US012387896B2

(12) **United States Patent**
Mizuma et al.

(10) **Patent No.: US 12,387,896 B2**
(45) **Date of Patent: Aug. 12, 2025**

(54) **CONTACT DEVICE AND ELECTROMAGNETIC RELAY EQUIPPED WITH SAME**

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(72) Inventors: **Shohei Mizuma**, Mie (JP); **Masahiro Ito**, Mie (JP); **Takuma Nakagawa**, Mie (JP); **Tomokazu Harano**, Mie (JP)

(73) Assignee: **PANASONIC INTELLECTUAL PROPERTY MANAGEMENT CO., LTD.**, Osaka (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 283 days.

(21) Appl. No.: **17/801,774**

(22) PCT Filed: **Feb. 25, 2021**

(86) PCT No.: **PCT/JP2021/006959**
§ 371 (c)(1),
(2) Date: **Aug. 23, 2022**

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PCT Pub. Date: **Sep. 10, 2021**

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(30) **Foreign Application Priority Data**

Mar. 3, 2020 (JP) 2020-036026

(51) **Int. Cl.**
H01H 50/54 (2006.01)
H01H 50/38 (2006.01)

(52) **U.S. Cl.**
CPC ***H01H 50/54*** (2013.01); ***H01H 50/38*** (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

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Primary Examiner — Bernard Rojas
(74) *Attorney, Agent, or Firm* — Rimon P.C.

(57) **ABSTRACT**

Provided is a contact device including a first contact, a second contact that is movable relative to the first contact and is brought into contact with or separated from the first contact, a first body part including the first contact, a second body part including the second contact, and a yoke arranged adjacent to at least one of the first body part or the second body part. At least a part of the yoke is arranged along magnetic flux generated by a current flowing through one body part of the first body part and the second body part that is adjacent to the yoke, in a region where the first body part and the second body part overlap each other when viewed along an axis in which the first contact and the second contact move relative to each other while the first contact and the second contact are in contact with each other.

19 Claims, 32 Drawing Sheets

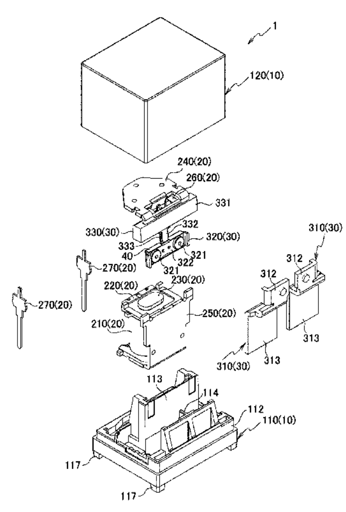

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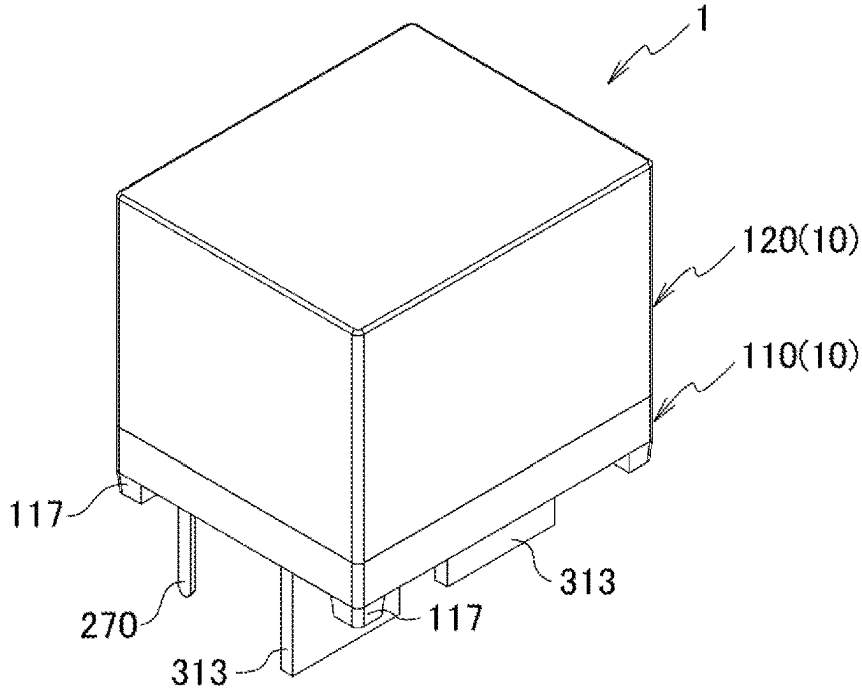
FIG. 1

(a)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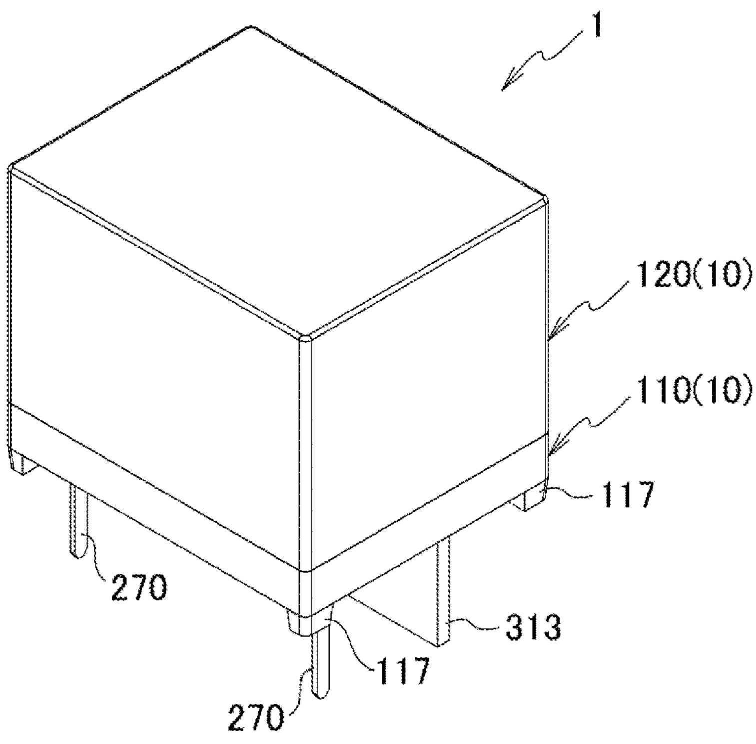
(b)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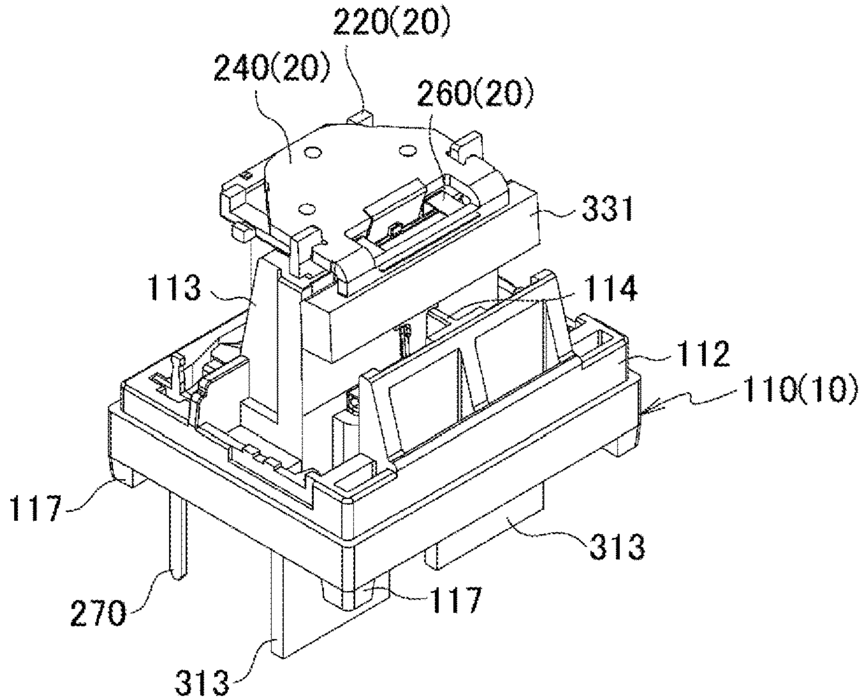
270

FIG. 2

(a)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(b)

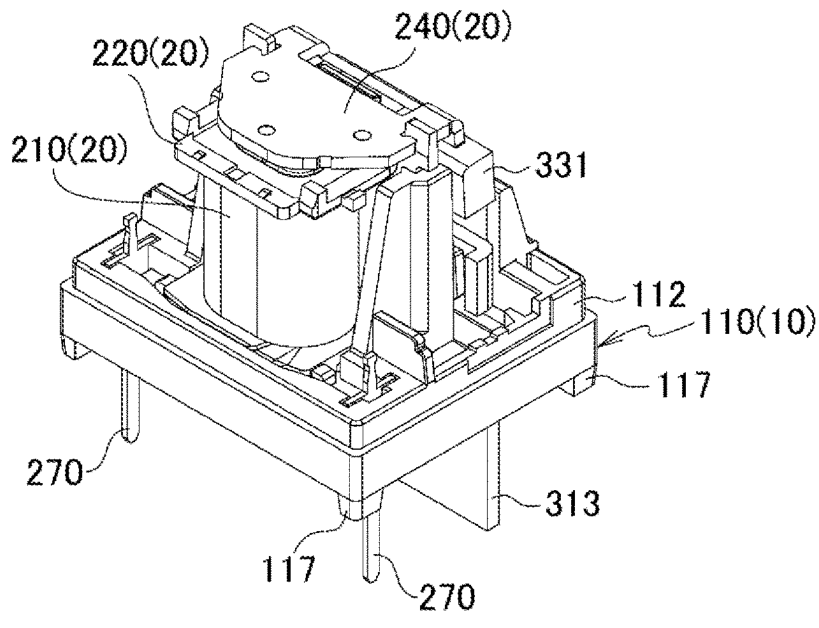
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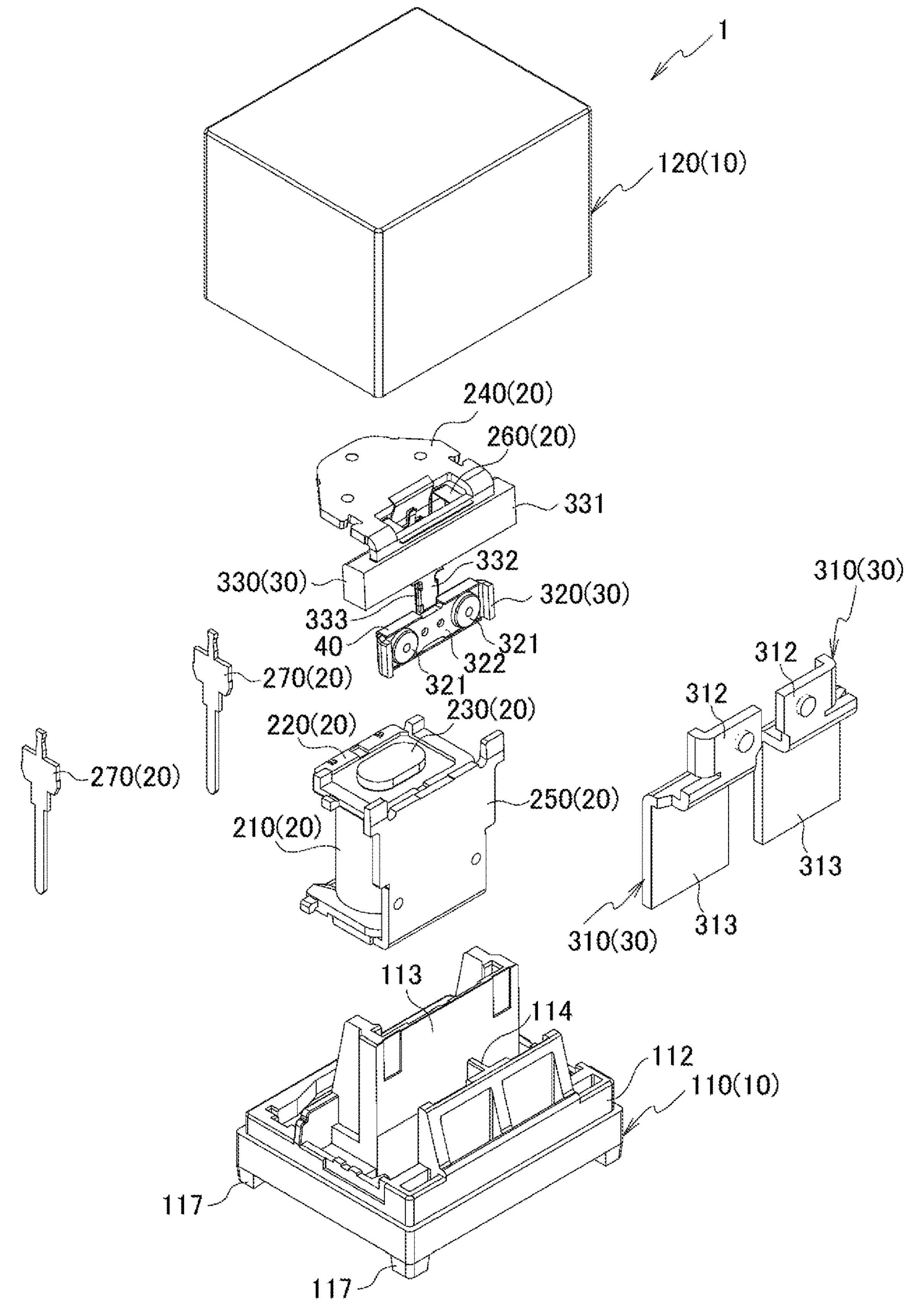
FIG. 3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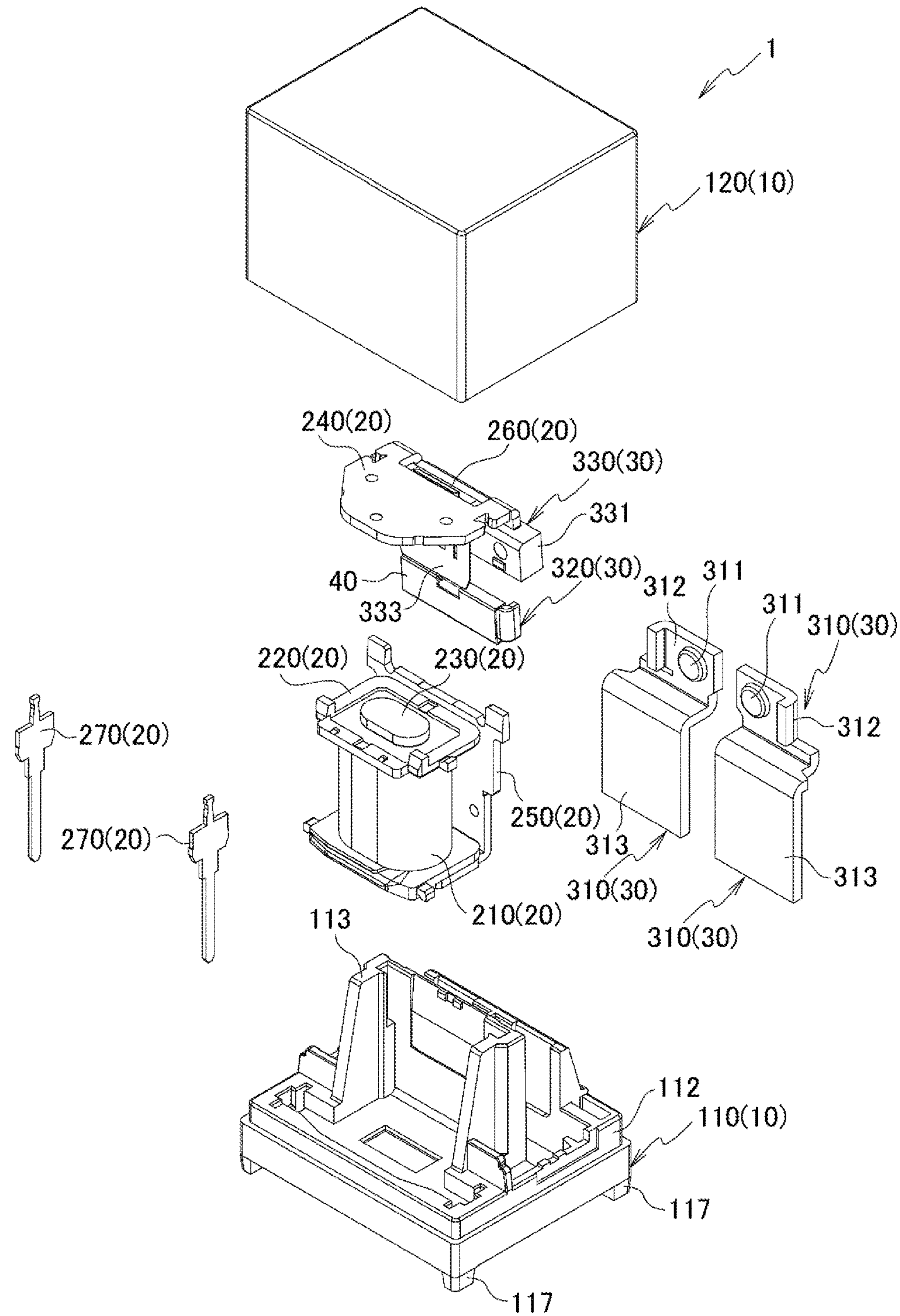
270(20)
220(20)
230(20)
250(20)
210(20)
310(30)
312
312
313
313
310(30)
113
114
112
110(10)
117
117

