US 20250259779A1

(19) **United States**
(12) **Patent Application Publication**
(10) **Pub. No.: US 2025/0259779 A1**
(43) **Pub. Date: Aug. 14, 2025**

YOSHIOKA et al.

(54) **INDUCTOR COMPONENT**

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

(72) Inventors: **Yoshimasa YOSHIOKA**, Nagaokakyo-shi (JP); **Tsuyoshi TAKAMATSU**, Nagaokakyo-shi (JP); **Hideki KAMO**, Nagaokakyo-shi (JP); **Katsufumi SASAKI**, Nagaokakyo-shi (JP)

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

(21) Appl. No.: **19/196,347**

(22) Filed: **May 1, 2025**

Related U.S. Application Data

(63) Continuation of application No. PCT/JP2023/030126, filed on Aug. 22, 2023.

(30) **Foreign Application Priority Data**

Nov. 2, 2022 (JP) 2022-176447

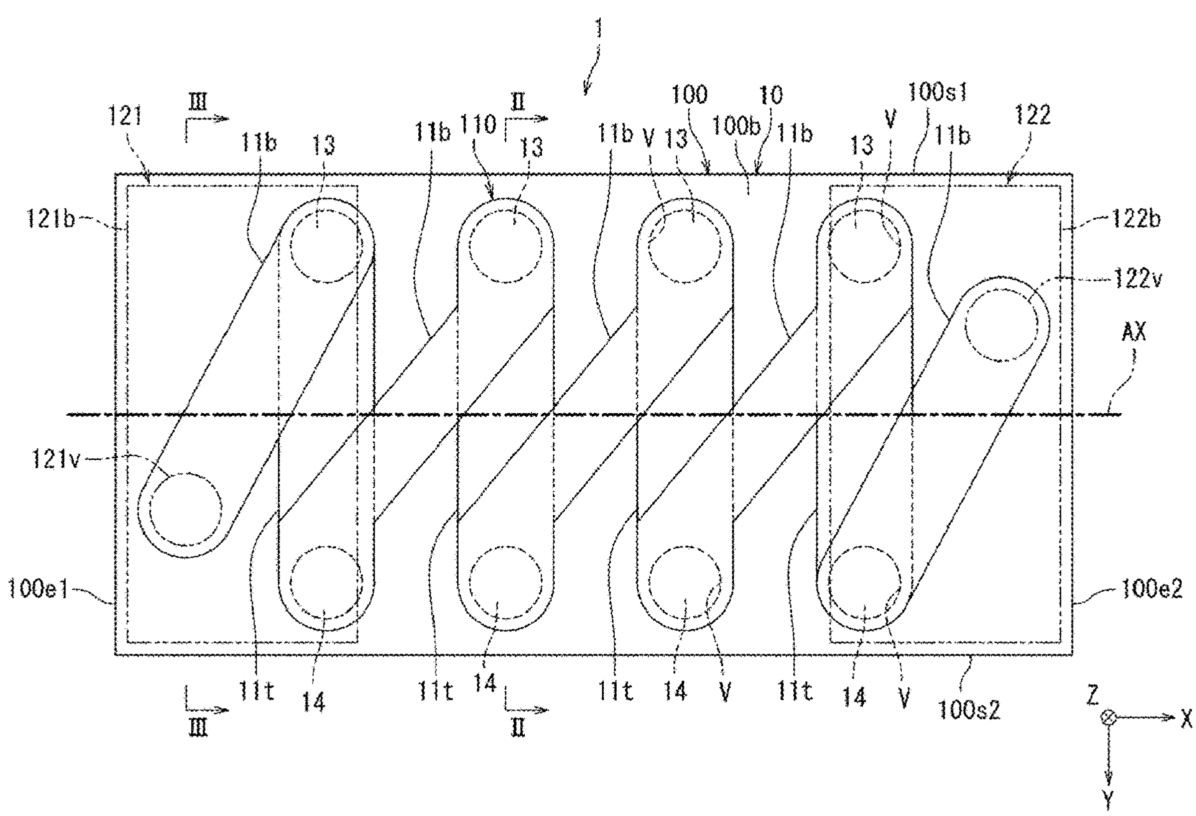
Publication Classification

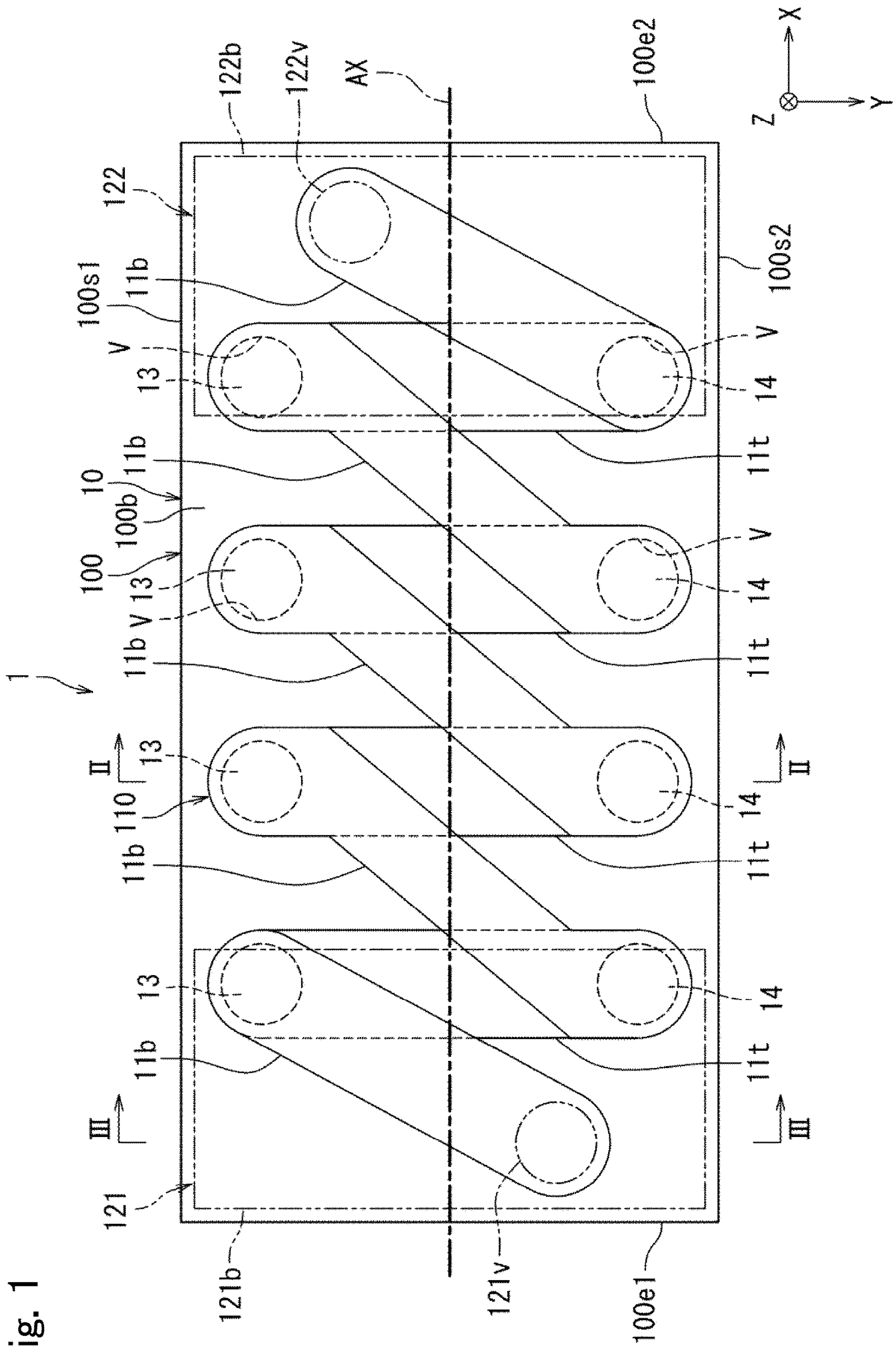
(51) **Int. Cl.**
H01F 27/28 (2006.01)
H01F 17/00 (2006.01)

(52) **U.S. Cl.**
CPC ***H01F 27/2828*** (2013.01); *H01F 17/00* (2013.01)

(57) **ABSTRACT**

An inductor component includes an element body having first and second principal surfaces opposite to each other; a coil that is in the element body and is wound in a spiral shape along an axis; and first and second external electrodes that are on the element body and electrically connected to the coil. The axis of the coil is parallel to the first principal surface. The coil includes first coil wirings which are on the first principal surface side with respect to the axis and are arranged along the axis on a plane parallel to the first principal surface, second coil wirings which are on the second principal surface side with respect to the axis and are arranged along the axis on a plane parallel to the second principal surface, and first penetration wirings which extend from the respective first coil wirings toward the respective second coil wirings.





1
10
100
100b
100s1
100s2
100e1
100e2
110
11b
11t
13
14
V
121
121b
121v
122
122b
122v
AX
II
III
X
Y
Z

Fig. 1

Fig. 2

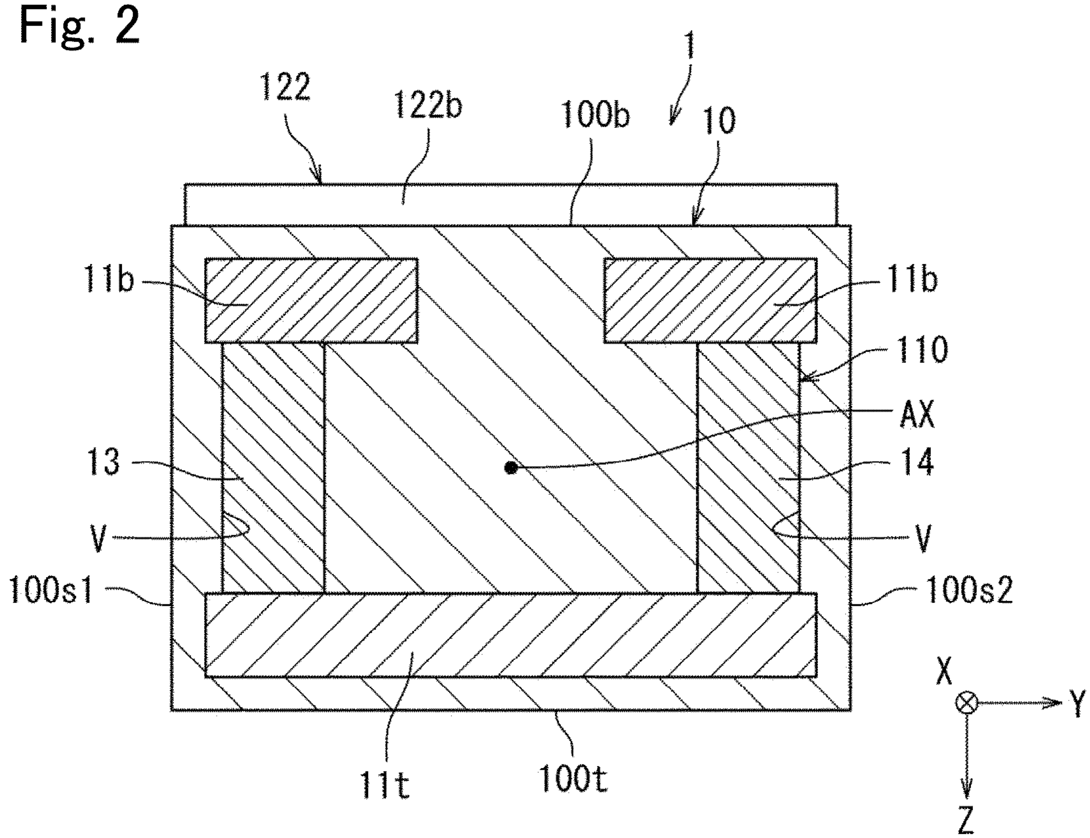
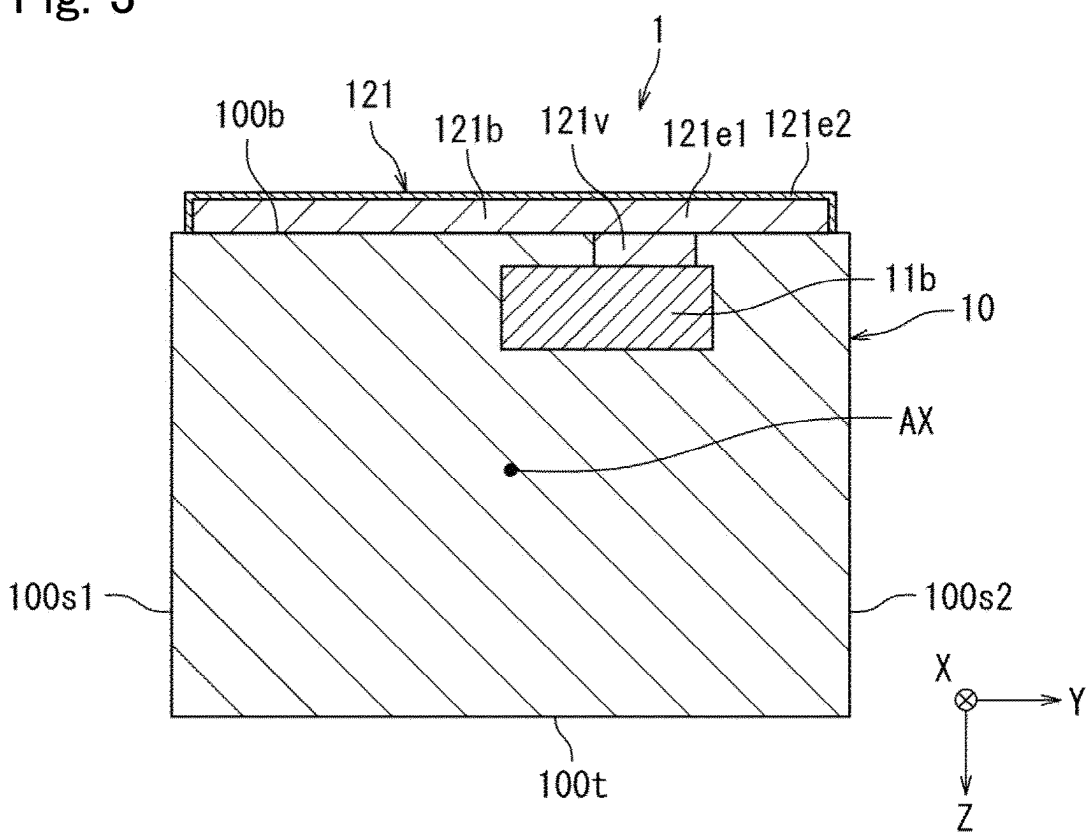
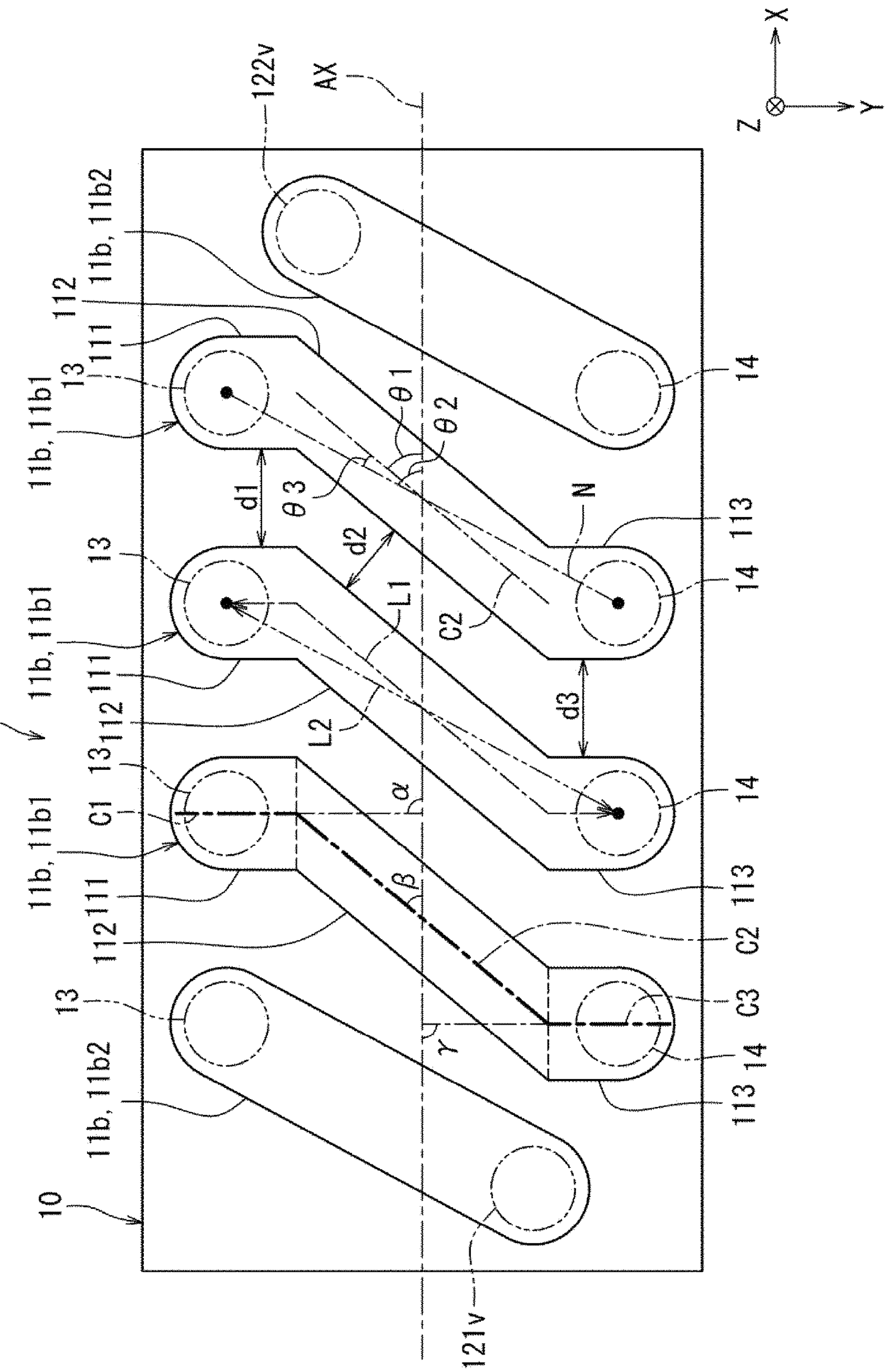

1
122
122b
100b
10
11b
11b
110
AX
13
14
V
V
100s1
100s2
X
Y
Z
11t
100t

Fig. 3


1
100b
121
121b
121v
121e1
121e2
11b
10
AX
100s1
100s2
X
Y
Z
100t



1
10
11b, 11b1
11b, 11b2
111
112
113
13
14
121v
122v
AX
C1
C2
C3
d1
d2
d3
L1
L2
N
θ1
θ2
θ3
α
β
γ
X
Y
Z

