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(54) **MULTILAYER ELECTRONIC COMPONENT MANUFACTURING METHOD AND MULTILAYER ELECTRONIC COMPONENT**

(71) Applicant: **Murata Manufacturing Co., Ltd.**, Kyoto-fu (JP)

(72) Inventor: **Kaoru TACHIBANA**, Nagaokakyo-shi (JP)

(73) Assignee: **Murata Manufacturing Co., Ltd.**, Kyoto-fu (JP)

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(57) **ABSTRACT**

A multilayer electronic component manufacturing method includes forming a multilayer body including a plurality of ceramic layers, and forming a groove by removing a part of a bottom surface of the multilayer body. The method further includes segmenting the multilayer body by dividing the multilayer body into a plurality of chip regions, and forming an outer electrode conductor layer on the bottom surface of the multilayer body after formation of the groove and segmentation.

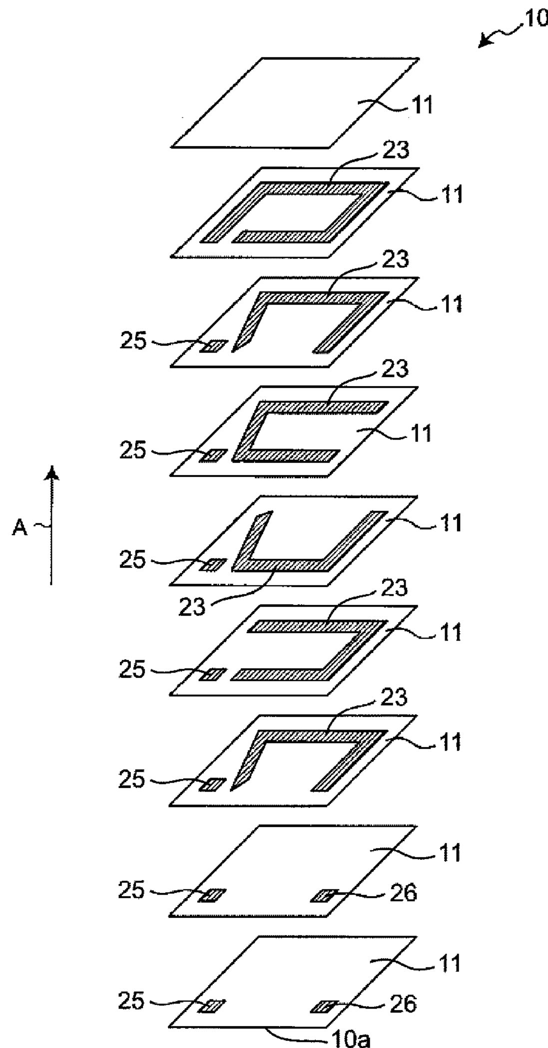


FIG. 1

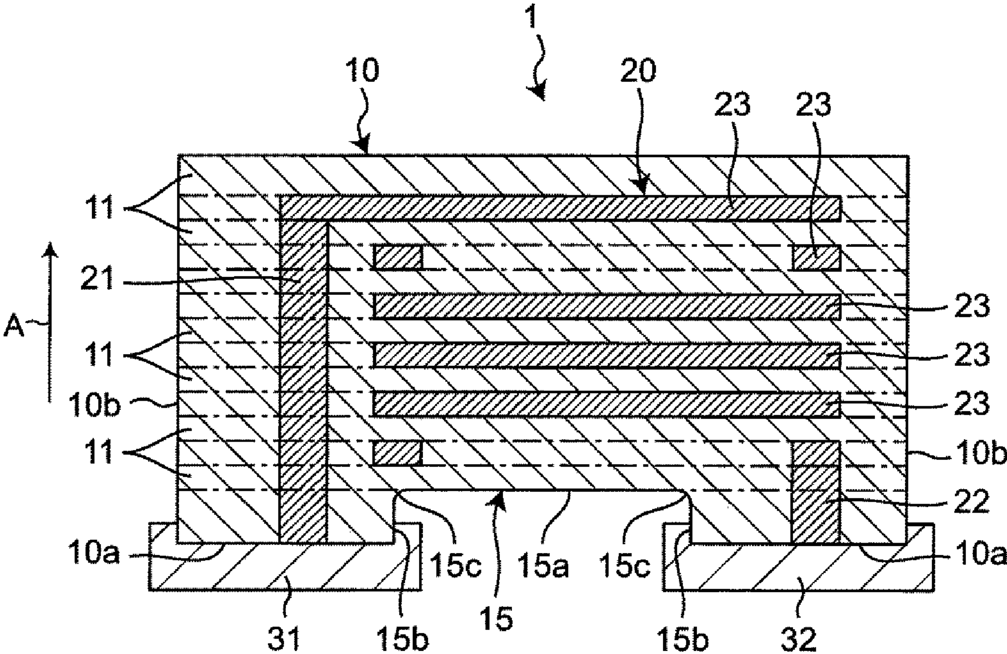


FIG. 2A

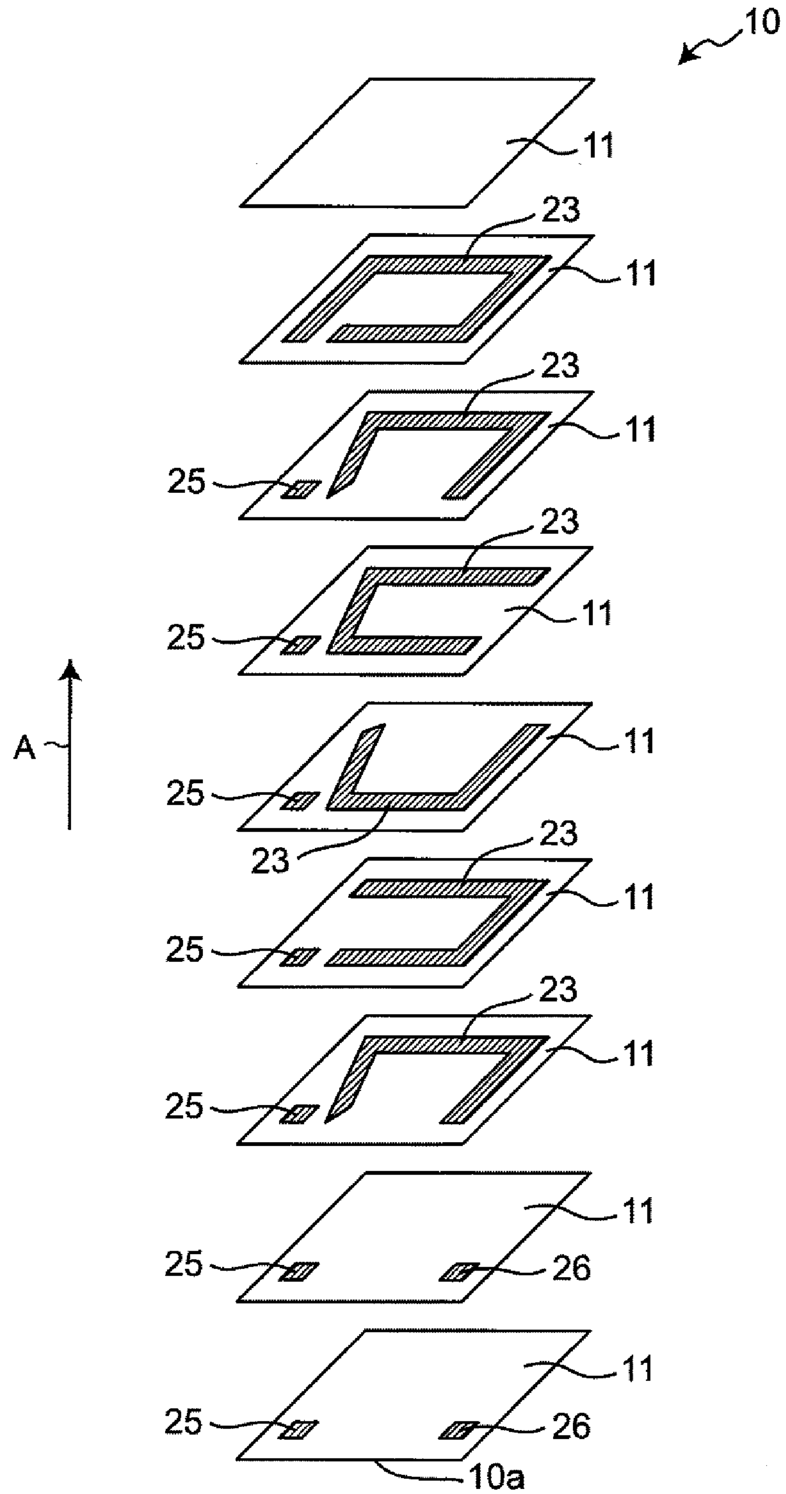


FIG. 2B

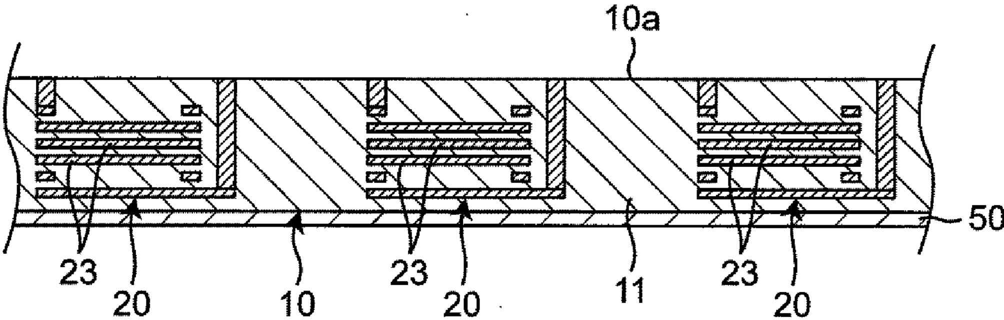


FIG. 2C

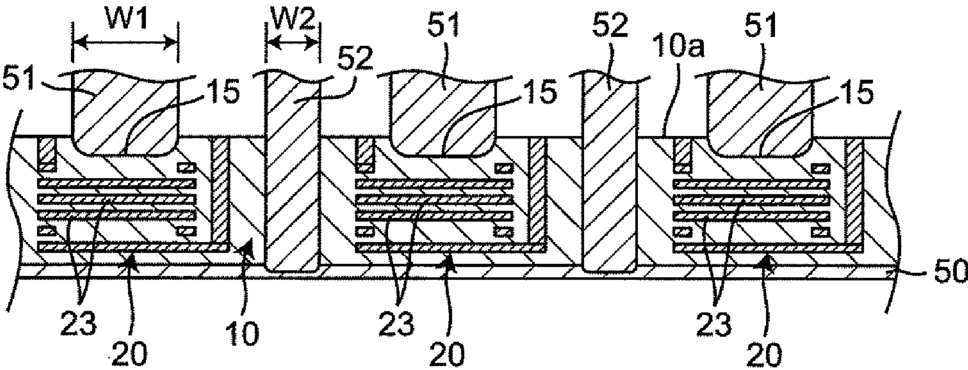


FIG. 2D

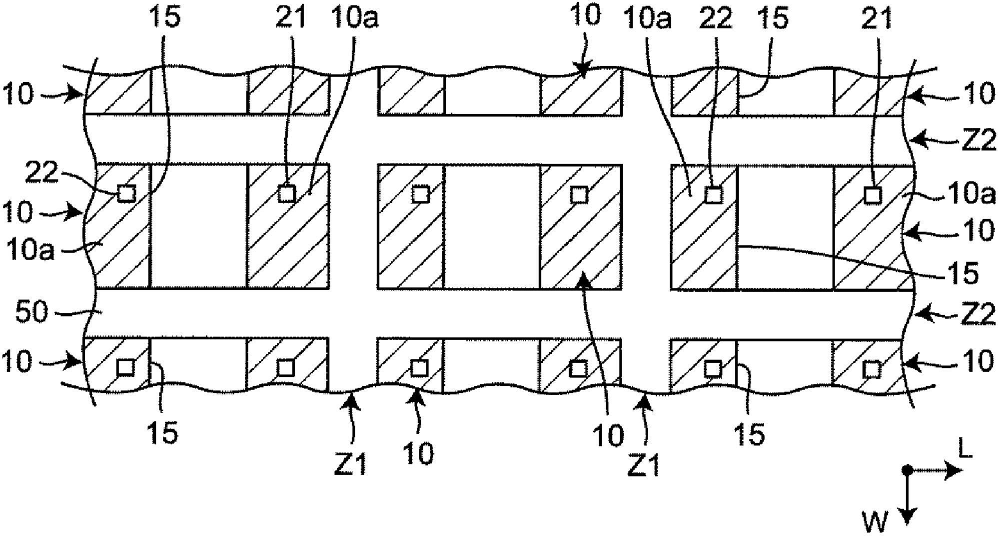


FIG. 2E

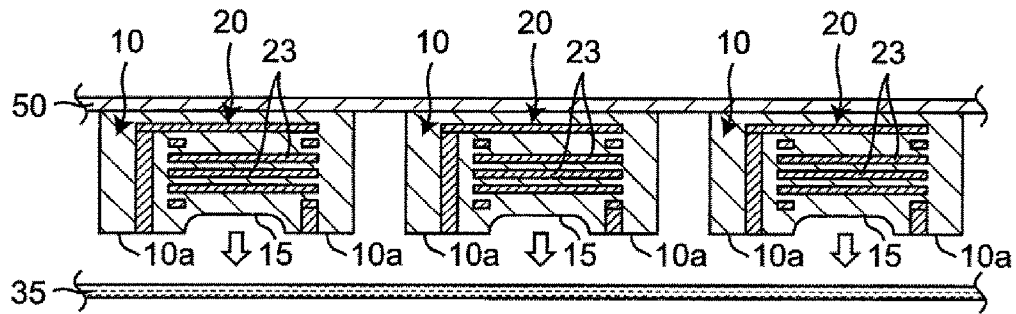


FIG. 2F

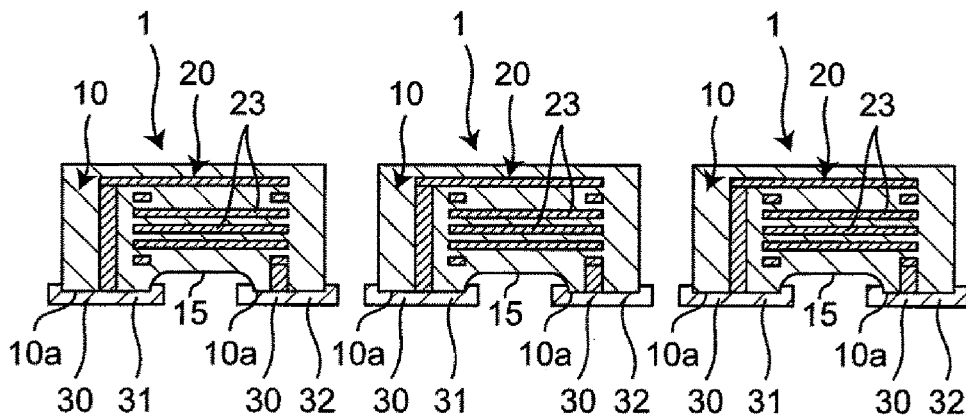


FIG. 3

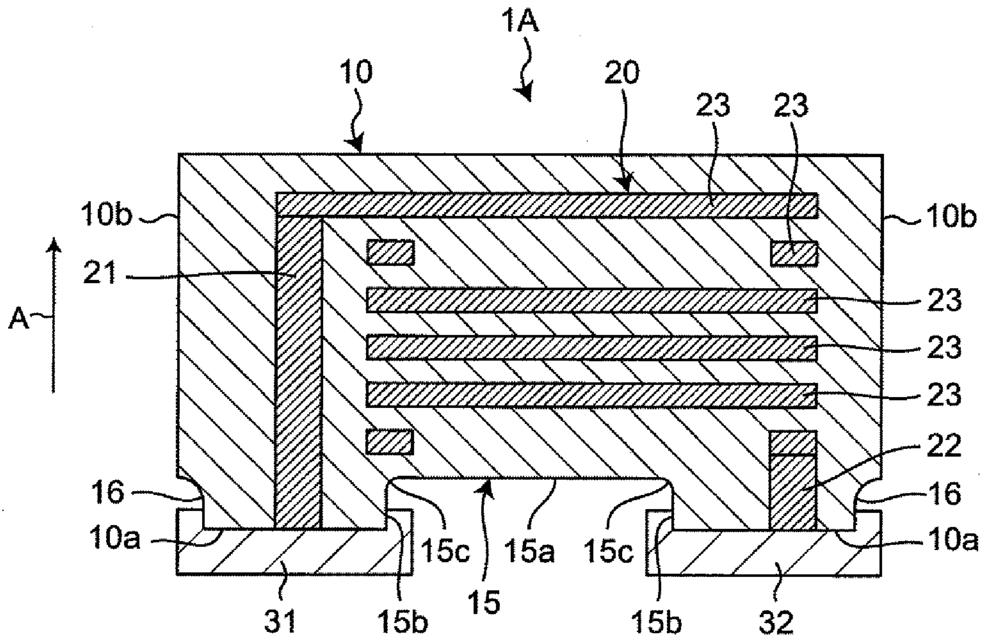


FIG. 4A

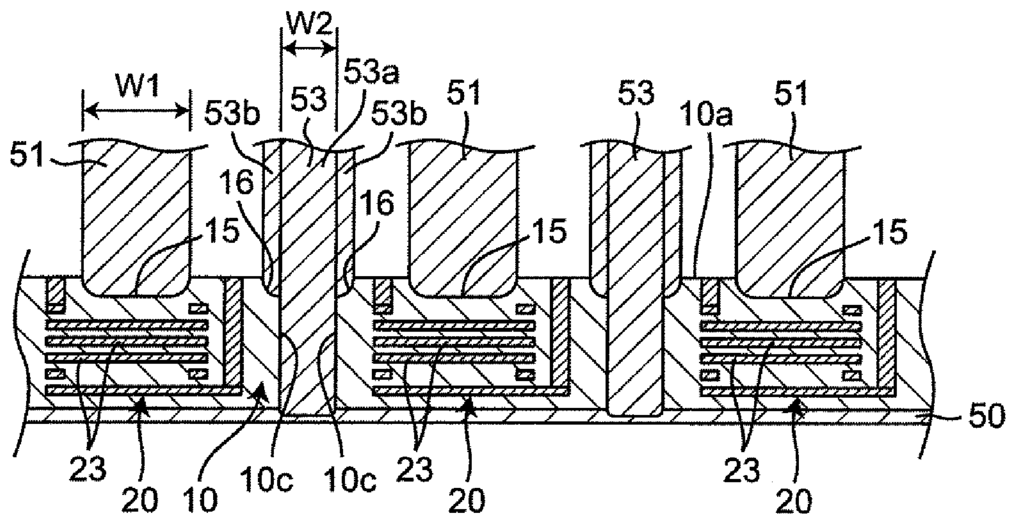


FIG. 4B

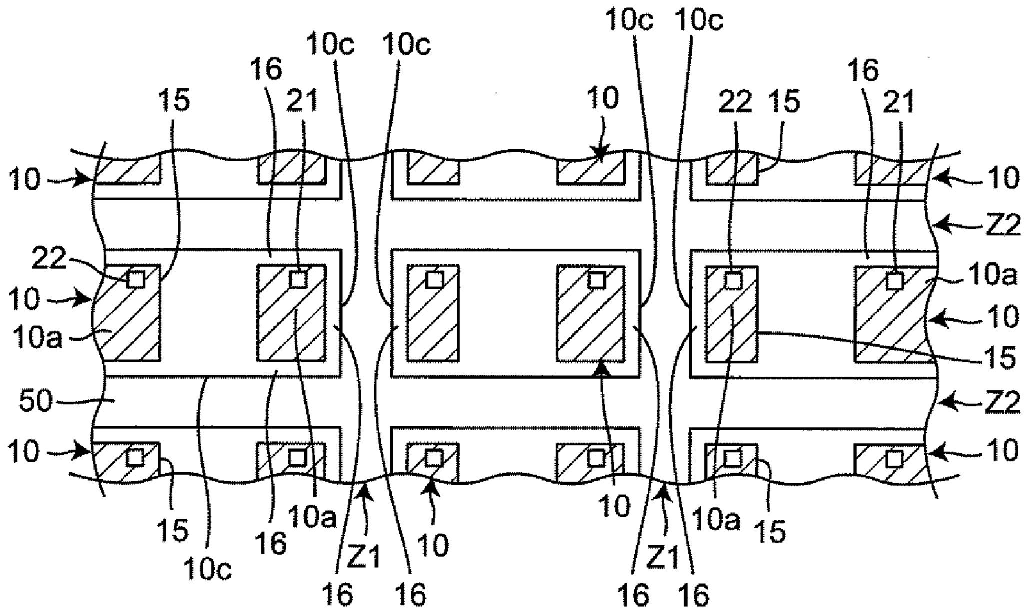


FIG. 5A

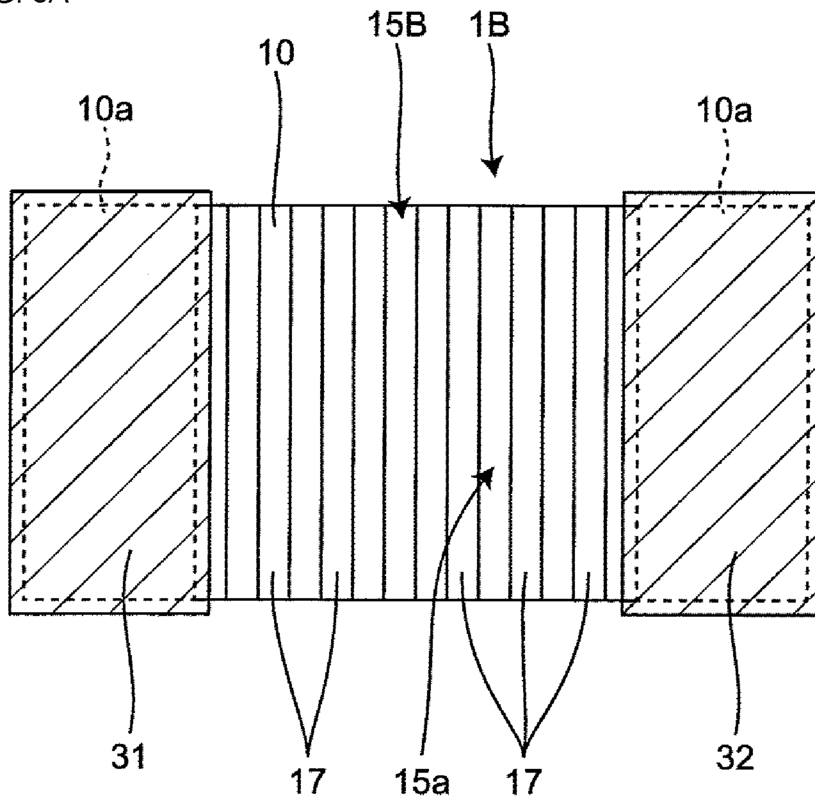


FIG. 5B

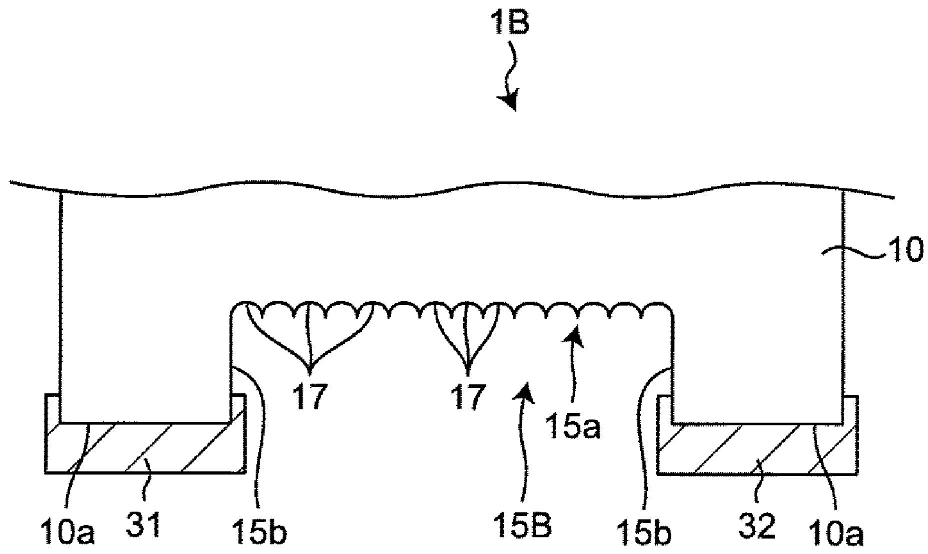


FIG. 6A

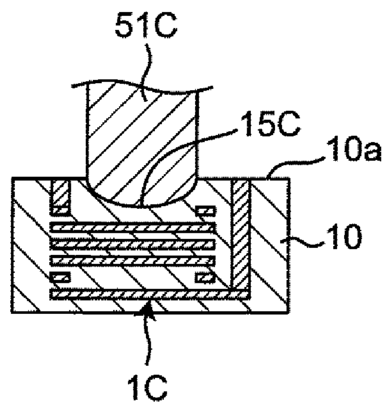


FIG. 6B

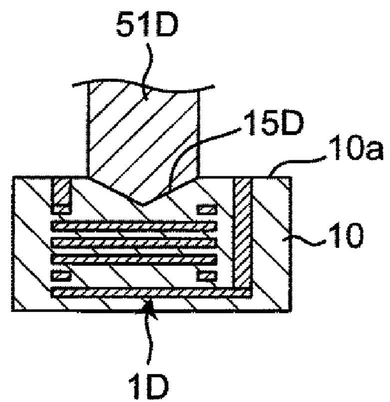
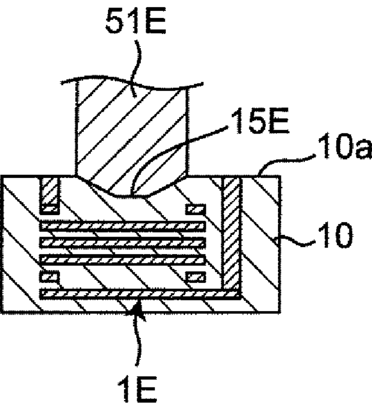


FIG. 6C



MULTILAYER ELECTRONIC COMPONENT MANUFACTURING METHOD AND MULTILAYER ELECTRONIC COMPONENT

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims benefit of priority to Japanese Patent Application No. 2016-255949, filed Dec. 28, 2016, the entire content of which is incorporated herein by reference.

BACKGROUND

Technical Field

[0002] The present disclosure relates to a multilayer electronic component manufacturing method and a multilayer electronic component.

Description of the Related Art