FIG. 4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320(30)
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311
310(30)
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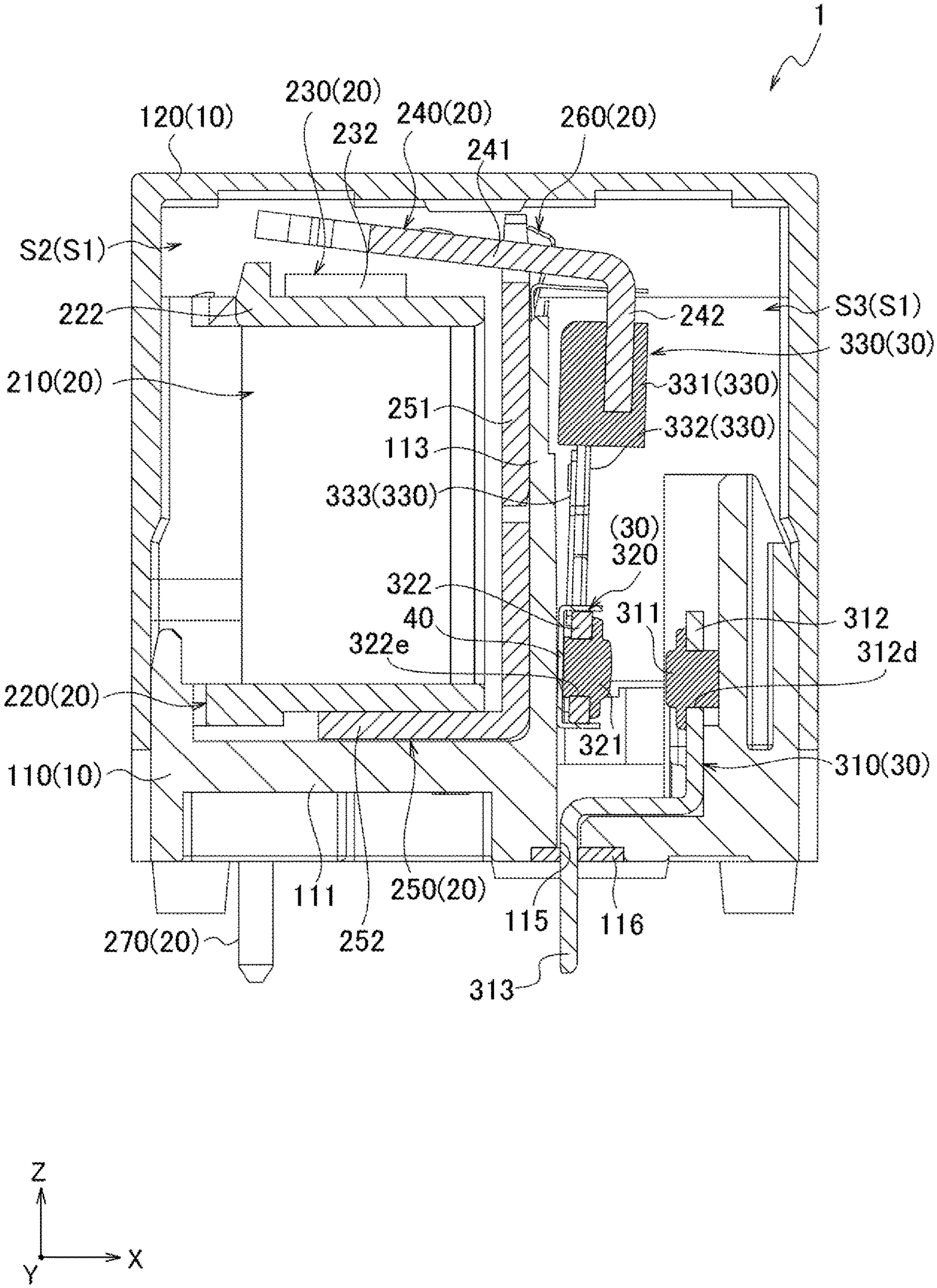
230(20)
312
270(20)
250(20)
270(20)
313
310(30)
313
210(20)
310(30)
113
112
110(10)
117
117

FIG. 5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230(20)
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240(20)
241
260(20)
S2(S1)
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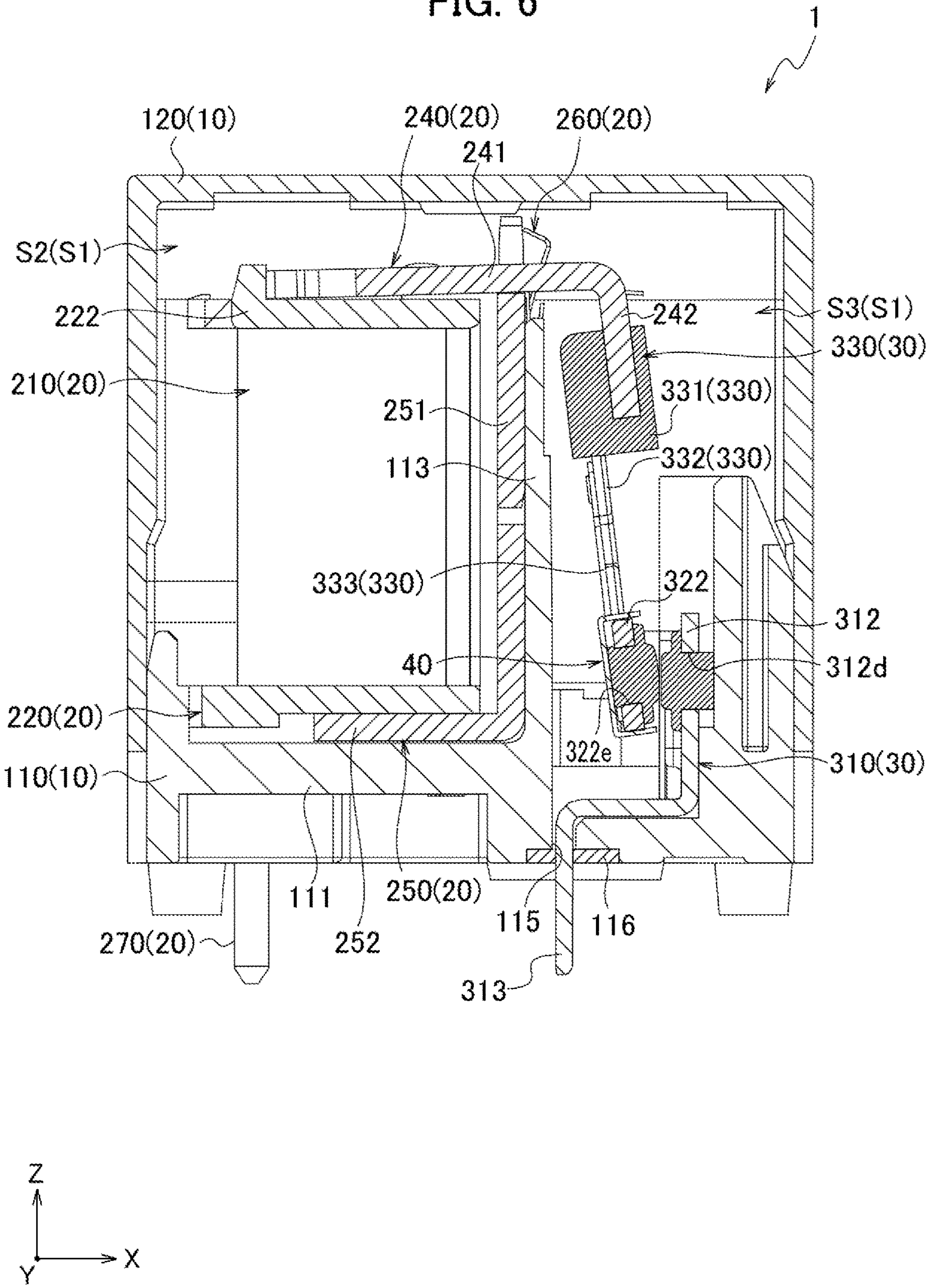
242
S3(S1)
330(30)
331(330)
210(20)
251
332(330)
113
333(330)
(30)
320
322
311
312
40
322e
312d
220(20)
321
310(30)
110(10)
111
250(20)
115
116
252
270(20)
313
Z
X
Y

FIG. 6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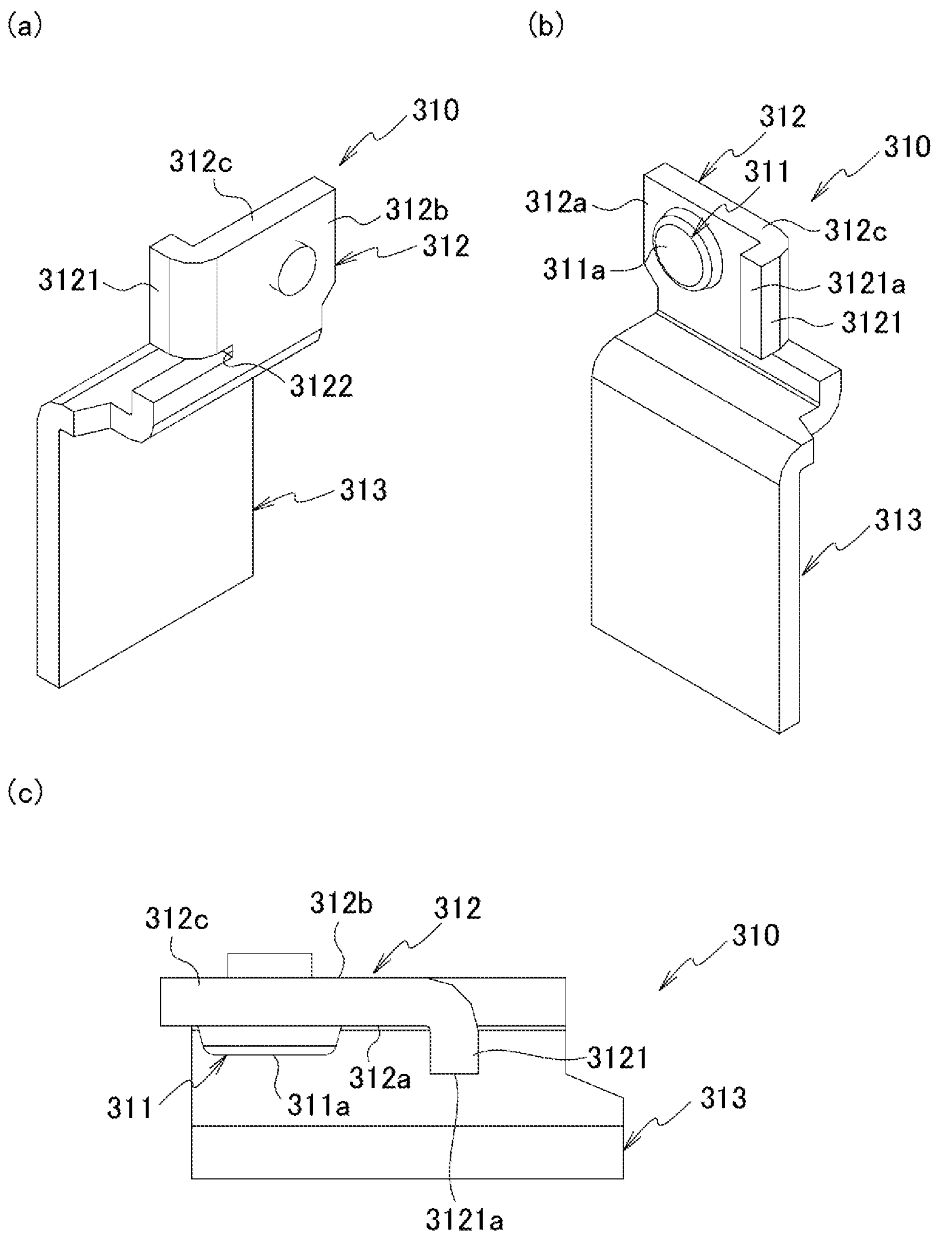
240(20)
260(20)
241
S2(S1)
222
242
S3(S1)
330(30)
210(20)
331(330)
251
113
332(330)
333(330)
322
312
40
312d
220(20)
322e
310(30)
110(10)
111
250(20)
115
116
252
270(20)
313
Z
X
Y

FIG. 7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312c
312b
312
3121
3122
313
(b)
312
310
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312a
312c
311a
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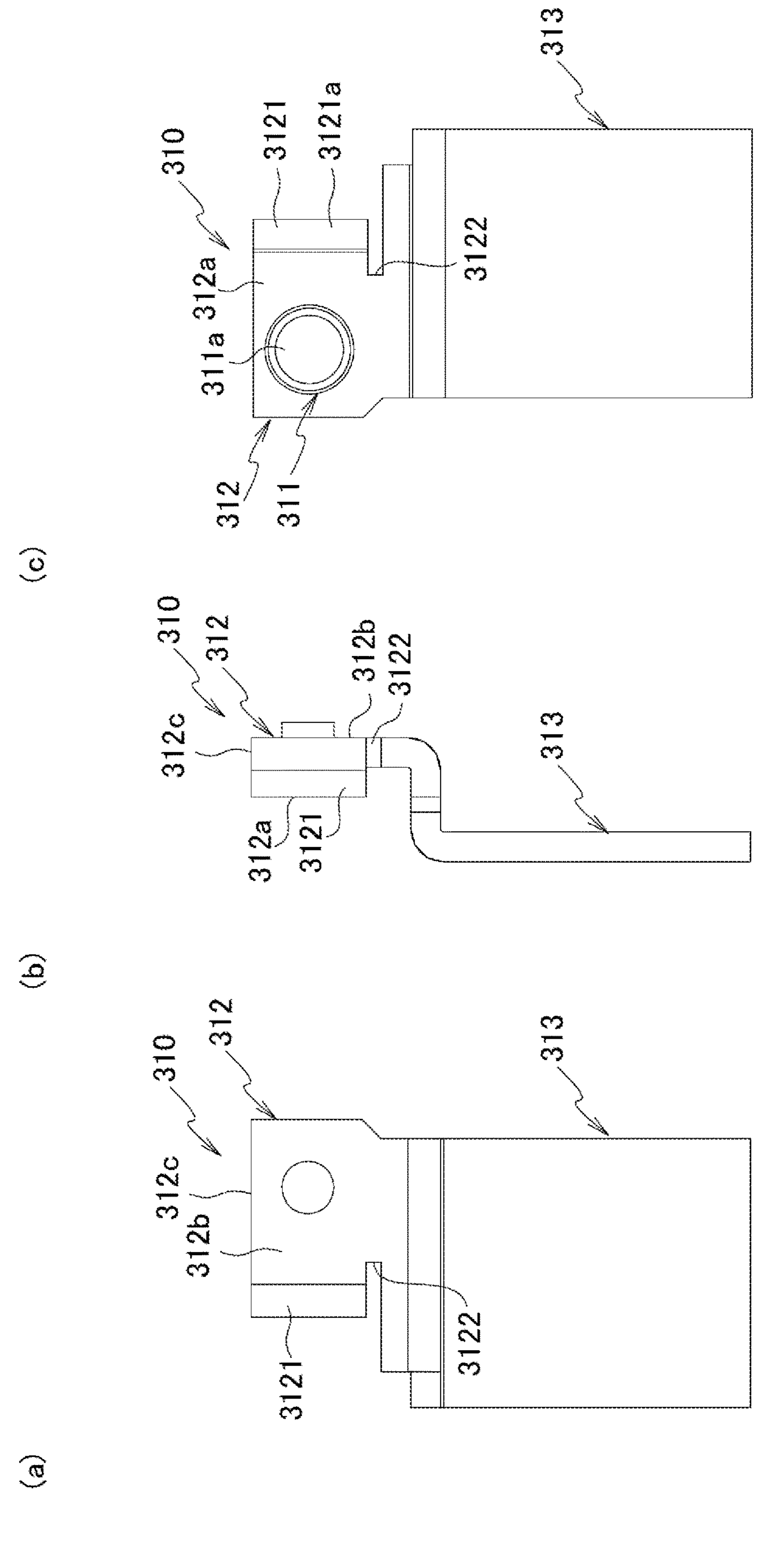
3121
313
(c)
312b
312
312c
310
3121
311
312a
311a
313
3121a