Fig. 4A

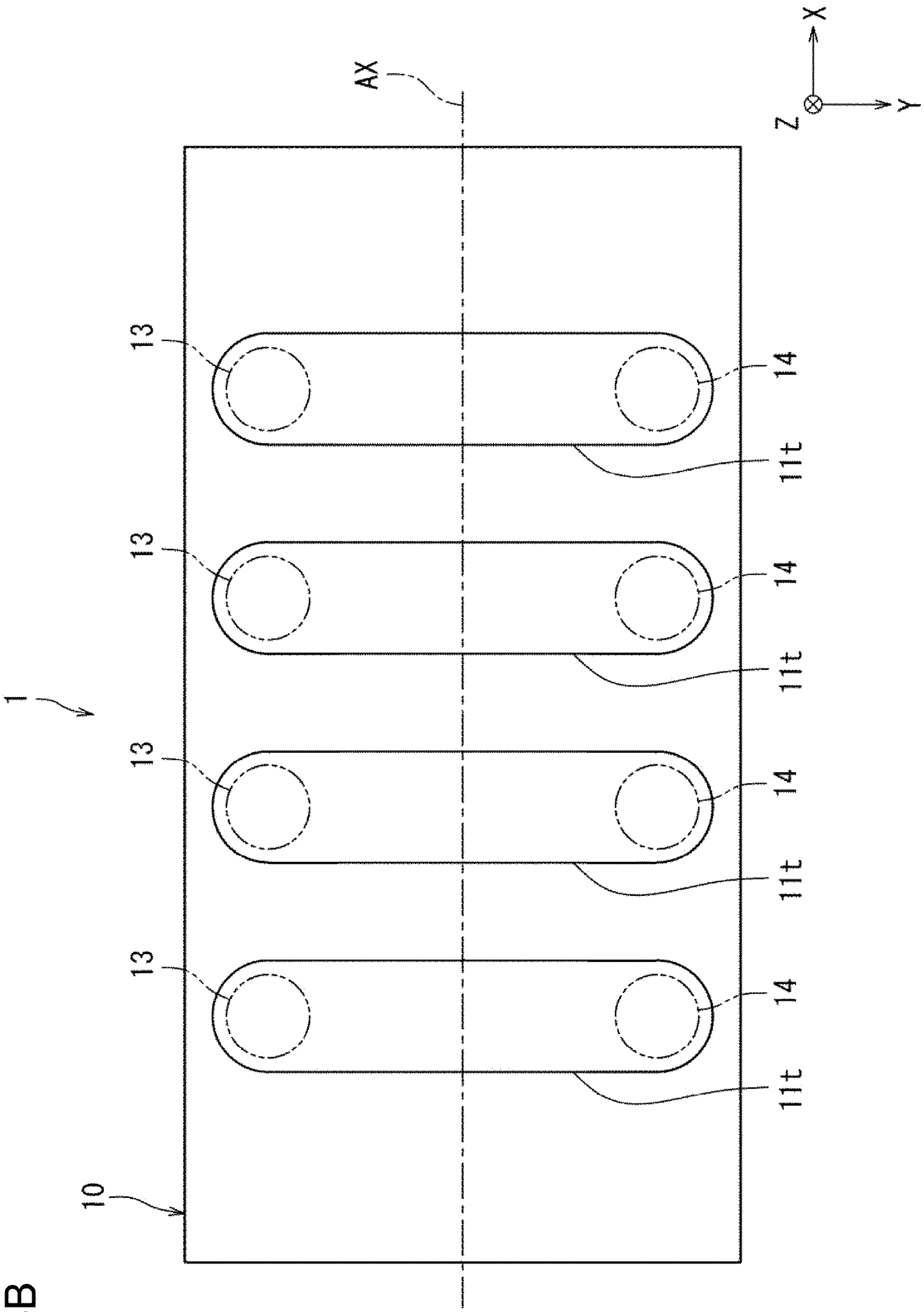


Fig. 4B

Fig. 5A

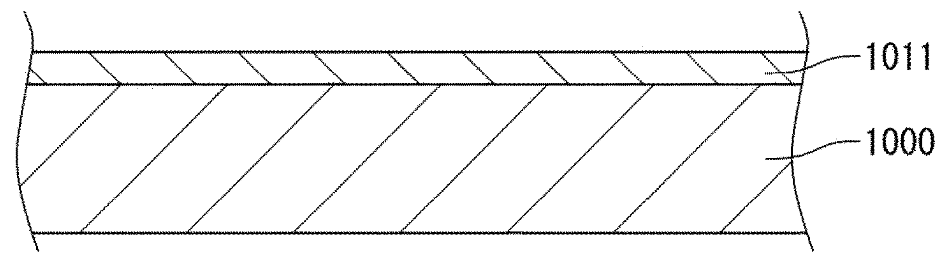


Fig. 5B

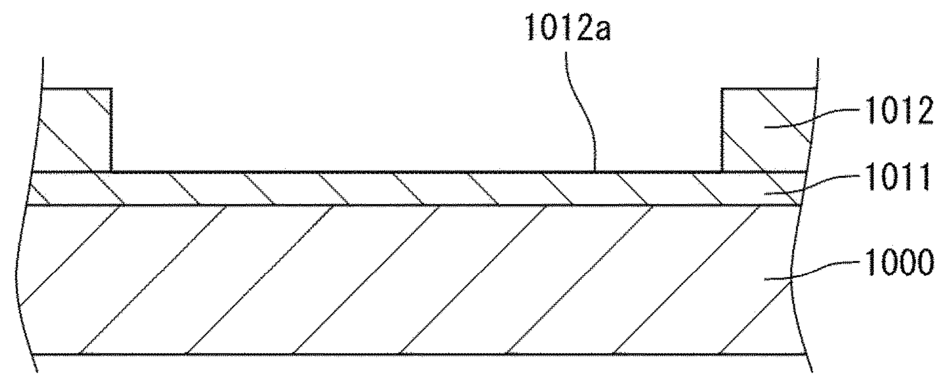


Fig. 5C

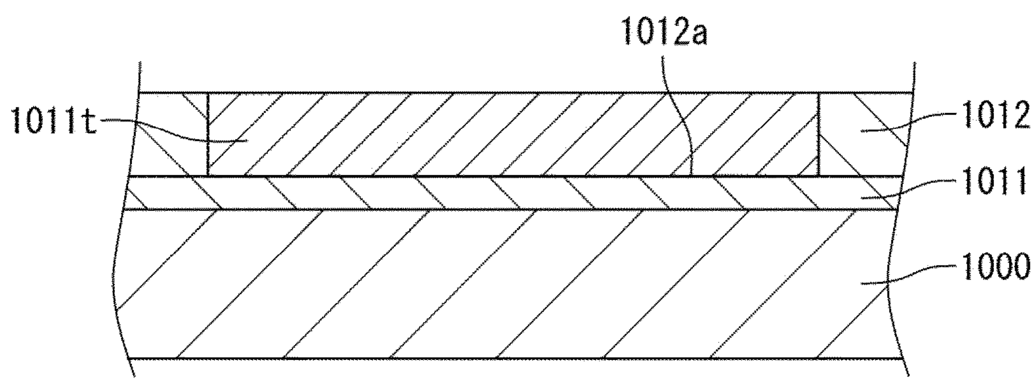


Fig. 5D

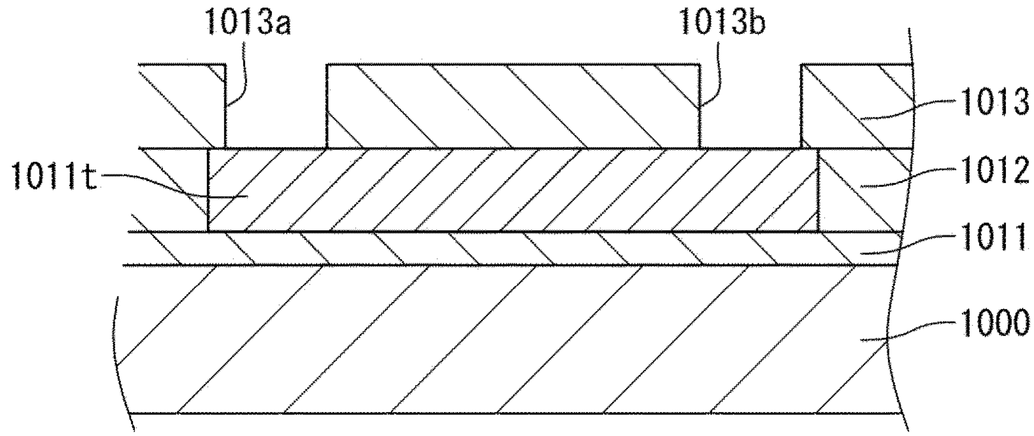


Fig. 5E

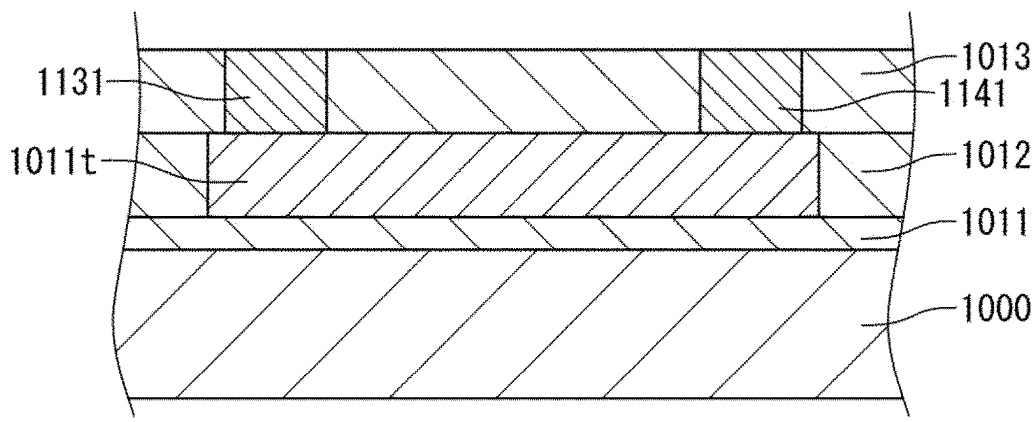


Fig. 5F

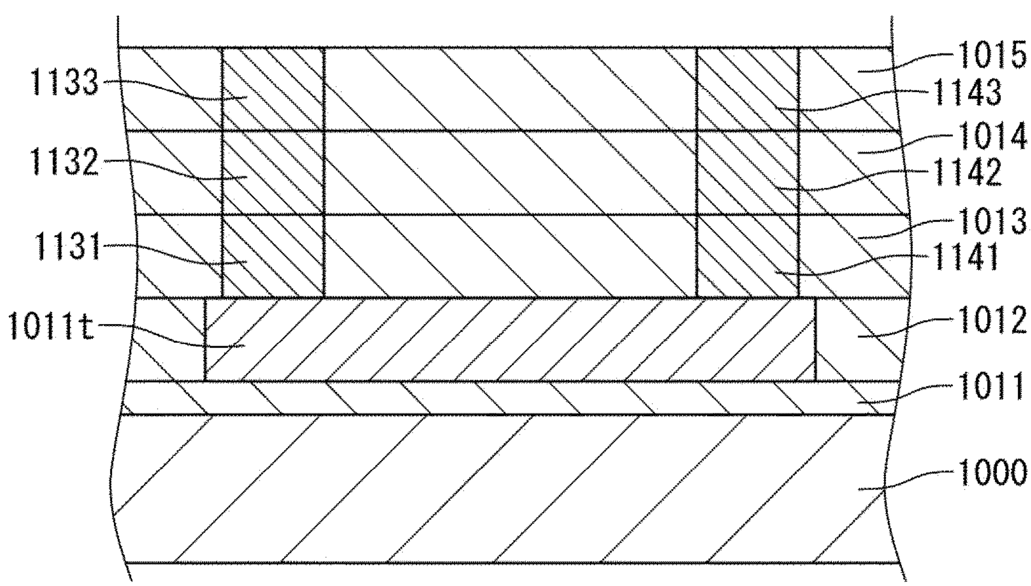


Fig. 5G

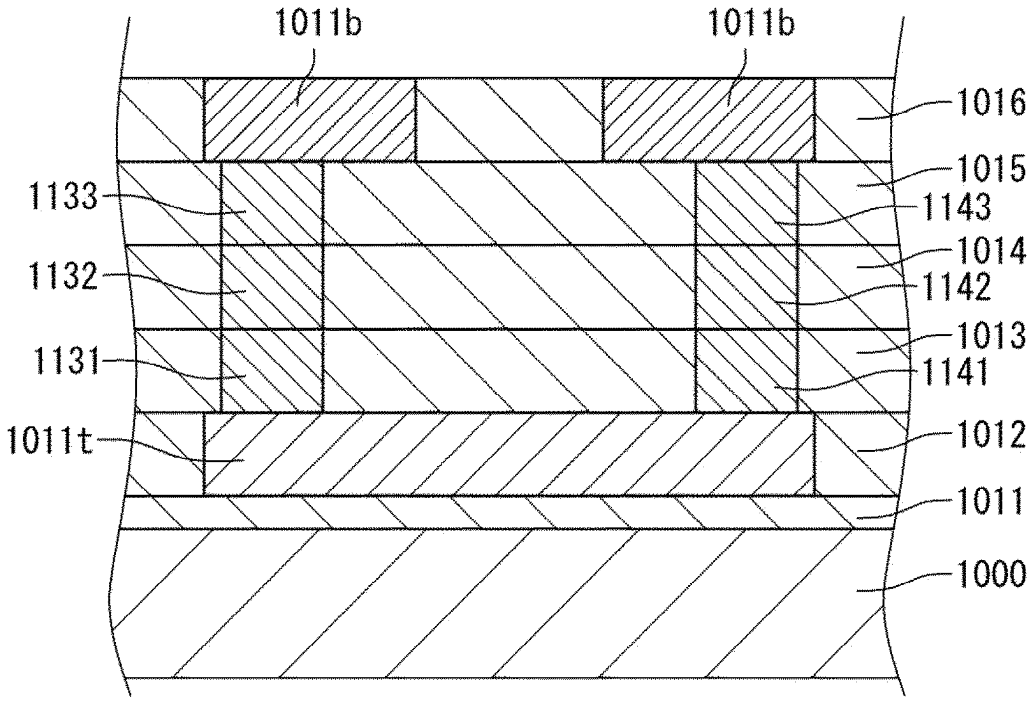

1011b
1011b
1016
1015
1133
1143
1014
1132
1142
1013
1131
1141
1011t
1012
1011
1000

Fig. 5H

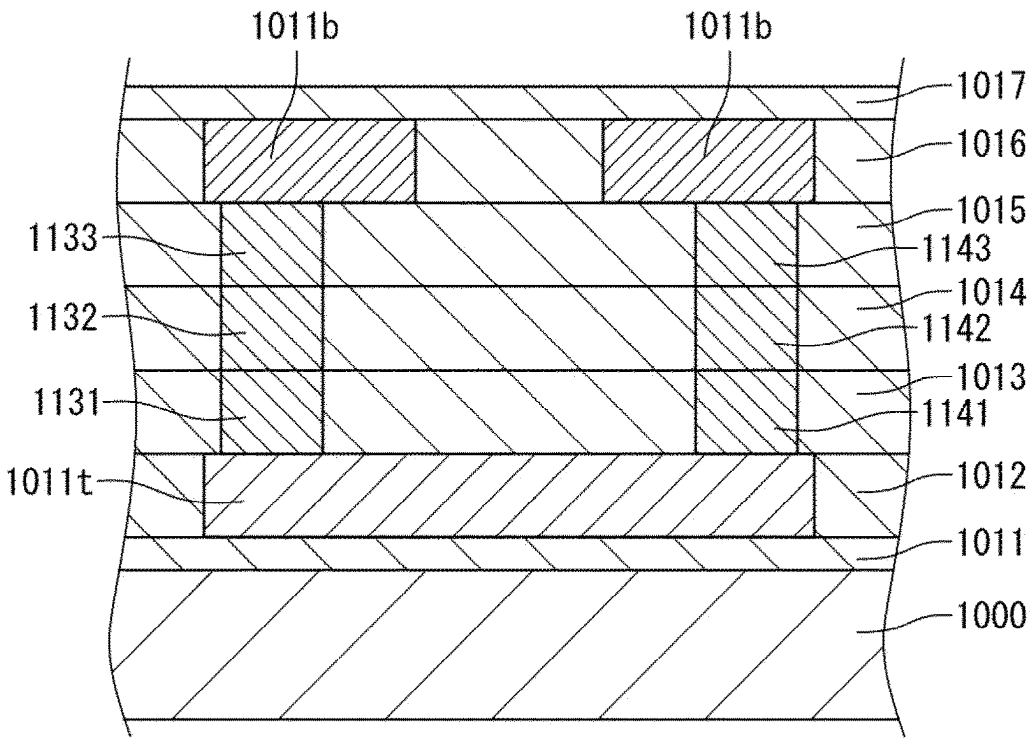

1011b
1011b
1017
1016
1015
1133
1143
1014
1132
1142
1013
1131
1141
1011t
1012
1011
1000

