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**YAMADA**(10) **Pub. No.: US 2025/0261471 A1**(43) **Pub. Date: Aug. 14, 2025**(54) **ELECTRONIC COMPONENT DEVICE**(71) Applicant: **OLYMPUS MEDICAL SYSTEMS CORP.**, Tokyo (JP)(72) Inventor: **Junya YAMADA**, Kawasaki-shi (JP)(73) Assignee: **OLYMPUS MEDICAL SYSTEMS CORP.**, Tokyo (JP)*A61B 1/05* (2006.01)*H01L 23/544* (2006.01)*H04N 23/50* (2023.01)(52) **U.S. Cl.**CPC ..... *H10F 39/811* (2025.01); *H01L 23/544* (2013.01); *H04N 23/555* (2023.01); *A61B 1/0011* (2013.01); *A61B 1/051* (2013.01); *H01L 2223/54426* (2013.01)(21) Appl. No.: **19/193,117**(22) Filed: **Apr. 29, 2025****Related U.S. Application Data**

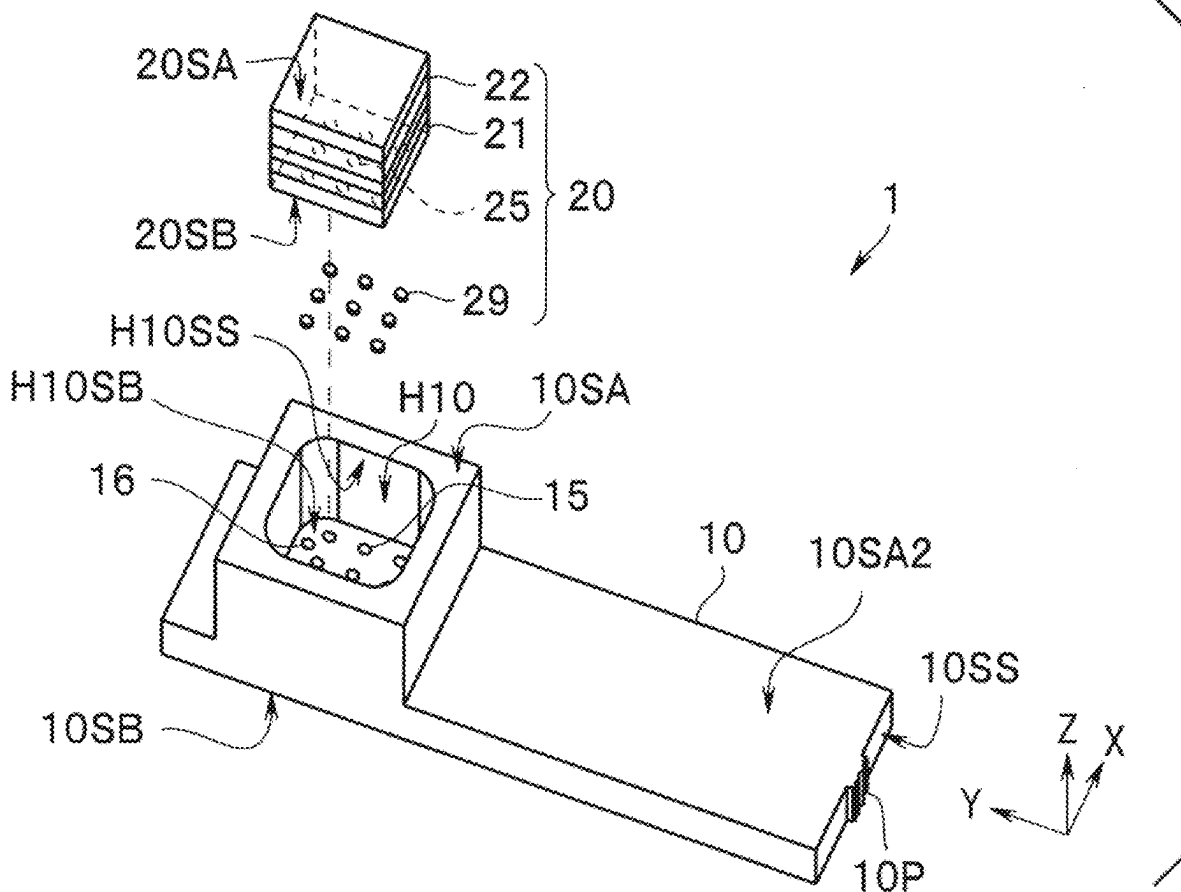
(63) Continuation of application No. 18/379,238, filed on Oct. 12, 2023, now Pat. No. 12,317,629, which is a continuation of application No. PCT/JP2021/024598, filed on Jun. 29, 2021.