FIG. 8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312
312c
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3122
313
(b)
310
312
312c
312b
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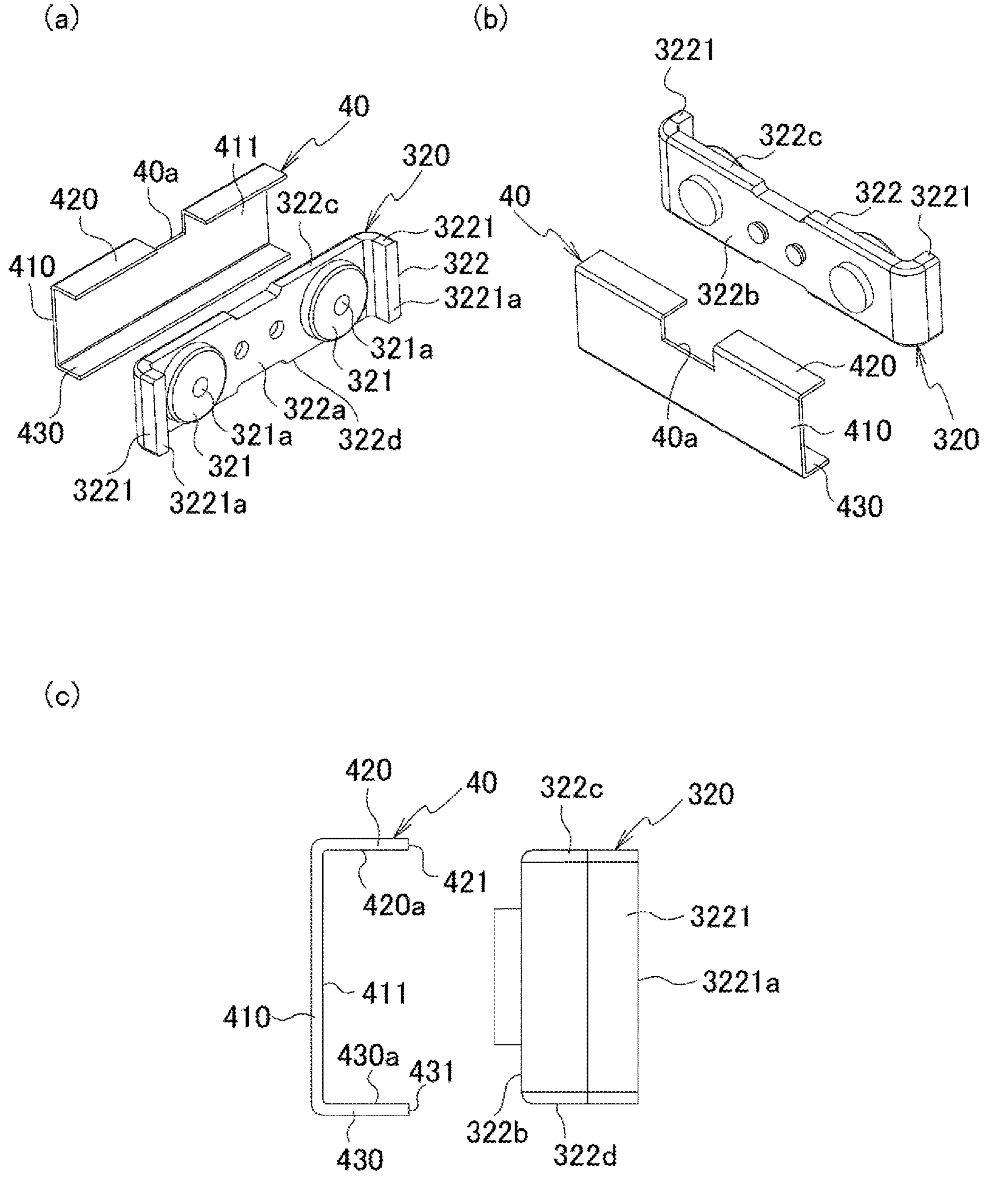
312a
3121
313
(c)
310
3121
3121a
312a
311a
3122
312
311
313

FIG. 9


(a)
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411
40a
420
410
430
320
322c
3221
322
3221a
321a
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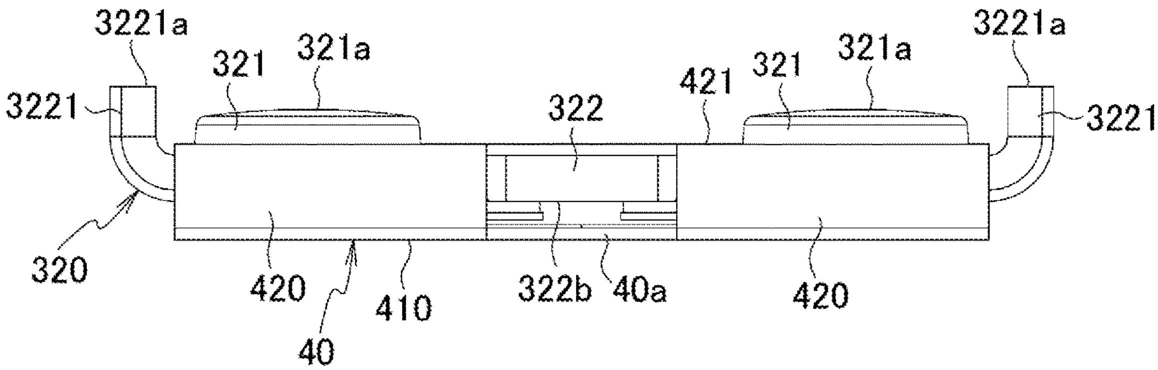
322a
322d
321a
321
3221
3221a
(b)
3221
322c
40
322
3221
322b
420
410
40a
430
320
(c)
420
40
421
420a
411
410
430a
431
430
322c
320
3221
3221a
322b
322d

FIG. 10

(a)


3221a
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321a
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3221
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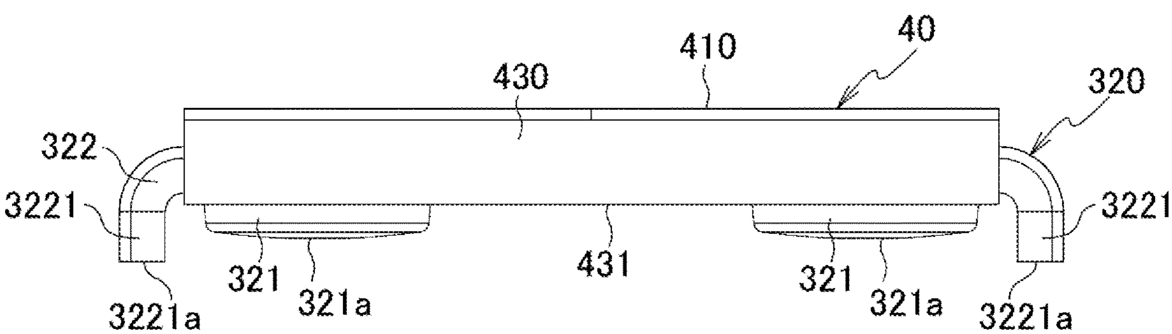
40
322b
40a
420

(b)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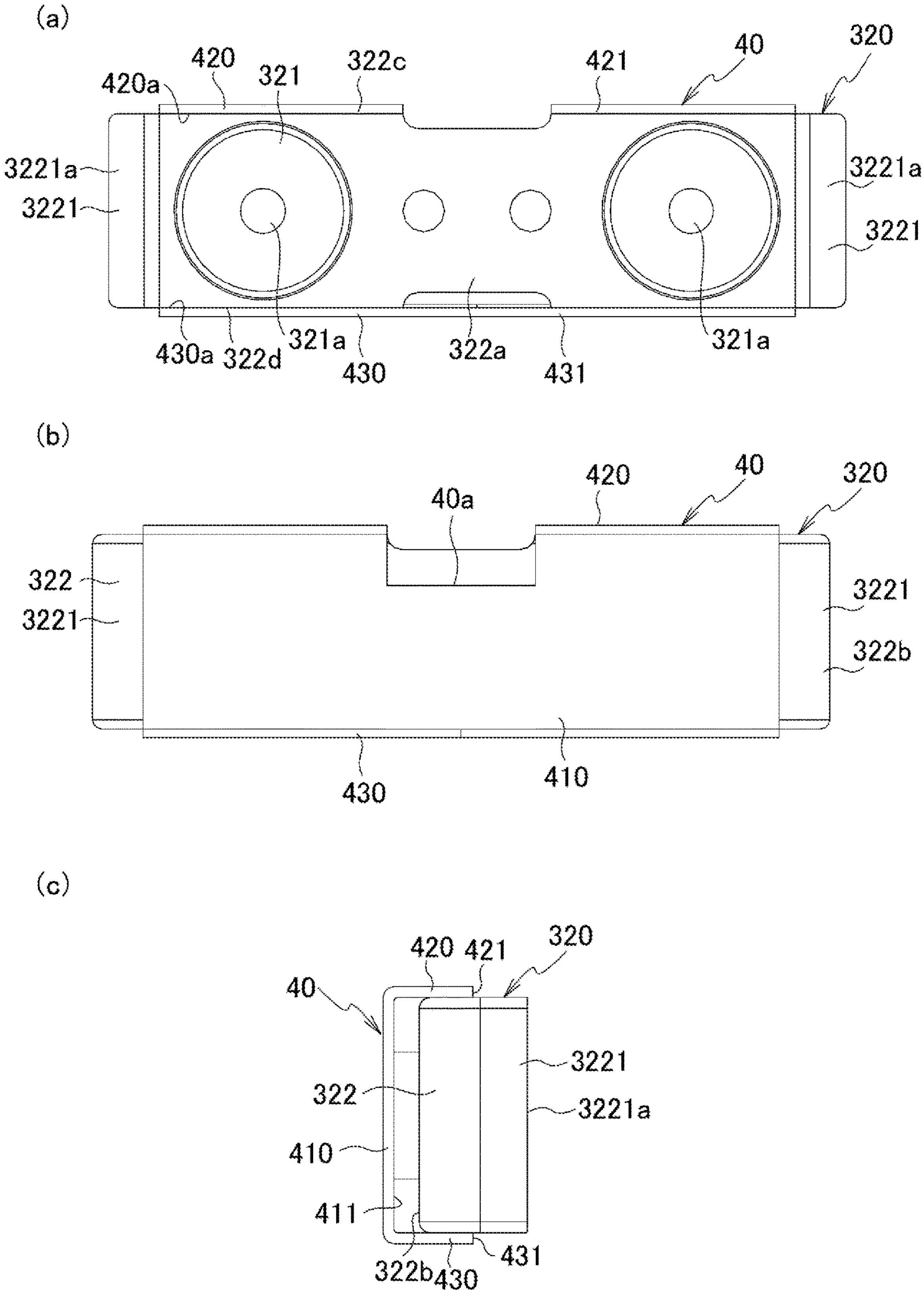
3221a

FIG. 11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420a
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40
320
3221a
3221
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3221
430a
322d
321a
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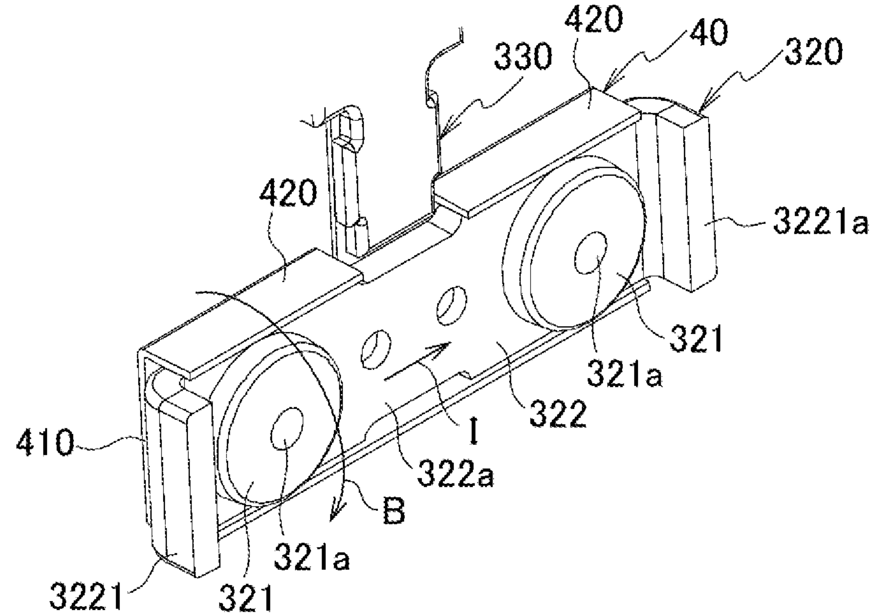
322a
431
321a
(b)
40a
420
40
320
322
3221
3221
322b
430
410
(c)
420
421
320
40
3221
322
3221a
410
411
322b
430
431

FIG. 12

(a)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320
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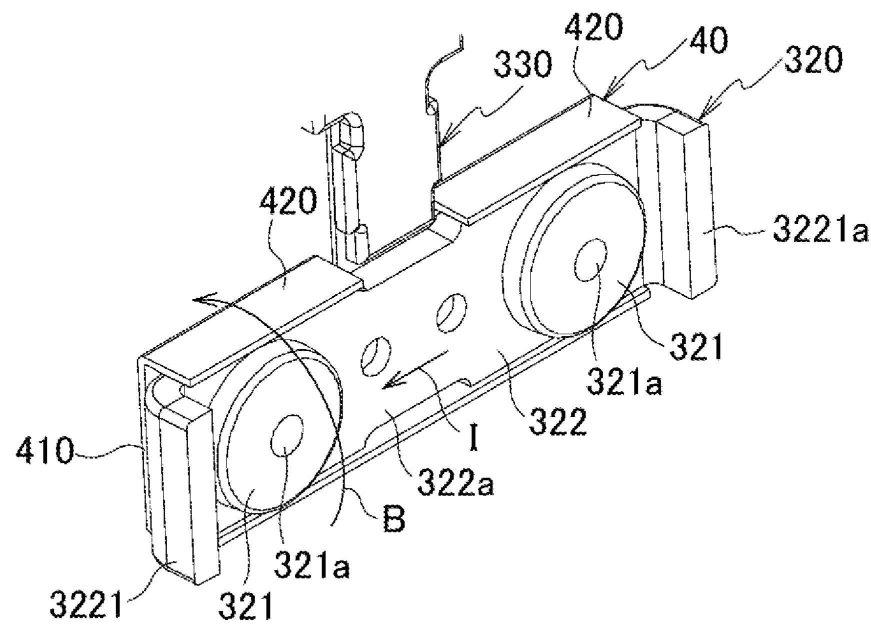
420
3221a
321
321a
322
I
410
322a
B
321a
3221
321

(b)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40
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I
410
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B
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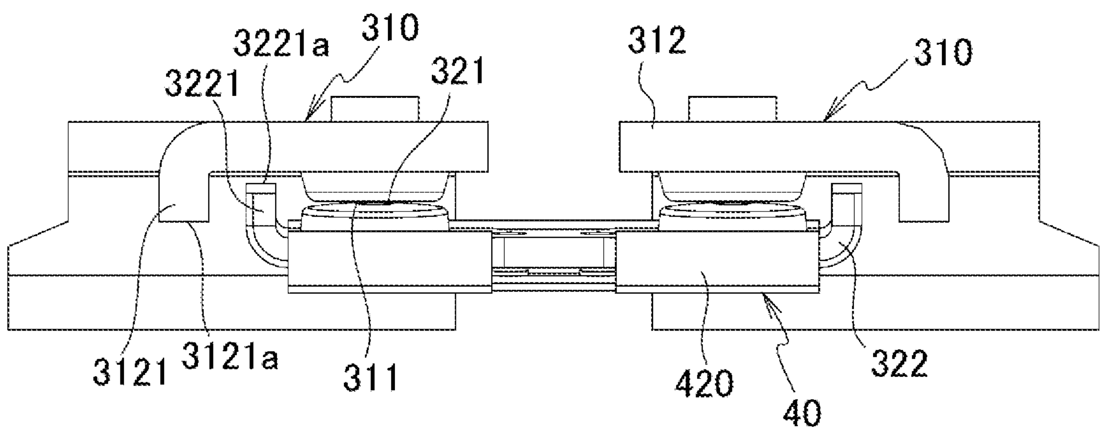
3221
321

FIG. 13

(a)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3121
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311
420
40
322

(b)