Fig. 5I

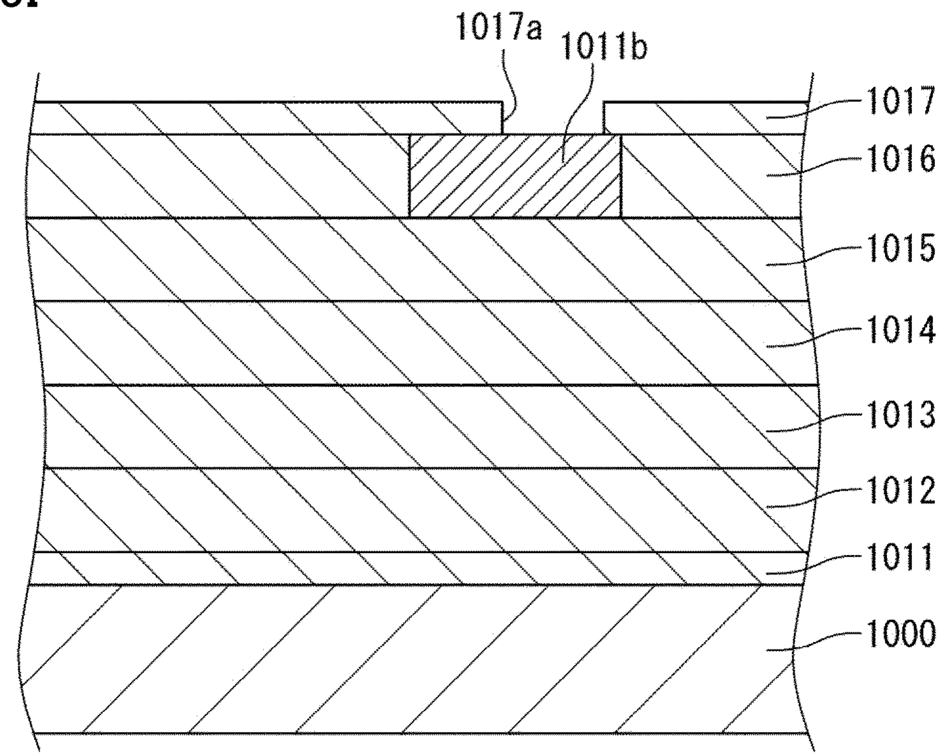

1017a
1011b
1017
1016
1015
1014
1013
1012
1011
1000

Fig. 5J

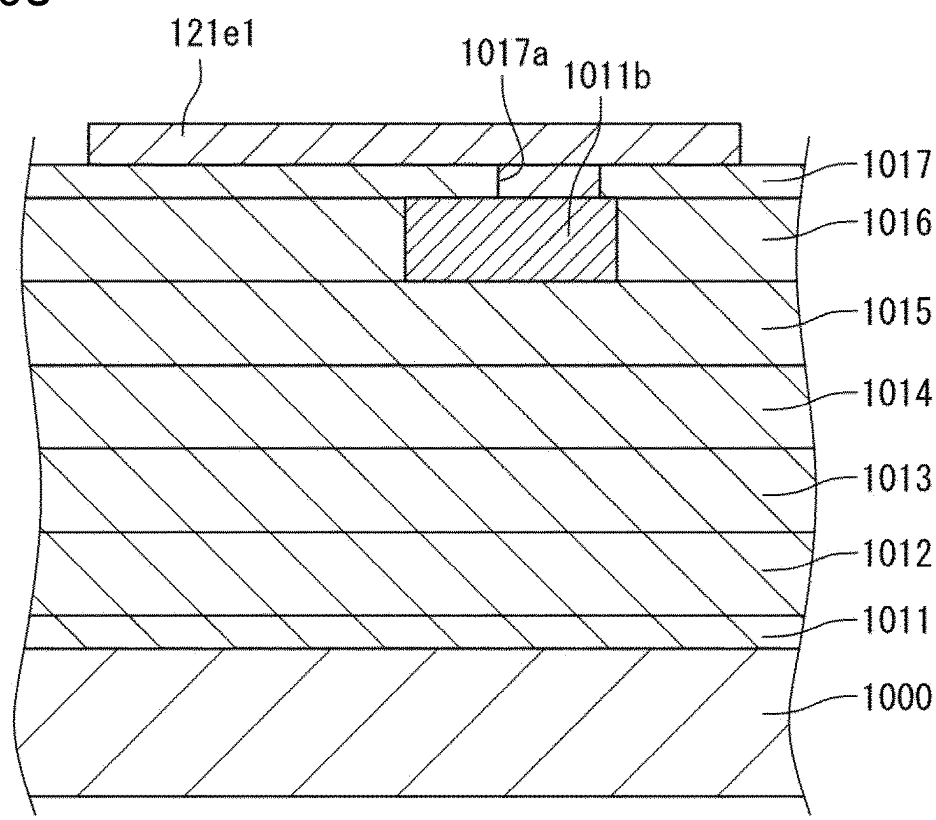

121e1
1017a
1011b
1017
1016
1015
1014
1013
1012
1011
1000

Fig. 5K

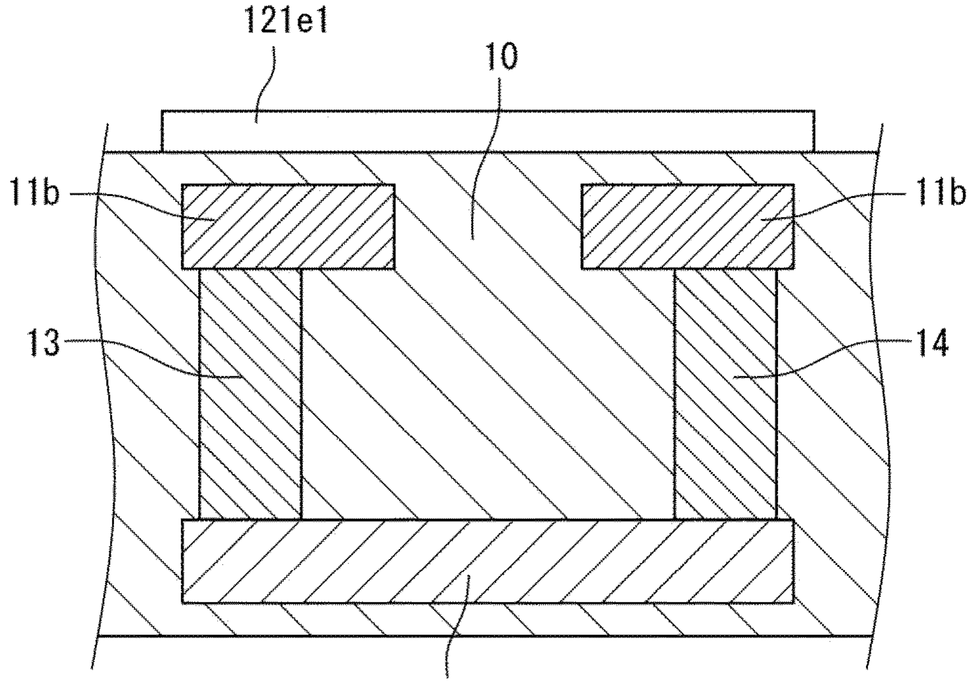


Fig. 5L

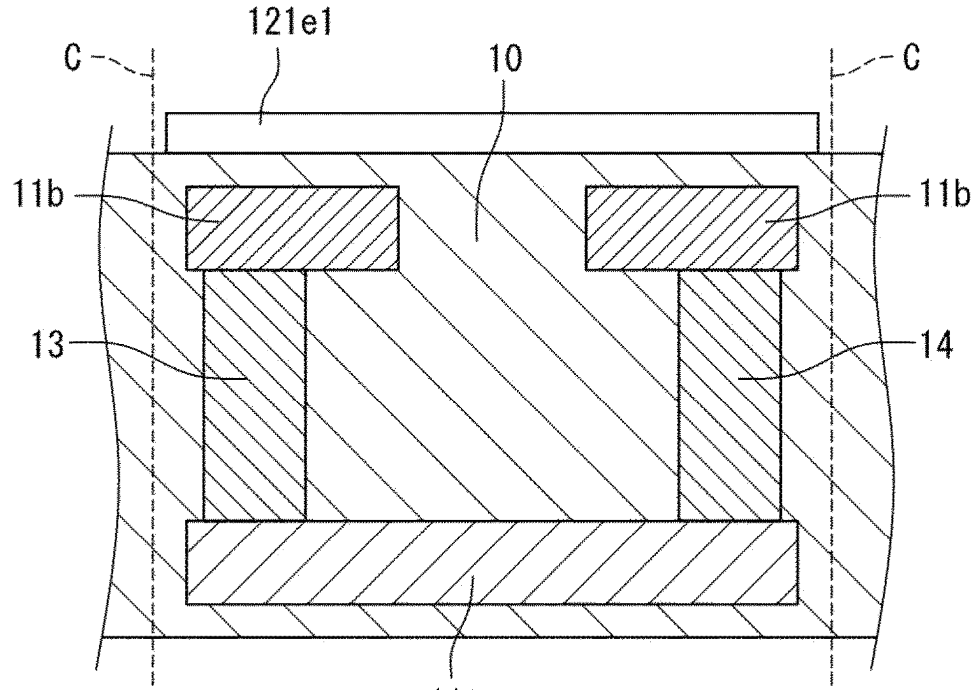


Fig. 5M

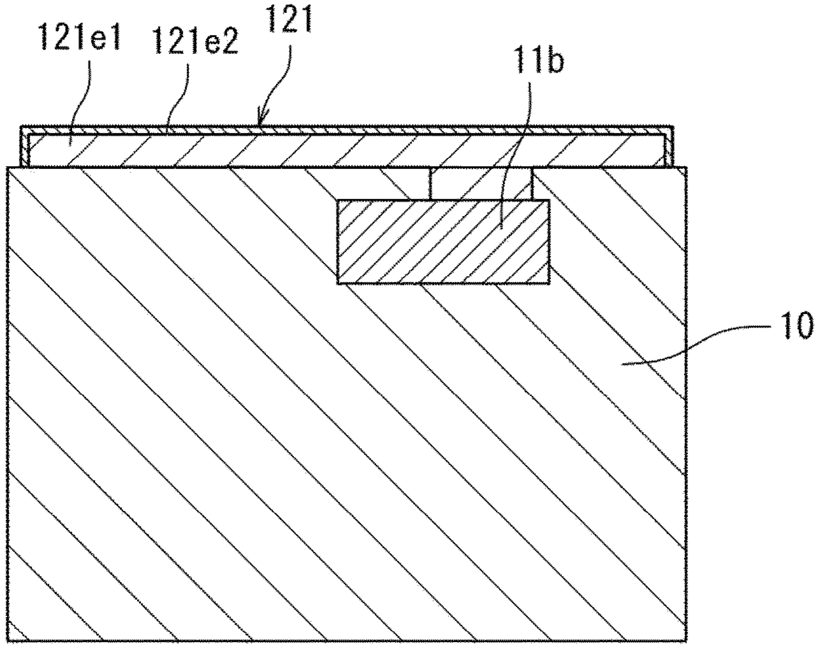


Fig. 6A

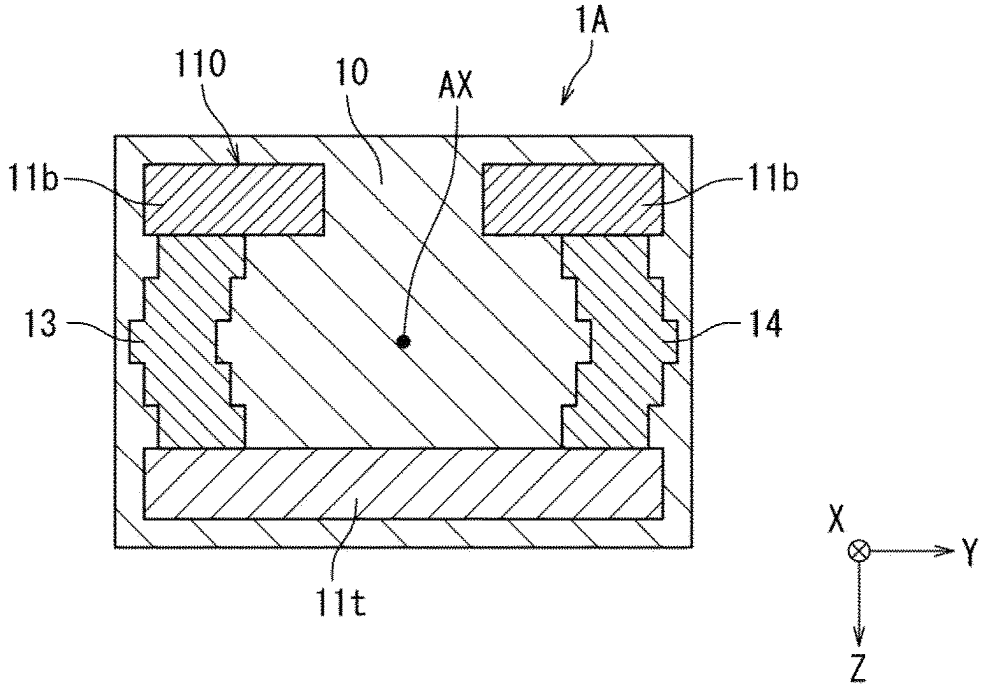


Fig. 6B

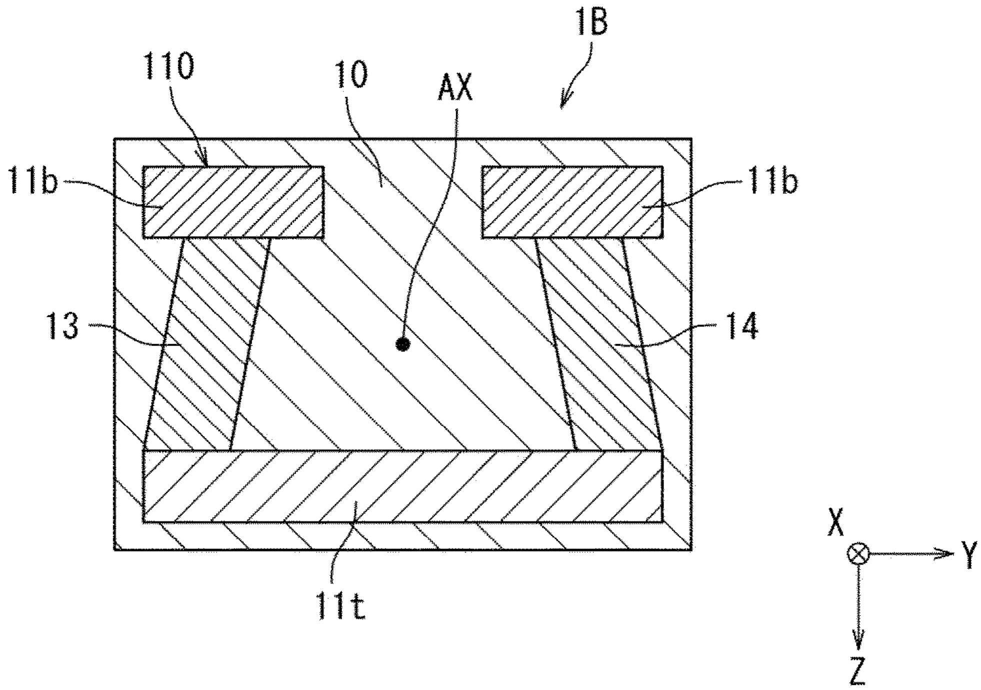

1B
110
10
AX
11b
11b
13
14
11t
X
Y
Z

Fig. 6C

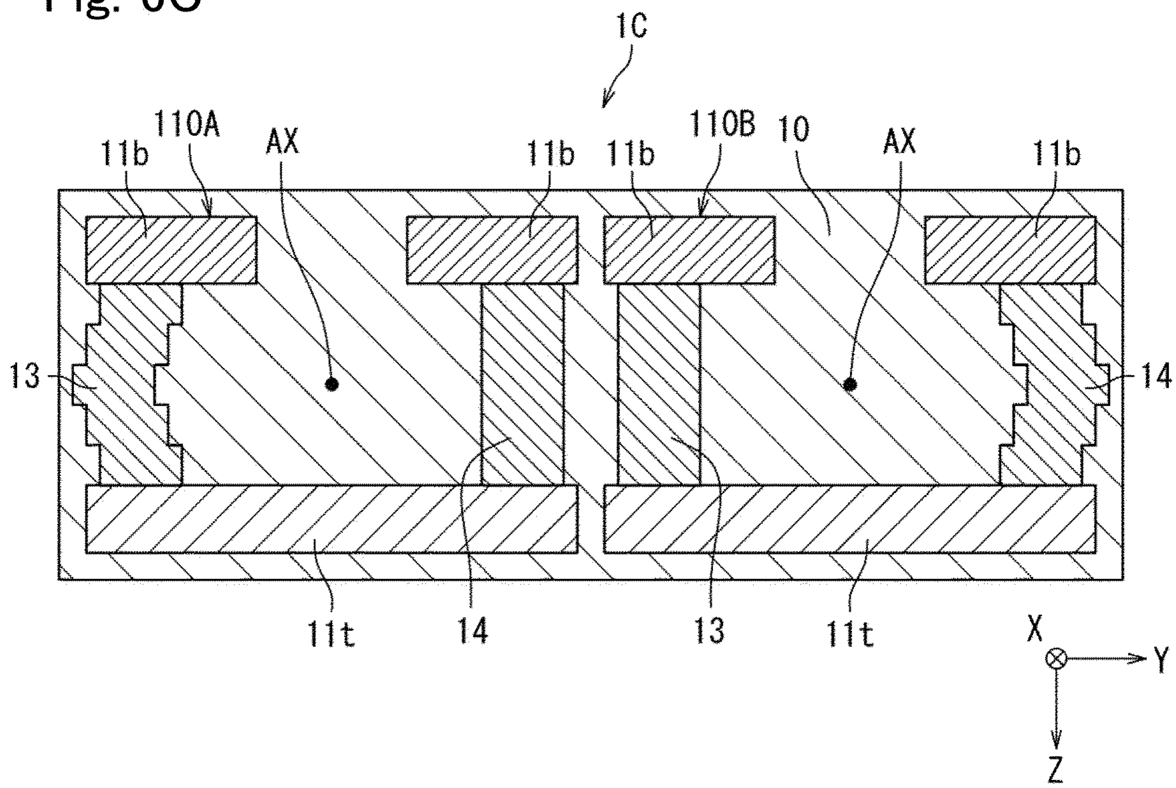

1C
11b
110A
AX
11b
11b
110B
10
AX
11b
13
14
11t
14
13
11t
X
Y
Z

Fig. 6D

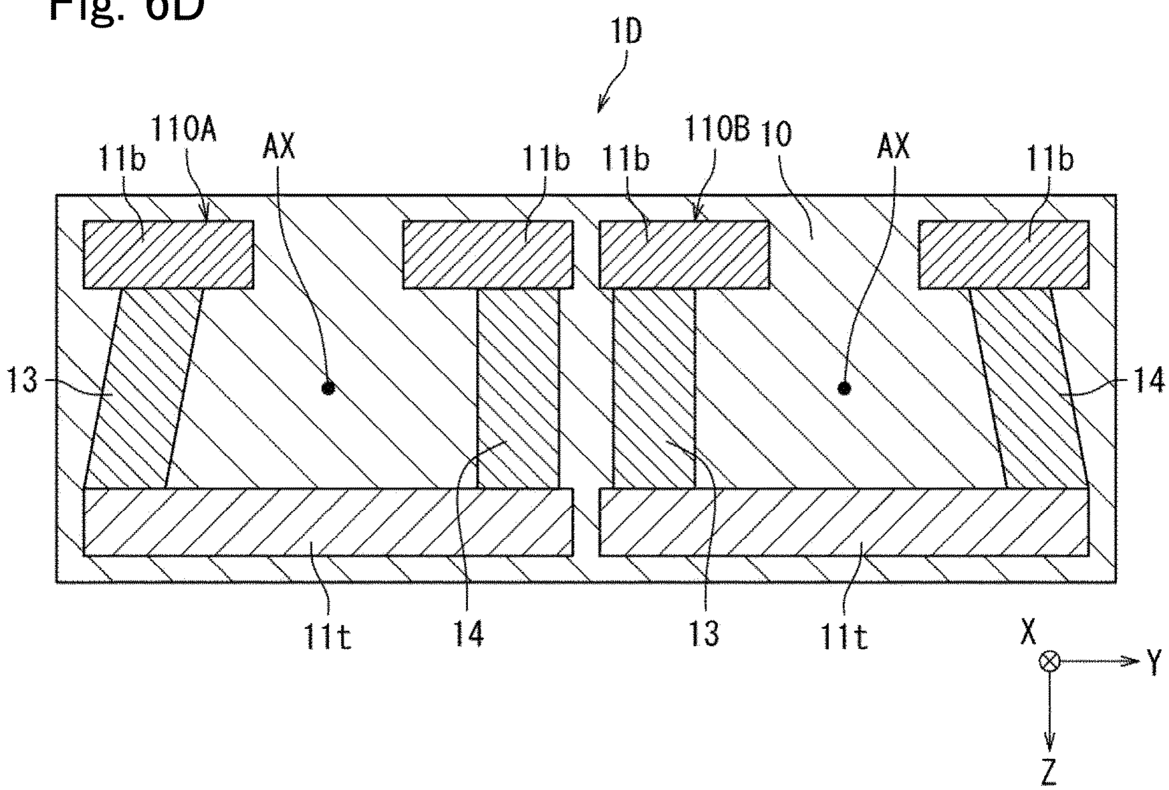
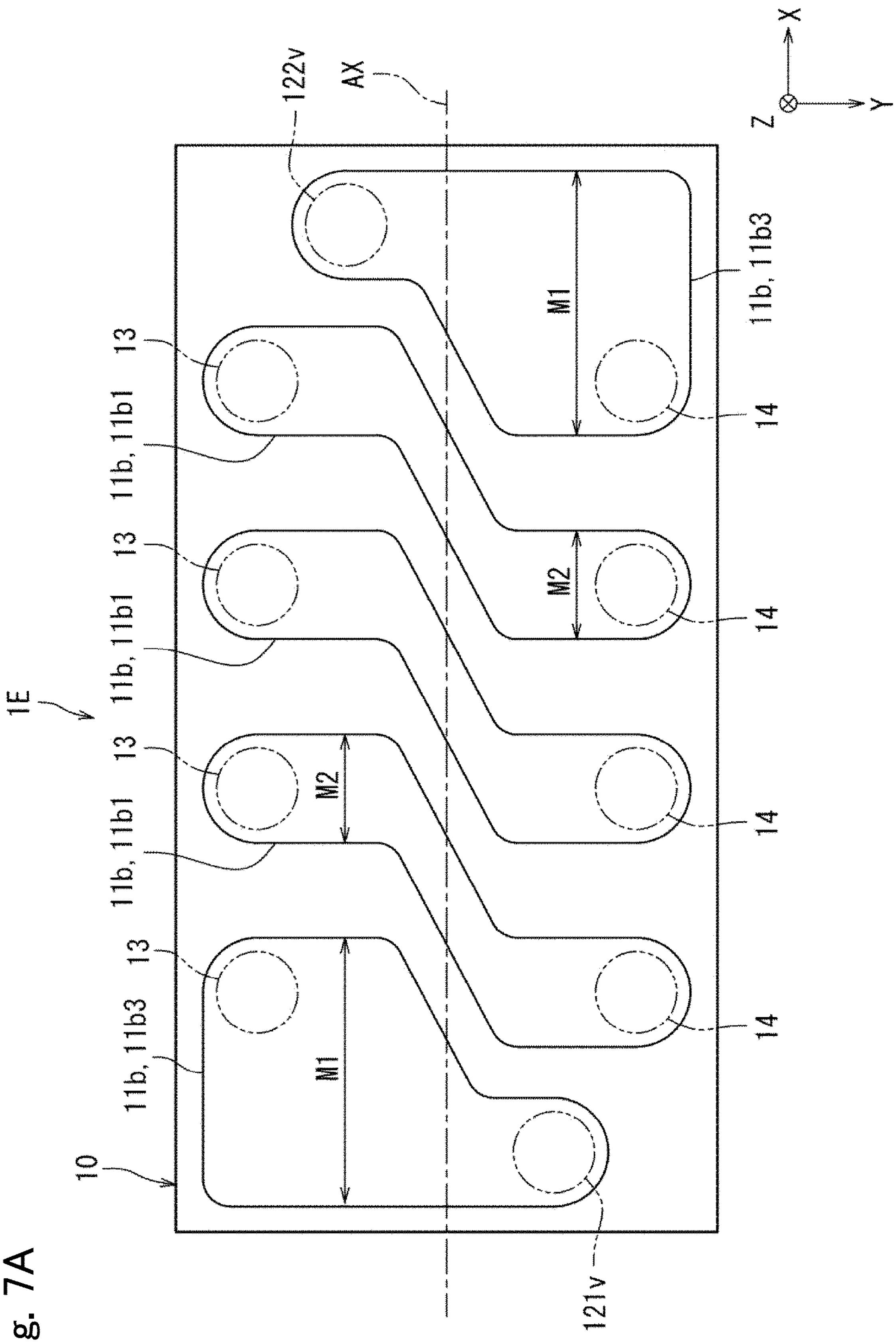
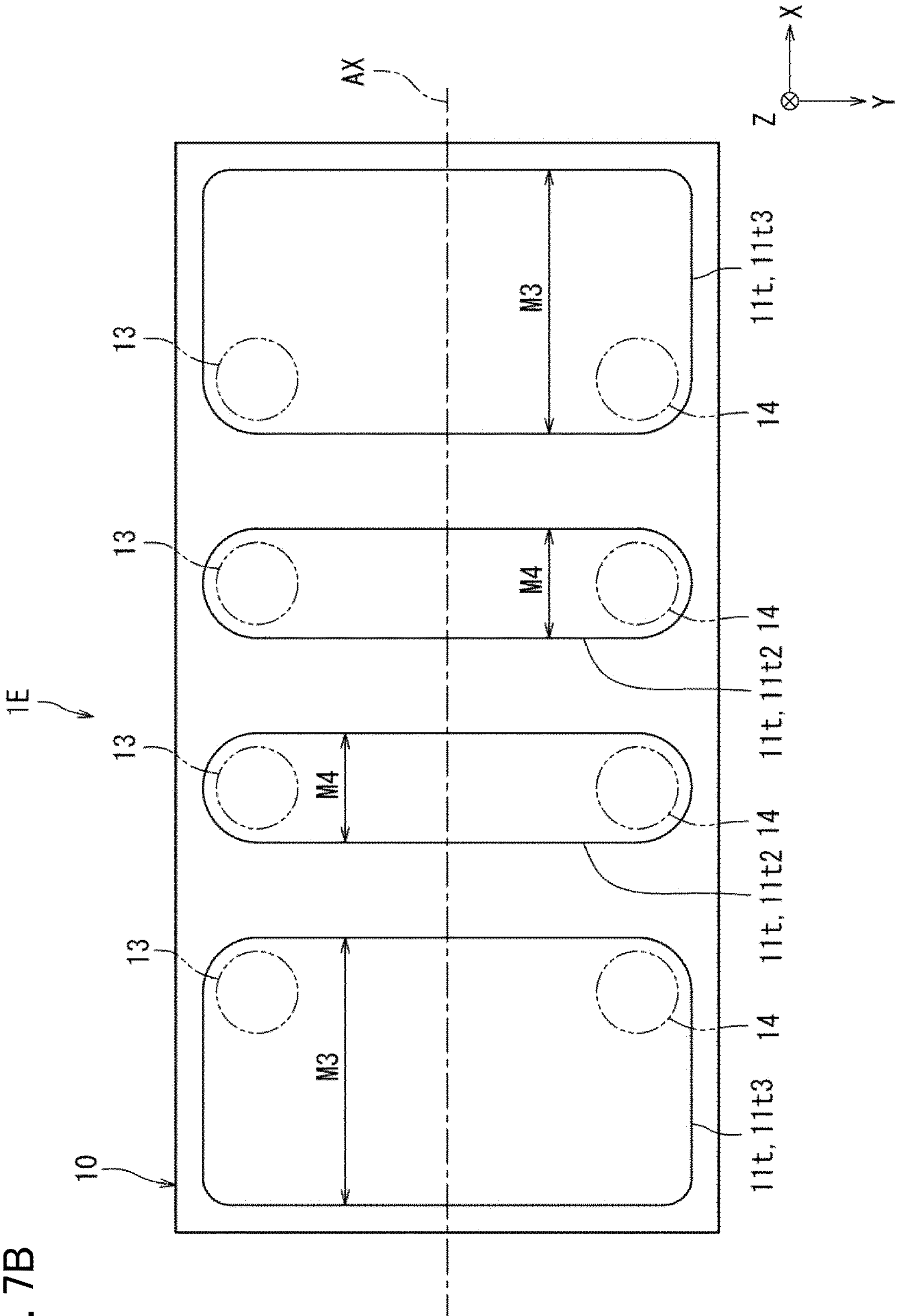


Fig. 7A



X
Y
Z
AX
122v
1E
10
13
13
13
13
11b, 11b1
11b, 11b1
11b, 11b1
11b, 11b3
11b, 11b3
M1
M1
M2
M2
14
14
14
14
121v



AX
X
Y
Z
1E
10
13
13
13
13
14
14
14
14
M3
M3
M4
M4
11t, 11t3
11t, 11t2
11t, 11t2
11t, 11t3

Fig. 7B

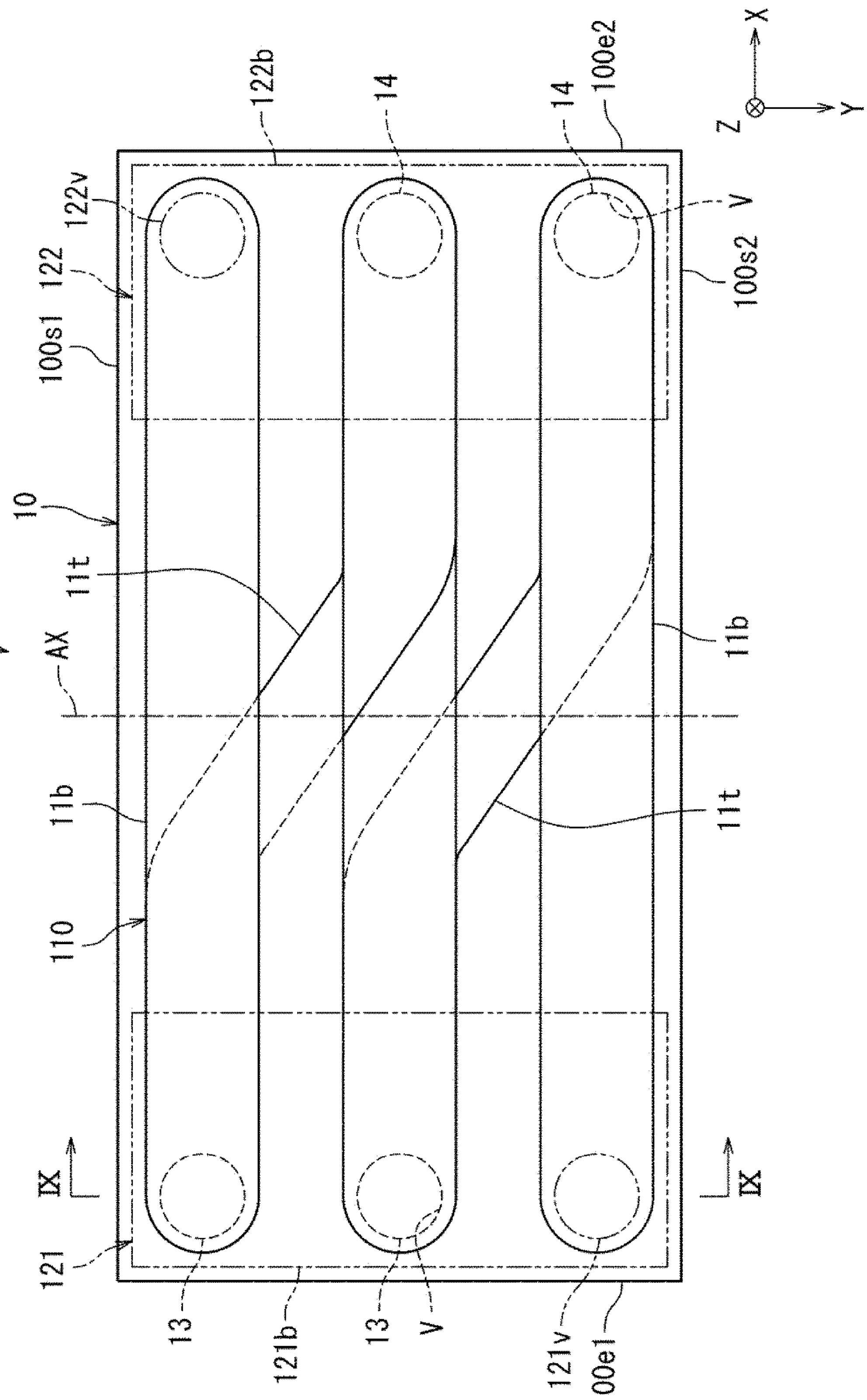
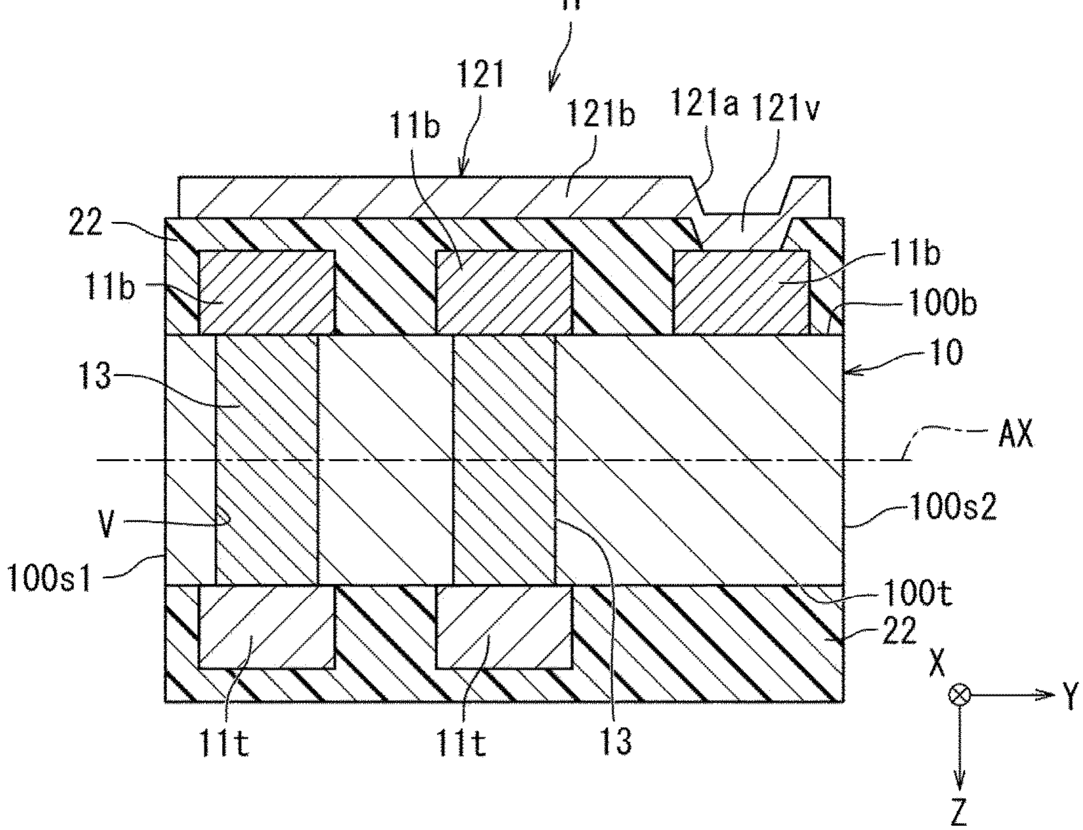
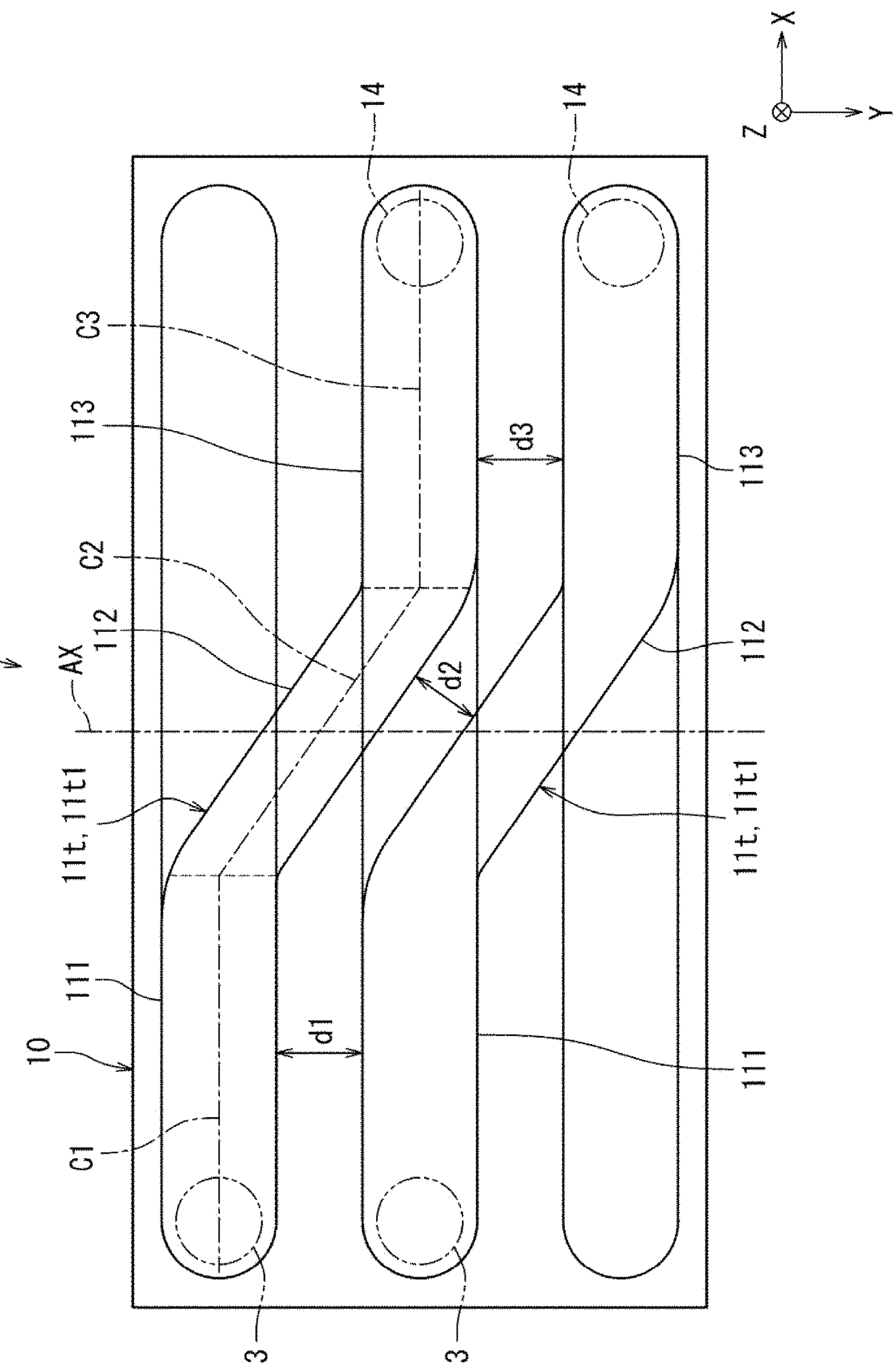

122b
14
14
100e2
X
Y
Z
122v
122
100s1
V
100s2
10
1F
AX
11t
11b
11b
11t
110
IX
IX
121
13
121b
13
V
121v
100e1

Fig. 8

Fig. 9


1F
121
121b
121a
121v
11b
22
11b
11b
100b
10
13
AX
V
100s2
100s1
100t
22
X
Y
Z
11t
11t
13



X
Y
Z
1F
AX
10
14
14
C3
113
113
d3
C2
112
112
d2
11t, 11t1
11t, 11t1
111
111
d1
C1
13
13