[0003] An existing multilayer electronic component has been disclosed in Japanese Patent No. 3351738. The multilayer electronic component includes a multilayer body, a coil that is provided in the multilayer body, and an outer electrode that is provided on the multilayer body and is electrically connected to the coil. In order to suppress stray capacitance that is generated between the outer electrode and the coil, the outer electrode having a predetermined shape is provided on a part of the bottom surface of the multilayer body.

[0004] When the existing multilayer electronic component is tried to be manufactured, it is considered that, in formation of the outer electrode, the upper surface side of the multilayer body is held and the outer electrode is formed by a dip method. The dip method is the easiest method with low cost. The dip method however has the problem that it is difficult to form the outer electrode having high dimensional accuracy on the part of the bottom surface of the multilayer body.

SUMMARY

[0005] Accordingly, the present disclosure provides a multilayer electronic component manufacturing method and a multilayer electronic component that enable an outer electrode having high dimensional accuracy to be formed on the bottom surface of a multilayer body at low cost.

[0006] A multilayer electronic component manufacturing method according to a preferred embodiment of the present disclosure includes forming a multilayer body including a plurality of ceramic layers; forming a groove by removing a part of a bottom surface of the multilayer body; segmenting the multilayer body by dividing the multilayer body into a plurality of chip regions; and forming an outer electrode conductor layer on the bottom surface of the multilayer body after formation of the groove and segmentation.

[0007] With the multilayer electronic component manufacturing method in the preferred embodiment of the present disclosure, the groove is formed by removing a part of the bottom surface of the multilayer body, the multilayer body is segmented by being divided into the plurality of chip regions, and then, the outer electrode conductor layer is formed on the bottom surface of the multilayer body. Therefore, the outer electrode having a predetermined shape can be formed. Accordingly, the outer electrode having high dimensional accuracy can be formed on the bottom surface of the multilayer body at low cost.