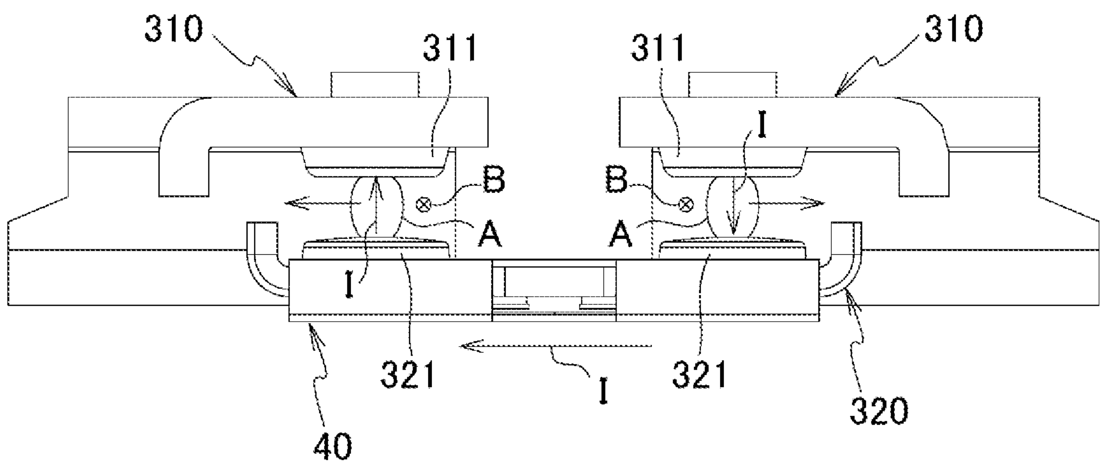
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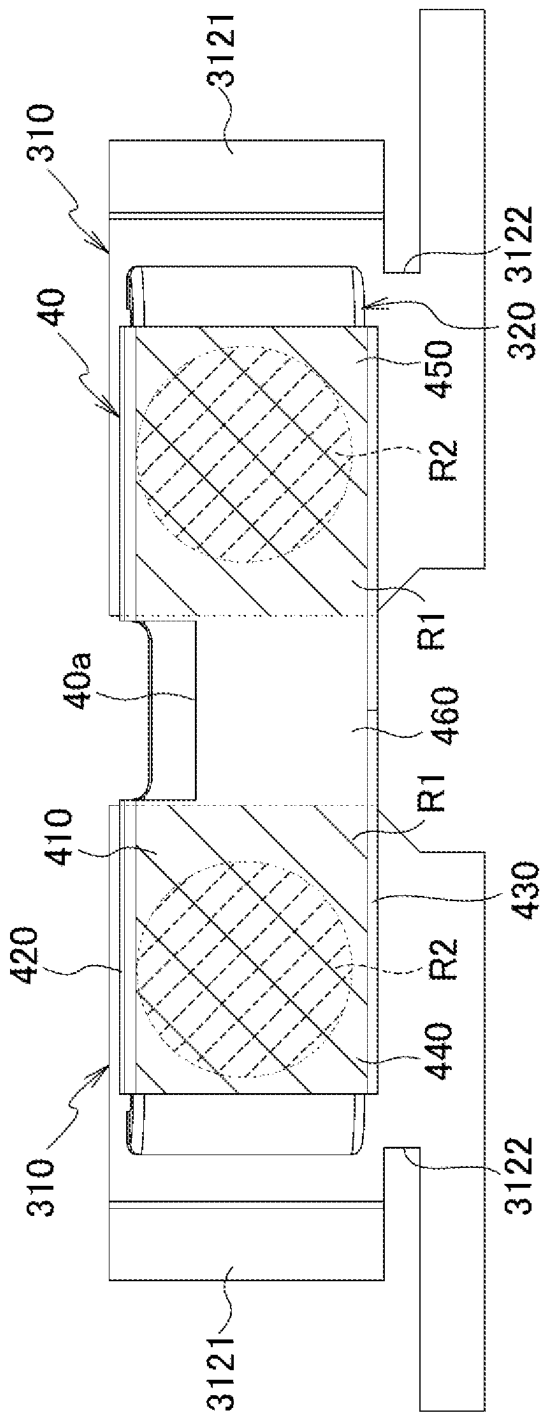
FIG. 14


3121
310
3122
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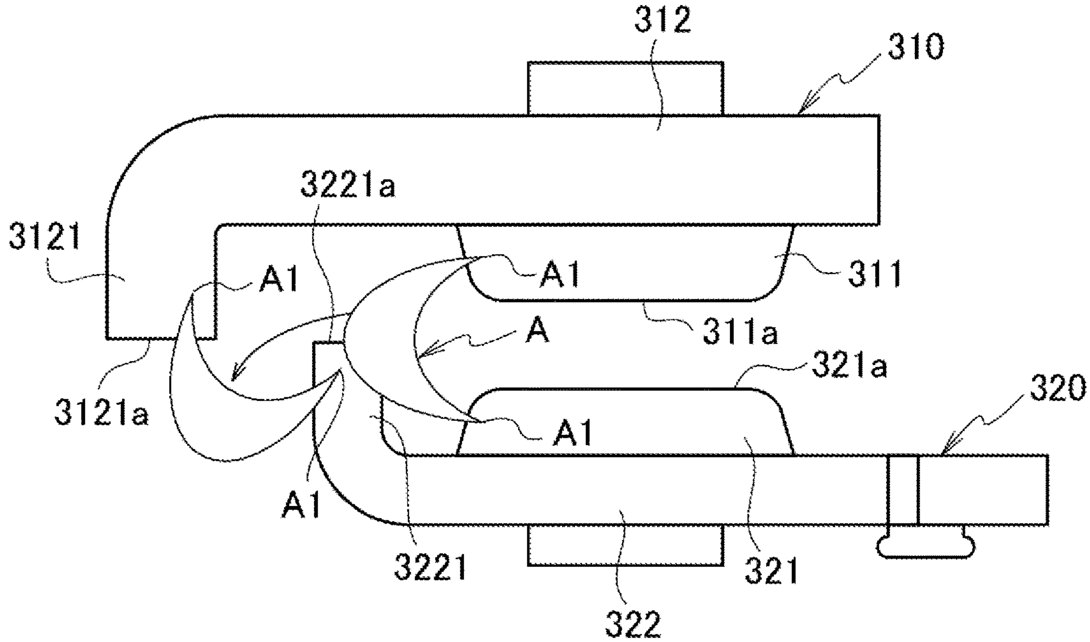
450
R2
R1
40a
460
410
430
420
440
310
3122
3121

FIG. 15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310
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A1
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3221
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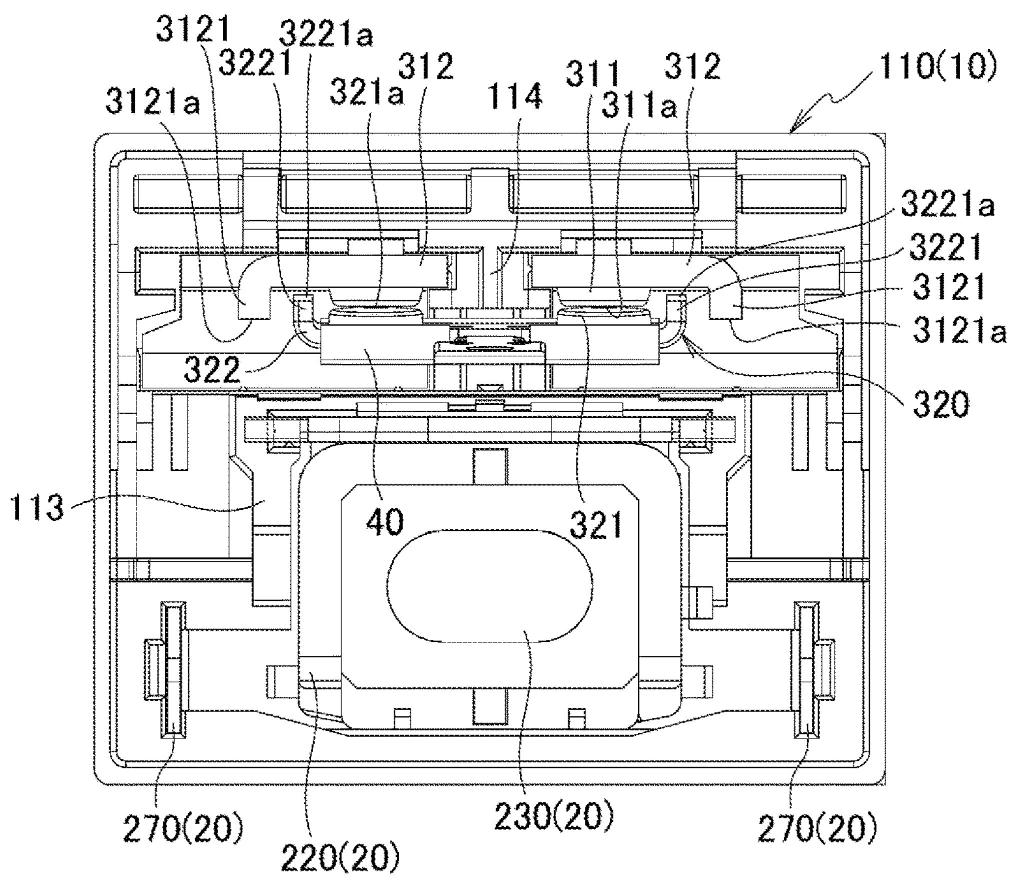
322

FIG. 16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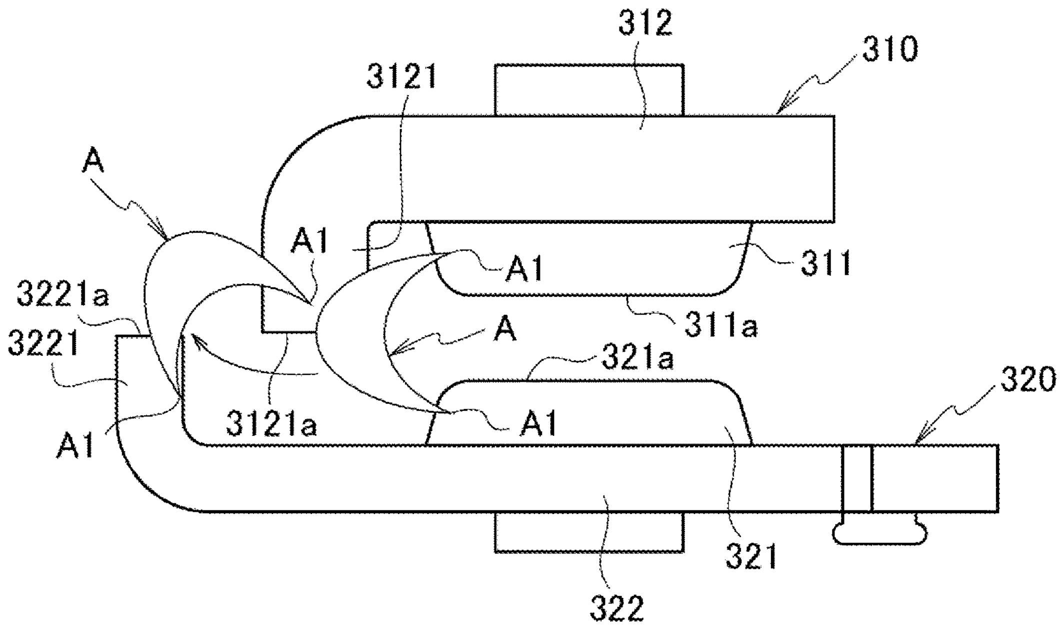
320
113
40
321
270(20)
220(20)
230(20)
270(20)

FIG. 17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A1
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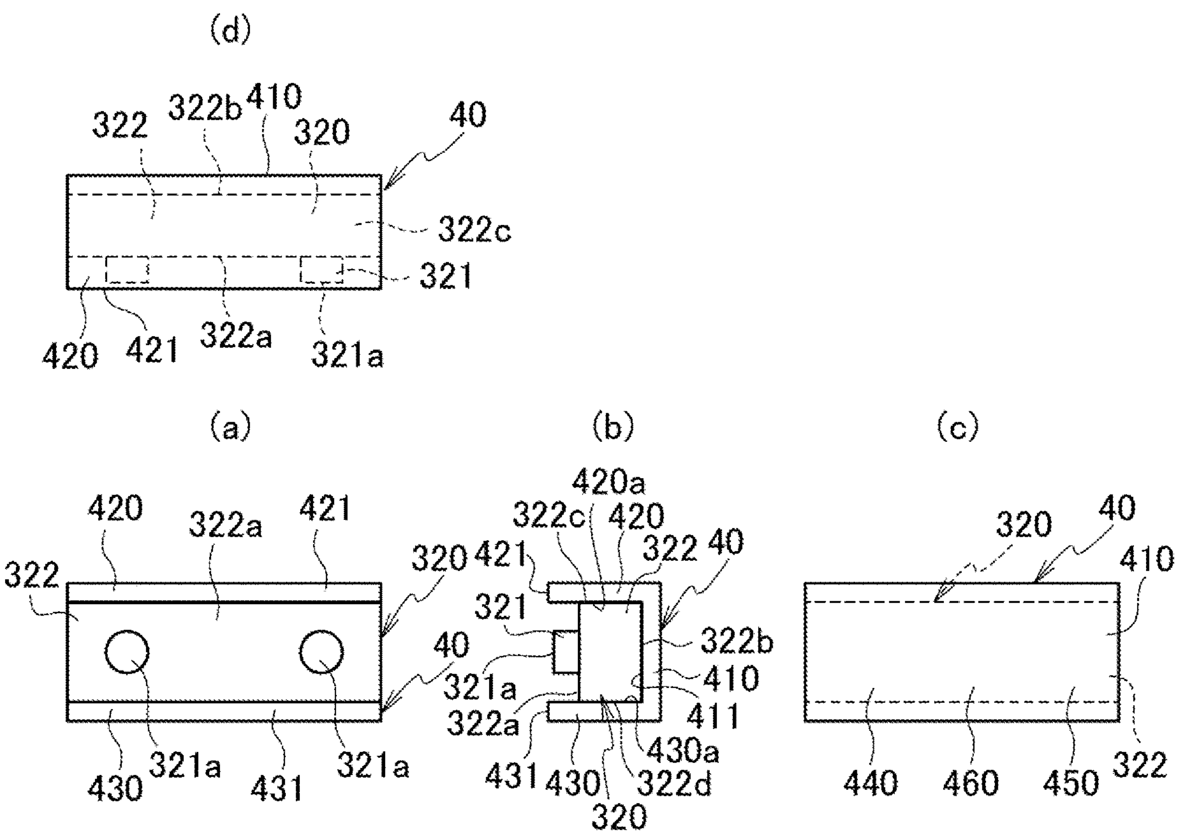
322

FIG. 18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322
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322a
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(a)
(b)
(c)
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421
322
320
40
430
321a
431
321a
420a
322c
420
322
40
421
321
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322d
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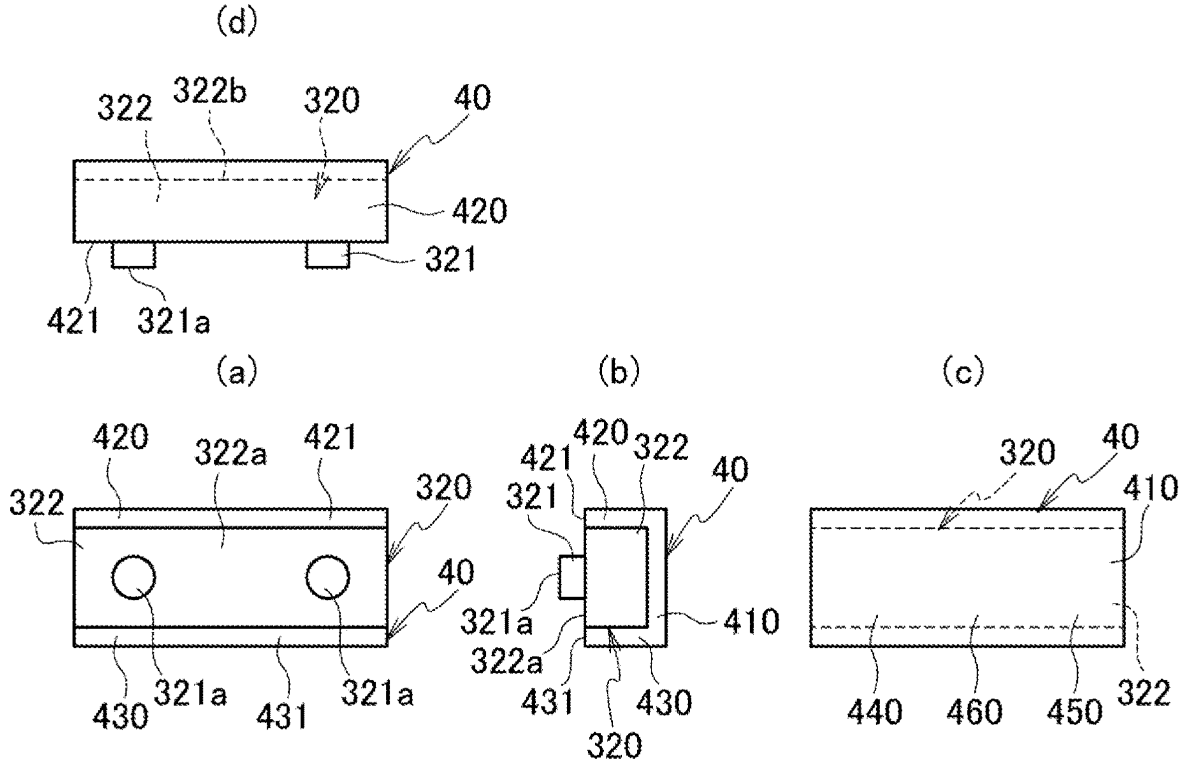
450
322