Fig. 10

Fig. 11A

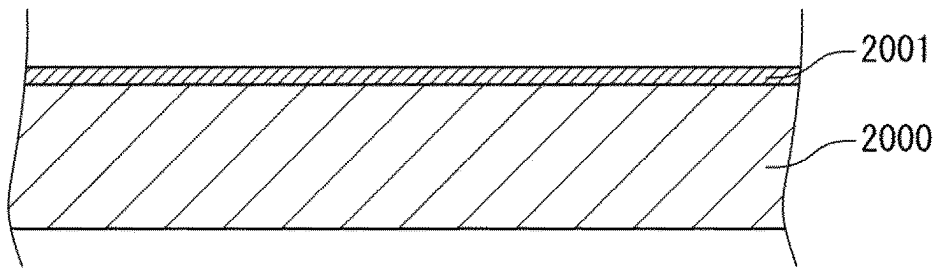


Fig. 11B

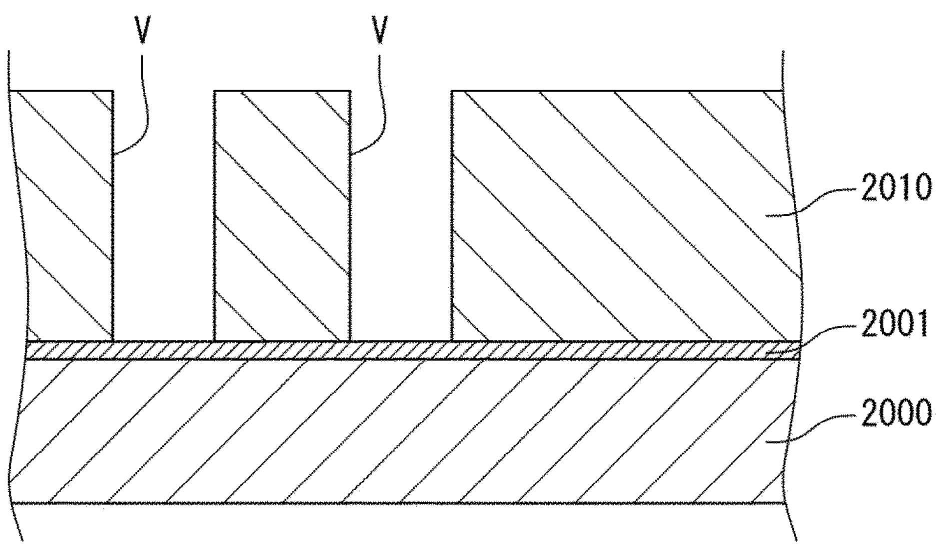


Fig. 11C

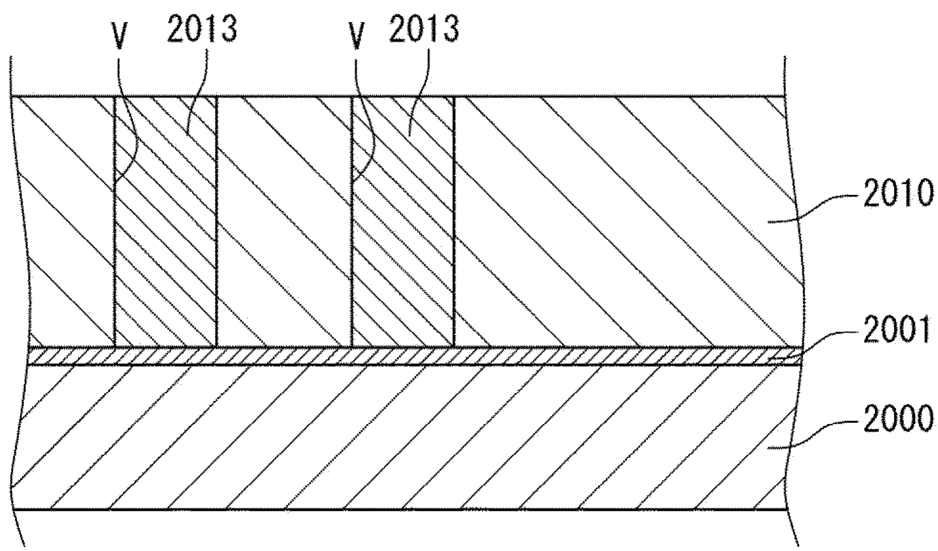


Fig. 11D

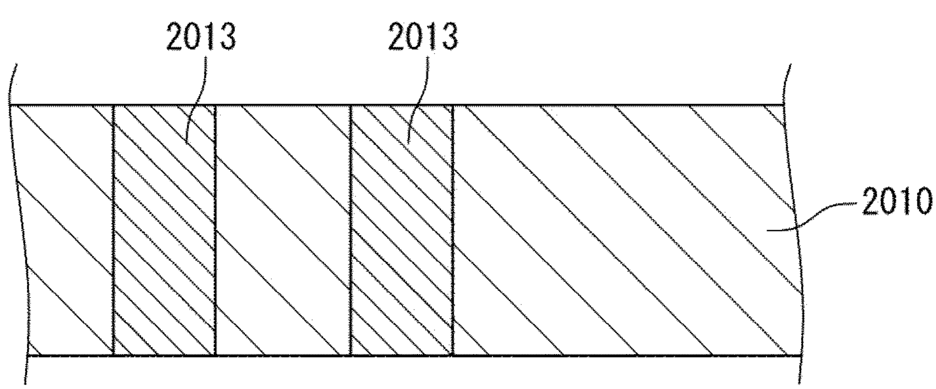


Fig. 11E

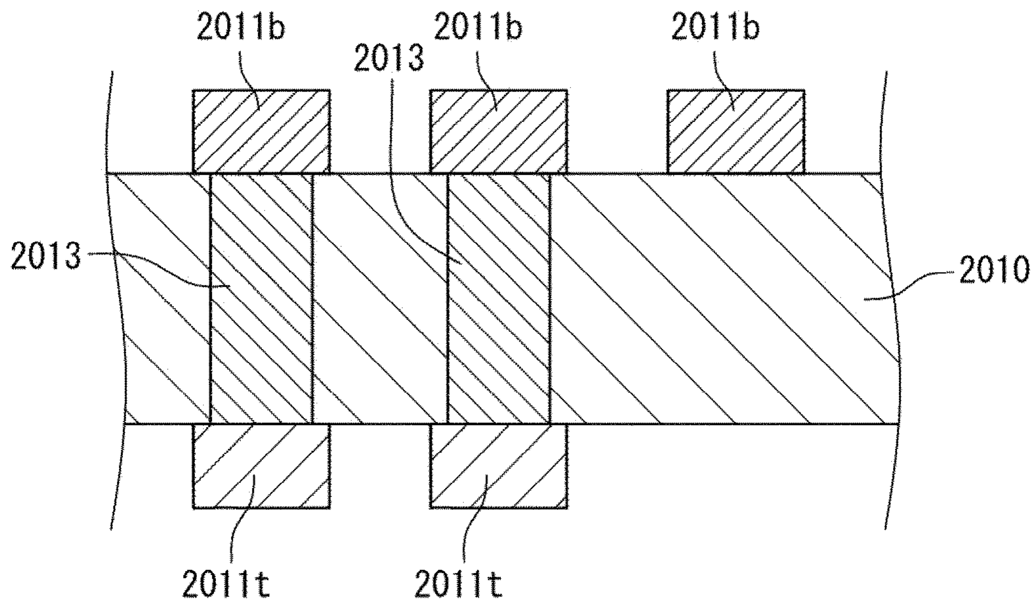


Fig. 11F

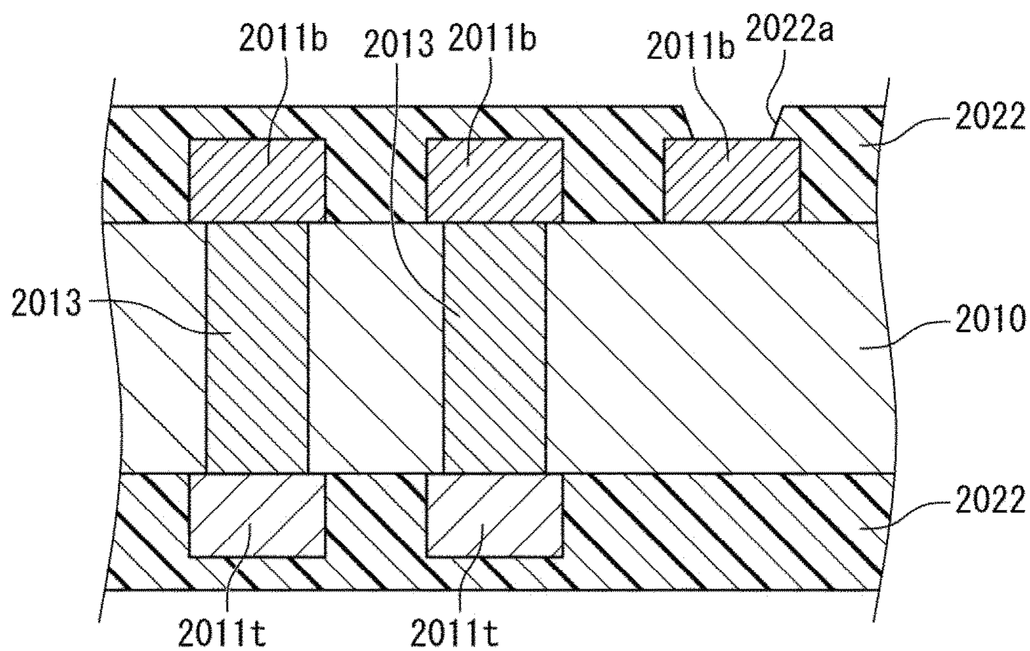


Fig. 11G

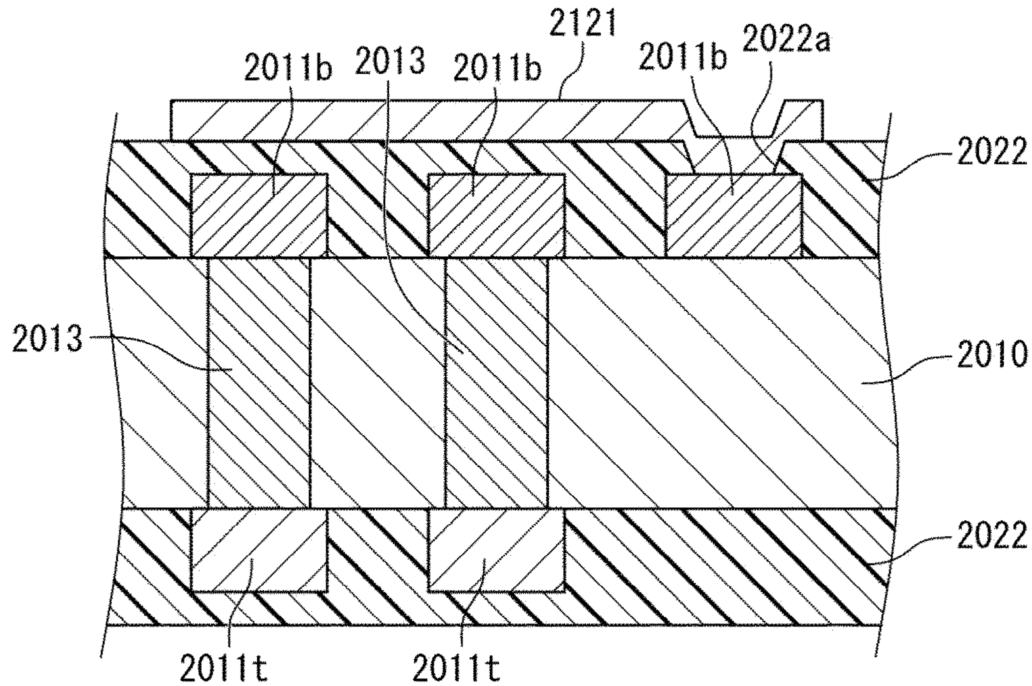


Fig. 11H

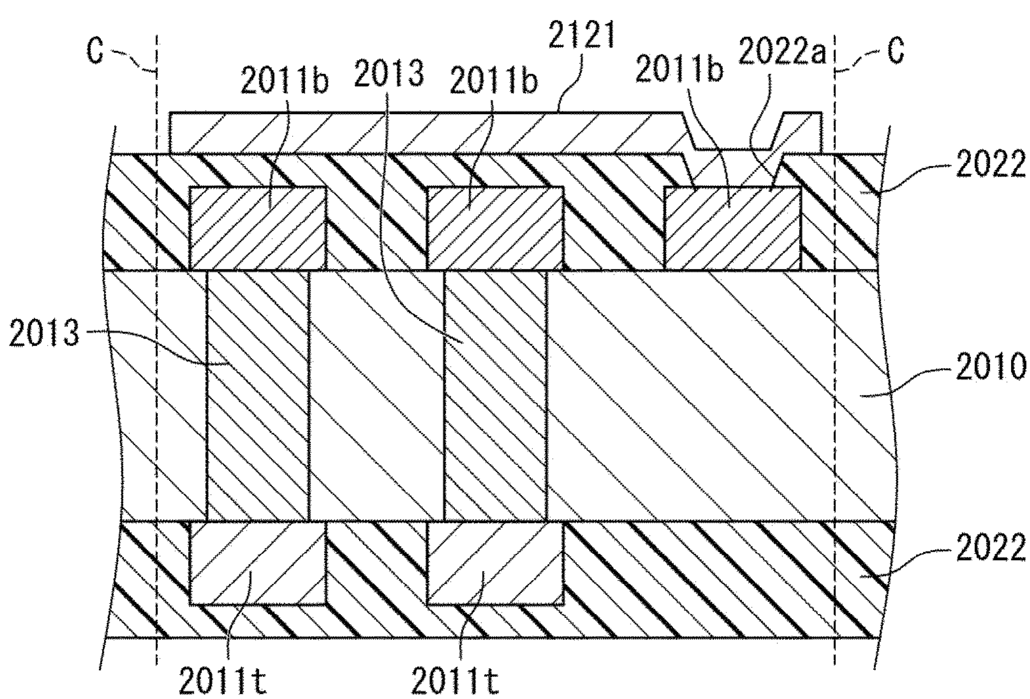


Fig. 12A

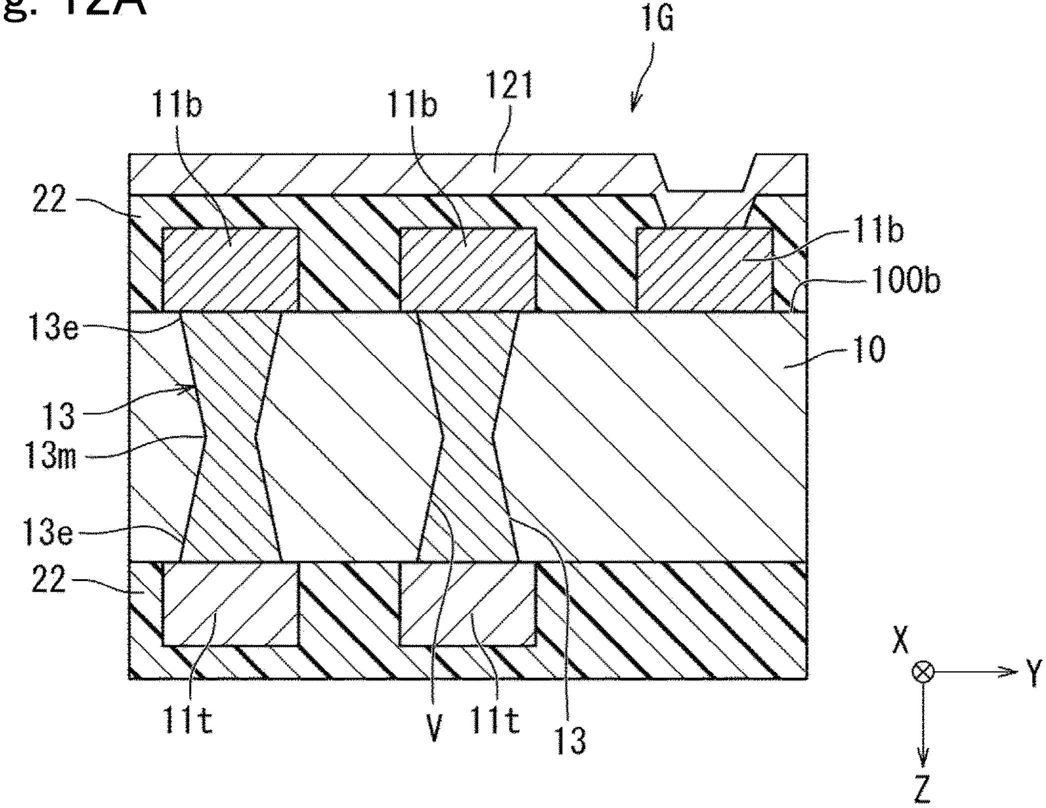


Fig. 12B

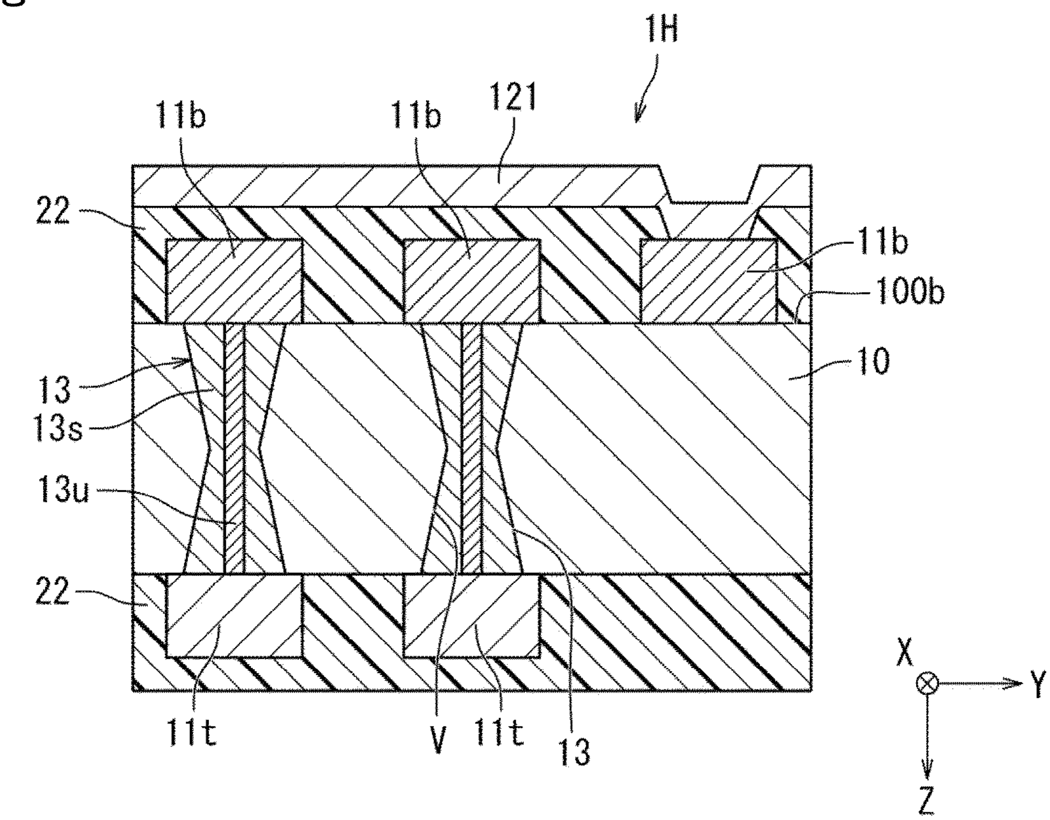
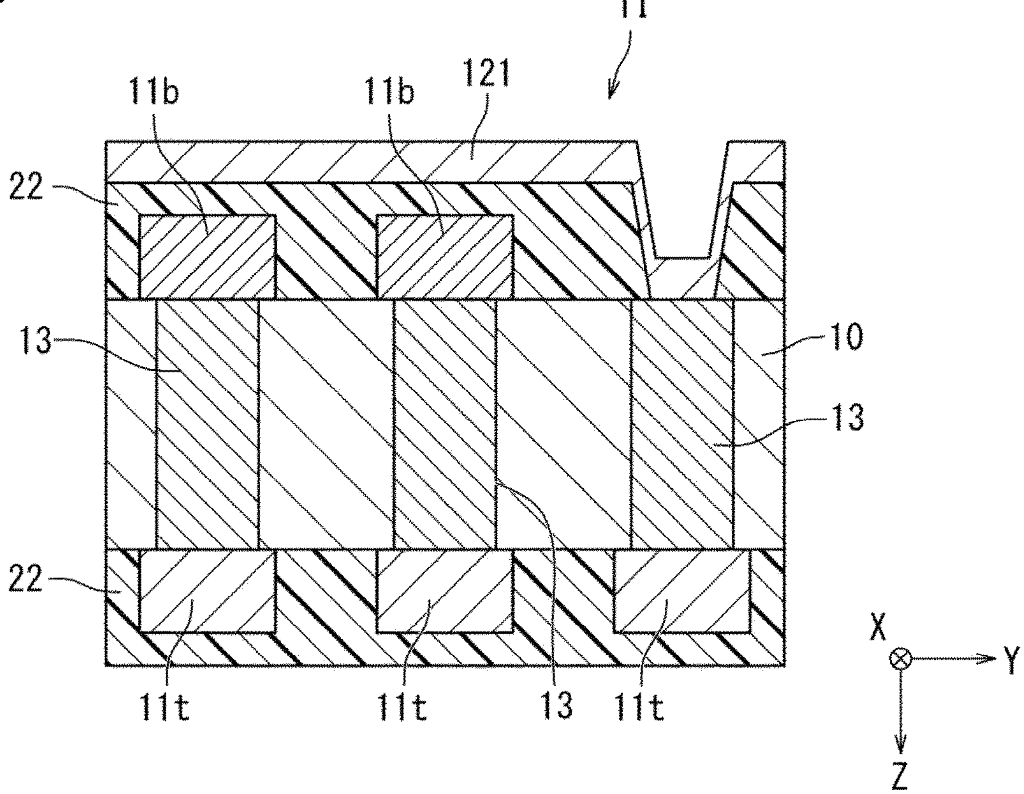


Fig. 12C



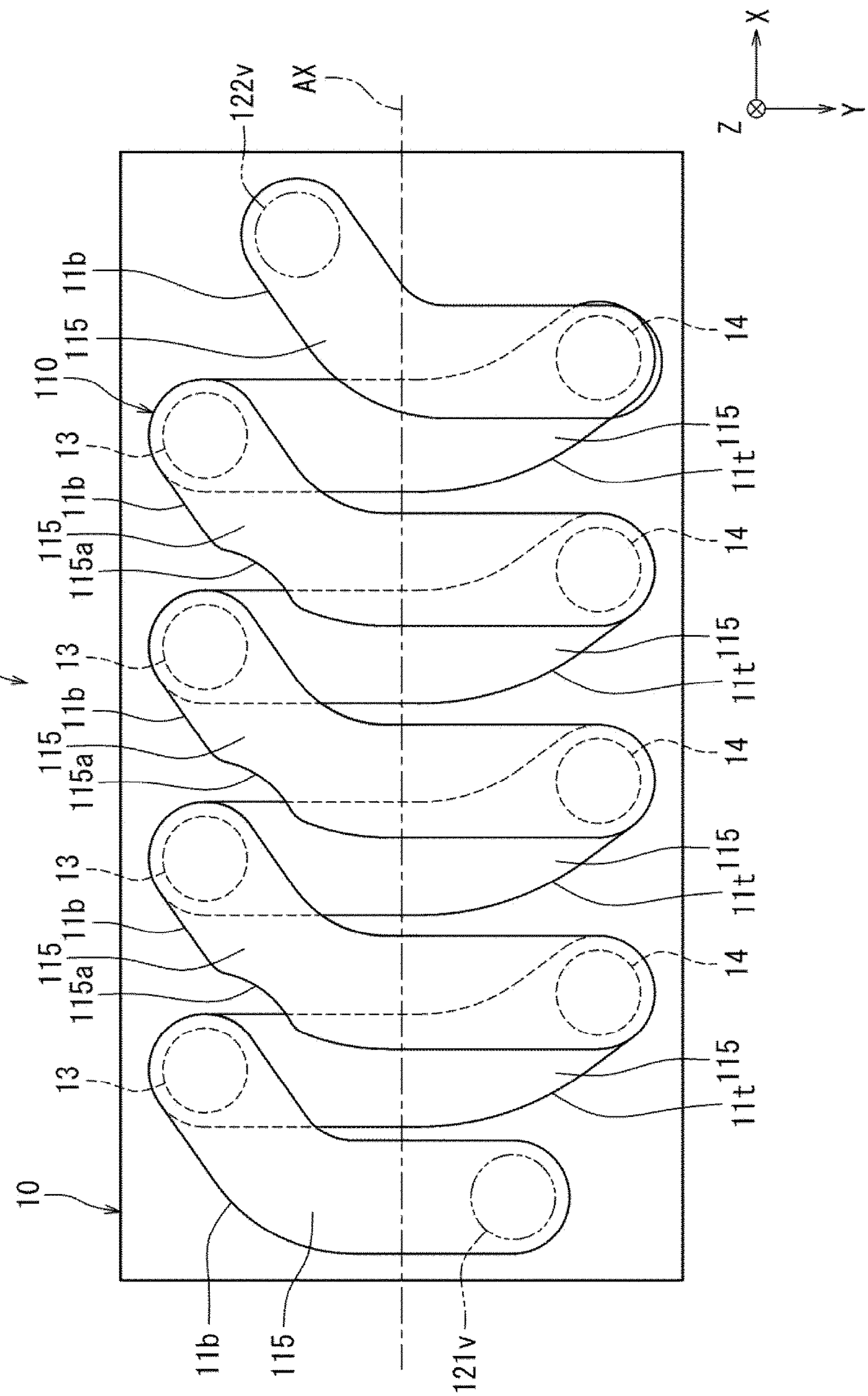


Fig. 13

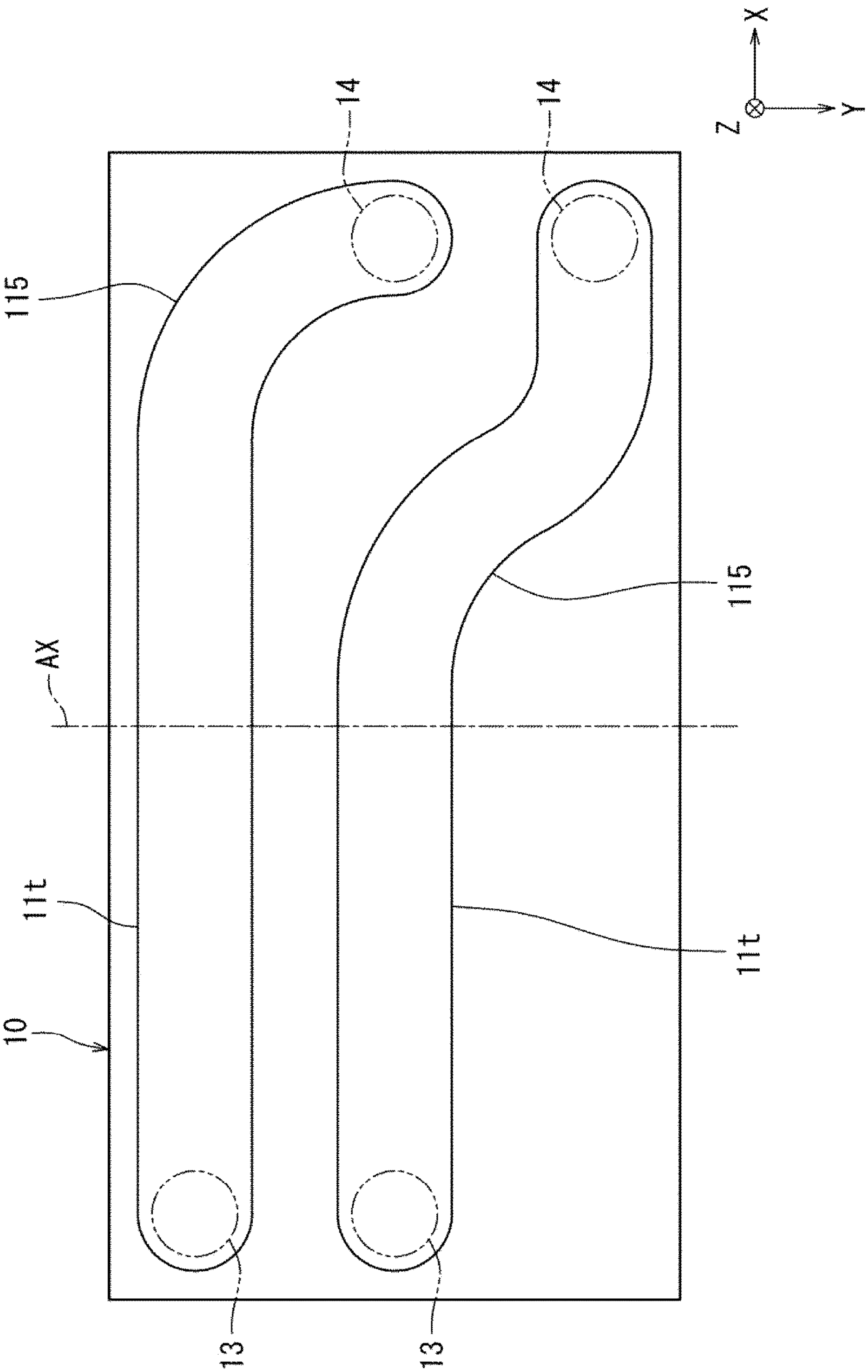


Fig. 14

INDUCTOR COMPONENT

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims benefit of priority to International Patent Application No. PCT/JP2023/030126, filed Aug. 22, 2023, and to Japanese Patent Application 2022-176447, filed Nov. 2, 2022, the entire contents of each are incorporated herein by reference.