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(57)

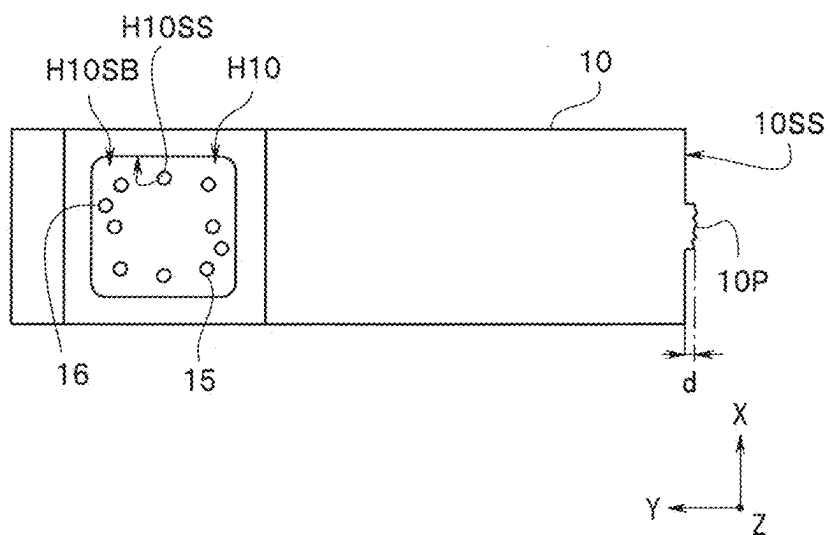
**ABSTRACT**

An image pickup unit, which is an electronic component device, includes: a stacked device which is an electronic component including an external electrode; and a wiring board. The wiring board has a first principal surface and includes a bonding electrode and an alignment mark on the first principal surface, the external electrode of the electronic component is bonded to the bonding electrode, and on the first principal surface, an area of a region in which a first region where the bonding electrode is virtually moved in a predetermined first direction, and the alignment mark are superimposed on each other is less than 50% of an area of the alignment mark.

