 500 may further include a buffer tray stack unit (not shown) for temporarily stacking thereon the trays 20 having been inverted after the first vision inspection.

The inversion unit 700 may have various configurations. The inversion unit 700 may receive the tray 20 firstly vision-inspection by the first inspection unit, and then invert the electronic components 10 loaded in the tray 20, so that the other surface (lower or upper surface) of the electronic components 10, having not been vision-inspected yet, can be secondly vision-inspected after the one surface (upper or lower surface) of the electronic components 10 has been firstly vision-inspected.

As shown in FIGS. 10A to 10C, the inversion unit 700 may include a tray pickup unit 322 for picking up a temporary tray 21 before inverting the tray 20; and an inversion device 720 for overlapping the tray 20 transferred by the tray transfer unit 780 with the temporary tray 21 picked-up by the tray pickup unit 322, and then turning the overlapped temporary tray 21 and tray 20 upside down, thereby inverting the electronic components 10 stacked on the tray 20 onto the temporary tray 21.

The tray pickup unit 322 for picking up the temporary tray 21 before and after an inversion process by the inversion unit 720 may have various configurations. The tray pickup unit 322 picks up the temporary tray 21 before inverting the tray 20. And, after inverting the tray 20, the tray pickup unit 322
5 picks up the empty tray 20 which the electronic components 10 are removed from so as to use it as another temporary tray.

The inversion device 720 for rotating the tray 20 and the temporary tray 21 in an overlapped state may have various configurations. The inversion device 720 may include a tray fixing unit 721 for overlapping the tray 20
10 transferred by the tray transfer unit 780 with the temporary tray 21 picked up by the tray pickup unit 322, and fixing the overlapped temporary tray 21 and tray 20; and a tray rotation unit 722 for rotating the overlapped temporary tray 21 and tray 20.

The tray 20 for loading the electronic components 10 thereon may
15 have various configurations. For instance, the tray 20 may have a configuration that both the upper surface and the lower surface thereof can be used. Or, the tray 20 may have a configuration that the electronic components 10 loaded on an upper surface of the tray 20 are stacked on the lower surface of the tray 20 after being inverted.

20 The temporary tray 21 picked-up by the tray pickup unit 322 should be picked-up so as to be in the same state as the tray 20 to be overlapped therewith. Since the tray 20 having been inverted by the inversion device 720 is in an upside down state, the tray 20 used as the temporary tray 21 after being inverted by the inversion device 720 may be inverted.

25 The temporary tray 21 loaded with the electronic components 10

thereon inverted by the inversion device 720 of the inversion unit 700 is transferred to the second inspection unit for second inspection, in a state inverted by another tray transfer unit 580.

The vision inspection apparatus according to the third embodiment of
5 the present invention will be explained in more detail.

Like in the second embodiment, firstly, the trays 20 to be vision-inspected are stacked on the first tray stack unit 510, and a predetermined number of empty trays 20 are stacked on the second tray stack unit 520.

Upon completion of the stack of the trays 20 on the first tray stack unit
10 510, the tray transfer unit 780 of the first inspection unit supplies the trays 20 loaded with the electronic components 10 to be vision-inspected, to the first tray mounting unit 810 from the first tray stack unit 510.

Upon completion of the loading of the trays 20 to the first tray mounting unit 810, the first vision inspection unit 630 of the first inspection unit
15 performs first vision inspection.

Upon completion of the first vision inspection, the tray transfer unit 780 withdraws the trays 20 from the first tray mounting unit 810, and transfers the trays 20 to the inversion unit 700. In case that two or more first tray mounting units 810 are implemented, when withdrawing the tray 20 from one
20 first tray mounting unit 810, the first vision inspection unit 630 can inspect the electronic components 10 loaded in the tray 20 of the other first tray mounting unit 810. This may allow the first vision inspection to be consecutively performed.

After transferring the tray 20 to the inversion unit 700, the tray transfer
25 unit 780 supplies another tray 20 to be vision-inspected to the first tray

mounting unit 810 from the first tray stack unit 610.

The inversion unit 700 having received the tray 20 which has undergone the first vision inspection overlaps the inverted tray 20 with the temporary tray 21 and then inverts the overlapped tray 20 and temporary tray
5 21, thereby inverting the electronic components 10 loaded in the tray 20.

Upon completion of the inversion of the tray 20 by the inversion unit 700, the tray transfer unit 580 moves to receive the tray 20 (temporary tray 21) loaded with the inverted electronic components 10, and then transfers the received tray 20 to the second tray mounting unit 820 of the second
10 inspection unit.