BACKGROUND

Technical Field

[0002] The present disclosure relates to an inductor component.

Background Art

[0003] Conventionally, as an inductor component, there is an inductor component described in Japanese Patent No. 6652280. The inductor component includes an element body, a coil that is provided in the element body and is wound along an axial direction, and a first external electrode and a second external electrode that are provided on the element body and are electrically connected to the coil.

[0004] The coil has a plurality of coil patterns layered along an axis. The coil patterns adjacent to each other in the axial direction are connected via a conductive via. Each coil pattern includes a wiring portion extending in a direction orthogonal to the axis and a pad portion that is provided at an end portion of the wiring portion and is connected to the conductive via. A width of the pad portion is wider than a width of the wiring portion in order to improve the connectivity between the pad portion and the conductive via.

SUMMARY

[0005] Incidentally, in the conventional inductor component, since the width of the pad portion is wider than the width of the wiring portion, a part of the pad portion is positioned on an inner side in a radial direction of the coil with respect to the wiring portion. Therefore, an inner diameter of the coil becomes small, and the efficiency of acquisition of inductance is not necessarily high.

[0006] In this regard, the present disclosure provides an inductor component capable of increasing the efficiency of acquisition of inductance.

[0007] Accordingly, one aspect of the present disclosure provides an inductor component comprising an element body having a first principal surface and a second principal surface opposite to each other; a coil that is provided in the element body and is wound in a spiral shape along an axis; and a first external electrode and a second external electrode that are provided on the element body and are electrically connected to the coil. The axis of the coil is disposed parallel to the first principal surface. The coil includes a plurality of first coil wirings which are provided on the first principal surface side with respect to the axis and are arranged along the axis on a plane parallel to the first principal surface, a plurality of second coil wirings which are provided on the second principal surface side with respect to the axis and are arranged along the axis on a plane parallel to the second principal surface, a plurality of first penetration wirings which extend from the respective first coil wirings toward the respective second coil wirings and are arranged along the axis, and a plurality of second penetration wirings which extend from the respective first coil wirings toward the respective second coil wirings, are provided on a side opposite to the respective first penetration wirings with respect to the axis, and are arranged along the axis. Each of the first coil wirings, each of the first penetration wirings, each of the second coil wirings, and each of the second penetration wirings form at least a part of the spiral shape by being connected in this order. At least one of the plurality of first coil wirings and the plurality of second coil wirings is a bent wiring including a first part and a second part having different angles from each other with respect to the axis when viewed in a direction orthogonal to the first principal surface.

[0008] Here, the angle of the first part with respect to the axis indicates an angle formed by a center line (or an extension line of the center line) of the first part and the axis. For example, in a case where the center line intersects the axis, the angle formed by the center line and the axis indicates a smaller angle of intersection angles formed by the center line and the axis. In a case where the center line and the axis are parallel to each other, the angle formed by the center line and the axis is set to 0°. The same applies to the second part.

[0009] That "the external electrode is provided on the element body" specifically indicates that the external electrode is provided on an outer surface side of the element body. For example, this includes a case where the external electrode is provided immediately on an outer surface of the element body, a case where the external electrode is provided on an outer side of the element body via an additional member on the element body, and a case where the external electrode is provided on the outer surface of the external electrode in a state where a part of the external electrode is embedded in the element body.

[0010] According to the aspect, since the coil includes the first coil wirings, the first penetration wirings, the second coil wirings, and the second penetration wirings, and each of the first coil wirings, each of the first penetration wirings, each of the second coil wirings, and each of the second penetration wirings form at least a part of the spiral shape by being connected in this order, it is possible to increase an inner diameter of the coil such that it is possible to increase the efficiency of acquisition of inductance. In addition, a Q value can be increased by increasing the efficiency of acquisition of inductance.

[0011] Further, since at least one of the plurality of first coil wirings and the plurality of second coil wirings is the bent wiring including the first part and the second part having different angles from each other with respect to the axis, a length of the wirings of the coil can be changed without changing a size of the inductor component such that the inductance can be easily adjusted.

[0012] Preferably, in an embodiment of the inductor component, the first part is a part orthogonal to the axis or a part parallel to the axis, and the second part is a part intersecting the axis at an acute angle, when viewed in the direction orthogonal to the first principal surface.

[0013] According to the embodiment, a length of the bent wirings can be easily increased.

[0014] Preferably, in the embodiment of the inductor component, the element body contains SiO_2.

[0015] According to the embodiment, it is possible to impart insulation properties and stiffness to the element body.

[0016] Preferably, in the embodiment of the inductor component, in the two bent wirings adjacent to each other in the axial direction, a distance between the second part of one of the bent wirings and the second part of the other of the bent wirings is smaller than a distance between the first part of one of the bent wirings and the first part of the other of the bent wirings, when viewed in the direction orthogonal to the first principal surface.

[0017] Here, the distance between the two second parts indicates a shortest distance between the two second parts when viewed in the direction orthogonal to the first principal surface. The same applies to the first part.

[0018] According to the embodiment, since the distance between the two second parts adjacent to each other in the axial direction is short, it is possible to reduce leakage flux.

[0019] Preferably, in the embodiment of the inductor component, the bent wirings are provided in at least the first coil wirings, and at least one second coil wiring of the plurality of second coil wirings extends in a direction in which centers of each of the first penetration wirings and each of the second penetration wirings connected to the same second coil wiring are connected by a straight line when viewed in the direction orthogonal to the first principal surface.

[0020] According to the embodiment, a length of the second coil wirings can be easily shortened.

[0021] Preferably, in the embodiment of the inductor component, the bent wirings are provided in at least the first coil wirings, one first coil wiring of the plurality of first coil wirings has a first end portion connected to the first external electrode and a second end portion connected to the first penetration wiring, and the one first coil wiring extends in a direction in which the first end portion and the second end portion are connected by a straight line when viewed in the direction orthogonal to the first principal surface.

[0022] According to the embodiment, a length of the first coil wiring constituting the outermost turn in the axial direction can be shortened, DC resistance of the coil can be reduced, and the coil can have a small size.

[0023] Preferably, in the embodiment of the inductor component, the first part is a part orthogonal to the axis when viewed in the direction orthogonal to the first principal surface, and a length of the first part is smaller than a half of a width of the element body in a direction orthogonal to the axis when viewed in the direction orthogonal to the first principal surface.

[0024] According to the embodiment, it is possible to reduce a likelihood that two bent wirings adjacent to each other in the axial direction will come into contact with each other.

[0025] Preferably, in the embodiment of the inductor component, the first part is a part orthogonal to the axis, and the second part is a part intersecting the axis at an acute angle, when viewed in the direction orthogonal to the first principal surface, and a width of the second part is 0.5 times or more and 0.95 times or less (i.e., from 0.5 times to 0.95 times) of a width of the first part when viewed in the direction orthogonal to the first principal surface.

[0026] According to the embodiment, since the width of the second part is 0.95 times or less of the width of the first part, the width of the second part can be decreased, and this enables the length of the second part to be increased so that the inductance can be increased. In addition, since the width of the second part is 0.5 times or more of the width of the first part, breakage of the second part can be prevented.

[0027] Preferably, in the embodiment of the inductor component, a shape of the coil has 180° rotational symmetry around a center of the coil in an axial direction when viewed in the direction orthogonal to the first principal surface.

[0028] According to the embodiment, directionality of the inductor component can be eliminated.

[0029] Preferably, in the embodiment of the inductor component, a length of each of the bent wirings between centers of each of the first penetration wirings and each of the second penetration wirings connected to each of the bent wirings is longer by 4% or more of a length obtained by connecting centers of each of the first penetration wirings and each of the second penetration wirings connected to the same bent wiring by a straight line, when viewed in the direction orthogonal to the first principal surface.

[0030] According to the embodiment, since the lengths of the bent wirings can be increased, the inductance can be increased.

[0031] Preferably, in the embodiment of the inductor component, the first part is a part orthogonal to the axis, and the second part is a part intersecting the axis at an acute angle. Also, when viewed in the direction orthogonal to the first principal surface, and when an angle of the second part with respect to the axis is defined as a first angle $\theta 1$, and with respect to the axis, an angle of a straight line connecting centers of each of the first penetration wirings and each of the second penetration wirings connected to each of the bent wirings having the same second part is defined as a second angle $\theta 2$. When viewed in the direction orthogonal to the first principal surface, the second angle $\theta 2$ is larger than the first angle $\theta 1$, the first angle $\theta 1$ is larger than 45° and smaller than 80° (i.e., from larger than 45° to smaller than) 80°, and a difference between the second angle $\theta 2$ and the first angle $\theta 1$ is larger than 1° and smaller than 45° (i.e., from larger than 1° to smaller than) 45°.

[0032] According to the embodiment, since the first angle $\theta 1$ is larger than 45°, the width of the second part can be ensured, and the efficiency of acquisition of inductance can be ensured. Since the first angle $\theta 1$ is smaller than 80°, the length of the second part can be increased, and the inductance can be improved.

[0033] Since the difference between the second angle $\theta 2$ and the first angle $\theta 1$ is larger than 1°, the length of the second part can be increased, and the inductance can be improved. Since the difference between the second angle $\theta 2$ and the first angle $\theta 1$ is smaller than 45°, the width of the second part can be ensured.

[0034] Preferably, in the embodiment of the inductor component, the bent wirings are provided in at least the first coil wirings, an outermost first coil wiring positioned on an outermost side in the axial direction of the plurality of first coil wirings is not one of the bent wirings, and a maximum length in the axial direction of the outermost first coil wiring is larger than a maximum length in the axial direction of one of the first coil wirings which is adjacent to the outermost first coil wiring in the axial direction when viewed in the direction orthogonal to the first principal surface.

[0035] According to the embodiment, a width of the first coil wiring at the outermost end can be increased such that the DC resistance of the coil can be reduced. In addition, the width of the first coil wiring at the outermost end can be increased by effectively utilizing a dead space in an outermost region of the coil in the axial direction in the element body.

[0036] Preferably, another embodiment of the inductor component comprises: an element body having a first principal surface and a second principal surface opposite to each other; a coil that is provided in the element body and is wound in a spiral shape along an axis; and a first external electrode and a second external electrode that are provided on the element body and are electrically connected to the coil. The axis of the coil is disposed parallel to the first principal surface. The coil includes a plurality of first coil wirings which are provided on the first principal surface side with respect to the axis and are arranged along the axis on a plane parallel to the first principal surface, a plurality of second coil wirings which are provided on the second principal surface side with respect to the axis and are arranged along the axis on a plane parallel to the second principal surface, a plurality of first penetration wirings which extend from the respective first coil wirings toward the respective second coil wirings and are arranged along the axis, and a plurality of second penetration wirings which extend from the respective first coil wirings toward the respective second coil wirings, are provided on a side opposite to the respective first penetration wirings with respect to the axis, and are arranged along the axis. Each of the first coil wirings, each of the first penetration wirings, each of the second coil wirings, and each of the second penetration wirings form at least a part of the spiral shape by being connected in this order. At least one of the plurality of first coil wirings and the plurality of second coil wirings is a bent wiring including a curved part, when viewed in a direction orthogonal to the first principal surface.

[0037] According to the embodiment, since the coil includes the first coil wirings, the first penetration wirings, the second coil wirings, and the second penetration wirings, and each of the first coil wirings, each of the first penetration wirings, each of the second coil wirings, and each of the second penetration wirings form at least a part of the spiral shape by being connected in this order, it is possible to increase an inner diameter of the coil such that it is possible to increase the efficiency of acquisition of inductance. In addition, a Q value can be increased by increasing the efficiency of acquisition of inductance.

[0038] Further, since at least one of the plurality of first coil wirings and the plurality of second coil wirings is the bent wiring including the curved part, a length of the wirings of the coil can be changed without changing a size of the inductor component such that the inductance can be easily adjusted.

[0039] Preferably, in the embodiment of the inductor component, a plurality of the bent wirings are present, and all the curved parts are curved to project toward one side in the axial direction when viewed in the direction orthogonal to the first principal surface.

[0040] According to the embodiment, since all the curved parts are curved to project to one side in the axial direction, a reverse magnetic field is not generated in all the curved parts such that the efficiency of acquisition of the inductor can be increased.

[0041] Preferably, in the embodiment of the inductor component, a side surface of each of the curved parts has a recess when viewed from the direction orthogonal to the first principal surface.

[0042] According to the embodiment, since the side surface of each of the curved parts has the recess, the width of the curved parts can be decreased such that it is possible to decrease a likelihood that two bent wirings adjacent to each other in the axial direction will come into contact with each other.

[0043] Preferably, in the embodiment of the inductor component, the bent wirings have only the respective curved parts.

[0044] According to the embodiment, since each of the bent wirings does not have a straight part, the length of the coil can be further increased.

[0045] According to the inductor component which is the one aspect of the present disclosure, it is possible to increase the efficiency of acquisition of inductance.

BRIEF DESCRIPTION OF THE DRAWINGS

[0046] FIG. **1** is a schematic bottom view of an inductor component from a bottom surface side according to a first embodiment;

[0047] FIG. **2** is a cross-sectional view taken along line II-II in FIG. **1**;

[0048] FIG. **3** is a cross-sectional view taken along line III-III in FIG. **1**;

[0049] FIG. **4**A is a schematic bottom view of a bottom surface wiring from the bottom surface side;

[0050] FIG. **4**B is a schematic bottom view of a top surface wiring from the bottom surface side;

[0051] FIG. **5**A is a schematic cross-sectional view illustrating a method for manufacturing an inductor component;

[0052] FIG. **5**B is a schematic cross-sectional view illustrating the method for manufacturing an inductor component;

[0053] FIG. **5**C is a schematic cross-sectional view illustrating the method for manufacturing an inductor component;

[0054] FIG. **5**D is a schematic cross-sectional view for illustrating the method for manufacturing an inductor component;

[0055] FIG. **5**E is a schematic cross-sectional view illustrating the method for manufacturing an inductor component;

[0056] FIG. **5**F is a schematic cross-sectional view illustrating the method for manufacturing an inductor component;

[0057] FIG. **5**G is a schematic cross-sectional view illustrating the method for manufacturing an inductor component;

[0058] FIG. **5**H is a schematic cross-sectional view illustrating the method for manufacturing an inductor component;

[0059] FIG. **5**I is a schematic cross-sectional view illustrating the method for manufacturing an inductor component;

[0060] FIG. **5**J is a schematic cross-sectional view illustrating the method for manufacturing an inductor component;

[0061] FIG. **5**K is a schematic cross-sectional view illustrating the method for manufacturing an inductor component;

[0062] FIG. **5**L is a schematic cross-sectional view illustrating the method for manufacturing an inductor component;

[0063] FIG. **5**M is a schematic cross-sectional view illustrating the method for manufacturing an inductor component;

[0064] FIG. **6**A is a cross-sectional view showing a first modification example of the inductor component;

[0065] FIG. **6**B is a cross-sectional view showing a second modification example of the inductor component;

[0066] FIG. **6**C is a cross-sectional view showing a third modification example of the inductor component;

[0067] FIG. **6**D is a cross-sectional view showing a fourth modification example of the inductor component;

[0068] FIG. **7**A is a schematic bottom view of a bottom surface wiring from the bottom surface side according to a fifth modification example of the inductor component;

[0069] FIG. **7**B is a schematic bottom view of a top surface wiring from the bottom surface side according to the fifth modification example of the inductor component;

[0070] FIG. **8** is a schematic bottom view of an inductor component from a bottom surface side according to a second embodiment;

[0071] FIG. **9** is a cross-sectional view taken along line IX-IX in FIG. **8**;

[0072] FIG. **10** is a schematic bottom view of the top surface wiring from the bottom surface side;

[0073] FIG. **11**A is a schematic cross-sectional view illustrating a method for manufacturing the inductor component;

[0074] FIG. **11**B is a schematic cross-sectional view illustrating the method for manufacturing an inductor component;

[0075] FIG. **11**C is a schematic cross-sectional view illustrating the method for manufacturing an inductor component;

[0076] FIG. **11**D is a schematic cross-sectional view illustrating the method for manufacturing an inductor component;

[0077] FIG. **11**E is a schematic cross-sectional view illustrating the method for manufacturing an inductor component;

[0078] FIG. **11**F is a schematic cross-sectional view illustrating the method for manufacturing an inductor component;

[0079] FIG. **11**G is a schematic cross-sectional view illustrating the method for manufacturing an inductor component;

[0080] FIG. **11**H is a schematic cross-sectional view illustrating the method for manufacturing an inductor component;

[0081] FIG. **12**A is a cross-sectional view showing a first modification example of the inductor component;

[0082] FIG. **12**B is a cross-sectional view showing a second modification example of the inductor component;

[0083] FIG. **12**C is a cross-sectional view showing a third modification example of the inductor component;

[0084] FIG. **13** is a schematic bottom view of an inductor component from a bottom surface side according to a third embodiment; and

[0085] FIG. **14** is a schematic bottom view of a top surface wiring of an inductor component from a bottom surface side according to a fourth embodiment.

DETAILED DESCRIPTION

[0086] Hereinafter, an inductor component which is the one aspect of the present disclosure will be described in detail with reference to embodiments shown in the drawings. Note that the drawings include some schematic drawings, and may not reflect actual dimensions and ratios.

First Embodiment

[0087] An inductor component **1** according to the first embodiment will be described below. FIG. **1** shows a schematic bottom view of the inductor component **1** from a bottom surface side thereof. FIG. **2** is a cross-sectional view taken along line II-II in FIG. **1**. FIG. **3** is a cross-sectional view taken along line III-III in FIG. **1**. Note that, in FIG. **1**, an external electrode is drawn by a two-dot chain line for convenience. In addition, in FIG. **1**, an element body **10** is drawn transparently so that a structure thereof can be easily understood, but may be translucent or opaque.

1. GENERAL CONFIGURATION

[0088] A general configuration of the inductor component **1** will be described. The inductor component **1** is, for example, a surface mount inductor component that is used in a high-frequency signal transmission circuit. As shown in FIGS. **1**, **2**, and **3**, the inductor component **1** includes the element body **10**, a coil **110** that is provided in the element body **10** and is wound in a spiral shape along an axis AX, and a first external electrode **121** and a second external electrode **122** that are provided on the element body **10** and are electrically connected to the coil **110**.

[0089] The element body **10** has a length, a width, and a height. The element body **10** has a first end surface **100*e*1** and a second end surface **100*e*2** on both end sides in a length direction, a first side surface **100*s*1** and a second side surface **100*s*2** on both end sides in a width direction, and a bottom surface **100*b*** and a top surface **100*t*** on both end sides in a height direction. That is, outer surfaces **100** of the element body **10** include the first end surface **100*e*1** and the second end surface **100*e*2**, the first side surface **100*s*1** and the second side surface **100*s*2**, and the bottom surface **100*b*** and the top surface **100*t***. The bottom surface **100*b*** corresponds to an example of a “first principal surface” described in CLAIMS, and the top surface **100*t*** corresponds to an example of a “second principal surface” described in CLAIMS.

[0090] As shown in the drawings, hereinafter, for convenience of description, a direction that is the length direction (longitudinal direction) of the element body **10** and is from the first end surface **100*e*1** toward the second end surface **100*e*2** is referred to as an X direction. In addition, a direction that is the width direction of the element body **10** and is from the first side surface **100*s*1** toward the second side surface **100*s*2** is referred to as a Y direction. In addition, a direction that is the height direction of the element body **10** and is from the bottom surface **100*b*** toward the top surface **100*t*** is referred to as a Z direction. The X direction, the Y direction, and the Z direction are directions orthogonal to each other and form a right-handed system when arranged in an order of X, Y, and Z.

[0091] In this specification, the “outer surfaces **100** of the element body” including the first end surface **100*e*1**, the second end surface **100*e*2**, the first side surface **100*s*1**, the second side surface **100*s*2**, the bottom surface **100*b***, and the top surface **100*t*** of the element body **10** do not simply mean surfaces of the element body **10** toward the outer circumferential sides of the element body **10**, but are surfaces serving as a boundary between an outside and an inside of the element body **10**. In addition, "above the outer surfaces **100** of the element body **10**" does not indicate an absolute direction such as a vertical upward direction defined in the direction of gravity, but indicates a direction toward the outside with the outer surfaces **100** as a reference, of the outside and inside with the outer surfaces **100** as the boundary therebetween. Hence, "above the outer surfaces **100**" indicates a relative direction determined depending on an orientation of the outer surfaces **100**. In addition, "above" with respect to a certain element means not only above from the corresponding element, that is, an upper position via another object on the corresponding element or an upper position apart from the corresponding element at an interval, but also a position immediately on the corresponding element to be in contact with the corresponding element.

[0092] The axis AX of the coil **110** is disposed parallel to the bottom surface **100***b*. The coil **110** includes a plurality of bottom surface wirings **11***b* which are provided on the bottom surface **100***b* side with respect to the axis AX and are arranged along the axis AX on a plane parallel to the bottom surface **100***b*, a plurality of top surface wirings **11***t* which are provided on the top surface **100***t* side with respect to the axis AX and are arranged along the axis AX on a plane parallel to the top surface **100***t*, a plurality of first penetration wirings **13** which extend from the respective bottom surface wirings **11***b* toward the respective top surface wirings **11***t*, and are arranged along the axis AX, and a plurality of second penetration wirings **14** which extend from the respective bottom surface wirings **11***b* toward the respective top surface wirings **11***t*, are provided on a side opposite to the respective first penetration wirings **13** with respect to the axis AX, and are arranged along the axis AX. Each of the bottom surface wirings **11***b*, each of the first penetration wirings **13**, each of the top surface wirings **11***t*, and each of the second penetration wirings **14** form at least a part of a spiral shape by being connected in this order.

[0093] The bottom surface wiring **11***b* corresponds to an example of a "first coil wiring" described in CLAIMS, and the top surface wiring **11***t* corresponds to an example of a "second coil wiring" described in CLAIMS. The axis AX indicates an intersection line of a first plane passing through centers between the bottom surface wirings **11***b* and the top surface wirings **11***t* and a second plane passing through centers between the first penetration wirings **13** and the second penetration wirings **14**. That is, the axis AX is a straight line passing through a center of an inner diameter portion of the coil **110**. The axis AX of the coil **110** does not have a dimension in a direction orthogonal to the axis AX.

[0094] According to the configuration described above, since the coil **110** includes the bottom surface wirings **11***b*, the first penetration wirings **13**, the top surface wirings **11***t*, and the second penetration wirings **14**, and each of the bottom surface wirings **11***b*, each of the first penetration wirings **13**, each of the top surface wirings **11***t*, and each of the second penetration wirings **14** form at least a part of the spiral shape by being connected in this order, it is possible to increase an inner diameter of the coil **110** such that it is possible to increase the efficiency of acquisition of inductance. In addition, a Q value can be increased by increasing the efficiency of acquisition of inductance.

[0095] To be more specific, since pad portions of a conventional inductor component or the bottom surface wirings **11***b* and the top surface wirings **11***t* of the present embodiment are "reception portions" of wirings (conductive vias of the conventional inductor component or the first penetration wirings **13** and the second penetration wirings **14** of the present embodiment) which penetrate an element body, the pad portions and the bottom and top surface wirings have a shape expanding perpendicularly to a direction in which to penetrate the element body. Here, in a configuration of the conventional inductor component, since the conductive vias extend in a direction parallel to an axis of a coil, the pad portions are expanded in a direction perpendicular to the axis of the coil and are likely to have a structure in which magnetic flux generated in an axial direction of the coil is blocked.

[0096] On the other hand, in the present embodiment, since the first penetration wiring **13** and the second penetration wiring **14** extend in a direction perpendicular to the axis AX of the coil **110**, the bottom surface wiring **11***b* and the top surface wiring **11***t* are expanded in a direction parallel to the axis AX of the coil **110**. Accordingly, it is difficult for the bottom surface wiring **11***b* and the top surface wiring **11***t* to have a structure in which magnetic flux generated in an axis AX direction is blocked. That is, according to the present embodiment, it is possible to have the structure in which it is difficult to block the magnetic flux such that it is possible to improve the efficiency of acquisition of inductance and the Q value.

[0097] FIG. **4**A is a schematic bottom view of the bottom surface wiring **11***b* from the bottom surface side. In FIG. **4**A, for convenience, the first penetration wirings **13** and the second penetration wirings **14** are drawn by two-dot chain lines, and a via part **121***v* of the first external electrode **121** connected to the bottom surface wiring **11***b* and a via part **122***v* of the second external electrode **122** connected to the bottom surface wiring **11***b* are drawn by two-dot chain lines. In addition, the element body **10** is drawn transparently.

[0098] As shown in FIG. **4**A, when viewed in a direction (Z direction) orthogonal to the bottom surface **100***b*, at least one bottom surface wiring **11***b* of the plurality of bottom surface wirings **11***b* is a bent wiring **11***b***1** having a first part **111** and a second part **112** having different angles from each other with respect to the axis AX. An angle of the first part **111** with respect to the axis AX is an angle α formed by the axis AX and an extension line of a first center line **C1** in a width direction of the first part **111** when viewed in the direction orthogonal to the bottom surface **100***b*. An angle of the second part **112** with respect to the axis AX is an angle β formed by the axis AX and a second center line **C2** in a width direction of the second part **112** when viewed in the direction orthogonal to the bottom surface **100***b*. The first center line **C1** is parallel with an extending direction of the first part **111**, and the second center line **C2** is parallel with an extending direction of the second part **112**. The first center line **C1** and the second center line **C2** are represented by a thick chain line.

[0099] According to the configuration described above, since at least one of the plurality of bottom surface wirings **11***b* is the bent wiring **11***b***1** including the first part **111** and the second part **112** having different angles from each other with respect to the axis AX, a length of the wirings of the coil **110** can be changed without changing a size of the inductor component **1** such that the inductance can be easily adjusted.