FIG. 19


(d)
322
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321a
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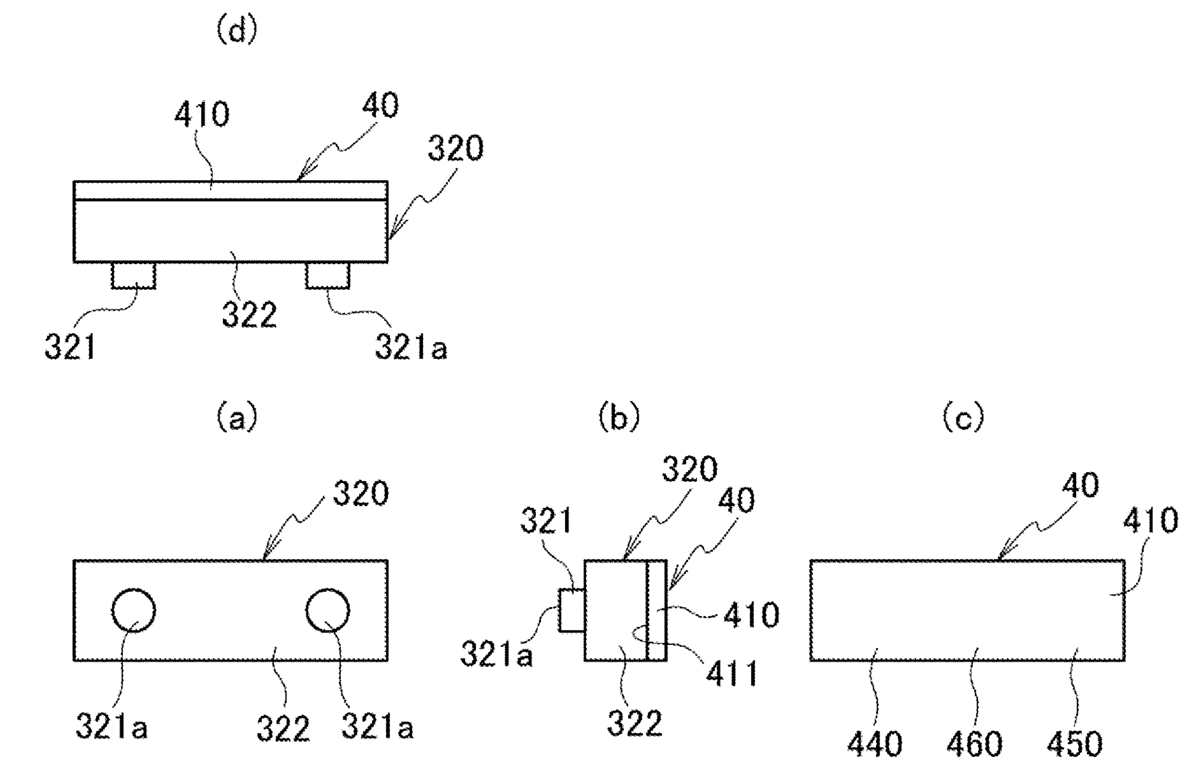
FIG. 20


(d)
410
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322
321a
(a)
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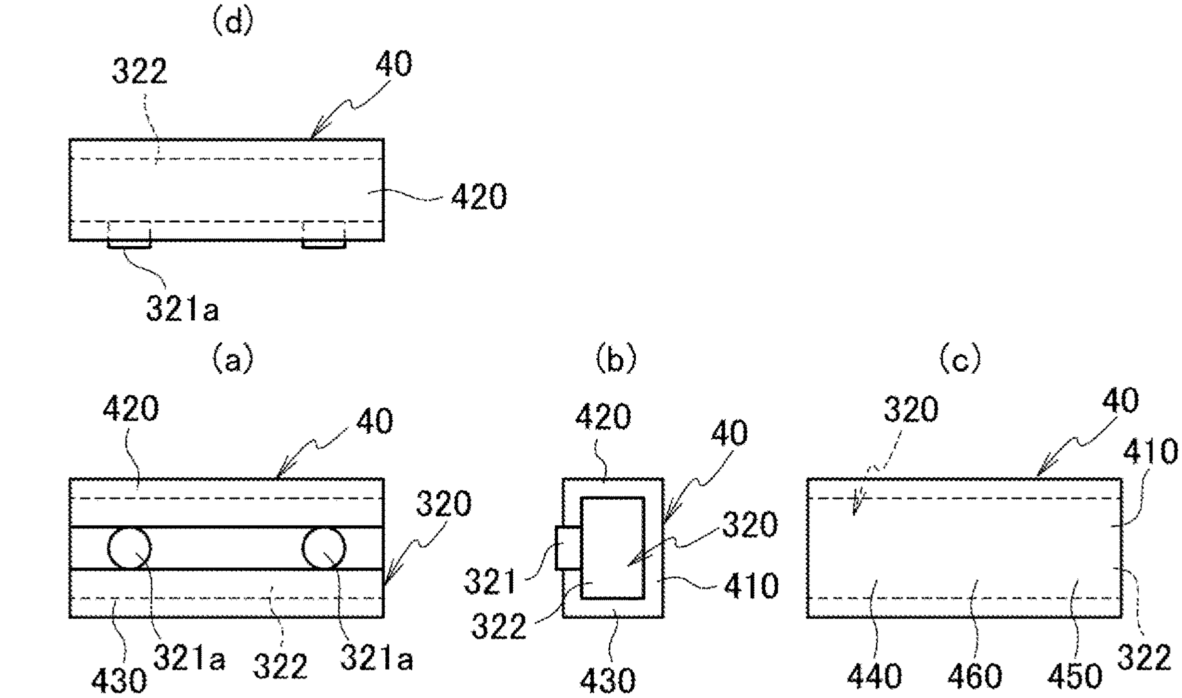
440
460
450

FIG. 21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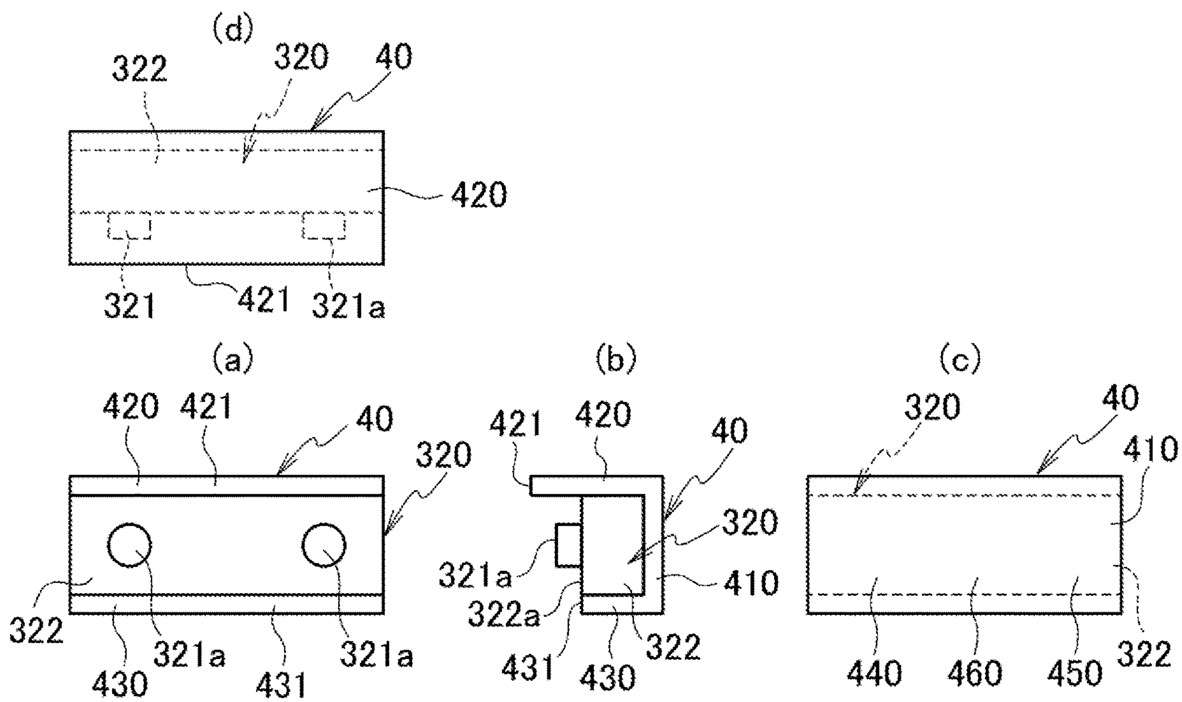
410
322
430
(c)
320
40
410
440
460
450
322

FIG. 22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(b)
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322a
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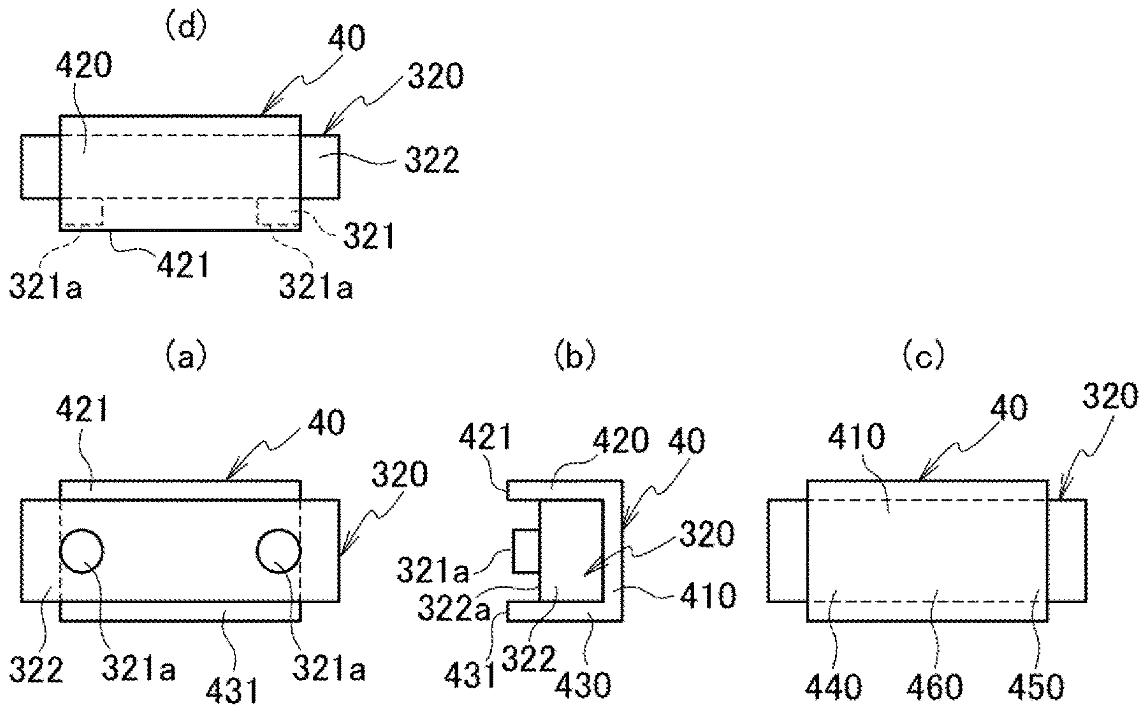
430
322
(c)
320
40
410
440
460
450
322

FIG. 23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321a
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321a
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40
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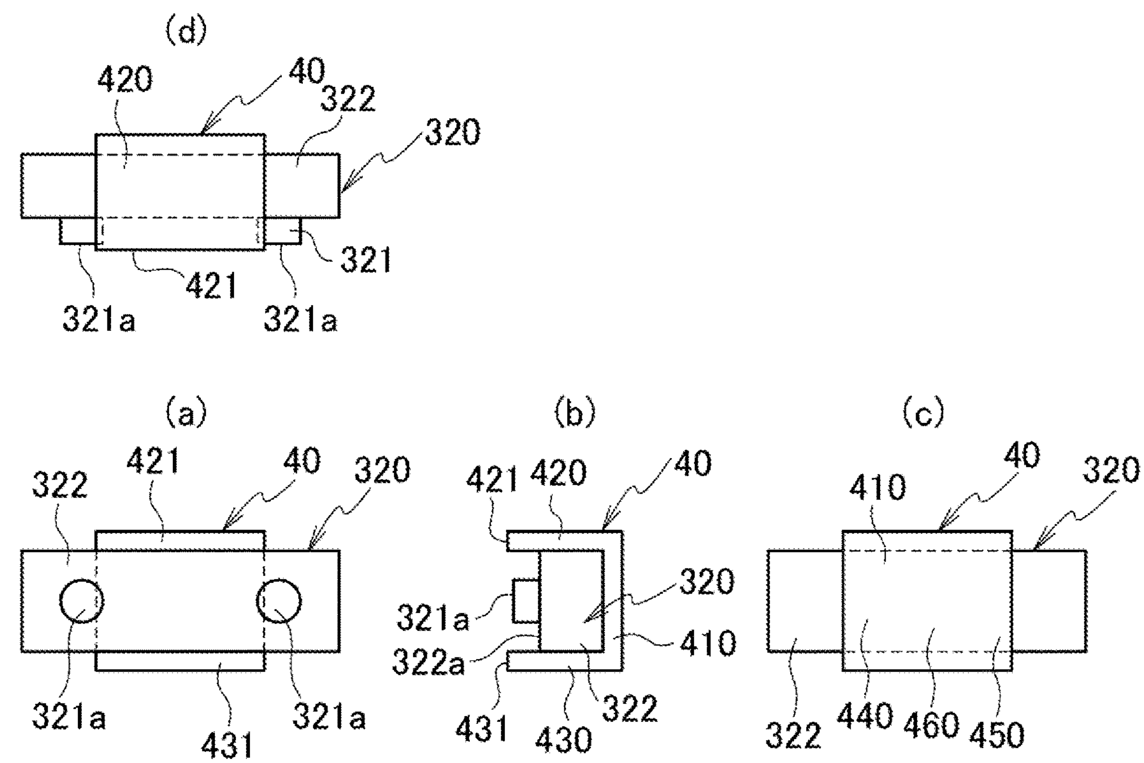
440
460
450

FIG. 24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431
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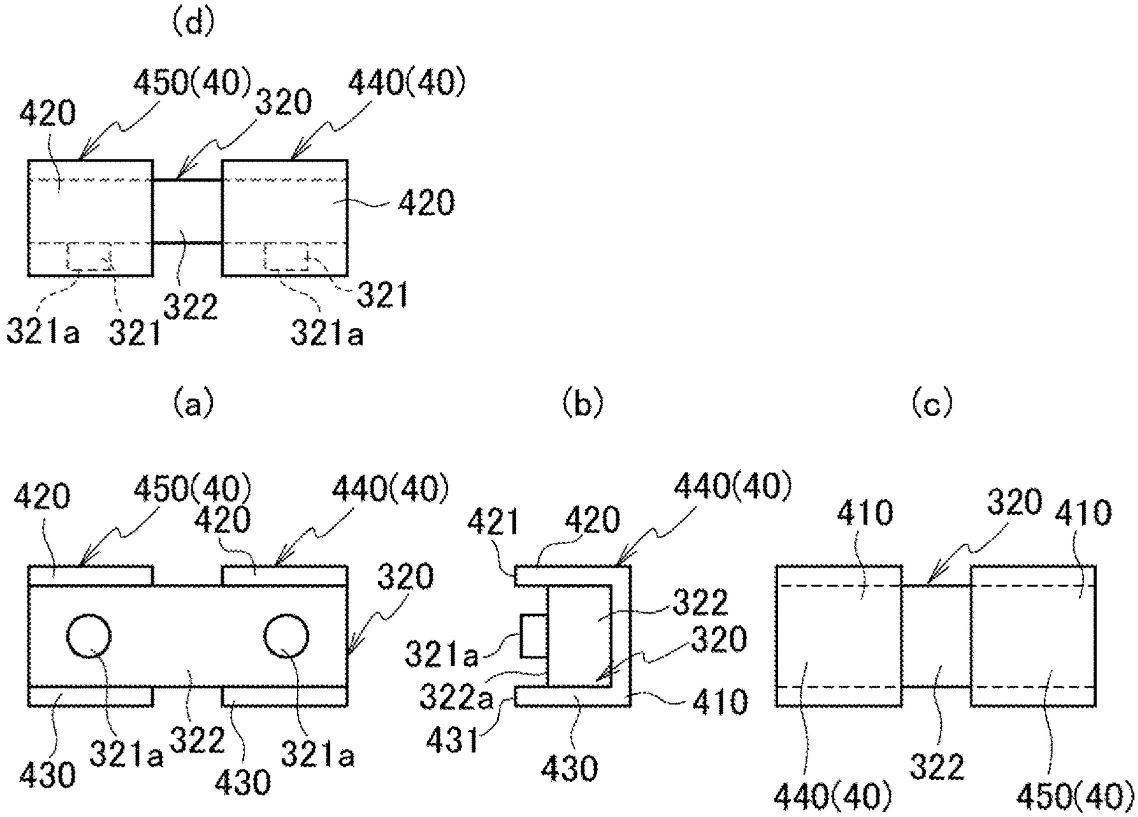
460
450

FIG. 25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321a
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321a
421
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440(40)
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410
440(40)
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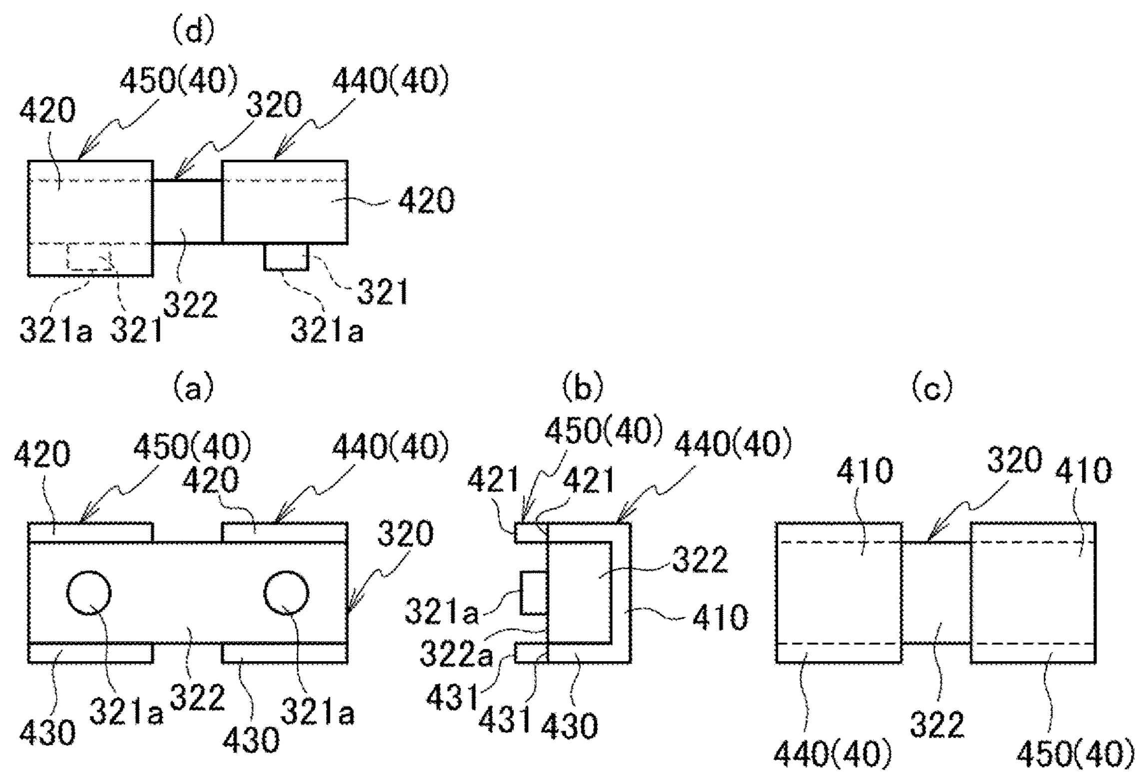
450(40)