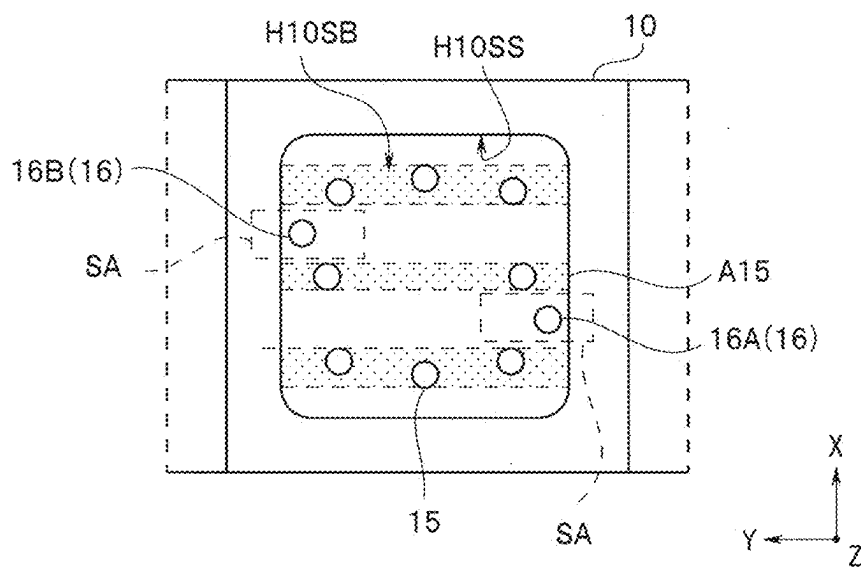




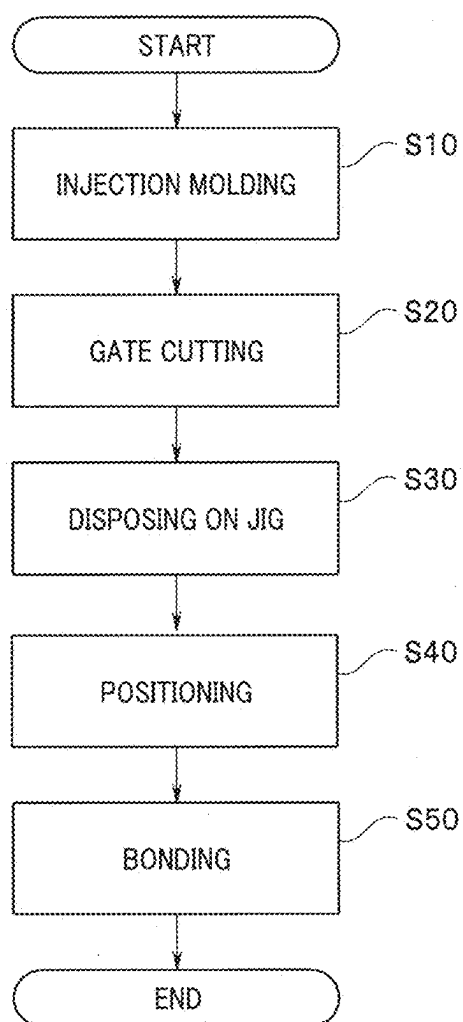
**FIG. 3**



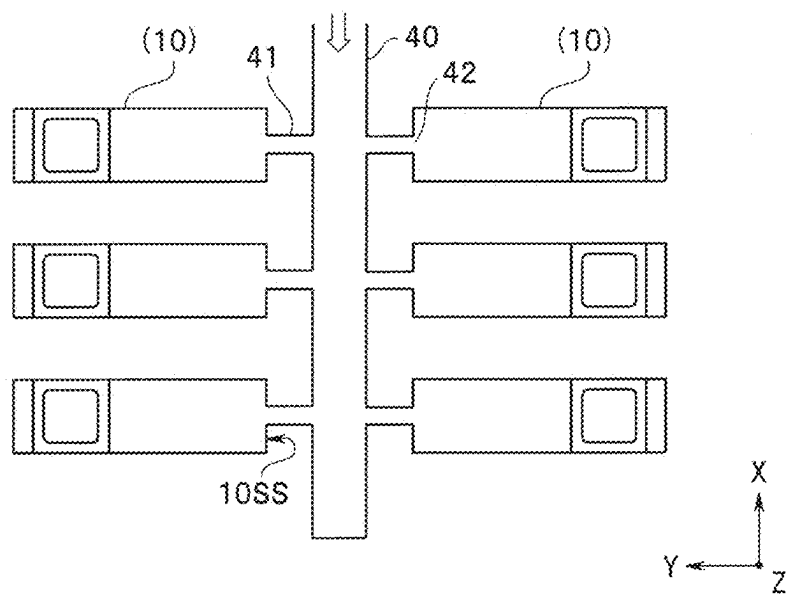
**FIG. 4**



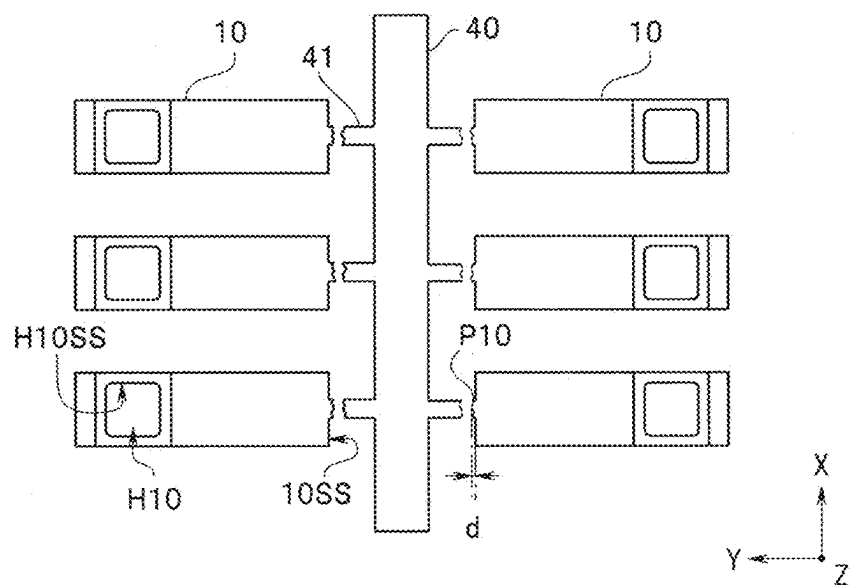
**FIG. 5**



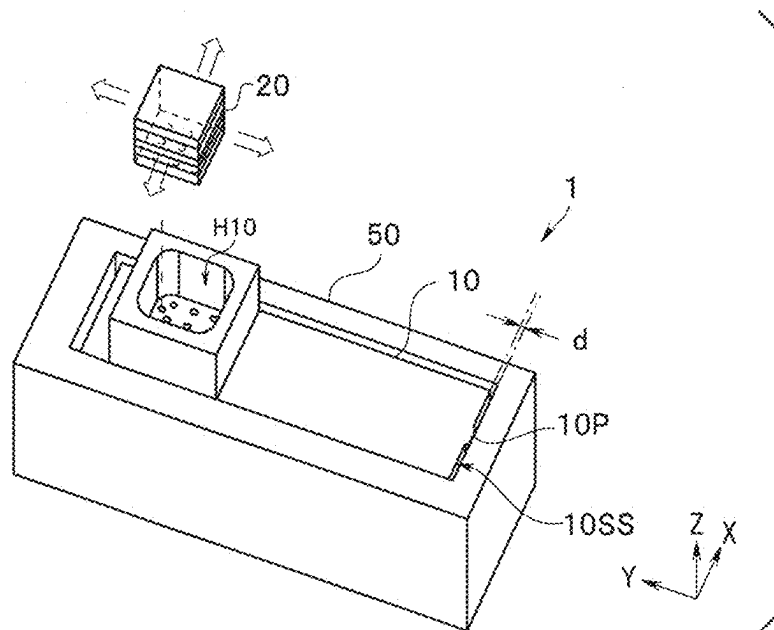
**FIG. 6**



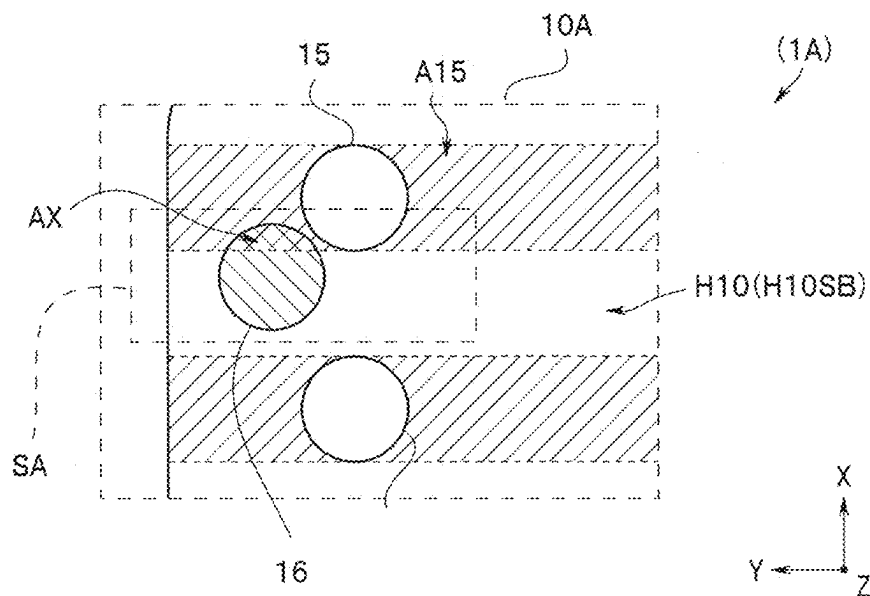
**FIG. 7**



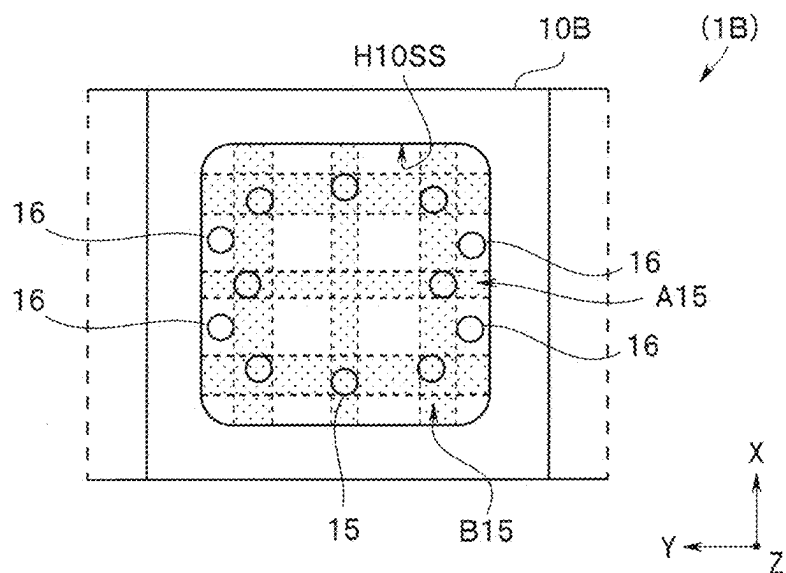
**FIG. 8**



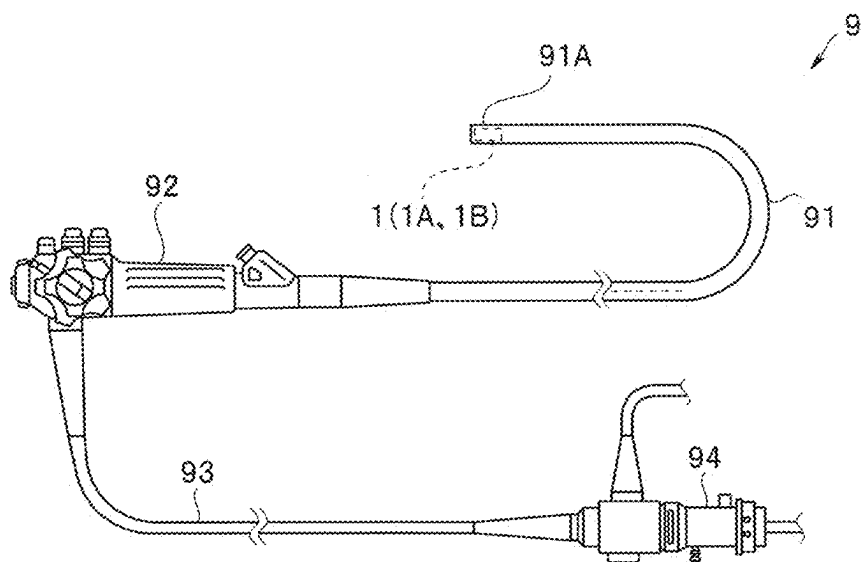
**FIG. 9**



**FIG. 10**



**FIG. 11**



## ELECTRONIC COMPONENT DEVICE

### CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation application of U.S. patent application Ser. No. 18/379,238 filed on Oct. 12, 2023, which is a continuation application of PCT/JP2021/024598 filed on Jun. 29, 2021, the entire contents of each of which are incorporated herein by reference.