[0100] To be more specific, a length of the bent wiring **11***b***1** can be adjusted to be longer than that of a straight wiring connecting the first penetration wiring **13** and the second penetration wiring **14** at the shortest distance. As described above, adjustment of the length of the wirings of the coil **110** without changing the size of the inductor component **1** enables the inductance to be adjusted without changing the number of turns or a pitch of the penetration wiring. For example, an inductor suitable for impedance matching can be easily obtained. A length of the bottom surface wiring **11*b*** (including the bent wiring **11*b*1**) is a dimension in an extending direction of the bottom surface wiring **11*b***, and indicates a length of a center line of the bottom surface wiring **11*b***, when viewed in the direction orthogonal to the bottom surface **100*b***.

[0101] Note that, at least one of the plurality of top surface wirings **11*t*** may be a bent wiring including a first part and a second part having different angles from each other with respect to the axis AX, and the length of the wirings of the coil **110** can be changed without changing the size of the inductor component **1** such that the inductance can be easily adjusted. In short, at least one of the plurality of bottom surface wirings **11*b*** and the plurality of top surface wirings **11*t*** may be a bent wiring.

2. CONFIGURATIONS OF RESPECTIVE UNITS

(Inductor Component 1)

[0102] A volume of the inductor component **1** is 0.08 mm^3 or smaller, and a size of a long side of the inductor component **1** is 0.65 mm or smaller. The size of the long side of the inductor component **1** indicates the largest value of a length, a width, and a height of the inductor component **1**, and in this embodiment, indicates the length in the X direction. According to the configuration described above, since the volume of the inductor component **1** is small and the long side of the inductor component **1** is short, a weight of the inductor component **1** is reduced. Therefore, even if the external electrodes **121** and **122** are small, necessary mounting strength can be obtained. In addition, a thickness of the inductor component **1** is preferably 200 μm or smaller. This enables a thin inductor component **1** to be obtained.

[0103] To be more specific, the size (length (X direction)× width (Y direction)× height (Z direction)) of the inductor component **1** is 0.6 mm×0.3 mm×0.3 mm, 0.4 mm×0.2 mm×0.2 mm, 0.25 mm×0.125 mm×0.120 mm, or the like. In addition, the width and the height may not be equal, and may be, for example, 0.4 mm×0.2 mm×0.3 mm.

(Element Body 10)

[0104] The element body **10** contains SiO_2. This enables insulation properties and stiffness to be imparted to the element body **10**. The element body **10** is made of, for example, a glass sintered body. The glass sintered body may contain alumina, and the strength of the element body can be further increased.

[0105] The glass sintered body is formed by, for example, layering insulating layers containing a plurality of types of glass. A layering direction of the plurality of insulating layers is the Z direction. That is, the insulating layer has a layer shape having a principal surface expanding on an X-Y plane. Note that, in the element body **10**, an interface between the plurality of insulating layers may not be distinct due to firing or the like.

[0106] Note that the element body **10** may include, for example, a glass substrate. The glass substrate may be a single-layer glass substrate, and since most of the element body is made of glass, it is possible to reduce a loss such as an eddy current loss at a high frequency.

(Coil 110)

[0107] The coil **110** includes the plurality of bottom surface wirings **11*b***, the plurality of top surface wirings **11*t***, the plurality of first penetration wirings **13**, and the plurality of second penetration wirings **14**. The bottom surface wirings **11*b***, the first penetration wirings **13**, the top surface wirings **11*t***, and the second penetration wirings **14** are connected in this order, respectively, to constitute at least a part of the coil **110** wound in the axis AX direction.

[0108] According to the configuration described above, since the coil **110** is a so-called helical coil **110**, in a cross section orthogonal to the axis AX, it is possible to reduce a region where the bottom surface wiring **11*b***, the top surface wiring **11*t***, the first penetration wiring **13**, and the second penetration wiring **14** are laid out parallel to each other in a winding direction of the coil **110**, and it is possible to reduce stray capacitance in the coil **110**.

[0109] Here, the helical shape indicates a shape in which the number of turns of the entire coil is more than one turn, and the number of turns of the coil in the cross section orthogonal to the axis is less than one turn. One or more turns indicate a state in which the wirings of the coil have, on the cross section orthogonal to the axis, parts that are adjacent to each other in a radial direction and are laid out parallel to each other in the winding direction when viewed in an axial direction, and less than one turn indicates a state in which the wirings of the coil does not have, on the cross section orthogonal to the axis, parts that are adjacent to each other in the radial direction and are laid out parallel to each other in the winding direction when viewed in the axial direction.

[0110] As shown in FIG. **4**A, the plurality of bottom surface wirings **11*b*** are arranged in the X direction. Each of the plurality of bottom surface wirings **11*b*** includes a bent wiring **11*b*1** and straight wirings **11*b*2**. The straight wirings **11*b*2** are disposed at both ends, respectively, in the axis AX direction. The bent wiring **11*b*1** is disposed between the straight wirings **11*b*2** at both ends.

[0111] One straight wiring **11*b*2** of both ends has a first end portion connected to the via part **121*v*** of the first external electrode **121** and a second end portion connected to the first penetration wiring **13**. One straight wiring **11*b*2** extends in a direction in which the first end portion and the second end portion are connected by a straight line when viewed in the direction orthogonal to the bottom surface **100*b***. This enables the length of the bottom surface wiring **11*b*** (straight wiring **11*b*2**) constituting the outermost turn in the axial direction to be shortened, enables the DC resistance of the coil **110** to be reduced, and enables the coil **110** to have a small size.

[0112] Similarly, the other straight wiring **11*b*2** of both ends has a first end portion connected to the via part **122*v*** of the second external electrode **122** and a second end portion connected to the second penetration wiring **14**. The other straight wiring **11*b*2** extends in a direction in which the first end portion and the second end portion are connected by a straight line when viewed in the direction orthogonal to the bottom surface **100*b***.

[0113] The bent wiring **11*b*1** has a first part **111**, a second part **112**, and a third part **113**. The first part **111**, the second part **112**, and the third part **113** are connected in series in this order. In FIG. **4**A, for convenience, in one bent wiring **11*b*1**, a boundary line between the first part **111** and the second part **112** and a boundary line between the second part **112** and the third part **113** are represented by dotted lines.

[0114] When viewed in the direction orthogonal to the bottom surface **100*b***, the angle α of the first part **111** with respect to the axis AX is different from the angle β of the second part **112** with respect to the axis AX as described above. When viewed in the direction orthogonal to the bottom surface **100*b***, an angle γ of the third part **113** with respect to the axis AX is different from the angle β of the second part **112** with respect to the axis AX. The angle γ of the third part **113** with respect to the axis AX is an angle formed by the axis AX and an extension line of a third center line C**3** of the third part **113** in a width direction thereof. The third center line C**3** is parallel to an extending direction of the third part **113**. The third center line C**3** is represented by a thick chain line.

[0115] The first part **111** is a part orthogonal to the axis AX, that is, the angle α is 90°. The second part **112** is a part intersecting the axis AX at an acute angle, that is, the angle β is an acute angle. The third part **113** is a part orthogonal to the axis AX, that is, the angle γ is 90°. According to the configuration described above, the length of the bent wiring **11*b*1** can be easily increased. Note that the angle α may be different from the angle β, and the first part **111** may be a part parallel to the axis AX or a part intersecting the axis AX at an acute angle. In addition, the third part **113** may be a part parallel to the axis AX, or may be a part intersecting the axis AX at an acute angle, or may not be provided. In addition, the bent wiring **11*b*1** may further include another part in addition to the first part **111** to the third part **113**.

[0116] Preferably, in the two bent wirings **11*b*1** adjacent to each other in the axis AX direction, when viewed in the direction orthogonal to the bottom surface **100*b***, a second distance d**2** between a second part **112** of one bent wiring **11*b*1** and a second part **112** of the other bent wiring **11*b*1** is smaller than a first distance d**1** between a first part **111** of one bent wiring **11*b*1** and a first part **111** of the other bent wiring **11*b*1**. The second distance d**2** indicates the shortest distance between the two second parts **112** when viewed in the direction orthogonal to the bottom surface **100*b***. The first distance d**1** indicates the shortest distance between the two first parts **111** when viewed in the direction orthogonal to the bottom surface **100*b***. According to the configuration described above, since the second distance d**2** is short, it is possible to reduce leakage flux. Similarly, the second distance d**2** is preferably smaller than a third distance d**3** between a third part **113** of one bent wiring **11*b*1** and a third part **113** of the other bent wiring **11*b*1**.

[0117] Preferably, when viewed in the direction orthogonal to the bottom surface **100*b***, a length of the first part **111** is smaller than a half of a width of the element body **10** in a direction (Y direction) orthogonal to the axis AX. The length of the first part **111** is a length of the first center line C**1** of the first part **111**. According to the configuration described above, it is possible to reduce a likelihood that two bent wirings **11*b*1** adjacent to each other in the axis AX direction will come into contact with each other. Similarly, a length of the third part **113** is preferably smaller than a half of the width of the element body **10** in the direction orthogonal to the axis AX.

[0118] Preferably, when viewed in the direction orthogonal to the bottom surface **100*b***, a width of the second part **112** in a direction orthogonal to the second center line C**2** is 0.5 times or more and 0.95 times or less (i.e., from 0.5 times to 0.95 times) of a width of the first part **111** in a direction orthogonal to the first center line C**1**. According to the configuration described above, since the width of the second part **112** is 0.95 times or less of the width of the first part **111**, the width of the second part **112** can be decreased, and this enables a length of the second part **112** to be increased so that the inductance can be increased. In addition, since the width of the second part **112** is 0.5 times or more of the width of the first part **111**, breakage of the second part **112** can be prevented. Similarly, when viewed in the direction orthogonal to the bottom surface **100*b***, preferably, the width of the second part **112** in the direction orthogonal to the second center line C**2** is 0.5 times or more and 0.95 times or less (i.e., from 0.5 times to 0.95 times) of the width of the third part **113** in a direction orthogonal to the third center line C**3**.

[0119] Preferably, when viewed in the direction orthogonal to the bottom surface **100*b***, a first length L**1** of the bent wiring **11*b*1** between centers of both the first penetration wiring **13** and the second penetration wiring **14** connected to the bent wiring **11*b*1** is longer by 4% or more of a second length L**2** obtained by connecting centers of both the first penetration wiring **13** and the second penetration wiring **14** connected to the same bent wiring **11*b*1** by a straight line. In FIG. **4**A, the first length L**1** is represented by a chain line, and the second length L**2** is represented by a two-dot chain line. The first length L**1** is a length between the centers of both the first penetration wiring **13** and the second penetration wiring **14** of lengths of center lines (the first center line C**1**, the second center line C**2**, and the third center line C**3**) of the bent wiring **11*b*1**. According to the configuration described above, since the length of the bent wiring **11*b*1** can be increased, the inductance can be increased.

[0120] Preferably, when viewed in the direction orthogonal to the bottom surface **100*b***, the angle β of the second part **112** (second center line C**2**) with respect to the axis AX is set to a first angle θ1, and an angle of a straight line N connecting centers of both the first penetration wiring **13** and the second penetration wiring **14** connected to the bent wiring **11*b*1** having the same second part **112**, with respect to the axis AX, is set to a second angle θ2. In this case, the second angle θ2 is larger than the first angle θ1. The first angle θ1 is larger than 45° and smaller than 80° (i.e., from larger than 45° to smaller than) 80°. A third angle θ3, which is a difference between the second angle θ2 and the first angle θ1, is larger than 1° and smaller than 45° (i.e., from larger than 1° to smaller than) 45°.

[0121] According to the configuration described above, since the first angle θ1 is larger than 45°, the width of the second part **112** can be ensured, and the efficiency of acquisition of inductance can be ensured. Meanwhile, since the first angle θ1 is smaller than 80°, the length of the second part **112** can be increased, and the inductance can be improved.

[0122] On the other hand, in a case where the first angle θ1 is smaller than 45°, regions of the first part **111** and the third part **113** in the bent wiring **11*b*1** increase, the width of the second part **112** connecting the first part **111** and the third part **113** is extremely decreased, and risk of breakage of the second part **112** increases. In addition, a distance between the first penetration wirings **13** adjacent to each other in the axis AX direction and a distance between the second penetration wirings **14** adjacent to each other in the axis AX direction are increased, a coil length is increased, and the efficiency of acquisition of inductance deteriorates. In addition, a distance between the first penetration wiring **13** and the second penetration wiring **14** is shortened, a coil diameter is reduced, and the efficiency of acquisition of inductance deteriorates. Meanwhile, in a case where the first angle θ1 is larger than 80°, the first penetration wiring **13** and the second penetration wiring **14** are connected at a distance close to the shortest distance, and it is not possible to increase a length of the bottom surface wiring **11***b*.

[0123] According to the configuration described above, since the third angle θ3 is larger than 1°, the length of the second part **112** can be increased, and the inductance can be improved. Meanwhile, since the third angle θ3 is smaller than 45°, the width of the second part **112** can be ensured.

[0124] On the other hand, in a case where the third angle θ3 is 0°, that is, the first penetration wiring **13** and the second penetration wiring **14** are connected by the shortest distance, the straight wiring **11***b***2** is formed instead of the bent wiring **11***b***1**, and it is not possible to increase the length of the bottom surface wiring **11***b*. Meanwhile, in a case where the third angle θ3 is larger than 45°, this means that the second part **112** is formed to be approximately parallel to the axis AX, a line width of the second part **112** is narrowed, and the breakage risk increases, similarly to the case where the first angle θ1 is smaller than 45°.

[0125] FIG. **4**B is a schematic bottom view of the top surface wiring **11***t* from the bottom surface side. In FIG. **4**B, for convenience, the first penetration wiring **13** and the second penetration wiring **14** are drawn by two-dot chain lines, and the element body **10** is drawn transparently.

[0126] As shown in FIG. **4**B, the top surface wiring **11***t* extends only in one direction. To be more specific, the top surface wiring **11***t* extends in a direction in which the centers of both the first penetration wiring **13** and the second penetration wiring **14** connected to the same top surface wiring **11***t* are connected by a straight line. That is, the top surface wiring **11***t* has a shape extending in the Y direction. The bent wiring is not provided at the top surface wiring **11***t*. Hence, the length of the top surface wiring **11***t* can be easily shortened.

[0127] All the top surface wirings **11***t* are arranged parallel to each other in the X direction. According to the configuration described above, since the top surface wirings **11***t* extend only in one direction and all the top surface wirings **11***t* are arranged parallel to each other, it is possible to form the fine top surface wirings **11***t* and reduce the size of the inductor component **1** by using, for example, modified illumination in a photolithography process. Note that at least one top surface wiring **11***t* of all the top surface wirings **11***t* may have a shape extending in the Y direction.

[0128] The bottom surface wirings **11***b* and the top surface wirings **11***t* are made of a good conductor material such as copper, silver, gold, or an alloy thereof. The bottom surface wirings **11***b* and the top surface wirings **11***t* may be a metal film formed by plating, vapor deposition, sputtering, or the like, or may be a metal sintered body obtained by applying and sintering a conductor paste. In addition, the bottom surface wirings **11***b* and the top surface wirings **11***t* may have a multilayer structure in which a plurality of metal layers are layered. The bottom surface wirings **11***b* and the top surface wirings **11***t* have a thickness of preferably 5 μm or more and 50 μm or less (i.e., from 5 μm to 50 μm).

[0129] As shown in FIG. **1**, the first penetration wirings **13** are disposed in through-holes V of the element body **10** on the first side surface **100***s***1** side with respect to the axis AX, and the second penetration wirings **14** are disposed in the other through-holes V of the element body **10** on the second side surface **100***s***2** side with respect to the axis AX. Each of the first penetration wirings **13** and the second penetration wirings **14** extends in a direction orthogonal to the bottom surface **100***b* and the top surface **100***t*. This enables lengths of the first penetration wirings **13** and the second penetration wirings **14** to be shortened, thus enabling the direct current resistance (Rdc) to be reduced. The first penetration wirings **13** and the second penetration wirings **14** are all arranged parallel to each other in the X direction.

[0130] Preferably, the first penetration wirings **13** contain SiO_2. This enables a linear expansion coefficient of the first penetration wiring **13** to be equal to a linear expansion coefficient of the element body **10** in a case where the element body **10** contains SiO_2, thus enabling cracks between the first penetration wirings **13** and the element body **10** to be reduced. The first penetration wiring **13** is made of, for example, a conductive paste. A conductive material is Ag, Cu, or the like. Similarly, the second penetration wirings **14** preferably contain SiO_2.

[0131] Preferably, at least one wiring of the bottom surface wirings **11***b*, the top surface wirings **11***t*, the first penetration wirings **13**, and the second penetration wirings **14** includes a void portion or a resin portion. This enables stress due to a difference in linear expansion coefficient between the wiring and the element body **10** to be absorbed by the void portion or the resin portion, thus enabling the stress to be alleviated. As a method of forming the void portion, for example, the void portion can be formed by sintering a wiring, by using a member which is burned into the material of the wiring by being sintered. As a method for forming the resin portion, for example, the resin portion can be formed by using a conductive paste in the material of the wiring.

[0132] Preferably, at least one wiring of the bottom surface wirings **11***b* and the top surface wirings **11***t* contains SiO_2. This enables a linear expansion coefficient of the wiring to be equal to the linear expansion coefficient of the element body **10** in a case where the element body **10** contains SiO_2, thus enabling cracks between the wiring and the element body **10** to be reduced.

[0133] Preferably, the shape of the coil **110** has 180° rotational symmetry around a center of the coil **110** in the axis AX direction when viewed in the direction orthogonal to the bottom surface **100***b*. According to the configuration described above, directionality of the inductor component **1** can be eliminated.

(First External Electrode **121** and Second External Electrode **122**)

[0134] As shown in FIG. **1**, the first external electrode **121** is connected to the first end portion of the coil **110**, and the second external electrode **122** is connected to the second end portion of the coil **110**. The first external electrode **121** is provided on the first end surface **100***e***1** side with respect to a center of the element body **10** in the X direction to be exposed from the outer surface **100** of the element body **10**. The second external electrode **122** is provided on the second end surface **100***e***2** side with respect to a center of the element body **10** in the X direction to be exposed from the outer surface **100** of the element body **10**.

[0135] When viewed in the direction orthogonal to the bottom surface **100***b*, the first external electrode **121** and the second external electrode **122** are positioned on an inner side with respect to the outer surface **100** of the element body **10**. That is, the first external electrode **121** and the second external electrode **122** are positioned on an inner side with respect to the first end surface **100***e***1**, the second end surface **100***e***2**, the first side surface **100***s***1**, and the second side surface **100***s***2** of the element body **10**.

[0136] According to the configuration described above, since the first external electrode **121** and the second external electrode **122** are not in contact with the outer surfaces **100** of the element body **10**, loads applied to the first external electrode **121** and the second external electrode **122** can be decreased, and deformation and peeling of the first external electrode **121** and the second external electrode **122** can be reduced, when division into individual inductor components is performed. Therefore, even if the inductor component has a small size, it is possible to prevent the first external electrode **121** and the second external electrode **122** from being deformed or peeled off.

[0137] Note that the first external electrode **121** may be provided to be continuously connected to the bottom surface **100***b* and the first end surface **100***e***1**. This enables a solder fillet to be formed on the first external electrode **121** when the inductor component **1** is mounted on a mounting substrate, since the first external electrode **121** is a so-called L-shaped electrode. Similarly, the second external electrode **122** may be provided to be continuously connected to the bottom surface **100***b* and the second end surface **100***e***2**.

[0138] The first external electrode **121** has a bottom surface part **121***b* provided on the bottom surface **100***b* and a via part **121***v* embedded in the bottom surface **100***b*. The via part **121***v* is connected to the bottom surface part **121***b*. The via part **121***v* is connected to an end portion of the bottom surface wiring **11***b* positioned on the first end surface **100***e***1** side in the axis AX direction.

[0139] The second external electrode **122** has a bottom surface part **122***b* provided on the bottom surface **100***b* and a via part **122***v* embedded in the bottom surface **100***b*. The via part **122***v* is connected to the bottom surface part **122***b*. The via part **122***v* is connected to an end portion of the bottom surface wiring **11***b* positioned on the second end surface **100***e***2** side in the axis AX direction.

[0140] As shown in FIG. **3**, the first external electrode **121** has a base layer **121***e***1** and a plating layer **121***e***2** covering the base layer **121***e***1**. The base layer **121***e***1** contains, for example, a conductive material such as Ag or Cu. The plating layer **121***e***2** contains, for example, a conductive material such as Ni or Sn. A part of the bottom surface part **121***b* and the via part **121***v* are formed by the base layer **121***e***1**. The other part of the bottom surface part **121***b* is formed by the plating layer **121***e***2**. Similarly, the second external electrode **122** has a base layer and a plating layer covering the base layer. Note that the first external electrode **121** and the second external electrode **122** may be made of a single-layer conductor material.

(Method for Manufacturing Inductor Component **1**)

[0141] Next, a method for manufacturing the inductor component **1** will be described with reference to FIGS. **5**A to **5**M. FIGS. **5**A to **5**H, **5**K, and **5**L are views corresponding to a cross section taken along line II-II in FIG. **1**. FIGS. **5**I, **5**J, and **5**M are views corresponding to a cross section taken along line III-III in FIG. **1**.

[0142] As shown in FIG. **5**A, a first insulating layer **1011** is printed on a base substrate **1000**. Examples of materials of the base substrate **1000** include a glass substrate, a silicon substrate, an alumina substrate, or the like, and examples of materials of the first insulating layer **1011** include a resin such as epoxy or polyimide, or an inorganic insulating film such as SiO or SiN.

[0143] As shown in FIG. **5**B, a second insulating layer **1012** is printed on the first insulating layer **1011**. A groove **1012***a* is provided in the second insulating layer **1012**. In this case, for example, the groove **1012***a* is formed by the photolithography process. Note that the groove may be formed as a printed pattern from the beginning.

[0144] As shown in FIG. **5**C, a top surface conductor layer **1011***t* is printed in the groove **1012***a*. Examples of materials of the top surface conductor layer **1011***t* include Ag, Cu, Au, Al, an alloy containing at least one of these elements, or a solder paste. In this case, for example, the top surface conductor layer **1011***t* is formed as a printed pattern to remain only in the groove **1012***a*. Note that, after the top surface conductor layer **1011***t* is printed on the second insulating layer **1012**, the top surface conductor layer **1011***t* may remain only in the groove **1012***a* by the photolithography process.

[0145] As shown in FIG. **5**D, a third insulating layer **1013** is printed on the second insulating layer **1012**. The third insulating layer **1013** has a first groove **1013***a* and a second groove **1013***b*. The first groove **1013***a* and the second groove **1013***b* are formed in the same method as described in FIG. **5**B.

[0146] As shown in FIG. **5**E, a first penetration conductor layer **1131** as a first layer is printed in the first groove **1013***a*, and a second penetration conductor layer **1141** as the other first layer is printed in the second groove **1013***b*. The first penetration conductor layer **1131** as the first layer and the second penetration conductor layer **1141** as the other first layer are formed by the same method described in FIG. **5**C.

[0147] By repeating the above-described processes, as shown in FIG. **5**F, a fourth insulating layer **1014** is provided on the third insulating layer **1013**, and a first penetration conductor layer **1132** as a second layer and a second penetration conductor layer **1142** as the other second layer are provided in two respective grooves provided in the fourth insulating layer **1014**. Further, a fifth insulating layer **1015** is provided on the fourth insulating layer **1014**, and a first penetration conductor layer **1133** as a third layer and a second penetration conductor layer **1143** as the other third layer are provided in two respective grooves provided in the fifth insulating layer **1015**.

[0148] As shown in FIG. **5**G, a sixth insulating layer **1016** is provided on the fifth insulating layer **1015**, and a bottom surface conductor layer **1011***b* is provided in a groove provided in the sixth insulating layer **1016**. A material of the bottom surface conductor layer **1011***b* is the same as the material of the top surface conductor layer **1011***t*. As shown in FIG. **5**H, a seventh insulating layer **1017** is provided on the sixth insulating layer **1016**.

[0149] As shown in FIG. **5**I, a groove **1017***a* is provided in the seventh insulating layer **1017** such that a part of the bottom surface conductor layer **1011***b* is exposed. As shown in FIG. **5**J, a base conductor layer **1121***e***1** is provided on the seventh insulating layer **1017** and in the groove **1017***a*. Examples of materials of the base conductor layer **1121***e***1** include resin pastes of Ag or Cu.

[0150] As shown in FIG. **5**K, an entire layered body is sintered in a furnace at a high temperature (for example, 500° C. or higher). The first to seventh insulating layers **1011** to **1017** are sintered to form the element body **10**, the top surface conductor layer **1011***t* is sintered to form the top surface wiring **11***t*, the bottom surface conductor layer **1011***b* is sintered to form the bottom surface wiring **11***b*, the first penetration conductor layers **1131** to **1133** as the first to third layers are sintered to form the first penetration wiring **13**, the second penetration conductor layers **1141** to **1143** as the first to third other layers are sintered to form the second penetration wiring **14**, and the base conductor layer **1121***e***1** is sintered to form the base layer **121***e***1**. Hence, it is possible to improve the strength by sintering the insulating layers, and a resin component which does not need to be contained in the conductor layers can be volatilized by sintering the conductor layers, and a conductor material contained in the conductor layers can be fused to realize high conductivity. The base substrate **1000** may be peeled off by decomposing a surface during sintering, may be mechanically removed by performing grinding or the like before and after the sintering, or may be chemically removed by performing etching or the like before and after the sintering.

[0151] As shown in FIG. **5**L, division into individual inductor components is performed along a cutting line C. As shown in FIG. **5**M, the plating layer **121***e***2** is formed by performing barrel plating to cover the base layer **121***e***1**, and the first external electrode **121** is formed. Consequently, as shown in FIG. **2**, the inductor component **1** is manufactured.

3. MODIFICATION EXAMPLES

First Modification Example

[0152] FIG. **6**A is a view showing a first modification example of the inductor component, and the view corresponds to the cross section taken along line II-II in FIG. **1**. As shown in FIG. **6**A, in an inductor component **1**A of the first modification example, the first penetration wiring **13** and the second penetration wiring **14** are not parallel to each other when viewed in the direction parallel to the axis AX of the coil **110**. This enables a distance between the first penetration wiring **13** and the second penetration wiring **14** to be increased and enables the inner diameter of the coil **110** to be increased such that it is possible to improve the Q value.