FIG. 26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(b)
(c)
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321a
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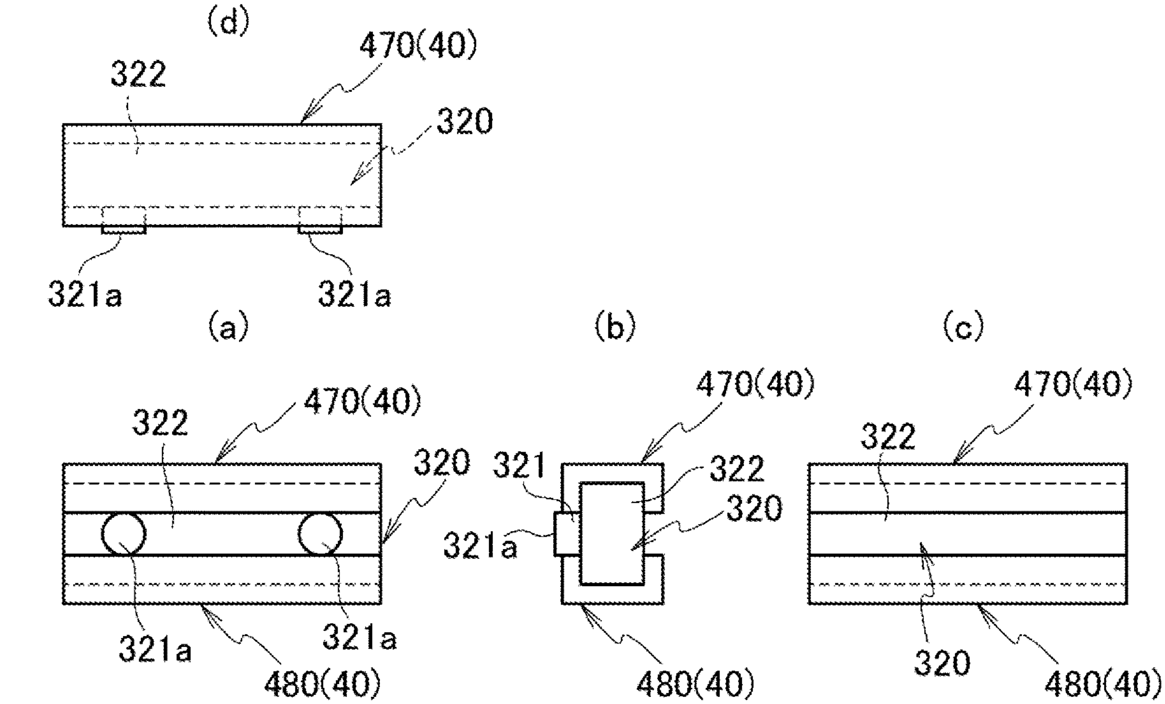
322
450(40)

FIG. 27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(a)
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321a
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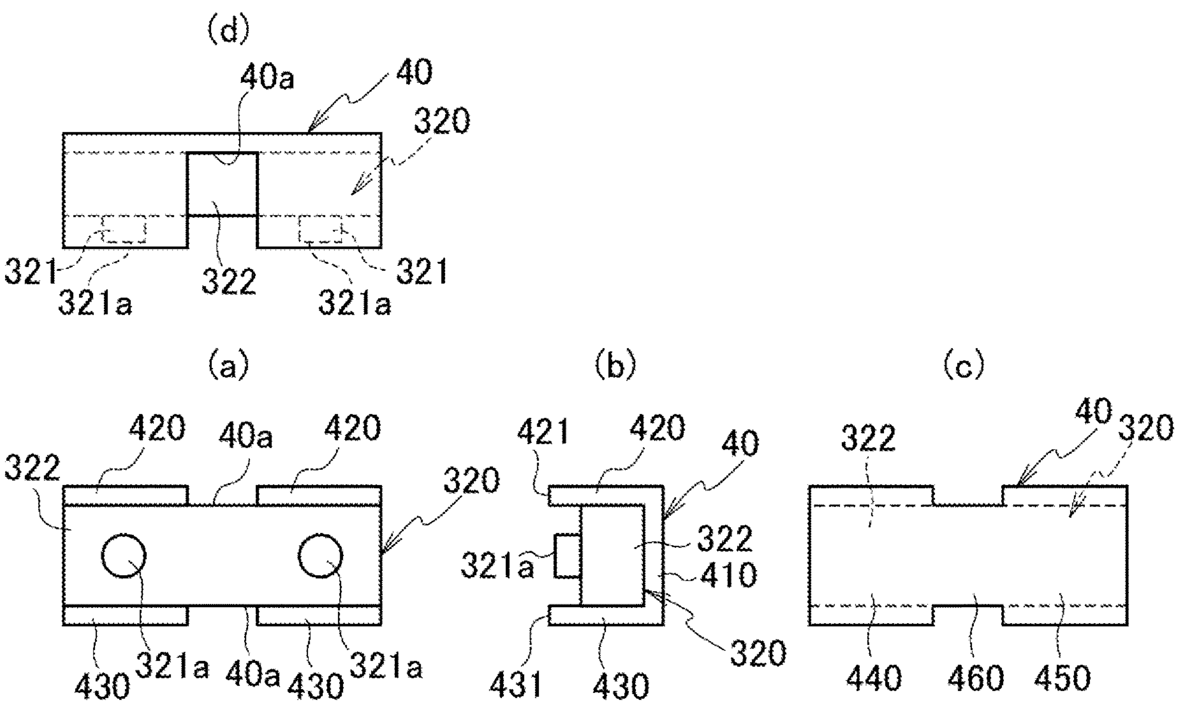
470(40)
322
320
480(40)

FIG. 28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(b)
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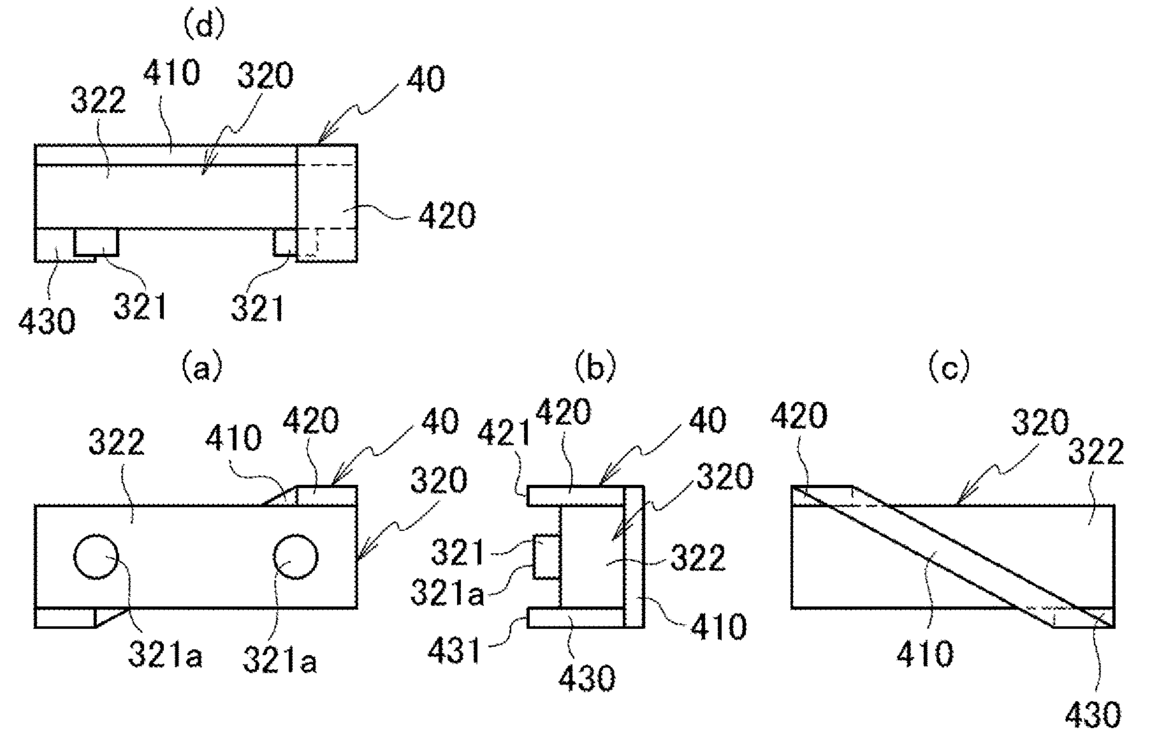
430
321a
40a
430
321a
421
420
40
321a
322
410
320
431
430
40
322
320
440
460
450

FIG. 29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(c)
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410
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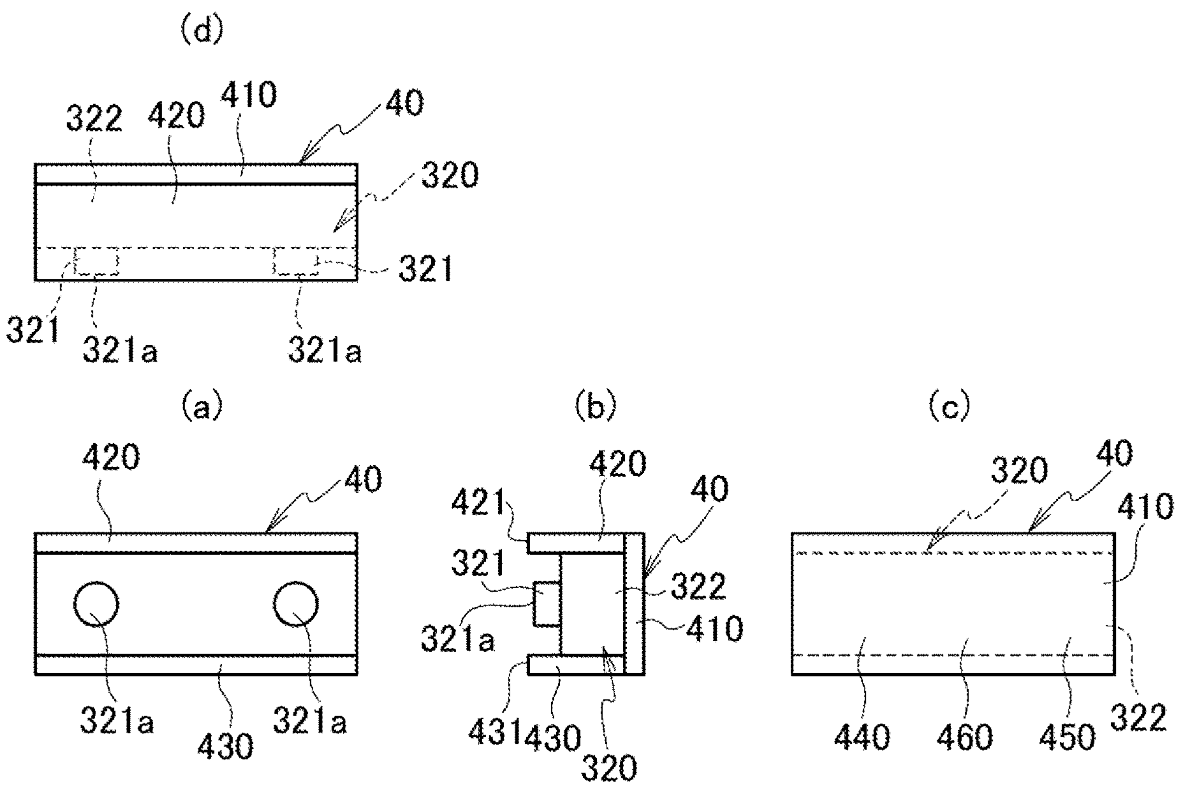
FIG. 30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(c)
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40
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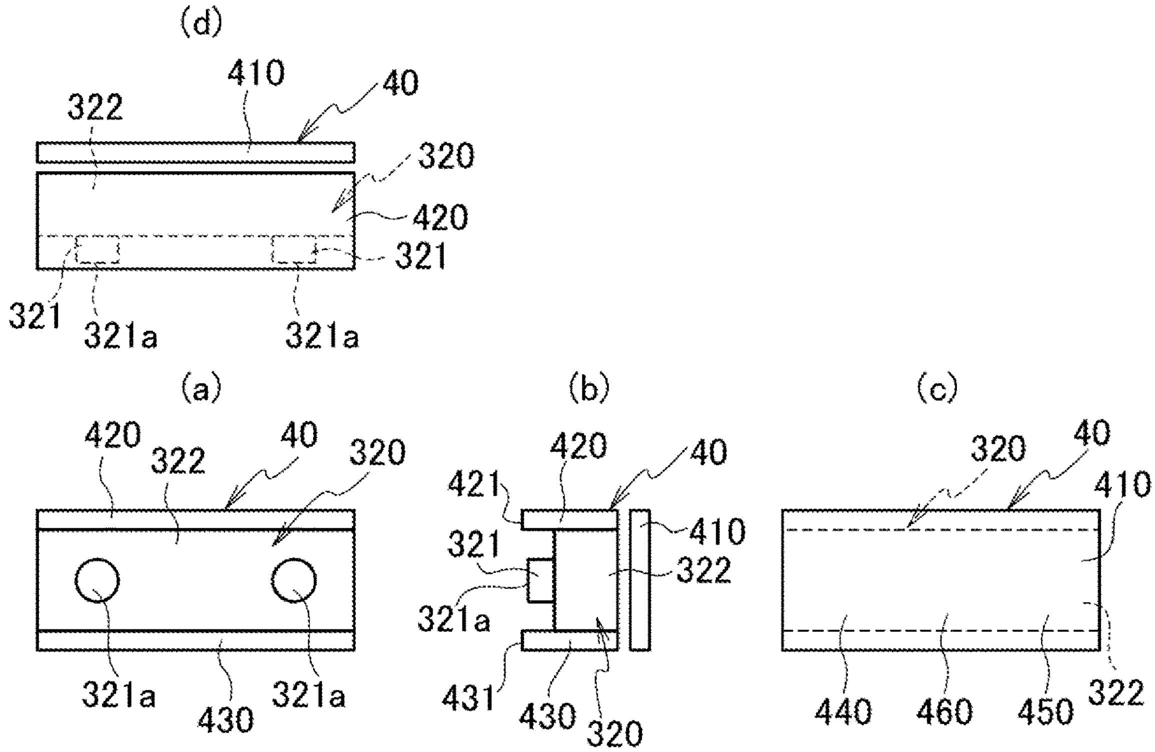
460
450
322

FIG. 31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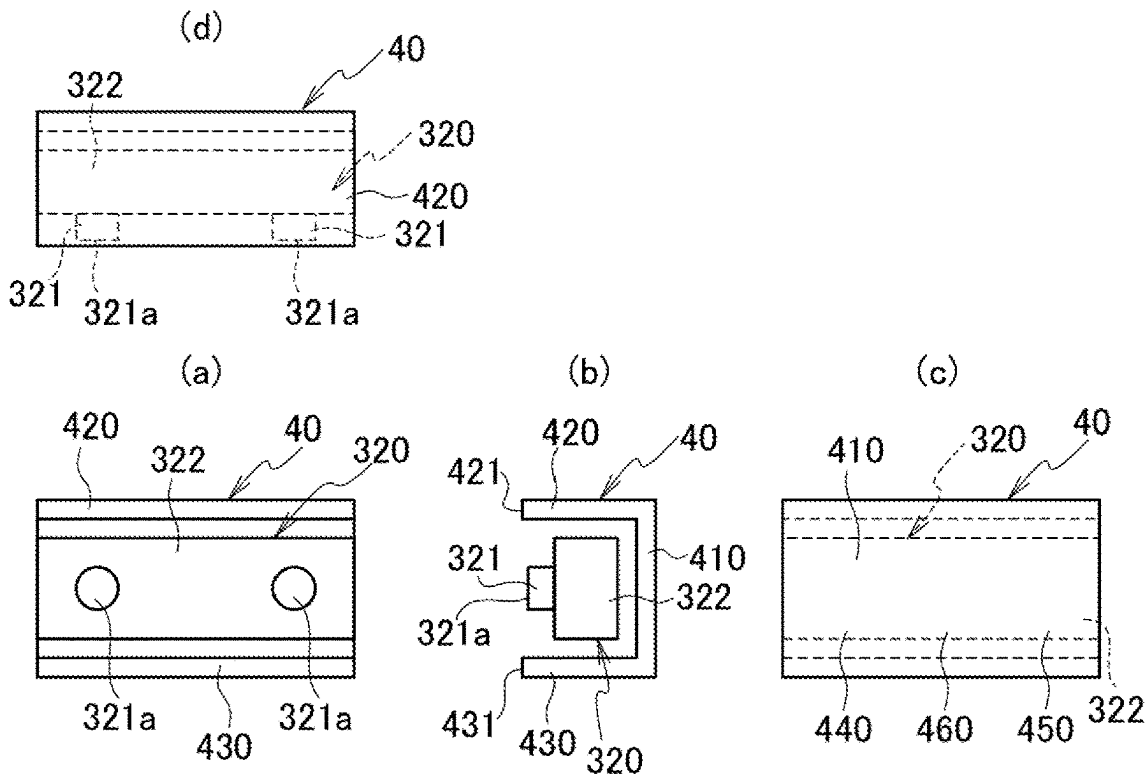
322