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

[0002] The present invention relates to an electronic component device including an electronic component disposed on a wiring board.

#### 2. Description of the Related Art

[0003] It is important to reduce a diameter of an image pickup unit disposed in a distal end portion of an insertion portion of an endoscope for alleviating invasiveness.

[0004] Japanese Patent Application Laid-Open Publication No. 2012-18993 discloses a stacked device manufactured using a wafer-level packaging method for efficiently manufacturing an image pickup unit with a small diameter. In the wafer-level packaging method, the stacked device is produced by dicing a stacked wafer in which a plurality of lens wafers each including a plurality of lenses and a plurality of image pickup devices are adhesively bonded.

[0005] International Publication No. 2015/082328 (Japanese Patent No. 6533787) discloses an image pickup unit in which a stacked device including an image pickup device is housed in a recess of a three-dimensional wiring board. By using an MID (molded interconnect device) as the three-dimensional wiring board, the manufacturing process can be simplified.

### SUMMARY OF THE INVENTION

[0006] An electronic component device according to an embodiment includes: an electronic component including an external electrode; and a wiring board. The wiring board has a first principal surface, and includes a bonding electrode and an alignment mark on the first principal surface, the external electrode of the electronic component is bonded to the bonding electrode, and on the first principal surface, an area of a region in which a first region where the bonding electrode is virtually moved in a predetermined first direction, and the alignment mark are superimposed on each other is less than 50% of an area of the alignment mark.

### BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. 1 is a perspective view of an image pickup unit of a first embodiment;

[0008] FIG. 2 is an exploded perspective view of the image pickup unit of the first embodiment;

[0009] FIG. 3 is a top view of a MID of the image pickup unit of the first embodiment;

[0010] FIG. 4 is a top view of a part of the MID of the image pickup unit of the first embodiment;

[0011] FIG. 5 is a flowchart of a method of manufacturing the image pickup unit of the first embodiment;

[0012] FIG. 6 is a plan view for explaining a method of manufacturing the MID of the image pickup unit of the first embodiment;

[0013] FIG. 7 is a plan view for explaining the method of manufacturing the MID of the image pickup unit of the first embodiment;

[0014] FIG. 8 is a perspective view for explaining the method of manufacturing the image pickup unit of the first embodiment;

[0015] FIG. 9 is a top view of a part of a MID of an image pickup unit of a modification 1 of the first embodiment;

[0016] FIG. 10 is a top view of a part of a MID of an image pickup unit of a modification 2 of the first embodiment; and

[0017] FIG. 11 is a perspective view of an endoscope of a second embodiment.

### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0018] Hereinafter, embodiments of the present invention will be described with reference to the drawings.

[0019] Note that the drawings based on the embodiments are schematic illustrations. The relation between the thickness and the width of each portion, the ratio in thickness of each portion, and the like differ from the actual relation, ratio, and the like. There are also some portions with different dimensional relations and ratios among the drawings. Illustration of and assignment of reference signs to some constituent elements are omitted. The direction toward an object is referred to as "upward."

#### First Embodiment

[0020] An image pickup unit 1, which is an electronic component device, of the present embodiment shown in FIG. 1 and FIG. 2 includes a wiring board 10, a stacked device 20 which is an electronic component, and a resin 30. Note that in FIG. 2, the resin 30 is not shown.

[0021] The stacked device 20 includes a light receiving surface 20SA and a back surface 20SB on a side opposite to the light receiving surface 20SA, and includes, on the back surface 20SB, external electrodes 25 that output an image pickup signal. The stacked device 20 in a substantially rectangular parallelepiped shape includes an optical system 22 in which a plurality of optical devices are stacked and an image pickup device (image sensor) 21. The optical device is, for example, a hybrid lens device (composite device) including a glass plate and a resin lens or an IR cut filter device.

[0022] The configuration of the optical system 22, that is, the configuration (thickness, shape), the type, the number, and the stacking order of the optical devices may be modified in various ways in accordance with the specification. A patterned light-shielding film may be disposed, as an aperture, on a principal surface of any one of the optical devices.

[0023] The stacked device 20 is produced using the wafer-level packaging method that dices a bonded wafer in which a stacked wafer composed of a plurality of optical device wafers each including a plurality of optical devices and a plurality of image pickup device wafers including a plurality of image pickup devices are bonded. Therefore, the stacked device 20 is in a rectangular parallelepiped shape. The stacked device 20 may be produced using the wafer-level



packaging method that dices a bonded wafer in which a plurality of image pickup devices are adhesively bonded to a stacked wafer.

[0024] The image pickup device 21 with a silicon base material includes a light receiving portion composed of a CCD or the like. The stacked device 20 (image pickup device 21) includes solder bumps 29 on the external electrodes 25 on the back surface 20SB. At least one semiconductor device that processes an image pickup signal may be stacked on a lower surface of the image pickup device 21. In the stacked device with the semiconductor device stacked, the electrodes on a lower surface of the semiconductor device are the external electrodes 25. A cover glass may be disposed on an upper surface of the image pickup device 21.