[0153] To be more specific, the first penetration wiring **13** and the second penetration wiring **14** are bent at respective centers thereof in the Z direction such that a space therebetween is widened toward the centers. That is, each of the first penetration wiring **13** and the second penetration wiring **14** has a shape expanding outward in a radial direction of the coil **110** toward the center in the Z direction. In addition, each of the first penetration wiring **13** and the second penetration wiring **14** has a stepped shape in the Z direction. According to the configuration described above, in a case where the first penetration wiring **13** and the second penetration wiring **14** are each formed by layering a plurality of conductor layers, the first penetration wiring **13** and the second penetration wiring **14** can be easily formed in the stepped shape by shifting and layering each conductor layer.

Second Modification Example

[0154] FIG. **6**B is a view showing a second modification example of the inductor component, and the view corresponds to the cross section taken along line II-II in FIG. **1**. As shown in FIG. **6**B, in an inductor component **1**B of the second modification example, the first penetration wiring **13** and the second penetration wiring **14** are not parallel to each other when viewed in the direction parallel to the axis AX of the coil **110**. This enables a distance between the first penetration wiring **13** and the second penetration wiring **14** to be increased and enables the inner diameter of the coil **110** to be increased such that it is possible to improve the Q value.

[0155] To be more specific, the first penetration wirings **13** and the second penetration wirings **14** are inclined such that a space therebetween is widened toward the top surface wiring **11***t* side in the Z direction. That is, each of the first penetration wirings **13** and the second penetration wirings **14** has a shape expanding outward in the radial direction of the coil **110** toward the top surface wiring **11***t* in the Z direction. As described above, the coil **110** has a trapezoidal shape when viewed from the axis AX direction. According to the configuration described above, the first penetration wirings **13** and the second penetration wirings **14** can be linearly formed and shortened, and the DC resistance of the first penetration wirings **13** and the second penetration wirings **14** can be reduced.

Third Modification Example

[0156] FIG. **6**C is a view showing a third modification example of the inductor component, and the view corresponds to the cross section taken along line II-II in FIG. **1**. As shown in FIG. **6**C, an inductor component **1**C of the third modification example includes a first coil **110**A and a second coil **110**B as compared with the inductor component **1**A of the first modification example shown in FIG. **6**A.

[0157] In the first coil **110**A, the first penetration wiring **13** and the second penetration wiring **14** are not parallel to each other when viewed in the direction parallel to the axis AX. This enables a distance between the first penetration wiring **13** and the second penetration wiring **14** to be increased and enables the inner diameter of the coil **110**A to be increased such that it is possible to improve the Q value.

[0158] To be more specific, the first penetration wiring **13** has the same configuration as that of the first penetration wiring **13** of the inductor component **1**A of the first modification example. Meanwhile, the second penetration wiring **14** has a linear shape parallel to the Z direction. That is, the first penetration wiring **13** is bent at a center thereof in the Z direction such that a space between the first penetration wiring **13** and the second penetration wiring **14** is widened toward the center. The first penetration wiring **13** has a stepped shape in the Z direction. According to the configuration described above, in a case where the first penetration wiring **13** is formed by layering a plurality of conductor layers, the first penetration wiring **13** can be easily formed in the stepped shape by shifting and layering each conductor layer.

[0159] In the second coil **110**B, the first penetration wiring **13** and the second penetration wiring **14** are not parallel to each other when viewed in the direction parallel to the axis AX. This enables a distance between the first penetration wiring **13** and the second penetration wiring **14** to be increased and enables the inner diameter of the coil **110**B to be increased such that it is possible to improve the Q value.

[0160] To be more specific, the second penetration wiring **14** has the same configuration as that of the second penetration wiring **14** of the inductor component **1**A of the first modification example. Meanwhile, the first penetration wiring **13** has a linear shape parallel to the Z direction. That is, the second penetration wiring **14** is bent at a center thereof in the Z direction such that a space between the first penetration wiring **13** and the second penetration wiring **14** is widened toward the center. The second penetration wiring **14** has a stepped shape in the Z direction. According to the configuration described above, in a case where the second penetration wiring **14** is formed by layering a plurality of conductor layers, the second penetration wiring **14** can be easily formed in the stepped shape by shifting and layering each conductor layer.

Fourth Modification Example

[0161] FIG. **6**D is a view showing a fourth modification example of the inductor component, and the view corresponds to the cross section taken along line II-II in FIG. **1**. As shown in FIG. **6**D, an inductor component **1**D of the fourth modification example includes a first coil **110**A and a second coil **110**B as compared with the inductor component **1**B of the second modification example shown in FIG. **6**B.

[0162] In the first coil **110**A, the first penetration wiring **13** and the second penetration wiring **14** are not parallel to each other when viewed in the direction parallel to the axis AX. This enables a distance between the first penetration wiring **13** and the second penetration wiring **14** to be increased and enables the inner diameter of the coil **110**A to be increased such that it is possible to improve the Q value.

[0163] To be more specific, the first penetration wiring **13** has the same configuration as that of the first penetration wiring **13** of the inductor component **1**B of the second modification example. Meanwhile, the second penetration wiring **14** has a linear shape parallel to the Z direction. That is, the first penetration wiring **13** is inclined such that a space between the first penetration wiring **13** and the second penetration wiring **14** is widened toward the top surface wiring **11***t* side in the Z direction. According to the configuration described above, the first penetration wirings **13** and the second penetration wirings **14** can be linearly formed and shortened, and the DC resistance of the first penetration wirings **13** and the second penetration wirings **14** can be reduced.

[0164] In the second coil **110**B, the first penetration wiring **13** and the second penetration wiring **14** are not parallel to each other when viewed in the direction parallel to the axis AX. This enables a distance between the first penetration wiring **13** and the second penetration wiring **14** to be increased and enables the inner diameter of the coil **110**B to be increased such that it is possible to improve the Q value.

[0165] To be more specific, the second penetration wiring **14** has the same configuration as that of the second penetration wiring **14** of the inductor component **1**B of the second modification example. Meanwhile, the first penetration wiring **13** has a linear shape parallel to the Z direction. That is, the second penetration wiring **14** is inclined such that a space between the first penetration wiring **13** and the second penetration wiring **14** is widened toward the top surface wiring **11***t* side in the Z direction. According to the configuration described above, the first penetration wirings **13** and the second penetration wirings **14** can be linearly formed, and the electrical resistance of the first penetration wirings **13** and the second penetration wirings **14** can be reduced.

Fifth Modification Example

[0166] FIG. **7**A is a schematic bottom view of a bottom surface wiring **11***b* from the bottom surface side according to a fifth modification example of the inductor component. In FIG. **7**A, for convenience, the first penetration wirings **13** and the second penetration wirings **14** are drawn by two-dot chain lines, and a via part **121***v* of the first external electrode **121** connected to the bottom surface wiring **11***b* and a via part **122***v* of the second external electrode **122** connected to the bottom surface wiring **11***b* are drawn by two-dot chain lines. In addition, the element body **10** is drawn transparently.

[0167] As shown in FIG. **7**A, in an inductor component **1**E of the fifth modification example, among the plurality of bottom surface wirings **11***b*, the bottom surface wiring **11***b* at the outermost end positioned on the outermost side in the axis AX direction is not a bent wiring but a wide wiring **11***b***3**. The bottom surface wirings **11***b* positioned between the wide wirings **11***b***3** at both ends are bent wirings **11***b***1**.

[0168] when viewed in the direction orthogonal to the bottom surface **100***b*, a maximum length M**1** of the wide wiring **11***b***3** in the axis AX direction is larger than a maximum length M**2** in the axis AX direction of the bottom surface wiring **11***b* (bent wiring **11***b***1**) adjacent to the wide wiring **11***b***3** in the axis AX direction.

[0169] According to the configuration described above, a width of the bottom surface wiring **11***b* at the outermost end can be increased such that the DC resistance of the coil can be reduced. In addition, the width of the bottom surface wiring **11***b* at the outermost end can be increased by effectively utilizing a dead space in an outermost region of the coil in the axis AX direction in the element body.

[0170] FIG. **7**B is a schematic bottom view of a top surface wiring **11***t* from the bottom surface side according to the fifth modification example of the inductor component. In FIG. **7**B, for convenience, the first penetration wiring **13** and the second penetration wiring **14** are drawn by two-dot chain lines, and the element body **10** is drawn transparently.

[0171] As shown in FIG. **7**B, among a plurality of top surface wirings **11***t*, the top surface wiring **11***t* at the outermost end positioned on the outermost side in the axis AX direction is a wide wiring **11***t***3**. The top surface wirings **11***t* positioned between the wide wirings **11***t***3** at both ends are straight wirings **11***t***2**.

[0172] when viewed in the direction orthogonal to the bottom surface **100***b*, a maximum length M**3** of the wide wiring **11***t***3** in the axis AX direction is larger than a maximum length M**4** in the axis AX direction of the top surface wiring **11***t* (straight wiring **11***t***2**) adjacent to the wide wiring **11***t***3** in the axis AX direction.

[0173] According to the configuration described above, a width of the top surface wiring **11***t* at the outermost end can be increased such that the DC resistance of the coil can be reduced. In addition, the width of the top surface wiring **11***t* at the outermost end can be increased by effectively utilizing a dead space in an outermost region of the coil in the axis AX direction in the element body.

[0174] Note that the bent wirings may be provided at least on as the bottom surface wirings **11***b*, or may be provided as both the bottom surface wirings **11***b* and the top surface wirings **11***t*.

Second Embodiment

[0175] FIG. **8** shows a schematic bottom view of a second embodiment of the inductor component from a bottom surface side. FIG. **9** is a cross-sectional view taken along line IX-IX in FIG. **8**. In FIG. **8**, for convenience, an insulating layer is omitted, and the external electrodes are drawn by two-dot chain lines. In addition, in FIG. **8**, the element body **10** is drawn transparently so that a structure thereof can be easily understood. The second embodiment differs from the first embodiment mainly in the shape of the coil, the position of the axis of the coil, the material of the element body, and providing of an insulating layer, and these different configurations will be mainly described below. The other configurations are the same as those of the first embodiment, and the description thereof will be omitted.

1. CONFIGURATIONS OF RESPECTIVE UNITS

(Inductor Component **1**F)

[0176] As shown in FIG. **8**, in an inductor component **1**F, an axis AX of a coil **110** is perpendicular to the X direction. To be more specific, the axis AX is parallel to the Y direction and passes a center of the element body **10** in the X direction. This enables interference in magnetic flux of the coil **110** by the first external electrode **121** and the second external electrode **122** to be reduced, and it is possible to improve the efficiency of acquisition of inductance.

[0177] A length of the coil **110** in the axis AX direction is shorter than an inner diameter of the coil **110**. The length of the coil **110** in the axis AX direction is also referred to as a coil length. This enables the Q value to be improved since the coil length is short and the coil inner diameter is large. The inner diameter of the coil indicates an equivalent circle diameter based on a minimum area of a region surrounded by the coil **110** when viewed therethrough in the axis AX direction.

(Element Body **10**)

[0178] The element body **10** is an inorganic insulating body. The material of the element body **10** is preferably glass, and this enables an eddy current to be reduced and enables the Q value to be increased since the glass has high insulation properties. The element body **10** preferably contains an Si element, and this enables the thermal stability of the element body **10** to be increased, thus, enabling variations in dimension or the like of the element body **10** due to heat to be reduced and enabling variations in electrical characteristics to be decreased.

[0179] The element body **10** is preferably a single-layer glass plate. This enables the strength of the element body **10** to be ensured. In addition, in the case of the single-layer glass plate, since dielectric loss is small, the Q value at a high frequency can be increased. In addition, since no sintering process for such a sintered body is performed, deformation of the element body **10** during sintering can be reduced. Hence, it is possible to reduce pattern misalignment and provide an inductor component with a small inductance tolerance.

[0180] As a material of the single-layer glass plate, a glass plate having photosensitivity represented by Foturan II (Schott AG's registered trademark) is preferable from the viewpoint of a manufacturing method. In particular, the single-layer glass plate preferably contains cerium oxide (ceria: CeO_2), and in this case, cerium oxide serves as a sensitizer, and processing by photolithography becomes easier.

[0181] However, since the single-layer glass plate can be processed by machining such as drilling or sandblasting, dry/wet etching using a photoresist/metal mask, laser processing, or the like, the single-layer glass plate may be a non-photosensitive glass plate. In addition, the single-layer glass plate may be obtained by sintering a glass paste, or may be formed by a known method such as a float process.

(Insulating Body **22**)

[0182] As shown in FIG. **9**, the inductor component **1**F includes an insulating body **22**. The insulating body **22** covers both the bottom surface **100***b* and the top surface **100***t* of the element body **10**. Note that the insulating body **22** may be provided only on the bottom surface **100***b* of the bottom and top surfaces **100***b* and **1100***t*.

[0183] The insulating body **22** is a member that protects the wirings from an external force by covering the wirings (the bottom surface wirings **11***b* and the top surface wirings **11***t*), and has a role of preventing the wirings from being damage and a role of improving insulation properties of the wirings. The insulating body **22** is preferably an organic insulating body. For example, the insulating body **22** may be a film made of a resin such as epoxy or polyimide which is easily formed. In particular, the insulating body **22** is preferably made of a material having a low dielectric constant. Consequently, in a case where the insulating body **22** is present between the coil **110** and the external electrode **121** or **122**, it is possible to decrease the stray capacitance formed between the coil **110** and the external electrode **121** or **122**. The insulating body **22** can be formed, for example, by laminating a resin film such as ABF GX-92 (manufactured by Ajinomoto Fine-Techno Co., Inc.), applying and thermal-curing a paste-like resin, or the like. Note that the insulating body **22** may be, for example, an inorganic film made of an oxide such as silicon or hafnium, a nitride, an oxynitride, or the like, which is excellent in insulating properties and thinning.

[0184] Preferably, when the element body **10** is the inorganic insulating body, and the insulating body **22** is an organic insulating body, the organic insulating body is positioned on an inner side with respect to the outer surfaces **100** of the inorganic insulating body when viewed in the direction orthogonal to the bottom surface **100***b*. According to this, since the organic insulating body is provided and easily imparts flowability, and thus is easily filled into a space between wirings adjacent to each other and enables insulating properties to be improved, in a case where the wirings (the bottom surface wirings **11***b* and the top surface wirings **11***t*) are covered with the organic insulating body. In addition, since the organic insulating body is not in contact with the outer surface of the inorganic insulating body, it is possible to decrease a load applied to the organic insulating body and reduce deformation and peeling of the organic insulating body when division into individual inductor components is performed.

(Coil **110**)

[0185] As shown in FIG. **8**, all the bottom surface wirings **11***b* are arranged parallel to each other in the Y direction. The bottom surface wirings **11***b* extend only in one direction. That is, the bottom surface wirings **11***b* have a shape extending in the X direction. To be more specific, one bottom surface wiring **11***b* of both ends in the axis AX direction has a first end portion connected to the via part **121***v* of the first external electrode **121** and a second end portion connected to the second penetration wiring **14**. The one bottom surface wiring **11***b* extends in a direction in which the first end portion and the second end portion are connected by a straight line when viewed in the direction orthogonal to the bottom surface **100***b*.

[0186] The other bottom surface wiring **11***b* of both ends in the axis AX direction has a first end portion connected to the via part **122***v* of the second external electrode **122** and a second end portion connected to the first penetration wiring **13**. The other bottom surface wiring **11***b* extends in a direction in which the first end portion and the second end portion are connected by a straight line when viewed in the direction orthogonal to the bottom surface **100***b*.

[0187] The rest of the other bottom surface wirings **11***b* has a first end portion connected to the first penetration wiring **13** and a second end portion connected to the second penetration wiring **14**. The rest of the other bottom surface wirings **11***b* extends in a direction in which the first end portion and the second end portion are connected by a straight line when viewed in the direction orthogonal to the bottom surface **100***b*.

[0188] As described above, the bottom surface wirings **11***b* are not the bent wirings but the straight wirings. Hence, a length of the bottom surface wiring **11***b* can be easily shortened.

[0189] The first penetration wirings **13** are disposed in the through-holes V of the element body **10** on the first end surface **100***e***1** side with respect to the axis AX, and the second penetration wirings **14** are disposed in the other through-holes V of the element body **10** on the second end surface **100***e***2** side with respect to the axis AX. Each of the first penetration wirings **13** and the second penetration wirings **14** extends in a direction orthogonal to the bottom surface **100***b* and the top surface **100***t*. The plurality of first penetration wirings **13** and the plurality of second penetration wirings **14** are all arranged parallel to each other in the Y direction.

[0190] FIG. **10** is a schematic bottom view of the top surface wirings **11***t* from the bottom surface side. In FIG. **10**, for convenience, the first penetration wiring **13** and the second penetration wiring **14** are drawn by two-dot chain lines, and the element body **10** is drawn transparently.

[0191] As shown in FIG. **10**, the plurality of top surface wirings **11***t* are arranged in the Y direction. The top surface wiring **11***t* is a bent wiring **11***t***1**. The bent wiring **11***t***1** has a first part **111**, a second part **112**, and a third part **113**. The first part **111**, the second part **112**, and the third part **113** are connected in series in this order.

[0192] The bent wiring **11***t***1** (the first part **111**, the second part **112**, and the third part **113**) of the top surface wiring **11***t* has the same configuration as that the bent wiring **11***b***1** (the first part **111**, the second part **112**, and the third part **113**) of the bottom surface wiring **11***b* described in the first embodiment, and has the same effects. Hereinafter, the bent wiring **11***t***1** of the top surface wiring **11***t* will be described, but the detailed configuration (definitions and the like) thereof is the same as that of the bent wiring **11***b***1** of the bottom surface wiring **11***b* described in the first embodiment, and thus the description thereof will be omitted.

[0193] When viewed in the direction orthogonal to the bottom surface **100***b*, an angle of the first part **111** with respect to the axis AX is different from an angle β of the second part **112** with respect to the axis AX. When viewed in the direction orthogonal to the bottom surface **100***b*, an angle γ of the third part **113** with respect to the axis AX is different from the angle β of the second part **112** with respect to the axis AX. According to the configuration described above, a length of the bent wiring **11***t***1** can be easily increased.

[0194] Preferably, in the two bent wirings **11***t***1** adjacent to each other in the axis AX direction, when viewed in the direction orthogonal to the bottom surface **100***b*, a second distance d**2** between a second part **112** of one bent wiring **11***t***1** and a second part **112** of the other bent wiring **11***t***1** is smaller than a first distance d**1** between a first part **111** of one bent wiring **11***t***1** and a first part **111** of the other bent wiring **11***t***1**. According to the configuration described above, since the second distance d**2** is short, it is possible to reduce leakage flux. Similarly, the second distance d**2** is preferably smaller than a third distance d**3** between a third part **113** of one bent wiring **11***t***1** and a third part **113** of the other bent wiring **11***t***1**.

[0195] Preferably, when viewed in the direction orthogonal to the bottom surface **100***b*, a length of the first part **111** is smaller than a half of a width of the element body **10** in a direction (X direction) orthogonal to the axis AX. The length of the first part **111** is a length of the first center line C**1** of the first part **111**. According to the configuration described above, it is possible to reduce a likelihood that two bent wirings **11***t***1** adjacent to each other in the axis AX direction will come into contact with each other. Similarly, a length of the third part **113** is preferably smaller than a half of the width of the element body **10** in the direction orthogonal to the axis AX.

[0196] Preferably, when viewed in the direction orthogonal to the bottom surface **100***b*, a width of the second part **112** in a direction orthogonal to the second center line C**2** is 0.5 times or more and 0.95 times or less (i.e., from 0.5 times to 0.95 times) of a width of the first part **111** in a direction orthogonal to the first center line C**1**. According to the configuration described above, since the width of the second part **112** is 0.95 times or less of the width of the first part **111**, the width of the second part **112** can be decreased, and this enables a length of the second part **112** to be increased so that the inductance can be increased. Meanwhile, since the width of the second part **112** is 0.5 times or more of the width of the first part **111**, breakage of the second part **112** can be prevented. Similarly, when viewed in the direction orthogonal to the bottom surface **100***b*, preferably, the width of the second part **112** in the direction orthogonal to the second center line C**2** is 0.5 times or more and 0.95 times or less (i.e., from 0.5 times to 0.95 times) of the width of the third part **113** in a direction orthogonal to the third center line C**3**.

[0197] Preferably, when viewed in the direction orthogonal to the bottom surface **100***b*, a first length of the bent wiring **11***t***1** between centers of both the first penetration wiring **13** and the second penetration wiring **14** connected to the bent wiring **11***t***1** is longer by 4% or more of a second length obtained by connecting centers of both the first penetration wiring **13** and the second penetration wiring **14** connected to the same bent wiring **11*t*1** by a straight line. The first length is a length between the centers of both the first penetration wiring **13** and the second penetration wiring **14** of lengths of center lines (the first center line C**1**, the second center line C**2**, and the third center line C**3**) of the bent wiring **11*t*1**. According to the configuration described above, since the length of the bent wiring **11*t*1** can be increased, the inductance can be increased.

[0198] Preferably, when viewed in the direction orthogonal to the bottom surface **100*b***, an angle of the second part **112** (second center line C**2**) with respect to the axis AX is set to a first angle, and an angle of a straight line connecting centers of both the first penetration wiring **13** and the second penetration wiring **14** connected to the bent wiring **11*t*1** having the same second part **112**, with respect to the axis AX, is set to a second angle. In this case, the second angle is larger than the first angle. The first angle is larger than 45° and smaller than 80° (i.e., from larger than 45° to smaller than) 80°. A third angle, which is a difference between the second angle and the first angle, is larger than 1° and smaller than 45° (i.e., from larger than 1° to smaller than) 45°.

[0199] According to the configuration described above, since the first angle is larger than 45°, the width of the second part **112** can be ensured, and the efficiency of acquisition of inductance can be ensured. Since the first angle is smaller than 80°, the length of the second part **112** can be increased, and the inductance can be improved. Since the third angle is larger than 1°, the length of the second part **112** can be increased, and the inductance can be improved. Meanwhile, since the third angle is smaller than 45°, a width of the second part **112** can be ensured.

(First External Electrode **121** and Second External Electrode **122**)

[0200] As shown in FIG. **9**, an outer surface of the first external electrode **121** has a recessed portion **121*a***. The recessed portion **121*a*** is provided at a position overlapping the via part **121*v*** on an upper surface of the first external electrode **121** when viewed in the direction orthogonal to the bottom surface **100*b***. This allows solder to enter the recessed portion **121*a*** of the first external electrode **121**, and allows the connection strength between the first external electrode **121** and the solder to be improved, in a case where the inductor component **1**F is mounted on a substrate.

[0201] Similarly, an outer surface of the second external electrode **122** may have a recessed portion. This allows solder to enter the recessed portion of the second external electrode **122**, and allows the connection strength between the second external electrode **122** and the solder to be improved, in a case where the inductor component **1**F is mounted on a substrate. Note that the first external electrode **121** and the second external electrode **122** may be formed to have flat upper surfaces, respectively.

(Method for Manufacturing Inductor Component **1**F)

[0202] Next, a method for manufacturing the inductor component **1**F will be described with reference to FIGS. **11**A to **11**H. FIGS. **11**A to **11**H are views corresponding to a cross section taken along line IX-IX in FIG. **8**.

[0203] As shown in FIG. **11**A, copper foil **2001** is printed on a base substrate **2000**. A material of the base substrate **2000** is the same as that of the base substrate **1000** of the first embodiment.

[0204] As shown in FIG. **11**B, a glass substrate **2010** which becomes the element body **10** is provided on the base substrate **2000**. For example, the base substrate **2000** and the glass substrate **2010** are brought into close contact with each other using a jig such as a conductive tape, a pin, or a frame. The glass substrate **2010** has a through-hole V. The glass substrate **2010** is, for example, a through glass via (TGV) substrate. The TGV substrate is a substrate in which a through-hole is formed in advance by a laser, photolithography, or the like. The glass substrate **2010** may be, for example, a through silicon via (TSV) substrate, or may be another substrate. In addition, Ti/Cu or other necessary conductive materials may be deposited on a surface of the glass substrate **2010** in advance as seeds by sputtering or the like.

[0205] As shown in FIG. **11**C, a first penetration conductor layer **2013** which becomes the first penetration wiring **13** is formed in the through-hole V of the glass substrate **2010**. Although not shown, similarly, a second penetration conductor layer which becomes the second penetration wiring **14** is formed in the through-hole V. To be more specific, by supplying electric power from the copper foil **2001** on the base substrate **2000**, electrolytic plating is performed on the through-hole V of the glass substrate **2010** to form the first penetration conductor layer **2013**. Otherwise, a seed layer may be formed on the surface of the glass substrate **2010** or an inner surface of the through-hole V by sputtering or the like, and the penetration conductor layer may be formed by using a known method such as fill plating, conformal plating, or a printing filling method of a conductive paste. In a case where there is unnecessary plating growth on the surface of the glass substrate **2010**, an unnecessary part is removed by polishing, CMP, wet etching (etchback), or dry etching.

[0206] As shown in FIG. **11**D, the base substrate **2000** is peeled off from the glass substrate **2010**. In this case, the base substrate **2000** may be mechanically removed by grinding or the like, or may be chemically removed by etching or the like.

[0207] As shown in FIG. **11**E, a bottom surface conductor layer **2011*b*** which becomes the bottom surface wiring **11*b*** and a top surface conductor layer **2011*t*** which becomes the top surface wiring **11*t*** are formed on the glass substrate **2010**. To be more specific, a seed layer (not shown) is provided on the entire surface of the glass substrate **2010**, and patterned photoresist is formed on the seed layer. A copper layer is formed on the seed layer in an opening portion of the photoresist by electrolytic plating. The photoresist and the seed layer are removed by wet etching or dry etching. Consequently, the bottom surface conductor layer **2011*b*** and the top surface conductor layer **2011*t*** patterned in an arbitrary shape are formed. In this case, the bottom surface conductor layer **2011*b*** and the top surface conductor layer **2011*t*** may be formed one by one, or may be formed simultaneously.

[0208] As shown in FIG. **11**F, an insulating layer **2022** serving as the insulating body **22** is provided on a top surface and a bottom surface of the glass substrate **2010** to cover the conductor layer. In this case, the insulating layer **2022** on the bottom surface side and the insulating layer **2022** on the top surface side may be formed one by one, or may be formed simultaneously. Thereafter, a hole **2022***a* is formed in the bottom surface conductor layer **2011***b* of the insulating layer **2022** on the bottom surface side by photolithography or laser processing.