FIG. 32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(b)
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321a
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430
320
410
320
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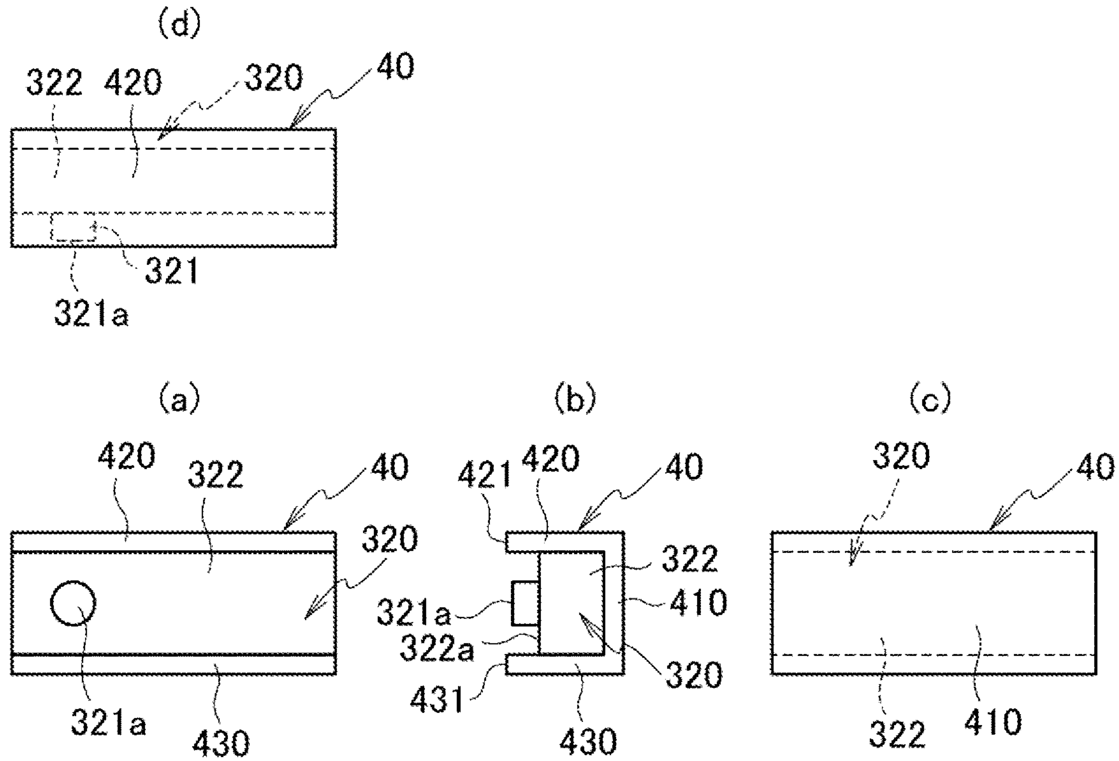
460
450
322

FIG. 33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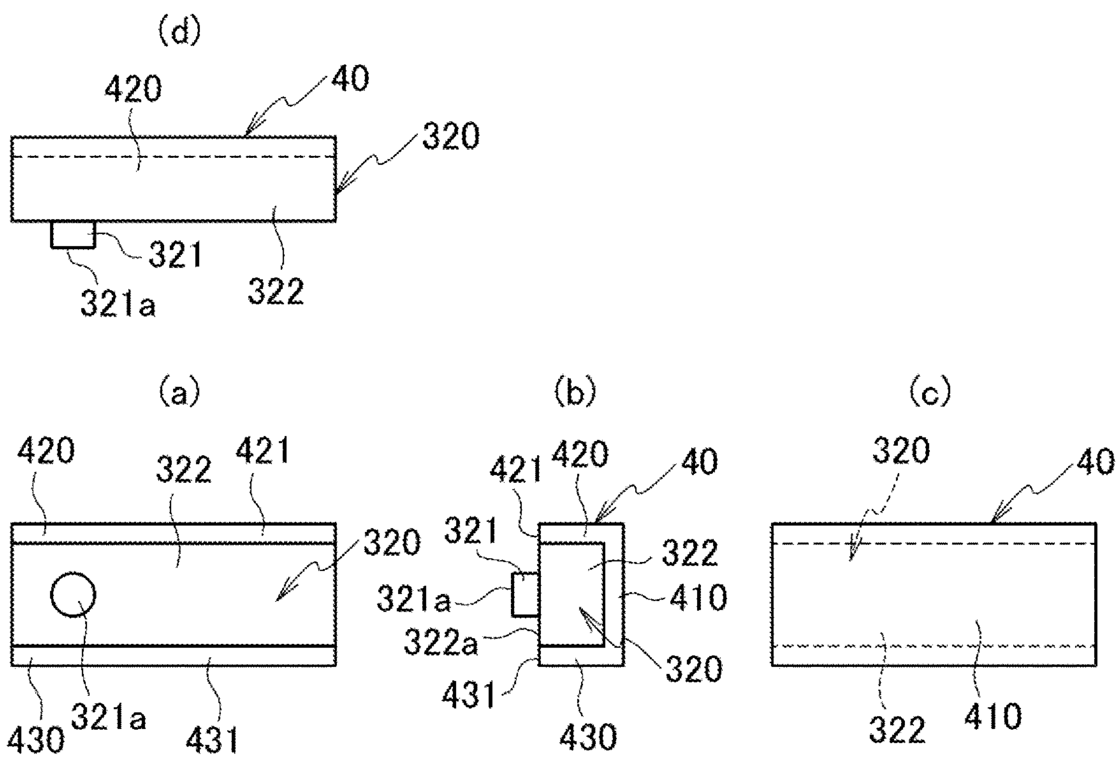
(c)
320
40
322
410

FIG. 34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321a
410
322a
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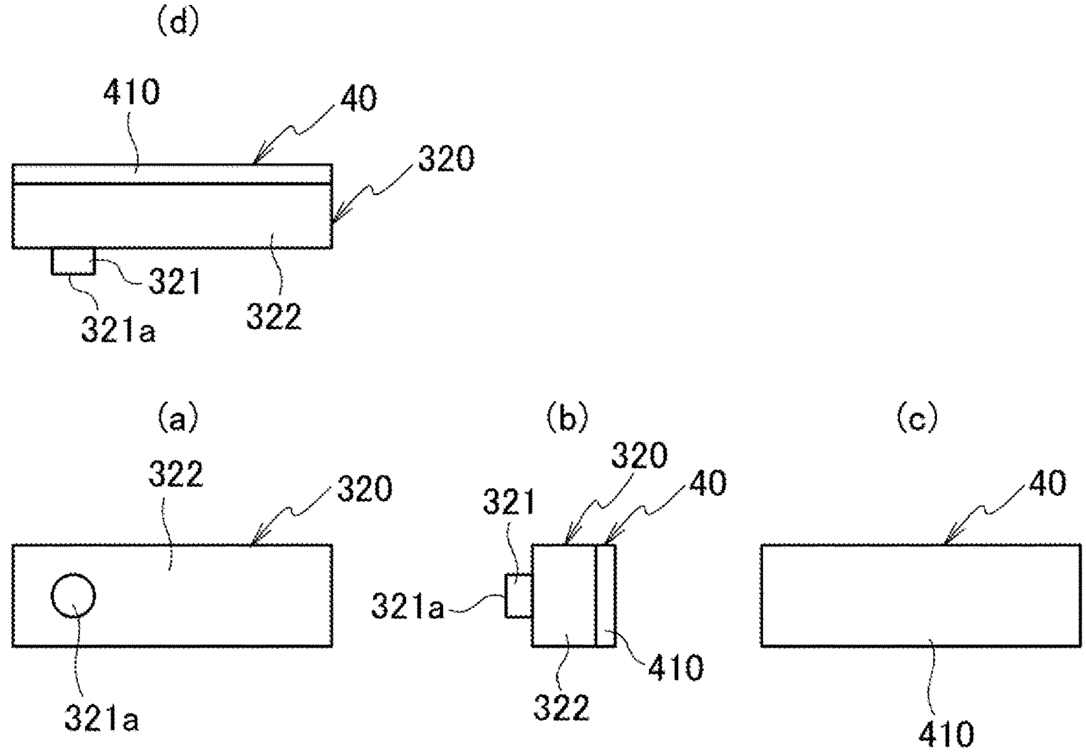
431
430
(c)
320
40
322
410

FIG. 35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(a)
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(c)
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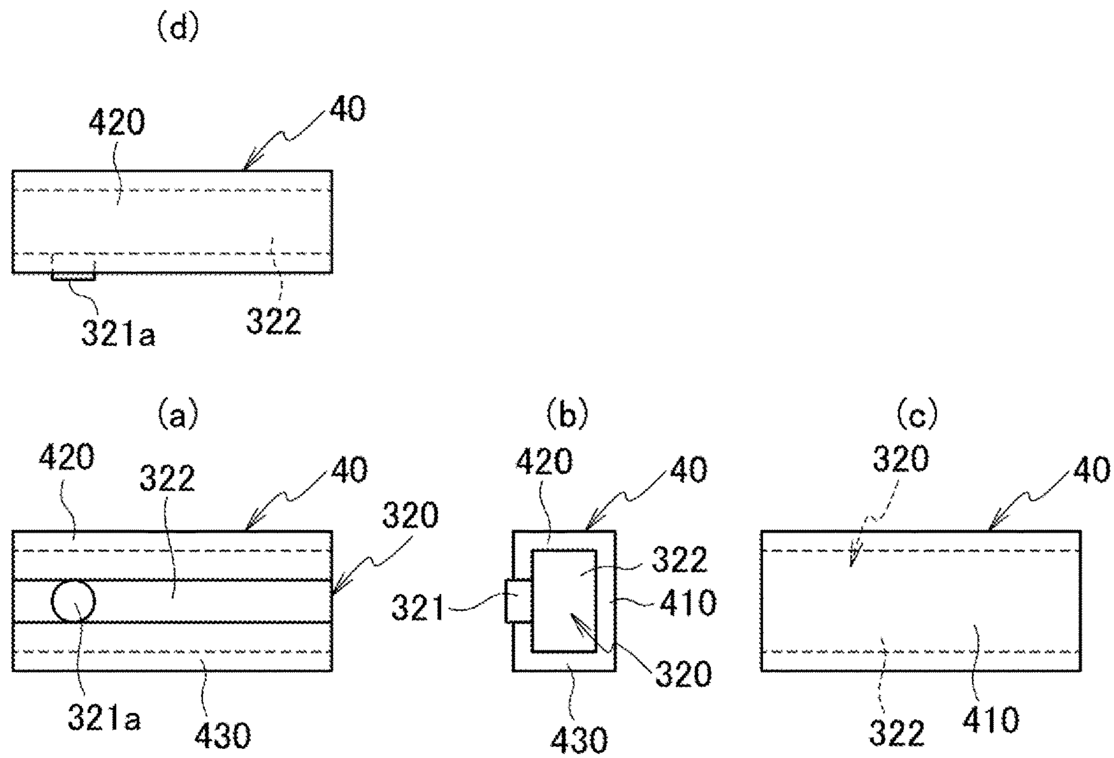
321a
322
410

FIG. 36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321a
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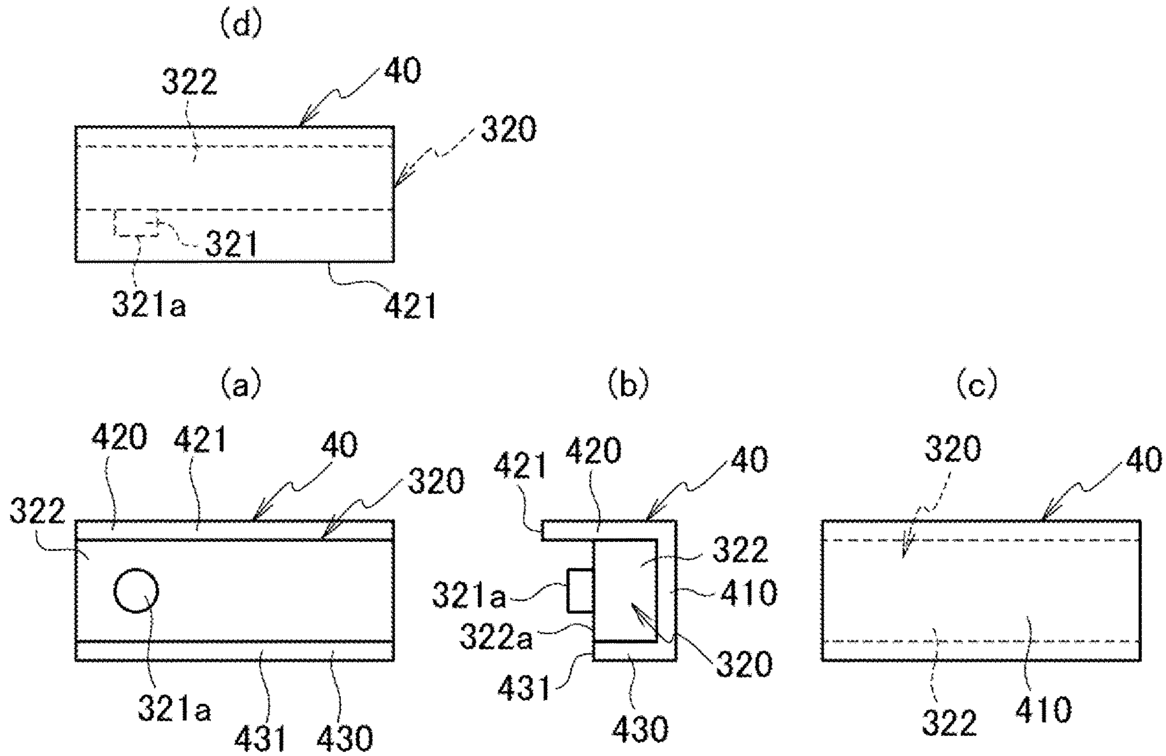
430
322
410

FIG. 37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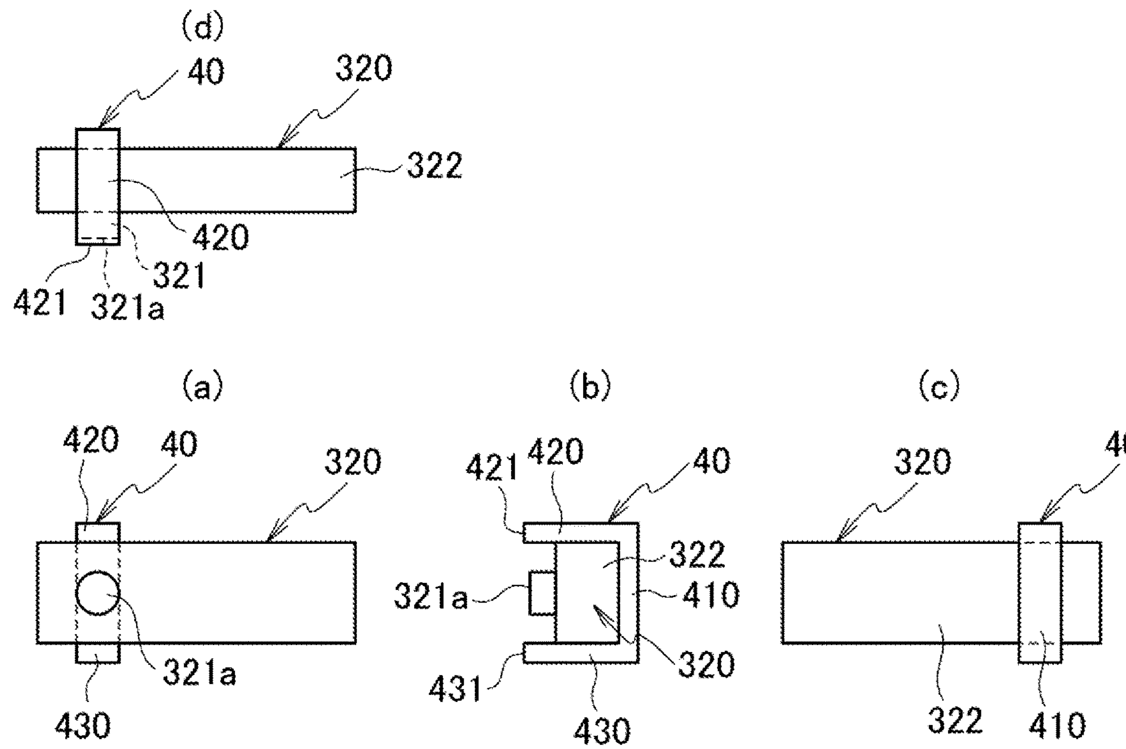
40
322
410