[0025] The three-dimensional wiring board 10 (hereinafter, referred to as a “wiring board 10”) includes a first principal surface 10SA, a side surface 10SS orthogonal to the first principal surface 10SA, and a second principal surface 10SB on a side opposite to the first principal surface 10SA. The first principal surface 10SA includes a recess H10. The recess H10 includes four wall surfaces H10SS and a bottom surface H10SB. Of the four wall surfaces H10SS, two side surfaces H10SS are parallel to the direction of the side surface 10SS relative to the recess H10 (first direction: Y-direction in the drawing). An opening of the recess H10 is in a substantially rectangular shape with curved corners, but may be in a rectangular shape.

[0026] The wiring board 10 includes a main portion 11 including the recess H10, and an extending portion 12 including a third principal surface 10SA2 that is parallel to the first principal surface 10SA and that has a distance from the second principal surface 10SB that is shorter as compared to the first principal surface 10SA. A side surface of the extending portion 12 is the side surface 10SS. The wiring board 10 also includes an extending portion 13 on a side opposite to the extending portion 12 across the main portion 11. As long as the extending portion 12 includes the side surface 10SS having a gate cut (projection) 10P described later, the third principal surface 10SA2 may not be parallel to the first principal surface 10SA, for example. The extending portion 12 may include a through hole or an electronic component may be mounted on the extending portion 12.

[0027] The wiring board 10 may not include the extending portions 12, 13. In the wiring board with no extending portions 12, 13, a side surface of the main portion 11 is the side surface 10SS.

[0028] As shown in FIG. 3 and FIG. 4, a plurality of bonding electrodes 15 and a plurality of alignment marks 16 (16A, 16B) are disposed on the bottom surface H10SB of the recess H10. Though not shown, the bonding electrodes 15 are electrically connected to electrodes on the second principal surface 10SB via surface wiring and through wiring. The bonding electrodes 15 may be connected to the electrodes on the second principal surface 10SB via wiring on the wall surface of the recess H10, wiring on the first principal surface 10SA, and wiring on the side surface of the main portion 11.

[0029] The stacked device 20 is disposed in the recess H10 of the wiring board 10. The external electrodes 25 of the stacked device 20 are bonded to the bonding electrodes 15 on the bottom surface H10SB of the recess H10 by means of the solder bumps 29. In other words, the light receiving portion of the image pickup device 21 is electrically con-

nected to the electrodes on the second principal surface 10SB via the external electrodes 25, the solder bumps 29, the bonding electrodes 15, and the through wiring.

[0030] For example, the resin 30, which is, a thermosetting epoxy resin, seals a gap between the recess H10 and the stacked device 20. The resin 30 seals the stacked device 20 and simultaneously mitigates the stress applied to the stacked device 20. To prevent external light from entering through a side surface of the stacked device 20, it is preferable that the resin 30 should have a light shielding property by, for example, including light shielding particles.

[0031] The external electrodes 25 of the stacked device 20 and the bonding electrodes 15 on the bottom surface H10SB of the recess H10 of the wiring board 10 are aligned using an alignment apparatus such that first, at least two alignment marks 16 of the wiring board 10 fixed to a jig 50 (see FIG. 8) are detected, and then, the stacked device 20 or the wiring board 10 is moved so that the stacked device 20 and the wiring board 10 are in a predetermined relative position based on the positions of the alignment marks 16.

[0032] For example, the alignment apparatus calculates a correlation coefficient (similarity) with a template (size/shape of the alignment mark 16) based on an image of a search region SA (FIG. 4) of the bottom surface H10SB of the recess H10 that is photographed, and performs geometric pattern matching using the similarity as a scale to detect the alignment mark 16.

[0033] The wiring board 10 includes, on the side surface 10SS, the projection 10P projecting in the first direction (Y-direction in the drawing) parallel to the two side surfaces H10SS of the four wall surfaces H10SS of the recess H10. As will be described later, since the projection 10P shown in FIG. 3 is a gate cut, a projecting length (d) of the projection 10P differs among a plurality of wiring boards 10. Therefore, the initial positions of the plurality of wiring boards 10 fixed to the jig 50 vary.

[0034] The bonding electrode 15 and the alignment mark 16 are identical in shape and size due to restrictions on the specification of the stacked device 20 and the detecting capacity of the alignment apparatus. For example, the bonding electrode 15 is in a round shape with a diameter of 100  $\mu\text{m}$  and the alignment mark 16 is also in a round shape with a diameter of 100  $\mu\text{m}$ . Therefore, when the alignment mark 16 is detected, the bonding electrode 15 could be misrecognized as the alignment mark 16. Even when the bonding electrode 15 and the alignment mark 16 are substantially identical in shape (substantially round shape) and size, the bonding electrode 15 could be misrecognized as the alignment mark 16.