[0008] In one embodiment of the multilayer electronic component manufacturing method, in the forming of the groove, the groove is formed in a state in which a holding layer holds a surface of the multilayer body at an opposite side to the bottom surface, in the segmenting, the multilayer body is segmented in a state in which the holding layer holds the multilayer body, and in the forming of the outer electrode conductor layer, the outer electrode conductor layer is formed on the bottom surface of the multilayer body in the state in which the holding layer holds the multilayer body. With this embodiment, formation of the groove, segmentation, and formation of the outer electrode conductor layer can be performed in the state in which the holding layer holds the multilayer body so as to prevent the plurality of chips from scattering.

[0009] In another embodiment of the multilayer electronic component manufacturing method, in the forming of the groove, the groove can be easily formed by using the dicer blade.

[0010] In still another embodiment of the multilayer electronic component manufacturing method, in the segmenting, the multilayer body is segmented using a dicer blade. With this embodiment, in the segmenting, the dicer blade that is the same as or similar to that used in the forming of the groove can be used, thereby simplifying manufacturing.

[0011] In still another embodiment of the multilayer electronic component manufacturing method, the dicer blade that is used in the forming of the groove and the dicer blade that is used in the segmenting simultaneously perform scanning. Therefore, a manufacturing period of time can be reduced.

[0012] In still another embodiment of the multilayer electronic component manufacturing method, the forming of the groove is performed before the segmenting. Therefore, the groove can be formed while the multilayer body is held in a stable state and the groove can be formed at an accurate position.