[0209] As shown in FIG. **11**G, a first external electrode conductor layer **2121** which becomes the first external electrode **121** is provided on the insulating layer **2022** on the bottom surface side. In this case, the first external electrode conductor layer **2121** is connected to the bottom surface conductor layer **2011***b* via the hole **2022***a*. To be more specific, a Pd catalyst (not shown) is provided on the insulating layer **2022** on the bottom surface side, and an Ni/Au plated layer is formed by electroless plating. Patterned photoresist is formed on the plating layer. A plating layer in an opening portion of the photoresist is removed by wet etching or dry etching. Consequently, the first external electrode conductor layer **2121** patterned in an arbitrary shape is formed. Alternatively, a seed layer (not shown) is provided on the insulating layer **2022** on the bottom surface side, and the patterned photoresist is formed on the seed layer. Next, the seed layer in the opening portion of the photoresist is removed by wet etching or dry etching. An Ni/Au plating layer may be formed on the remaining seed layer by electroless plating. Although not shown, a second external electrode conductor layer which becomes the second external electrode **122** is provided on the insulating layer **2022** on the bottom surface side.

[0210] Here, since the first external electrode conductor layer **2121** is formed to conform to a shape of an upper surface of the insulating layer **2022** on the bottom surface side, an upper surface of the first external electrode conductor layer **2121** has a recessed portion in a region overlapping the hole **2022***a*.

[0211] As shown in FIG. **11**H, division into individual components is performed along the cutting line C. Consequently, as shown in FIG. **9**, the inductor component **1**F is manufactured.

2. MODIFICATION EXAMPLES

First Modification Example

[0212] FIG. **12**A is a view showing a first modification example of the inductor component, and the view corresponds to the cross section taken along line IX-IX in FIG. **8**. As shown in FIG. **12**A, in an inductor component **1**G of the first modification example, the first penetration wiring **13** extends in a direction orthogonal to the bottom surface wiring **11***b*, and a cross-sectional area of each of both end portions **13***e* of the first penetration wiring **13** in an extending direction thereof is larger than a cross-sectional area of a central portion **13***m* of the first penetration wiring **13** in the extending direction. That is, in a cross section of the first penetration wiring **13** in the extending direction, a width of the first penetration wiring **13** in a direction orthogonal to the extending direction continuously increases from the central portion **13***m* toward both the end portions **13***e*.

[0213] This enables the cross-sectional area of the end portion **13***e* of the first penetration wiring **13** to be increased, so that the connectivity between the first penetration wiring **13** and at least one of the bottom surface wiring **11***b* and the top surface wiring **11***t* can be improved. In addition, when the through-hole V is formed as a hole portion in the element body **10**, the through-hole V is filled with a conductive material by fill plating or the like, and the first penetration wiring **13** is formed in the through-hole V, it is easy to fill the through-hole V on an opening side with the conductive material. Since the cross-sectional area of the end portion **13***e* of the first penetration wiring **13** is large, and the cross-sectional area of the central portion **13***m* of the first penetration wiring **13** is small, the first penetration wiring **13** is easily formed.

[0214] Note that the cross-sectional area of one end portion **13***e* of the first penetration wiring **13** may be larger than the cross-sectional area of the central portion **13***m* of the first penetration wiring **13**. Similarly, the cross-sectional area of at least one end portion of the second penetration wiring **14** may be larger than the cross-sectional area of the central portion **13***m* of the first penetration wiring **13**.

Second Modification Example

[0215] FIG. **12**B is a view showing a second modification example of the inductor component, and the view corresponds to the cross section taken along line IX-IX in FIG. **8**. As shown in FIG. **12**B, in an inductor component **1**H of the second modification example, the first penetration wiring **13** includes a conductive layer **13***s* positioned on an outer circumferential side thereof when viewed from an extending direction of the first penetration wiring **13**, and a non-conductive layer **13***u* positioned inside the conductive layer **13***s*. This prevents the Q value from being reduced by providing the conductive layer **13***s* on the outer circumferential side since a current mainly flows in a surface of the first penetration wiring **13** due to a skin effect in the case of use in a high frequency band. In addition, by providing the non-conductive layer **13***u* inside, stress can be alleviated, and manufacturing costs can be reduced by using no conductor.

[0216] An example of a method of forming the conductive layer **13***s* and the non-conductive layer **13***u* will be described. A seed layer is provided on the inner surface of the through-hole V of the element body **10** by sputtering or electroless plating. A plating layer is formed on the seed layer by electrolytic plating. In this manner, for example, a plurality of conductive layers **13***s* of Ti/Cu/electrolytic Cu, Pd/electroless Cu/electrolytic Cu, or the like can be formed on the first penetration wiring **13** on the outer circumferential side thereof. Thereafter, the inside of the conductive layer **13***s* is sealed with a resin by printing, hot pressing, or the like to form the non-conductive layer **13***u* made of a resin. In this manner, stress can be alleviated by the non-conductive layer **13***u* inside the first penetration wiring **13** while a current flows in the surface (the conductive layer **13***s*) of the first penetration wiring **13**.

[0217] Similarly, the second penetration wiring **14** may include a conductive layer positioned on an outer circumferential side thereof when viewed from an extending direction of the second penetration wiring **14**, and a non-conductive layer positioned inside the conductive layer. Note that a cross-sectional area of each of both end portions of the first penetration wiring **13** in the extending direction is larger than a cross-sectional area of a central portion of the first penetration wiring **13** in the extending direction, but the cross-sectional area of each of both the end portions of the first penetration wiring **13** in the extending direction may be the same as the cross-sectional area of the central portion of the first penetration wiring **13** in the extending direction.

Third Modification Example

[0218] FIG. **12**C is a view showing a third modification example of the inductor component, and the view corresponds to the cross section taken along line IX-IX in FIG. **8**. As shown in FIG. **12**C, in an inductor component **1**I of the third modification example, the first external electrode **121** is not connected to the bottom surface wiring **11***b* but is connected to the first penetration wiring **13** on the rightmost side in FIG. **12**C. That is, a first end portion of the corresponding first penetration wiring **13** is connected to the first external electrode **121**, and a second end portion of the corresponding first penetration wiring **13** is connected to the top surface wiring **11***t* on the rightmost side in FIG. **12**C. This enables the coil **110** to be easily connected to the first external electrode **121** even when the number of turns of the coil **110** is changed.

[0219] Similarly, although not shown, the second external electrode **122** is not connected to the bottom surface wiring **11***b* but is connected to the second penetration wiring **14** on the leftmost side in FIG. **12**C. That is, a first end portion of the corresponding second penetration wiring **14** is connected to the second external electrode **122**, and a second end portion of the corresponding second penetration wiring **14** is connected to the top surface wiring **11***t* on the rightmost side in FIG. **12**C.

[0220] The number of the bottom surface wirings **11***b* is smaller than the number of the top surface wirings **11***t*, and two bottom surface wirings **11***b* and three top surface wirings **11***t* are provided. The bottom surface wirings **11***b* are the bent wirings, and the top surface wirings **11***t* are the straight wirings.

Third Embodiment

[0221] FIG. **13** is a schematic bottom view of a third embodiment of the inductor component from the bottom surface side. In FIG. **13**, an external electrode is drawn by a two-dot chain line for convenience. In addition, in FIG. **13**, the element body **10** is drawn transparently so that a structure thereof can be easily understood. The third embodiment differs from the first embodiment in that the bottom surface wiring and the top surface wiring have different shapes from each other, and these different configurations will be described below. The other configurations are the same as those of the first embodiment, and the description thereof will be omitted.

[0222] As shown in FIG. **13**, in an inductor component **1**J according to the third embodiment, when viewed in a direction (Z direction) orthogonal to the bottom surface **100***b*, all the bottom surface wirings **11***b* and all the top surface wirings **11***t* are bent wirings having respective curved parts **115**. To be more specific, each of the bent wirings includes a curved part **115** and a straight part. The straight part is positioned at each of both ends of the bent wiring, and the curved part **115** is positioned between the straight parts at both ends. The straight parts at both ends have different angles from each other with respect to the axis AX.

[0223] According to the configuration described above, since the bottom surface wirings **11***b* and the top surface wirings **11***t* are the bent wirings, a length of the wirings of the coil **110** can be changed without changing a size of the inductor component **1**J such that the inductance can be easily adjusted. Note that at least one of the plurality of bottom surface wirings **11***b* and the plurality of top surface wirings **11***t* may be a bent wiring having the curved part **115**.

[0224] Preferably, a plurality of bent wirings are present, and all the curved parts **115** of the bent wirings are curved to project toward one side in the axial direction when viewed in the direction orthogonal to the bottom surface **100***b*. According to the configuration described above, a magnetic field in a reverse direction is not generated in all the curved parts **115**, and the efficiency of acquisition of the inductor can be increased.

[0225] Preferably, a side surface of the curved part **115** of the bottom surface wiring **11***b* has a recess **115***a* when viewed in the direction orthogonal to the bottom surface **100***b*. The recess **115***a* is provided in the side surface of the curved part **115** on a projecting side. The recess **115***a* is provided at a position opposite to a first penetration wiring **13** connected to a bottom surface wiring **11***b* adjacent to the corresponding bottom surface wiring **11***b* in the axis AX direction. According to the configuration described above, since the side surface of the curved part **115** has the recess **115***a*, a width of the curved part **115** can be decreased such that it is possible to decrease a likelihood that two bent wirings adjacent to each other in the axial direction will come into contact with each other. Note that a side surface of a curved part **115** of the top surface wiring **11***t* may have a recess **115***a*.

[0226] Preferably, the bent wiring is made of only the curved part **115**. According to the configuration described above, since the bent wiring does not have a straight part, it is possible to further increase the length of the coil **110**. Note that at least one of the plurality of bent wirings may be made of only the curved part **115**.

[0227] Note that curvature radii of all the curved parts **115** may be the same, or the curvature radii of at least two curved parts **115** may be different from each other. In addition, one curved part **115** may have a plurality of different radii of curvature. In this case, the radii of curvature may change continuously or stepwise.

Fourth Embodiment

[0228] FIG. **14** is a schematic bottom view of a fourth embodiment of the inductor component from the bottom surface side. FIG. **14** shows a view of the top surface wiring **11***t* from the bottom surface side. In FIG. **14**, for convenience, the first penetration wiring **13** and the second penetration wiring **14** are drawn by two-dot chain lines, and the element body **10** is drawn transparently. The fourth embodiment differs from the second embodiment in FIG. **10** in that the top surface wirings have a different shape, and these different configurations will be described below. The other configurations are the same as those of the second embodiment, and the description thereof will be omitted.

[0229] As shown in FIG. **14**, in an inductor component **1**K according to the fourth embodiment, when viewed in a direction (Z direction) orthogonal to the bottom surface **100***b*, all the top surface wirings **11***t* are bent wirings having respective curved parts **115**.

[0230] To be more specific, the top surface wiring **11***t* on one side (the upper side in FIG. **14**) in the axis AX direction includes the curved part **115** and a straight part. The straight part is positioned at an end portion of the top surface wiring **11***t* on the first penetration wiring **13** side. The curved part **115** is positioned at an end portion of the top surface wiring

11*t* on the second penetration wiring **14** side. The curved part **115** is curved to project upward in FIG. **14**.

[0231] The top surface wiring **11***t* on the other side (the lower side in FIG. **14**) in the axis AX direction includes the curved part **115** and straight parts. The straight parts are positioned at an end portion of the top surface wiring **11***t* on the first penetration wiring **13** side and at an end portion of the top surface wiring **11***t* on the second penetration wiring **14** side. The curved part **115** is positioned between the straight parts at both ends. The curved part **115** is curved in a meandering manner.

[0232] According to the configuration described above, since the top surface wirings **11***t* are the bent wirings, a length of the wirings of the coil **110** can be changed without changing a size of the inductor component **1**K such that the inductance can be easily adjusted. Note that at least one of the plurality of bottom surface wirings **11***b* and the plurality of top surface wirings **11***t* may be a bent wiring having the curved part **115**.

[0233] Preferably, similarly to the third embodiment, a plurality of bent wirings are present, and all the curved parts **115** of the bent wirings are curved to project toward one side in the axial direction when viewed in the direction orthogonal to the bottom surface **100***b*. According to the configuration described above, a magnetic field in a reverse direction is not generated in all the curved parts **115**, and the efficiency of acquisition of the inductor can be increased.

[0234] Preferably, similarly to the third embodiment, a side surface of the curved part **115** has a recess when viewed in the direction orthogonal to the bottom surface **100***b*. According to the configuration described above, since the side surface of the curved part **115** has the recess, a width of the curved part **115** can be decreased such that it is possible to decrease a likelihood that two bent wirings adjacent to each other in the axial direction will come into contact with each other.

[0235] Preferably, similarly to the third embodiment, the bent wiring is made of only the curved part **115**. According to the configuration described above, since the bent wiring does not have a straight part, it is possible to further increase the length of the coil **110**. Note that at least one of the plurality of bent wirings may be made of only the curved part **115**.

[0236] Note that the present disclosure is not limited to the embodiments described above, and can be modified in design without departing from the gist of the present disclosure. For example, the individual characteristic points of the first to fourth embodiments may be variously combined. For example, two or more kinds of bent wirings of all the first to fourth embodiments may be mixed.

[0237] The present disclosure includes the following aspects.

[0238] <1> An inductor component including an element body having a first principal surface and a second principal surface opposite to each other; a coil that is provided in the element body and is wound in a spiral shape along an axis; and a first external electrode and a second external electrode that are provided on the element body and are electrically connected to the coil. The axis of the coil is disposed parallel to the first principal surface. The coil includes a plurality of first coil wirings which are provided on the first principal surface side with respect to the axis and are arranged along the axis on a plane parallel to the first principal surface, a plurality of second coil wirings which are provided on the second principal surface side with respect to the axis and are arranged along the axis on a plane parallel to the second principal surface, a plurality of first penetration wirings which extend from the respective first coil wirings toward the respective second coil wirings and are arranged along the axis, and a plurality of second penetration wirings which extend from the respective first coil wirings toward the respective second coil wirings, are provided on a side opposite to the respective first penetration wirings with respect to the axis, and are arranged along the axis. Each of the first coil wirings, each of the first penetration wirings, each of the second coil wirings, and each of the second penetration wirings form at least a part of the spiral shape by being connected in this order, and at least one of the plurality of first coil wirings and the plurality of second coil wirings is a bent wiring including a first part and a second part having different angles from each other with respect to the axis when viewed in a direction orthogonal to the first principal surface.

[0239] <2> The inductor component according to <1>, in which the first part is a part orthogonal to the axis or a part parallel to the axis, and the second part is a part intersecting the axis at an acute angle, when viewed in the direction orthogonal to the first principal surface.

[0240] <3> The inductor component according to <1> or <2>, in which the element body contains SiO_2.

[0241] <4> The inductor component according to any one of <1> to <3>, in which, in the two bent wirings adjacent to each other in the axial direction, a distance between the second part of one of the bent wirings and the second part of the other of the bent wirings is smaller than a distance between the first part of one of the bent wirings and the first part of the other of the bent wirings, when viewed in the direction orthogonal to the first principal surface.

[0242] <5> The inductor component according to any one of <1> to <4>, in which the bent wirings are provided in at least the first coil wirings, and at least one second coil wiring of the plurality of second coil wirings extends in a direction in which centers of each of the first penetration wirings and each of the second penetration wirings connected to the same second coil wiring are connected by a straight line when viewed in the direction orthogonal to the first principal surface.

[0243] <6> The inductor component according to any one of <1> to <5>, in which the bent wirings are provided in at least the first coil wirings, one first coil wiring of the plurality of first coil wirings has a first end portion connected to the first external electrode and a second end portion connected to the first penetration wiring, and the one first coil wiring extends in a direction in which the first end portion and the second end portion are connected by a straight line when viewed in the direction orthogonal to the first principal surface.

[0244] <7> The inductor component according to any one of <1> to <6>, in which the first part is a part orthogonal to the axis when viewed in the direction orthogonal to the first principal surface, and a length of the first part is smaller than a half of a width of the element body in a direction orthogonal to the axis when viewed in the direction orthogonal to the first principal surface.

[0245] <8> The inductor component according to any one of <1> to <7>, in which the first part is a part orthogonal to the axis, and the second part is a part intersecting the axis at an acute angle, when viewed in the direction orthogonal to the first principal surface, and a width of the second part is 0.5 times or more and 0.95 times or less (i.e., from 0.5 times to 0.95 times) of a width of the first part when viewed in the direction orthogonal to the first principal surface.

[0246] <9> The inductor component according to any one of <1> to <8>, in which the coil has a shape with 180° rotational symmetry around a center of the coil in an axial direction when viewed in the direction orthogonal to the first principal surface.

[0247] <10> The inductor component according to any one of <1> to <9>, in which a length of each of the bent wirings between centers of each of the first penetration wirings and each of the second penetration wirings connected to each of the bent wirings is longer by 4% or more of a length obtained by connecting centers of each of the first penetration wirings and each of the second penetration wirings connected to the same bent wiring by a straight line, when viewed in the direction orthogonal to the first principal surface.

[0248] <11> The inductor component according to any one of <1> to <10>, in which the first part is a part orthogonal to the axis, and the second part is a part intersecting the axis at an acute angle, when viewed in the direction orthogonal to the first principal surface. Also, when an angle of the second part with respect to the axis is defined as a first angle θ1, and with respect to the axis, an angle of a straight line connecting centers of each of the first penetration wirings and each of the second penetration wirings connected to each of the bent wirings having the same second part is defined as a second angle θ2. In addition, when viewed in the direction orthogonal to the first principal surface, the second angle θ2 is larger than the first angle θ1, the first angle θ1 is larger than 45° and smaller than 80° (i.e., from larger than 45° to smaller than) 80°, and a difference between the second angle θ2 and the first angle θ1 is larger than 1° and smaller than 45° (i.e., from larger than 1° to smaller than) 45°.

[0249] <12> The inductor component according to any one of <1> to <11>, in which the bent wirings are provided in at least the first coil wirings, an outermost first coil wiring positioned on an outermost side in the axial direction of the plurality of first coil wirings is not one of the bent wirings, and a maximum length in the axial direction of the outermost first coil wiring is larger than a maximum length in the axial direction of one of the first coil wirings which is adjacent to the outermost first coil wiring in the axial direction when viewed in the direction orthogonal to the first principal surface.

[0250] <13> An inductor component including an element body having a first principal surface and a second principal surface opposite to each other; a coil that is provided in the element body and is wound in a spiral shape along an axis; and a first external electrode and a second external electrode that are provided on the element body and are electrically connected to the coil. The axis of the coil is disposed parallel to the first principal surface. The coil includes a plurality of first coil wirings which are provided on the first principal surface side with respect to the axis and are arranged along the axis on a plane parallel to the first principal surface, a plurality of second coil wirings which are provided on the second principal surface side with respect to the axis and are arranged along the axis on a plane parallel to the second principal surface, a plurality of first penetration wirings which extend from the respective first coil wirings toward the respective second coil wirings and are arranged along the axis, and a plurality of second penetration wirings which extend from the respective first coil wirings toward the respective second coil wirings, are provided on a side opposite to the respective first penetration wirings with respect to the axis, and are arranged along the axis. Each of the first coil wirings, each of the first penetration wirings, each of the second coil wirings, and each of the second penetration wirings form at least a part of the spiral shape by being connected in this order. Also, at least one of the plurality of first coil wirings and the plurality of second coil wirings is a bent wiring including a curved part, when viewed in a direction orthogonal to the first principal surface.

[0251] <14> The inductor component according to <13>, in which a plurality of the bent wirings are present, and all the curved parts are curved to project toward one side in the axial direction when viewed in the direction orthogonal to the first principal surface.

[0252] <15> The inductor component according to <13> or <14>, in which a side surface of each of the curved parts has a recess when viewed from the direction orthogonal to the first principal surface.

[0253] <16> The inductor component according to any one of <13> to <15>, in which the bent wirings have only the respective curved parts.

What is claimed is:

1. An inductor component comprising:

an element body having a first principal surface and a second principal surface opposite to each other;

a coil that is in the element body and is wound in a spiral shape along an axis; and

a first external electrode and a second external electrode that are on the element body and are electrically connected to the coil, in which

the axis of the coil is parallel to the first principal surface,

the coil includes

a plurality of first coil wirings which are on the first principal surface side with respect to the axis and are arranged along the axis on a plane parallel to the first principal surface,

a plurality of second coil wirings which are on the second principal surface side with respect to the axis and are arranged along the axis on a plane parallel to the second principal surface,

a plurality of first penetration wirings which extend from the respective first coil wirings toward the respective second coil wirings and are arranged along the axis, and

a plurality of second penetration wirings which extend from the respective first coil wirings toward the respective second coil wirings, are on a side opposite to the respective first penetration wirings with respect to the axis, and are arranged along the axis,

each of the first coil wirings, each of the first penetration wirings, each of the second coil wirings, and each of the second penetration wirings configure at least a part of the spiral shape by being connected in this order, and

at least one of the plurality of first coil wirings and the plurality of second coil wirings is a bent wiring including a first part and a second part having different angles from each other with respect to the axis when viewed in a direction orthogonal to the first principal surface.

2. The inductor component according to claim 1, wherein the first part is a part orthogonal to the axis or a part parallel to the axis, and the second part is a part intersecting the axis at an acute angle, when viewed in the direction orthogonal to the first principal surface.

3. The inductor component according to claim 1, wherein the element body includes SiO_2.

4. The inductor component according to claim 1, wherein in the two bent wirings adjacent to each other in the axial direction, a distance between the second part of one of the bent wirings and the second part of the other of the bent wirings is smaller than a distance between the first part of one of the bent wirings and the first part of the other of the bent wirings, when viewed in the direction orthogonal to the first principal surface.

5. The inductor component according to claim 1, wherein the bent wirings are in at least the first coil wirings, and at least one second coil wiring of the plurality of second coil wirings extends in a direction in which centers of each of the first penetration wirings and each of the second penetration wirings connected to the same second coil wiring are connected by a straight line when viewed in the direction orthogonal to the first principal surface.

6. The inductor component according to claim 1, wherein the bent wirings are in at least the first coil wirings, one first coil wiring of the plurality of first coil wirings has a first end portion connected to the first external electrode and a second end portion connected to the first penetration wiring, and the one first coil wiring extends in a direction in which the first end portion and the second end portion are connected by a straight line when viewed in the direction orthogonal to the first principal surface.

7. The inductor component according to claim 1, wherein the first part is a part orthogonal to the axis when viewed in the direction orthogonal to the first principal surface, and a length of the first part is smaller than a half of a width of the element body in a direction orthogonal to the axis when viewed in the direction orthogonal to the first principal surface.

8. The inductor component according to claim 1, wherein the first part is a part orthogonal to the axis, and the second part is a part intersecting the axis at an acute angle, when viewed in the direction orthogonal to the first principal surface, and a width of the second part is from 0.5 times to 0.95 times of a width of the first part when viewed in the direction orthogonal to the first principal surface.

9. The inductor component according to claim 1, wherein the coil has a shape with 180° rotational symmetry around a center of the coil in an axial direction when viewed in the direction orthogonal to the first principal surface.

10. The inductor component according to claim 1, wherein a length of each of the bent wirings between centers of each of the first penetration wirings and each of the second penetration wirings connected to each of the bent wirings is longer by 4% or more of a length obtained by connecting centers of each of the first penetration wirings and each of the second penetration wirings connected to the same bent wiring by a straight line, when viewed in the direction orthogonal to the first principal surface.

11. The inductor component according to claim 1, wherein the first part is a part orthogonal to the axis, and the second part is a part intersecting the axis at an acute angle, when viewed in the direction orthogonal to the first principal surface, and when an angle of the second part with respect to the axis is defined as a first angle $\theta 1$, and with respect to the axis, an angle of a straight line connecting centers of each of the first penetration wirings and each of the second penetration wirings connected to each of the bent wirings having the same second part is defined as a second angle $\theta 2$, when viewed in the direction orthogonal to the first principal surface, the second angle $\theta 2$ is larger than the first angle $\theta 1$, the first angle $\theta 1$ is from larger than 45° to smaller than 80°, and a difference between the second angle $\theta 2$ and the first angle $\theta 1$ is from larger than 1° to smaller than 45°.

12. The inductor component according to claim 1, wherein the bent wirings are in at least the first coil wirings, an outermost first coil wiring positioned on an outermost side in the axial direction of the plurality of first coil wirings is not one of the bent wirings, and a maximum length in the axial direction of the outermost first coil wiring is larger than a maximum length in the axial direction of one of the first coil wirings which is adjacent to the outermost first coil wiring in the axial direction when viewed in the direction orthogonal to the first principal surface.

13. The inductor component according to claim 2, wherein the element body includes SiO_2.

14. The inductor component according to claim 2, wherein in the two bent wirings adjacent to each other in the axial direction, a distance between the second part of one of the bent wirings and the second part of the other of the bent wirings is smaller than a distance between the first part of one of the bent wirings and the first part of the other of the bent wirings, when viewed in the direction orthogonal to the first principal surface.

15. An inductor component comprising:

an element body having a first principal surface and a second principal surface opposite to each other;

a coil that is in the element body and is wound in a spiral shape along an axis; and

a first external electrode and a second external electrode that are on the element body and are electrically connected to the coil, in which

the axis of the coil is parallel to the first principal surface,

the coil includes

a plurality of first coil wirings which are on the first principal surface side with respect to the axis and are arranged along the axis on a plane parallel to the first principal surface, a plurality of second coil wirings which are on the second principal surface side with respect to the axis and are arranged along the axis on a plane parallel to the second principal surface,

a plurality of first penetration wirings which extend from the respective first coil wirings toward the respective second coil wirings and are arranged along the axis, and

a plurality of second penetration wirings which extend from the respective first coil wirings toward the respective second coil wirings, are on a side opposite to the respective first penetration wirings with respect to the axis, and are arranged along the axis,

each of the first coil wirings, each of the first penetration wirings, each of the second coil wirings, and each of the second penetration wirings configure at least a part of the spiral shape by being connected in this order, and

at least one of the plurality of first coil wirings and the plurality of second coil wirings is a bent wiring including a curved part, when viewed in a direction orthogonal to the first principal surface.

16. The inductor component according to claim **15**, wherein

a plurality of the bent wirings are present, and

all the curved parts are curved to project toward one side in the axial direction when viewed in the direction orthogonal to the first principal surface.

17. The inductor component according to claim **15**, wherein

a side surface of each of the curved parts has a recess when viewed from the direction orthogonal to the first principal surface.

18. The inductor component according to claim **15**, wherein

the bent wirings have only the respective curved parts.

19. The inductor component according to claim **16**, wherein

a side surface of each of the curved parts has a recess when viewed from the direction orthogonal to the first principal surface.

20. The inductor component according to claim **16**, wherein

the bent wirings have only the respective curved parts.

* * * * *