[0035] Note that substantially identical in shape and size means that the area of a superposed region where the bonding electrode 15 and the alignment mark 16 smaller than the bonding electrode 15 are virtually superposed on each other is, for example, 60% or greater of the area of the alignment mark 16. The bonding electrode 15 and the alignment mark 16 are in a substantially round shape including a circle or in a substantially rectangular shape including a rectangle.

[0036] As shown in FIG. 4, in the wiring board 10 of the image pickup unit 1, a first region A15 where the bonding electrode 15 is virtually moved in the first direction (Y-direction) and the alignment mark 16 are not superposed on each other on the bottom surface H10SB of the recess H10.

[0037] In a micro-image pickup unit, it is not easy to accurately perform positioning between the bonding electrodes on the bottom surface of the recess and the external electrodes on the back surface of the stacked device. Particularly in the MID, variations in the outer dimension inevitably occur. Therefore, the bonding electrode was occasionally misrecognized as the alignment mark for positioning.

[0038] However, in the image pickup unit 1, the search region SA of the alignment apparatus is set larger in the Y-direction considering the variations in the projecting amount of the projection 10P. Meanwhile, by setting the search region SA so as not to include the first region A15, the bonding electrode 15 is not misrecognized as the alignment mark 16. Since the stacked device 20 and the wiring board 10 can be easily aligned, the image pickup unit 1 can be easily manufactured.

#### <Method of Manufacturing Image Pickup Unit>

[0039] Following a flowchart of FIG. 5, a method of manufacturing the image pickup unit 1 will be described.

#### <Step S10> Injection Molding

[0040] As shown in FIG. 6, the plurality of wiring boards 10 are produced using the injection molding method. A MID resin is injected from gates 42 into a mold (not shown) including the shape of a plurality of three-dimensional wiring boards, via a sprue 40 through runners 41. A plurality of molded bodies removed from the mold, which become the plurality of wiring boards 10, are connected by means of the sprue 40 and the runners 41.

[0041] The surface of the molded bodies formed of the MID resin is irradiated with a laser so that a region having a catalytic activity for electroless plating is formed. Further, a through hole is formed on the bottom surface of the recess H10. Thereafter, the molded bodies are subjected to an electroless plating treatment, so as to become the wiring boards 10 on which the bonding electrodes 15, the alignment marks 16, and the like are disposed.

[0042] As already described, the wiring board 10 includes the first principal surface 10SA and the side surface 10SS orthogonal to the first principal surface 10SA, and includes the bonding electrodes 15 and the alignment marks 16 on the bottom surface H10SB of the recess H10 on the first principal surface 10SA.

#### <Step S20> Gate Cutting

[0043] As shown in FIG. 7, the plurality of wiring boards 10 that are connected by means of the runners 41 are cut at the respective gates 42 to be made into individual pieces of the wiring boards 10. Therefore, the wiring board 10 includes, on the side surface 10SS, the gate cut 10P that is a projection projecting in the first direction parallel to the wall surface H10SS of the recess H10.

#### <Step S30> Disposing on Jig

[0044] Though not shown, the stacked device 20 in a rectangular parallelepiped shape is produced using the wafer-level packaging method that dices the bonded wafer in which the plurality of image pickup devices are bonded to the stacked wafer composed of the plurality of optical device wafers each including the plurality of optical devices. The

stacked device 20 includes the solder bumps 29 on the external electrodes 25 on the back surface 20SB.

[0045] As shown in FIG. 8, the wiring board 10 is fixed to the jig 50. The jig 50 may be a part of the alignment apparatus. At this time, the gate cut 10P of the wiring board 10 abuts on one surface of the jig 50.

[0046] As already described, the projecting amount d of the gate cut 10P from the side surface 10SS is not constant among the plurality of wiring boards 10.

#### <Step S40> Positioning

[0047] While moving at least one of the wiring board 10 or the stacked device 20, the positioning between the bonding electrodes 15 of the wiring board 10 and the external electrodes 25 of the stacked device 20 is performed.

[0048] First, the alignment mark 16 is detected. Depending on the shape of the alignment mark 16, only one alignment mark 16 may be detected, but to improve the accuracy, it is preferable that at least two alignment marks 16 should be detected.

[0049] When the alignment mark 16 is detected, the positions of the bonding electrodes 15 in predetermined relative positions with respect to the position of the alignment mark 16 are presumed. With a state in which the positions of the external electrodes 25 of the stacked device 20 are aligned so as to be superposed on the presumed positions of the bonding electrodes 15 of the wiring board 10, the stacked device 20 is inserted into the recess H10 of the wiring board 10.

[0050] For example, from the positions of the two alignment marks 16 (X-coordinate value, Y-coordinate value) of the wiring board 10 fixed to the jig on a stage of the alignment apparatus, XY coordinates 15P of two of the plurality of bonding electrodes 15 are presumed. A retaining member retaining the stacked device 20 moves the positions of the external electrodes 25 to the XY coordinates 15P and then moves the stacked device 20 in a Z-direction, so that with the aligned state, the stacked device 20 is inserted into the recess H10 of the wiring board 10. Note that for temporarily fixing the stacked device 20 to the recess H10, an adhesive may be used.