[0013] In still another embodiment of the multilayer electronic component manufacturing method, a scanning direction of the dicer blade that is used in the segmenting includes two directions, and one direction of the two directions is the same direction as a scanning direction of the dicer blade that is used in the forming of the groove. Therefore, segmentation and formation of the groove can be performed without changing an orientation of the multilayer body.

[0014] In still another embodiment of the multilayer electronic component manufacturing method, the dicer blade that is used in the forming of the groove and the dicer blade that is used in the segmenting are positioned with reference to common cut marks provided on the multilayer body for scanning. With this embodiment, in the forming of the groove and the segmenting, dicer cutting is performed using the common cut marks. Therefore, cutting positions can be easily adjusted.

[0015] In still another embodiment of the multilayer electronic component manufacturing method, in the segmenting, the multilayer body is divided to form a divided surface on the multilayer body, and the method includes forming a cutout groove in a corner portion at which the bottom surface of the multilayer body and the outer surface (divided surface) of the multilayer body intersect with each other before the forming of the outer electrode conductor layer.

Accordingly, when the multilayer electronic component is mounted on a mounting substrate, if the outer electrode of the multilayer electronic component is bonded to the mounting substrate by solder, the solder wets up the cutout groove and the solder that protrudes to an outer side portion relative to the outer surface of the multilayer body can be reduced. With this configuration, the mounting area of the multilayer electronic component can be reduced.

[0016] In still another embodiment of the multilayer electronic component manufacturing method, a width W**2** of the dicer blade that is used in the segmenting is smaller than a width W**1** of the dicer blade that is used in the forming of the groove. Therefore, the width of segmentation can be decreased, thereby improving a yield.