After the tray 20 has been transferred to the second tray mounting unit 820 of the second inspection unit, especially, the first sub-tray mounting unit 821, the second inspection unit 300 is operated in a similar manner to that of the second embodiment.

15

-SECOND VISION INSPECTION AND SORTING PROCESS

Once the trays 20 are mounted to the first sub-tray mounting units 821 of the second tray mounting unit 820 of the second inspection unit, the second vision inspection unit 300 performs second vision inspection.

20 After the second vision inspection, the trays 20 are transferred to the second sub-tray mounting units 822 by the tray transfer unit 580. Then, the electronic components 10 loaded in the trays 20 are sorted by the dumping unit 210 based on results of the first and the second vision inspections.

The sorting process may be implemented in various manners
25 according to the number and arrangement of the second sub-tray mounting

units 822.

As aforementioned, the second sub-tray mounting units 822 may include 2-1 to 2-3 sub-tray mounting units 822a,822b, 822c. To these 2-1 to 2-3 sub-tray mounting units 822a,822b, 822c, the trays 20 to be sorted may be continuously supplied from the first sub-tray mounting units 821.

According to results of the sorting processes, good electronic components 10 may be placed in the 2-1 sub-tray mounting unit 822a, bad electronic components 10 (R1) resulting from first vision inspection may be placed in the 2-2 sub-tray mounting unit 822b, and bad electronic components 10 (R2) resulting from second vision inspection may be placed in the 2-3 sub-tray mounting unit 822c.

The sorting processes by the dumping unit 210 will be explained as follows.

Firstly, the dumping unit 210 picks up bad electronic components 10 (R1 resulting from the first vision inspection and R2 resulting from second vision inspection) loaded in the 2-1 sub-tray mounting unit 822a, and then transfers the picked-up bad electronic components 10 to the 2-2 sub-tray mounting unit 822b or the 2-3 sub-tray mounting unit 822c.

Next, the dumping unit 210 picks-up good electronic components 10 from the trays 20 of the 2-2 sub-tray mounting unit 822b or the 2-3 sub-tray mounting unit 822c, and then places the good electronic components 10 (R1 resulting from first vision inspection, and R2 resulting from second vision inspection) in the empty space.

Next, the dumping unit 210 moves back to the 2-1 sub-tray mounting unit 822a, and places good electronic components 10 picked-up from the 2-2

sub-tray mounting unit 822b or the 2-3 sub-tray mounting unit 822c, in the empty spaces of the tray 20 of the 2-1 sub-tray mounting unit 822a.

When the trays 20 of the 2-1 sub-tray mounting unit 822a, the 2-2 and the 2-3 sub-tray mounting units 822b, 822c have been completely filled with
5 good electronic components 10, bad (R1) electronic components 10, and bad (R2) electronic components 10, respectively, the trays 20 are replaced by new trays 20, or are transferred to the tray stack unit 500.

The 2-1 to 2-3 sub-tray mounting units 822a, 822b, 822c may be provided with additional empty trays supplied from the second tray stack unit
10 520 if necessary.

The trays 20 having completely undergone the sorting processes are transferred from the second sub-tray mounting units 822, and are stacked on the tray stack unit 500.

More concretely, if the trays 20 of the 2-1 sub-tray mounting unit 822a
15 are filled with good electronic components 10, the trays 20 are stacked on the good tray stack unit 531. And, if the trays 20 of the 2-2 and 2-3 sub-tray mounting units 822b, 822c are filled with bad electronic components 10 (R1 and R2), the trays 20 are stacked on the reject tray stack units 532, 533.

On one of the two reject tray stack units 532, 533, the trays 20
20 determined as bad products (R1) as a result of first vision inspection may be stacked. And, on the other of the two reject tray stack units 532, 533, the trays 20 determined as bad products (R2) as a result of second vision inspection may be stacked.

The foregoing embodiments and advantages are merely exemplary
25 and are not to be construed as limiting the present disclosure. The present

5 teachings can be readily applied to other types of apparatuses. This description is intended to be illustrative, and not to limit the scope of the claims. Many alternatives, modifications, and variations will be apparent to those skilled in the art. The features, structures, methods, and other characteristics of the exemplary embodiments described herein may be combined in various ways to obtain additional and/or alternative exemplary embodiments.

10 As the present features may be embodied in several forms without departing from the characteristics thereof, it should also be understood that the above-described embodiments are not limited by any of the details of the foregoing description, unless otherwise specified, but rather should be construed broadly within its scope as defined in the appended claims, and therefore all changes and modifications that fall within the metes and bounds of the claims, or equivalents of such metes and bounds are therefore intended
15 to be embraced by the appended claims.