[0051] The search region SA of the alignment apparatus is set so as not to include the first region A15. Therefore, the bonding electrode 15 is not misrecognized as the alignment mark 16.

#### <Step S50> Bonding

[0052] With the state in which the wiring board 10 and the stacked device 20 are positioned, e.g., the state of temporary fixing, a reflow heating treatment is performed and the external electrodes 25 and the bonding electrodes 15 are bonded by means of the solder bumps 29. Thereafter, the resin 30 is injected into a gap between the recess H10 and the stacked device 20 and then, curing treatment is performed. In bonding by means of the solder bumps 29, a solder paste may be applied to the external electrodes 25 in advance.

[0053] In the method of manufacturing the image pickup unit 1 of the present embodiment, positioning between the wiring board 10 and the stacked device 20 is easy.

## Modifications of First Embodiment

[0054] Since image pickup units 1A, 1B of modifications 1, 2 are similar to and have the same effects as the effects of the image pickup unit 1, the components having the same functions are assigned the same reference signs and the description will be omitted.

## Modification 1

[0055] As shown in FIG. 9, in a wiring board 10A of the image pickup unit 1A of the present modification, a superposed region AX in which the first region A15 where the bonding electrode 15 is virtually moved in the first direction (Y-direction) and the alignment mark 16 are superposed on each other is on the bottom surface H10SB of the recess H10.

[0056] However, the area of the superposed region AX is 20% of the area of the alignment mark 16.

[0057] Since the search region SA of the alignment apparatus includes the first region A15, but does not entirely include the bonding electrode 15, the bonding electrode 15 is not misrecognized as the alignment mark 16.

[0058] Note that to prevent the misrecognition, the area of the superposed region AX is preferably less than 50%, particularly less than 30%, of the area of the alignment mark 16.

## Modification 2

[0059] As shown in FIG. 10, in a wiring board 10B of the image pickup unit 1B of the present modification, the first region A15 where the bonding electrode 15 is virtually moved in the first direction (Y-direction) and a second region B15 where the bonding electrode 15 is virtually moved in a second direction (X-direction) orthogonal to the first direction (Y-direction), and the alignment mark 16 are not superposed on each other.

[0060] The search region (not shown) of the alignment apparatus does not include the first region A15 or the second region B15. Therefore, in the image pickup unit 1B, the bonding electrode 15 is far less likely to be misrecognized as the alignment mark 16 than in the image pickup unit 1.

[0061] Note that even when a part of the alignment mark 16 is superposed on the first region A15 and the second region B15, as long as the total of the area of the first region A15 and the alignment mark 16 superposed on each other and the area of the second region B15 and the alignment mark 16 superposed on each other is less than 50% of the area of the alignment mark 16, the bonding electrode 15 is not misrecognized as the alignment mark 16.

## Second Embodiment

[0062] An endoscope 9 of the present embodiment shown in FIG. 11 includes an insertion portion 91, an operation portion 92, a universal cord 93, and an endoscope connector 94. The insertion portion 91 in an elongated tubular shape is inserted into a body cavity of a living body.

[0063] The endoscope 9 includes the image pickup unit 1, 1A, or 1B that is disposed in a distal end portion 91A of the insertion portion 91. As already described, since the image pickup units 1, 1A, and 1B are easily manufactured, the endoscope 9 is easily manufactured.

[0064] Note that the three-dimensional wiring board including the recess H10 where the stacked device 20 is disposed may be formed by, for example, processing using a 3D printer or cutting processing, without being limited to the MID. The material of the three-dimensional wiring board is not limited to resin, but may be ceramics or glass epoxy.

[0065] The endoscope 9 is a flexible endoscope for medical use, but the endoscope of another embodiment may be an endoscope for industrial use, or a rigid endoscope including a rigid straight tube as the insertion portion.

[0066] The present invention is not limited to the aforementioned embodiments and the like, and various changes, modifications, and the like can be made within the scope without changing the gist of the present invention.

What is claimed is:

1. An electronic component device comprising:  
an electronic component including an external electrode;  
and  
a wiring board, wherein  
the wiring board has a first principal surface,  
the wiring board includes a bonding electrode and an alignment mark on the first principal surface,  
the external electrode of the electronic component is bonded to the bonding electrode, and  
on the first principal surface, an area of a region in which a first region where the bonding electrode is virtually moved in a predetermined first direction and the alignment mark are superimposed on each other is less than 50% of an area of the alignment mark.
2. The electronic component device according to claim 1, wherein  
the alignment mark is not superimposed on the first region.
3. The electronic component device according to claim 1, wherein  
the alignment mark is substantially identical in shape and size to the bonding electrode.
4. The electronic component device according to claim 1, wherein  
the alignment mark and the bonding electrode are in a substantially round shape.
5. The electronic component device according to claim 1, wherein a total of the area of the region in which the first region and the alignment mark are superposed on each other and an area of a region in which a second region where the bonding electrode is virtually moved in a second direction orthogonal to the first direction and the alignment mark are superposed on each other is less than 50% of the area of the alignment mark.

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