[0017] In still another embodiment of the multilayer electronic component manufacturing method, a width W**1** of the dicer blade that is used in the forming of the groove and a width W**2** of the dicer blade that is used in the segmenting are the same. Therefore, the dicer blade can be commonly used in the forming of the groove and the segmenting.

[0018] A multilayer electronic component according to another preferred embodiment of the disclosure includes a multilayer body including a plurality of ceramic layers, and an outer electrode provided on the multilayer body, wherein a groove is provided in a bottom surface of the multilayer body, and the outer electrode is provided on the bottom surface of the multilayer body. Therefore, when the multilayer electronic component is mounted on a mounting substrate, if the outer electrode of the multilayer electronic component is bonded to the mounting substrate by solder, the solder wets up an inner surface of the groove and bonding strength of the multilayer electronic component is improved to make a posture of the multilayer electronic component stable.

[0019] In one embodiment of the multilayer electronic component, the outer electrode extends to an outer surface of the multilayer body at the bottom surface side and an inner surface of the groove at the bottom surface side. Therefore, when the multilayer electronic component is mounted on a mounting substrate, if the outer electrode of the multilayer electronic component is bonded to the mounting substrate by solder, the solder wets up the outer surface of the multilayer body and the inner surface of the groove while passing through the outer electrode and the bonding strength of the multilayer electronic component is further improved.

[0020] In another embodiment of the multilayer electronic component, an inner surface of the groove has a bottom surface, side surfaces, and connection portions that are formed into recessed curved surfaces between the bottom surface and the side surfaces. Therefore, stress concentration on the connection portions is dispersed to improve strength.

[0021] In still another embodiment of the multilayer electronic component, the multilayer body has a plurality of coil patterns provided between the plurality of ceramic layers, and the plurality of coil patterns are electrically connected to each other to configure a spiral coil. With this embodiment, the multilayer electronic component can be applied to an inductor component.

[0022] In still another embodiment of the multilayer electronic component, a lamination direction of the plurality of ceramic layers is a direction that is orthogonal to the bottom surface, and an axis of the spiral coil is orthogonal to the bottom surface. With this embodiment, the multilayer electronic component can be applied to a so-called, vertically laminated and vertically wound inductor component.

[0023] In still another embodiment of the multilayer electronic component, a lamination direction of the plurality of ceramic layers is a direction that is orthogonal to the bottom surface, and an axis of the spiral coil is in parallel with the bottom surface. With this embodiment, the multilayer electronic component can be applied to a so-called, vertically laminated and horizontally wound inductor component.

[0024] In still another embodiment of the multilayer electronic component, a cutout groove is provided in a corner portion at which the bottom surface of the multilayer body and an outer surface of the multilayer body intersect with each other. With this embodiment, when the multilayer electronic component is mounted on a mounting substrate, if the outer electrode of the multilayer electronic component is bonded to the mounting substrate by solder, the solder wets up the cutout groove and the solder that protrudes to an outer side portion relative to the outer surface of the multilayer body can be reduced. With this configuration, the mounting area of the multilayer electronic component can be reduced.

[0025] In still another embodiment of the multilayer electronic component, the bottom surface of the groove has a plurality of recess portions extending along an extension direction of the groove. With this embodiment, when the multilayer electronic component is manufactured, the groove can be formed by forming the plurality of recess portions with a dicer blade while the width of the dicer blade that is used for forming the groove is made smaller than the width of the groove. Accordingly, the dicer blade having a small width can be used.

[0026] Other features, elements, characteristics and advantages of the present disclosure will become more apparent from the following detailed description of preferred embodiments of the present disclosure with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] FIG. **1** is a cross-sectional view illustrating a first embodiment of a multilayer electronic component according to the present disclosure;

[0028] FIG. **2**A is a perspective view illustrating the first embodiment of a multilayer electronic component manufacturing method in the present disclosure;

[0029] FIG. **2**B is a cross-sectional view illustrating the first embodiment of the multilayer electronic component manufacturing method in the present disclosure;

[0030] FIG. **2**C is a cross-sectional view illustrating the first embodiment of the multilayer electronic component manufacturing method in the present disclosure;

[0031] FIG. **2**D is a plan view illustrating the first embodiment of the multilayer electronic component manufacturing method in the present disclosure;

[0032] FIG. **2**E is a cross-sectional view illustrating the first embodiment of the multilayer electronic component manufacturing method in the present disclosure;

[0033] FIG. **2**F is a plan view illustrating the first embodiment of the multilayer electronic component manufacturing method in the present disclosure;

[0034] FIG. **3** is a cross-sectional view illustrating a second embodiment of a multilayer electronic component according to the present disclosure;

[0035] FIG. **4**A is a perspective view illustrating the second embodiment of a multilayer electronic component manufacturing method in the present disclosure;

[0036] FIG. **4**B is a cross-sectional view illustrating the second embodiment of the multilayer electronic component manufacturing method in the present disclosure;

[0037] FIG. **5**A is a bottom view illustrating a third embodiment of a multilayer electronic component according to the present disclosure;

[0038] FIG. **5**B is a side view illustrating the third embodiment of the multilayer electronic component in the present disclosure;

[0039] FIG. **6**A is a cross-sectional view illustrating another shape of a groove of the multilayer electronic component;

[0040] FIG. **6**B is a cross-sectional view illustrating still another shape of the groove of the multilayer electronic component; and

[0041] FIG. **6**C is a cross-sectional view illustrating still another shape of the groove of the multilayer electronic component.

DETAILED DESCRIPTION

[0042] Hereinafter, the present disclosure will be described more in detail using embodiments in the drawings.

First Embodiment

[0043] FIG. **1** is a cross-sectional view illustrating a first embodiment of a multilayer electronic component according to the present disclosure. As illustrated in FIG. **1**, a multilayer electronic component **1** includes a multilayer body **10** and outer electrodes **31** and **32** provided on the multilayer body **10**. The multilayer body **10** includes therein a spiral coil **20**. The outer electrodes **31** and **32** are electrically connected to the coil **20**. The multilayer electronic component **1** is an inductor component.

[0044] The multilayer electronic component **1** is electrically connected to wirings of a circuit substrate (not illustrated) with the outer electrodes **31** and **32**. The multilayer electronic component **1** is used as, for example, a noise removal filter, and is used for electronic apparatuses such as a personal computer, a DVD (digital versatile disk) player, a digital camera, a TV (television), a cellular phone, and an automotive electronic device.

[0045] The multilayer body **10** is configured by laminating a plurality of ceramic layers **11**. The ceramic layers **11** are made of, for example, a magnetic material such as ferrite. The multilayer body **10** is formed to have a substantially rectangular parallelepiped shape. A lamination direction A of the plurality of ceramic layers **11** is a direction that is orthogonal to a bottom surface **10***a* of the multilayer body **10**. The bottom surface **10***a* of the multilayer body **10** is a surface with which the multilayer electronic component **1** is mounted on a mounting substrate. In FIG. **1**, a direction from the front side of a paper plane toward the back side is a width direction of the multilayer body **10** and a right-left direction of the paper plane is a lengthwise direction of the multilayer body **10**.

[0046] A groove **15** is provided in the bottom surface **10***a* of the multilayer body **10**. The groove **15** extends in the width direction of the multilayer body **10** and is provided at a center portion of the multilayer body **10** in the lengthwise direction. The bottom surface **10***a* is divided into both sides of the width direction with the groove **15** interposed therebetween. In other words, the multilayer body **10** includes a leg portion at each of the sides of the width direction.

[0047] The inner surface of the groove **15** has a bottom surface **15***a*, side surfaces **15***b*, and connection portions **15***c* between the bottom surface **15***a* and the side surfaces **15***b*. The inner surface of the groove **15** is formed to have a substantially rectangular shape. The bottom surface **15***a* and the side surfaces **15***b* are respectively formed to be substantially flat. The connection portions **15***c* are formed into recessed curved surfaces. With the connection portions **15***c* formed into the recessed curved surfaces, stress concentration on the connection portions **15***c* is dispersed to improve strength.