CLAIMS

1. A vision inspection apparatus, comprising:
 - two or more trays loaded with electronic components thereon;
 - a vision inspection unit for performing vision inspection with respect to the electronic components loaded in the trays; and
 - a dumping unit for exchanging good product and bad product with each other between the trays according to a result of the vision inspection,wherein the dumping unit places good electronic component in one or more trays, and places bad electronic component in the remained one or more trays; and
wherein the vision inspection unit and the dumping unit are interworked with each other by being fixed to at least one shaft.
2. A vision inspection apparatus, comprising:
 - a plurality of first tray mounting units for mounting trays loaded with electronic components thereon, respectively;
 - one or more second tray mounting units for mounting empty trays;
 - a vision inspection unit for vision-inspecting the electronic components loaded in the trays; and
 - a dumping unit for sorting good and bad electronic components to at least one of the first and the second mounting units according to a result of the vision inspection,wherein the vision inspection unit and the dumping unit are interworked with each other by being fixed to at least one shaft.
3. The apparatus of claim 1 or 2, wherein the dumping unit includes a plurality of pickers for picking and placing the electronic components.
4. The apparatus of claim 1 or 2, wherein the vision inspection unit and the dumping unit are installed in an X-Y robot so as to be movable in X and Y directions.
5. The apparatus of claim 2, wherein the dumping unit is configured to place good electronic components on one or more trays of the first tray mounting units, and to place bad electronic components on the empty trays of the second tray mounting unit.
6. A vision inspection apparatus, comprising:
 - a plurality of first tray mounting units for mounting trays loaded with electronic components thereon, respectively;
 - one or more second tray mounting units for mounting empty trays;

a vision inspection unit for vision-inspecting the electronic components loaded in the trays;

a dumping unit for sorting good and bad electronic components to at least one of the first and the second mounting units according to a result of the vision inspection;

one or more first tray stack units for stacking thereon the trays loaded with the electronic components thereon;

one or more second tray stack units for stacking the empty trays thereon;

one or more good tray stack units for stacking trays loaded with good electronic components thereon;

one or more reject tray stack units for stacking trays loaded with bad electronic components thereon; and

a tray transfer unit for transferring the trays among the first tray mounting units, the second tray mounting unit, the first tray stack units, the second tray stack units, the good tray stack units, and the reject tray stack units.

7. A vision inspection apparatus, comprising:

one or more first tray mounting units for mounting one or more trays loaded with electronic components thereon for vision inspection;

a first inspection unit including a first vision inspection unit for performing first vision inspection with respect to the electronic components loaded in the trays of the first tray mounting units;

an inversion unit for receiving the trays having completely undergone the first vision inspection, and inverting the electronic components loaded in the trays;

two or more second tray mounting units for mounting the trays inverted by the inversion unit;

a second vision inspection unit for performing second vision inspection with respect to the electronic components loaded in the trays of the second tray mounting units;

a second inspection unit including a dumping unit for sorting the electronic components loaded in the trays of the second tray mounting units into good and bad electronic products according to results of the first and the second vision inspections after the second vision inspection; and

a tray transfer unit for transferring the trays among the first inspection unit, the inversion unit, and the second inspection unit,

wherein the vision inspection unit and the dumping unit are interworked with each other by being fixed to at least one shaft.

8. The apparatus of claim 7, wherein the inversion unit comprises:

a tray pickup unit for picking up the inversed tray before inverting the tray; and
an inversion device for overlapping the tray transferred by the tray transfer unit with the tray picked-up by the tray pickup unit, and then turning the overlapped one pair of the trays upside down, thereby inverting the electronic components loaded in the tray.

9. A vision inspection apparatus, comprising:

one or more first tray mounting units for mounting one or more trays loaded with electronic components thereon for vision inspection;

a first inspection unit including a first vision inspection unit for performing first vision inspection with respect to the electronic components loaded in the trays of the first tray mounting units;

an inversion unit for receiving the trays having completely undergone the first vision inspection, and inverting the electronic components loaded in the trays;

two or more second tray mounting units for mounting the trays inverted by the inversion unit;

a second vision inspection unit for performing second vision inspection with respect to the electronic components loaded in the trays of the second tray mounting units;

a second inspection unit including a dumping unit for sorting the electronic components loaded in the trays of the second tray mounting units into good and bad electronic products according to results of the first and the second vision inspections after the second vision inspection; and

a tray transfer unit for transferring the trays among the first inspection unit, the inversion unit, and the second inspection unit,

wherein an X-Y robot for moving the first vision inspection unit, and an X-Y robot for moving the second vision inspection unit share guide rails along which their motions are guided.