[0048] The outer electrodes **31** and **32** are provided on the bottom surface **10***a* of the multilayer body **10**. That is to say, the first outer electrode **31** is provided on the bottom surface **10***a* (leg portion) at one side of the width direction and the second outer electrode **32** is provided on the bottom surface **10***a* (leg portion) at the other side of the width direction.

[0049] Furthermore, the outer electrodes **31** and **32** extend to outer side portions of the peripheral edge of the bottom surface **10***a*. That is to say, the outer electrodes **31** and **32** extend to the outer surfaces **10***b* of the multilayer body **10** at the bottom surface **10***a* side and to the inner surface (side surfaces **15***b*) of the groove **15** at the bottom surface **10***a* side.

[0050] The coil **20** includes a plurality of coil patterns **23** provided between the plurality of ceramic layers **11**. The plurality of coil patterns **23** are electrically connected to each other with via conductors (not illustrated) interposed therebetween to configure the spiral coil **20**. An axis of the coil **20** is orthogonal to the bottom surface **10***a* and is identical to the lamination direction of the ceramic layers **11**. That is to say, the multilayer electronic component **1** is a so-called, vertically laminated and vertically wound inductor component.

[0051] A first extended conductor **21** and a second extended conductor **22** are respectively provided at both ends of the coil **20**. The first extended conductor **21** is exposed from the bottom surface **10***a* at one side of the width direction and makes contact with the first outer electrode **31**. The second extended conductor **22** is exposed from the bottom surface **10***a* at the other side of the width direction and makes contact with the second outer electrode **32**.

[0052] With the multilayer electronic component **1**, the outer electrodes **31** and **32** are provided on the bottom surface **10***a* of the multilayer body **10**. Therefore, when the multilayer electronic component **1** is mounted on a mounting substrate (not illustrated), if the outer electrodes **31** and **32** of the multilayer electronic component **1** are bonded to the mounting substrate by solder, the solder wets up the inner surface of the grooves **15** and bonding strength of the multilayer electronic component **1** is improved to make a posture of the multilayer electronic component **1** stable.

[0053] Moreover, the outer electrodes **31** and **32** extend to the outer surfaces **10***b* of the multilayer body **10** at the bottom surface **10***a* side and to the inner surface of the groove **15** at the bottom surface **10***a* side. With the outer electrodes **31** and **32**, when the multilayer electronic component **1** is mounted on the mounting substrate, if the outer electrodes **31** and **32** of the multilayer electronic component **1** are bonded to the mounting substrate by the solder, the solder wets up the outer surfaces **10***b* of the multilayer body

10 and the inner surface of the groove **15** while passing through the outer electrodes **31** and **32** and the bonding strength of the multilayer electronic component **1** is further improved.

[0054] Next, a method for manufacturing the multilayer electronic component **1** will be described.

[0055] As illustrated in FIG. **2**A, the multilayer body **10** including the plurality of ceramic layers **11** is formed. As is described in detail, the coil patterns **23** are formed on green sheets forming the predetermined ceramic layers **11** using screen printing or the like. Furthermore, through-holes are formed in green sheets forming the predetermined ceramic layers **11** using laser or the like and first extended conductor layers **25** and second extended conductor layers **26** are formed in the through-holes together with the coil patterns **23**. The first extended conductor layers **25** configure the first extended conductor **21** and the second extended conductor layers **26** configure the second extended conductor **22**. In FIG. **2**A, the coil patterns **23**, the first extended conductor layers **25**, and the second extended conductor layers **26** are hatched for illustration.

[0056] Then, all of the green sheets forming the ceramic layers **11** are laminated in the lamination direction A and are pressure-bonded to form the multilayer body **10** that is unbaked. In FIG. **2**A, the bottom surface **10***a* of the multilayer body **10** is located at the lower side for illustration. Although FIG. **2**A illustrates only a single chip for facilitating understanding, in practice, the single chips are arranged in a manner adjacent to one another to configure a plurality of chips as illustrated in FIG. **2**B.

[0057] Thereafter, as illustrated in FIG. **2**B, a holding sheet **50** as an example of a holding layer is bonded to the surface of the multilayer body **10** at the opposite side to the bottom surface **10***a*. The holding sheet **50** is removed in, for example, a baking process, which will be described later. In FIG. **2**B, the bottom surface **10***a* of the multilayer body **10** is located at the upper side for illustration.

[0058] After that, as illustrated in FIG. **2**C, the grooves **15** are formed by removing some parts of the bottom surface **10***a* of the multilayer body **10** (hereinafter, referred to as a groove formation process). Furthermore, the multilayer body **10** is segmented by being divided into a plurality of chip regions (hereinafter, referred to as a segmentation process). With these processes, as illustrated in a plan view of FIG. **2**D, the plurality of multilayer bodies **10** having the bottom surfaces **10***a* of predetermined shapes are formed. In FIG. **2**D, the bottom surfaces **10***a* are hatched for illustration.

[0059] As is described in detail, in the groove formation process, the grooves **15** are formed using groove dicer blades **51**. In the segmentation process, the multilayer body **10** is segmented using segmentation dicer blades **52**. A width W**2** of the segmentation dicer blades **52** is smaller than a width W**1** of the groove dicer blades **51**. The groove dicer blades **51** and the segmentation dicer blades **52** simultaneously perform scanning. Regions removed by the segmentation dicer blades **52** are assumed to removal regions Z**1** and Z**2** in FIG. **2**D.

[0060] In this case, the scanning direction of the segmentation dicer blades **52** includes two directions along the bottom surface **10***a* of the multilayer body **10**. In the embodiment, the two directions are the width direction W and the lengthwise direction L of the multilayer body **10**. The first removal regions Z**1** are formed by scanning in the width direction W by the segmentation dicer blades **52**. The second removal regions Z**2** are formed by scanning in the lengthwise direction L by the segmentation dicer blades **52**.

[0061] The width direction W as one of the two scanning directions of the segmentation dicer blades **52** is the same direction as the scanning direction of the groove dicer blades **51**. That is to say, the segmentation dicer blades **52** perform scanning in the width direction W whereas the groove dicer blades **51** perform scanning in the width direction W. With this scanning manner, formation of the grooves and the segmentation can be performed without changing an orientation of the multilayer body **10**. After the segmentation dicer blades **52** perform scanning in the width direction W, they perform scanning in the lengthwise direction L. Alternatively, after the segmentation dicer blades **52** perform scanning in the lengthwise direction L, they may perform scanning in the width direction W.

[0062] In the groove formation process and the segmentation process, the holding sheet **50** holds the surface of the multilayer body **10** at the opposite side to the bottom surface **10***a*. The holding sheet **50** can fix the plurality of chips so as to prevent them from scattering when the multilayer body **10** is segmented into the plurality of chips.

[0063] In the groove formation process and the segmentation process, the groove dicer blades **51** and the segmentation dicer blades **52** may be positioned with reference to common cut marks provided on the multilayer body for scanning. Cutting positions can therefore be easily adjusted. The cut marks are formed on the bottom surface of the multilayer body using, for example, screen printing or the like. This formation manner enables the cut marks to be easily recognized. It should be noted that the cut marks may be formed on the side surfaces of the multilayer body or in the multilayer body.

[0064] As illustrated in FIG. **2**E, after the formation of the grooves **15** and the segmentation, outer electrode pastes **35** are applied to the bottom surfaces **10***a* of the multilayer bodies **10** by a dip method to form outer electrode conductor layers **30** on the bottom surfaces **10***a* of the multilayer bodies **10**, as illustrated in FIG. **2**F. The outer electrode conductor layers configure the outer electrodes **31** and **32**. In this case, the outer electrode conductor layers **30** are formed in the state in which the holding sheet **50** holds the multilayer bodies **10**. Therefore, the outer electrode conductor layers **30** can be formed in the state in which the holding layer **50** holds the multilayer bodies **10** so as to prevent the plurality of chips from scattering.

[0065] Thereafter, the plurality of segmented chips are baked to manufacture the plurality of multilayer electronic components **1**. It should be noted that the baking process may be performed before the groove formation process and the segmentation process. In this case, a holding sheet that is used in the groove formation process and the segmentation process before the baking process and a holding sheet that is used in the formation process of the outer electrode conductor layers after the baking process may be made different from each other.

[0066] With the method for manufacturing the multilayer electronic component **1**, the grooves **15** are formed by removing some parts of the bottom surface **10***a* of the multilayer body **10**, the multilayer body **10** is segmented by being divided into the plurality of chip regions, and then, the outer electrode conductor layers **30** are formed on the bottom surfaces **10***a* of the multilayer bodies **10**. Therefore,

the formation of the grooves **15** and the segmentation can be easily performed accurately and the outer electrodes **31** and **32** having the predetermined shapes can be formed. Accordingly, the outer electrodes **31** and **32** having high dimensional accuracy can be formed on the bottom surfaces **10***a* of the multilayer bodies **10** at low cost.

[0067] The groove **15** are formed by removing some parts of the bottom surface **10***a* of the multilayer body **10**. Therefore, when each multilayer electronic component **1** is mounted on the mounting substrate, if the outer electrodes **31** and **32** of the multilayer electronic component **1** are bonded to the mounting substrate by the solder, the solder can wet up the inner surface of the groove **15** of the multilayer body **10**. The bonding strength of the multilayer electronic component **1** is therefore improved to make the posture of the multilayer electronic component **1** stable.

[0068] In the groove formation process, the grooves **15** are formed using the groove dicer blades **51**. Therefore, the grooves **15** can be easily formed. In the segmentation process, the multilayer body **10** is segmented using the segmentation dicer blades **52**. This enables the dicer blades that are the same as or similar to those used in the groove formation process to be used, thereby simplifying manufacturing.

[0069] The groove dicer blades **51** and the segmentation dicer blades **52** simultaneously perform scanning and a manufacturing period of time can therefore be reduced. Furthermore, the width W**2** of the segmentation dicer blades is smaller than the width W**1** of the groove dicer blades. Therefore, the width of the segmentation can be decreased, thereby improving a yield.

[0070] The groove formation process may be performed before the segmentation process. In this case, the grooves can be formed while the multilayer body is held in a stable state and the grooves can be formed at accurate positions. Alternatively, the groove formation process may be performed after the segmentation process.

[0071] The scanning direction of the segmentation dicer blades may include two directions along the bottom surface of the multilayer body. In this case, one direction of the two directions is the same direction as the scanning direction of the dicer blades that are used in the groove formation process. The two directions may not be orthogonal to each other.

[0072] The groove dicer blades and the segmentation dicer blades may be provided so as to correspond to all of the grooves and the removal regions or at least one pair of the groove dicer blade and the segmentation dicer blade may be provided and moved in turn.

[0073] In the segmentation process, the segmentation may be performed using hand push processing.

[0074] The multilayer electronic component may be applied to a so-called, vertically laminated and horizontally wound inductor component. As is described in detail, the lamination direction of the plurality of ceramic layers is a direction that is orthogonal to the bottom surface and an axis of the spiral coil is in parallel with the bottom surface. The vertically laminated and horizontally wound inductor component is disclosed in, for example, Japanese Unexamined Patent Application Publication No. 2006-130724.

[0075] The outer electrodes may be provided on only the bottom surface of the multilayer body. In this case, the outer electrode conductor layers are formed on the bottom surfaces of the multilayer bodies using, for example, screen printing or the like.

Second Embodiment

[0076] FIG. **3** is a cross-sectional view illustrating a second embodiment of a multilayer electronic component according to the present disclosure. The second embodiment is different from the first embodiment in the point that cutout grooves are provided. The different configuration will be described below. In the second embodiment, the same reference numerals as those in the first embodiment denote the same components as those in the first embodiment and description thereof is omitted.

[0077] As illustrated in FIG. **3**, in a multilayer electronic component **1**A, cutout grooves **16** are provided in corner portions at which the bottom surface **10***a* of the multilayer body **10** and the outer surfaces **10***b* of the multilayer body **10** intersect with each other. The depth of the cutout grooves **16** is substantially the same as the depth of the groove **15**.

[0078] With the above-described multilayer electronic component **1**A, when the multilayer electronic component **1**A is mounted on a mounting substrate, if the outer electrodes **31** and **32** of the multilayer electronic component **1**A are bonded to the mounting substrate by solder, the solder wets up the cutout grooves **16** and the solder that protrudes to outer side portions relative to the outer surfaces **10***b* of the multilayer body **10** can be reduced. In particular, when the outer electrodes **31** and **32** are also provided in the cutout grooves **16**, the solder wets up the cutout grooves **16** after passing through the outer electrodes **31** and **32** and the solder that protrudes to the outer side portions relative to the outer surfaces **10***b* can be reduced. With this configuration, the mounting area of the multilayer electronic component **1**A can be reduced.

[0079] Next, a method for manufacturing the multilayer electronic component **1**A will be described.

[0080] The manufacturing method is different from the manufacturing method in the first embodiment in the point that a process (hereinafter, referred to as a cutout groove formation process) of forming the cutout grooves **16** is added before the process of forming the outer electrode conductor layers **30**. It should be noted that other processes are the same as those in the manufacturing method in the first embodiment and description thereof is omitted.

[0081] The groove formation process, the segmentation process, and the cutout groove formation process are performed as illustrated in FIG. **4**A to form the plurality of multilayer electronic components **1**A as illustrated in a plan view in FIG. **4**B.

[0082] As is described in detail, in the segmentation process, the integrated multilayer body **10** is divided to form divided surfaces **10***c* on the individual multilayer bodies **10**. The divided surfaces **10***c* are identical to the outer surfaces **10***b* of the multilayer electronic components **1**A. In the cutout groove formation process, the cutout grooves **16** are formed in the corner portions at which the bottom surfaces **10***a* of the multilayer bodies **10** and the divided surfaces **10***c* of the multilayer bodies **10** intersect with each other.

[0083] Dicer blades are used in the groove formation process, the segmentation process, and the cutout groove formation process. The groove dicer blades **51** are used in the groove formation process, and segmentation and cutout groove dicer blades **53** are used in the segmentation process

and the cutout groove formation process. The segmentation and cutout groove dicer blades **53** include segmentation blade portions **53***a* and cutout groove blade portions **53***b*.

[0084] The groove dicer blades **51** and the segmentation and cut dicer blades **53** simultaneously perform scanning. That is to say, the grooves **15** are formed using the groove dicer blades **51** whereas segmentation and formation of the divided surfaces **10***c* are performed using the segmentation blade portions **53***a* and the cutout grooves **16** are formed using the cutout groove blade portions **53***b*. The regions removed by the segmentation blade portions **53***a* are assumed to the removal regions Z**1** and Z**2** in FIG. **4**B.

[0085] The cutout grooves **16** are formed along the removal regions Z**1** and Z**2** (divided surfaces **10***c*). A cut depth in the multilayer bodies **10** by the cutout groove blade portions **53***b* is substantially the same as a cut depth in the multilayer body **10** by the groove dicer blades **51**. The width W**2** of the segmentation dicer blades **53***a* is smaller than the width W**1** of the groove dicer blades **51**. In FIG. **4**B, the bottom surfaces **10***a* are hatched for illustration.

[0086] With the method for manufacturing the multilayer electronic component **1**A, the multilayer electronic component **1**A in which the cutout grooves **16** are formed in the corner portions at which the bottom surface **10***a* of the multilayer body **10** and the outer surfaces **10***b* (divided surfaces) of the multilayer body **10** intersect with each other can be manufactured. Accordingly, when the multilayer electronic component **1**A is mounted on a mounting substrate, if the outer electrodes **31** and **32** of the multilayer electronic component **1**A are bonded to the mounting substrate by solder, the solder wets up the cutout grooves **16** and the solder that protrudes to outer side portions relative to the outer surfaces **10***b* of the multilayer body **10** can be reduced. With this configuration, the mounting area of the multilayer electronic component **1**A can be reduced.

[0087] It should be noted that the cutout groove formation process and the segmentation process may be separately performed. That is to say, the cutout groove formation process is performed before or after the segmentation process. In this case, dicer blades that are used in the cutout groove formation process and dicer blades that are used in the segmentation process can be made different from each other.

Third Embodiment

[0088] FIG. **5**A is a bottom view illustrating a third embodiment of a multilayer electronic component according to the present disclosure. FIG. **5**B is a side view illustrating the third embodiment of the multilayer electronic component in the present disclosure. The third embodiment is different from the first embodiment in a shape of the bottom surface of the groove of the multilayer body. The different configuration will be described below. In the third embodiment, the same reference numerals as those in the first embodiment denote the same components as those in the first embodiment and description thereof is omitted.

[0089] As illustrated in FIG. **5**A and FIG. **5**B, a multilayer electronic component **1**B has a plurality of recess portions **17** extending along an extension direction of a groove **15**B of the multilayer body **10** in a bottom surface **15***a* of the groove **15**B. The plurality of recess portions **17** are aligned along the width direction of the groove **15**B. In other words, linear projections extending along the extension direction of the groove **15**B are provided between the adjacent recess portions **17** on the bottom surface **15***a* of the groove **15**B. In FIG. **5**A and FIG. **5**B, the outer electrodes **31** and **32** are hatched for illustration.

[0090] With the multilayer electronic component **1**B, when the multilayer electronic component **1**B is manufactured, the groove **15**B can be formed by forming the plurality of recess portions **17**B with a dicer blade while the width of the dicer blade that is used for forming the groove **15**B is made smaller than the width of the groove **15**B. Accordingly, the dicer blade having a small width can be used.

[0091] In a method for manufacturing the multilayer electronic component **1**B, the width W**1** of the dicer blades that are used in the groove formation process and the width W**2** of the dicer blades that are used in the segmentation process may be the same. With this, the dicer blades can be commonly used in the groove formation process and the segmentation process.

[0092] The present disclosure is not limited to the above-described embodiments and design can be changed in a range without departing from the gist of the present disclosure. For example, characteristic points in the first to third embodiments may be variously combined.

[0093] Although the multilayer electronic component is the inductor component in the above-described embodiments, it may be a capacitor component or a resistor component. Although the multilayer body includes the coil, it may include only the ceramic layers.

[0094] Although the inner surface of the groove of the multilayer body has the substantially rectangular shape in the above-described embodiments, the shape is not limited thereto. For example, as illustrated in FIG. **6**A, the shape of a groove **15**C of the multilayer body **10** in a multilayer electronic component **1**C may be formed into a recessed curved surface that is continuously curved. That is to say, the shape of a front end of a groove dicer blade **51**C is formed into a projecting curved surface that is continuously curved. As illustrated in FIG. **6**B, a groove **15**D of the multilayer body **10** in a multilayer electronic component **1**D may be formed into a V shape. That is to say, a front end of a groove dicer blade **51**D is formed into a V shape. As illustrated in FIG. **6**C, a groove **15**E of the multilayer body **10** in a multilayer electronic component **1**E may be formed into an inverted trapezoid shape. That is to say, a front end of a groove dicer blade **51**E is formed into an inverted trapezoid shape.

[0095] Although the two outer electrodes are provided on the multilayer electronic component in the above-described embodiments, equal to or more than four outer electrodes may be provided.

[0096] While preferred embodiments of the disclosure have been described above, it is to be understood that variations and modifications will be apparent to those skilled in the art without departing from the scope and spirit of the disclosure. The scope of the disclosure, therefore, is to be determined solely by the following claims.

What is claimed is:

1. A multilayer electronic component manufacturing method comprising:

forming a multilayer body including a plurality of ceramic layers;

forming a groove by removing a part of a bottom surface of the multilayer body;

segmenting the multilayer body by dividing the multilayer body into a plurality of chip regions; and

forming an outer electrode conductor layer on the bottom surface of the multilayer body after formation of the groove and segmentation.

2. The multilayer electronic component manufacturing method according to claim **1**,

wherein in the forming of the groove, the groove is formed in a state in which a holding layer holds a surface of the multilayer body at an opposite side to the bottom surface;

in the segmenting, the multilayer body is segmented in a state in which the holding layer holds the multilayer body; and

in the forming of the outer electrode conductor layer, the outer electrode conductor layer is formed on the bottom surface of the multilayer body in the state in which the holding layer holds the multilayer body.

3. The multilayer electronic component manufacturing method according to claim **1**, wherein in the forming of the groove, the groove is formed using a dicer blade.

4. The multilayer electronic component manufacturing method according to claim **3**, wherein in the segmenting, the multilayer body is segmented using a dicer blade.

5. The multilayer electronic component manufacturing method according to claim **4**, wherein the dicer blade that is used in the forming of the groove and the dicer blade that is used in the segmenting simultaneously perform scanning.

6. The multilayer electronic component manufacturing method according to claim **1**, wherein the forming of the groove is performed before the segmenting.

7. The multilayer electronic component manufacturing method according to claim **4**,

wherein a scanning direction of the dicer blade that is used in the segmenting includes two directions; and

one direction of the two directions is the same direction as a scanning direction of the dicer blade that is used in the forming of the groove.

8. The multilayer electronic component manufacturing method according to claim **4**, wherein the dicer blade that is used in the forming of the groove and the dicer blade that is used in the segmenting are positioned with reference to common cut marks provided on the multilayer body for scanning.

9. The multilayer electronic component manufacturing method according to claim **1**,

wherein in the segmenting, the multilayer body is divided to form a divided surface on the multilayer body; and

the method includes forming a cutout groove in a corner portion at which the bottom surface of the multilayer body and the divided surface of the multilayer body intersect with each other before the forming of the outer electrode conductor layer.

10. The multilayer electronic component manufacturing method according to claim **4**, wherein a width W**2** of the dicer blade that is used in the segmenting is smaller than a width W**1** of the dicer blade that is used in the forming of the groove.

11. The multilayer electronic component manufacturing method according to claim **4**, wherein a width W**1** of the dicer blade that is used in the forming of the groove and a width W**2** of the dicer blade that is used in the segmenting are the same.

12. A multilayer electronic component comprising:

a multilayer body including a plurality of ceramic layers, and a groove is provided in a bottom surface of the multilayer body; and

an outer electrode provided on the bottom surface of the multilayer body, with a portion of the outer electrode extending into an inner surface of the groove at the bottom surface.

13. The multilayer electronic component according to claim **12**,

wherein the outer electrode extends to an outer surface of the multilayer body at the bottom surface.

14. The multilayer electronic component according to claim **12**, wherein the inner surface of the groove has a bottom surface, side surfaces, and connection portions that are formed into recessed curved surfaces between the bottom surface and the side surfaces.

15. The multilayer electronic component according to claim **12**,

wherein the multilayer body has a plurality of coil patterns provided between the plurality of ceramic layers; and

the plurality of coil patterns are electrically connected to each other to configure a spiral coil.

16. The multilayer electronic component according to claim **15**,

wherein a lamination direction of the plurality of ceramic layers is a direction that is orthogonal to the bottom surface of the multilayer body; and

an axis of the spiral coil is orthogonal to the bottom surface of the multilayer body.

17. The multilayer electronic component according to claim **15**,

wherein a lamination direction of the plurality of ceramic layers is a direction that is orthogonal to the bottom surface of the multilayer body; and

an axis of the spiral coil is in parallel with the bottom surface of the multilayer body.

18. The multilayer electronic component according to claim **12**, wherein a cutout groove is provided in a corner portion at which the bottom surface of the multilayer body and an outer surface of the multilayer body intersect with each other.

19. The multilayer electronic component according to claim **12**, wherein the bottom surface of the groove has a plurality of recess portions extending along an extension direction of the groove.

20. The multilayer electronic component according to claim **13**, wherein the inner surface of the groove has a bottom surface, side surfaces, and connection portions that are formed into recessed curved surfaces between the bottom surface and the side surfaces.

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