FIG. 38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(b)
(c)
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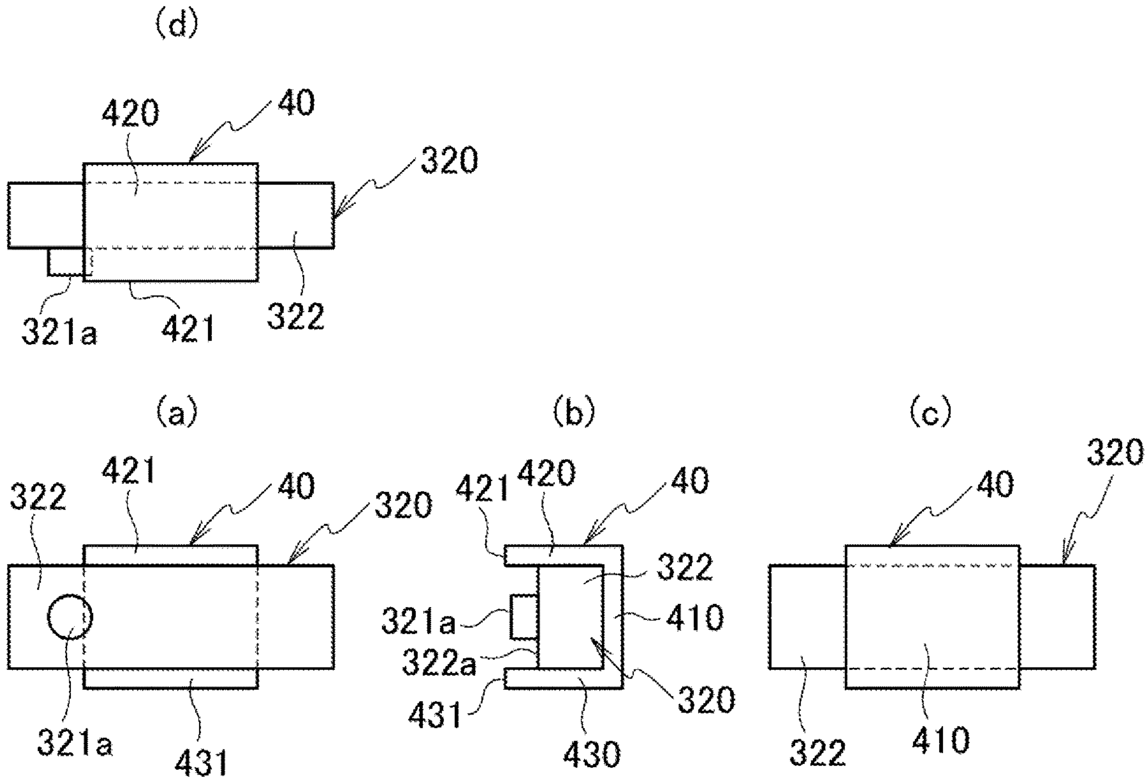
40
322
410

FIG. 39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(b)
(c)
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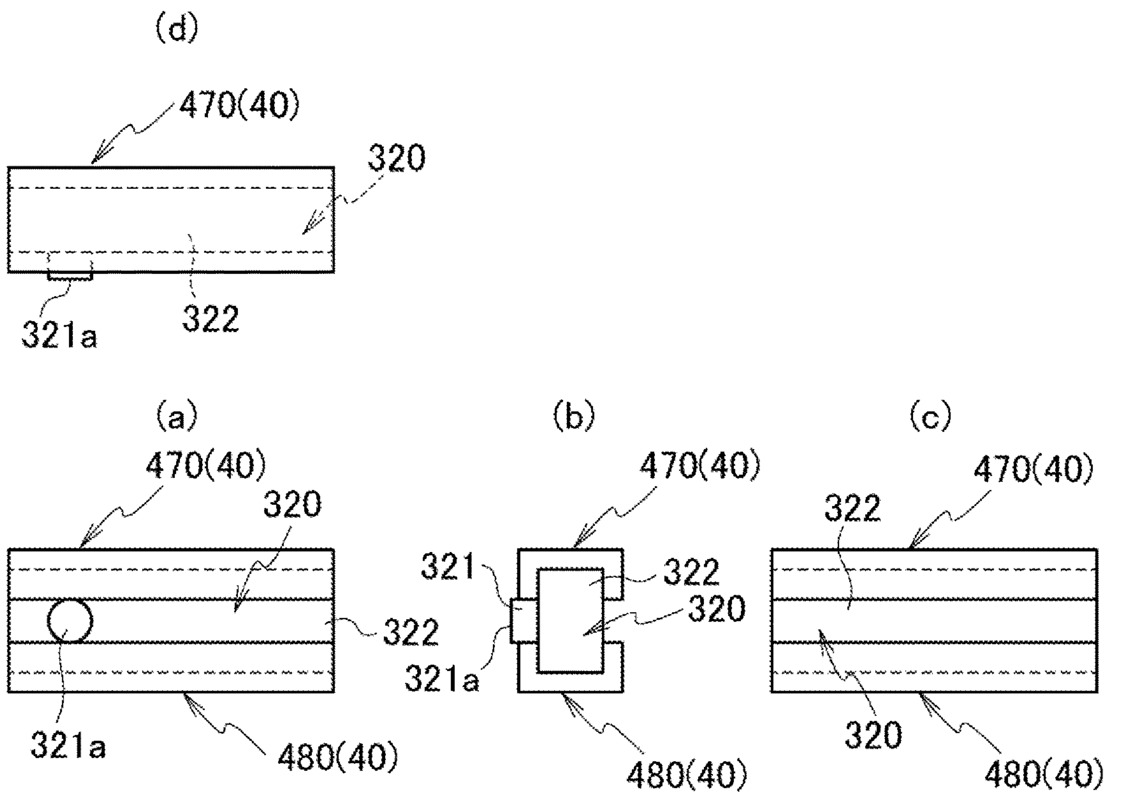
322
410

FIG. 40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(b)
(c)
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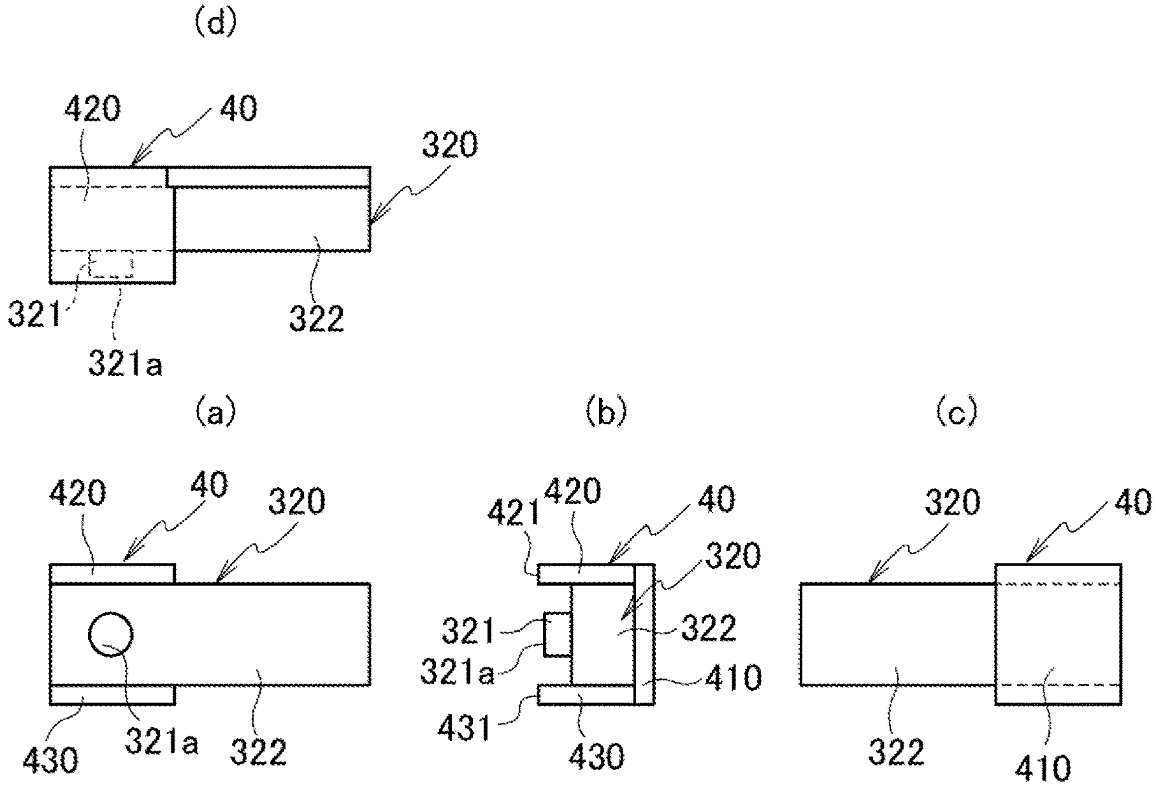
470(40)
321
322
320
321a
480(40)
470(40)
322
320
480(40)

FIG. 41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322
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FIG. 42

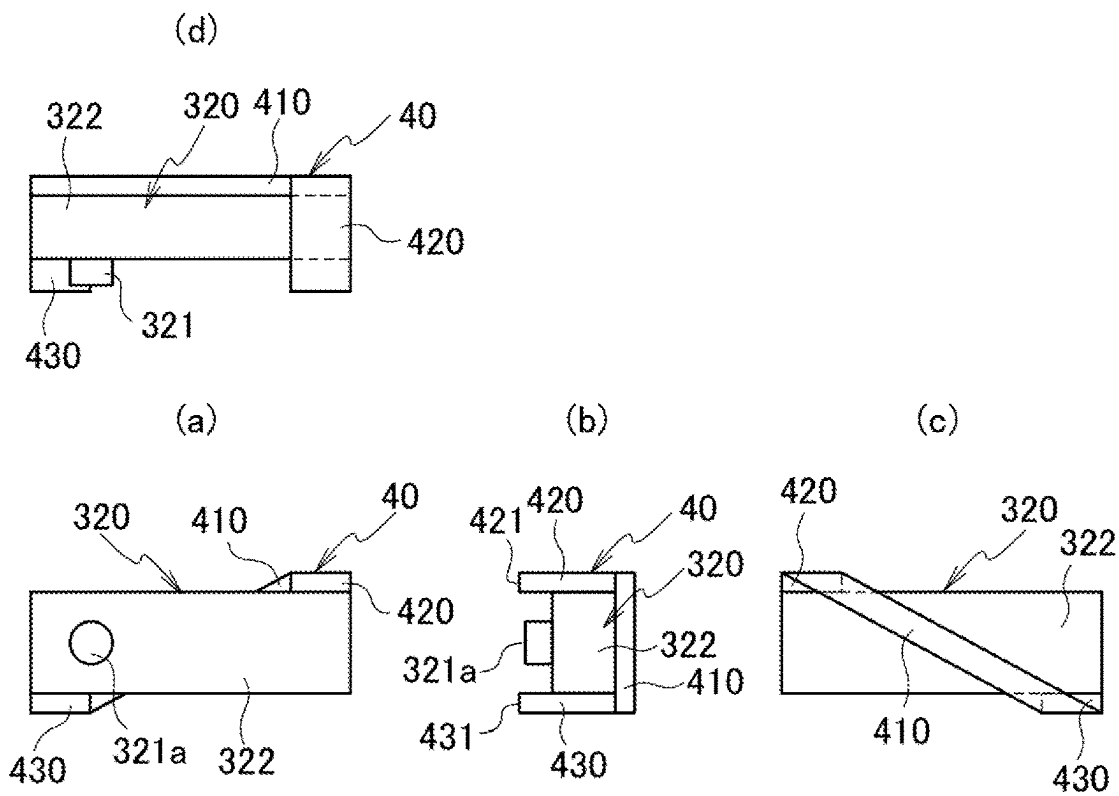
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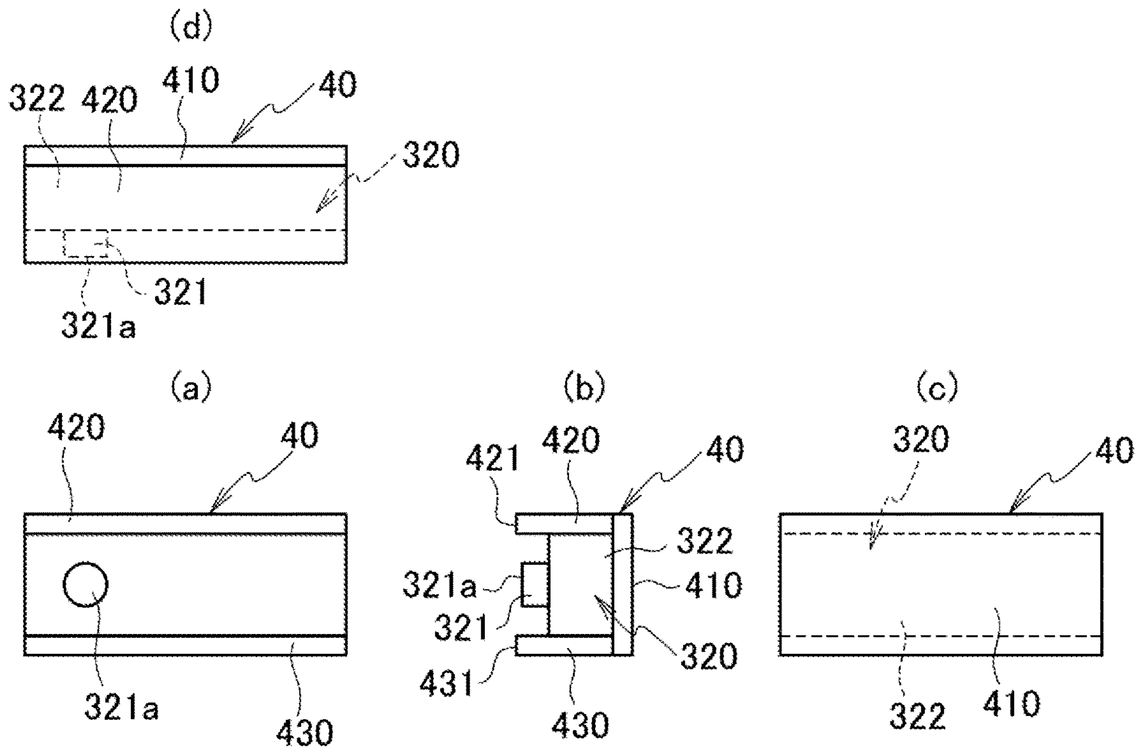
FIG. 43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(c)
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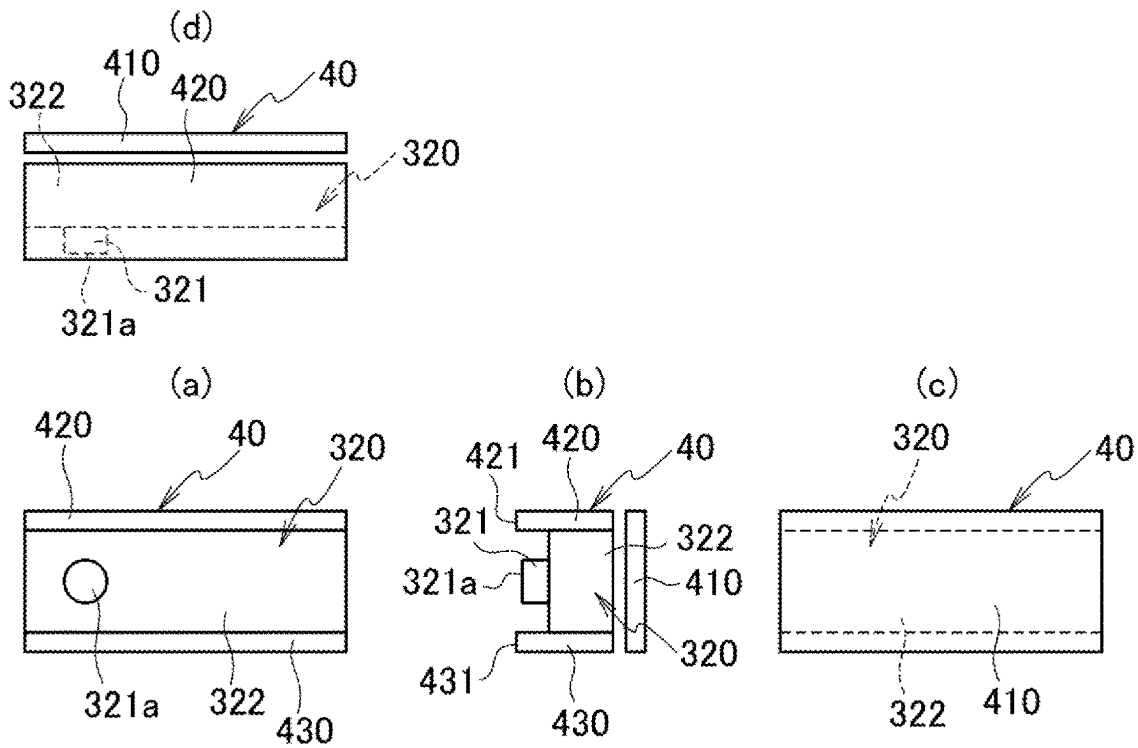
FIG. 44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(c)
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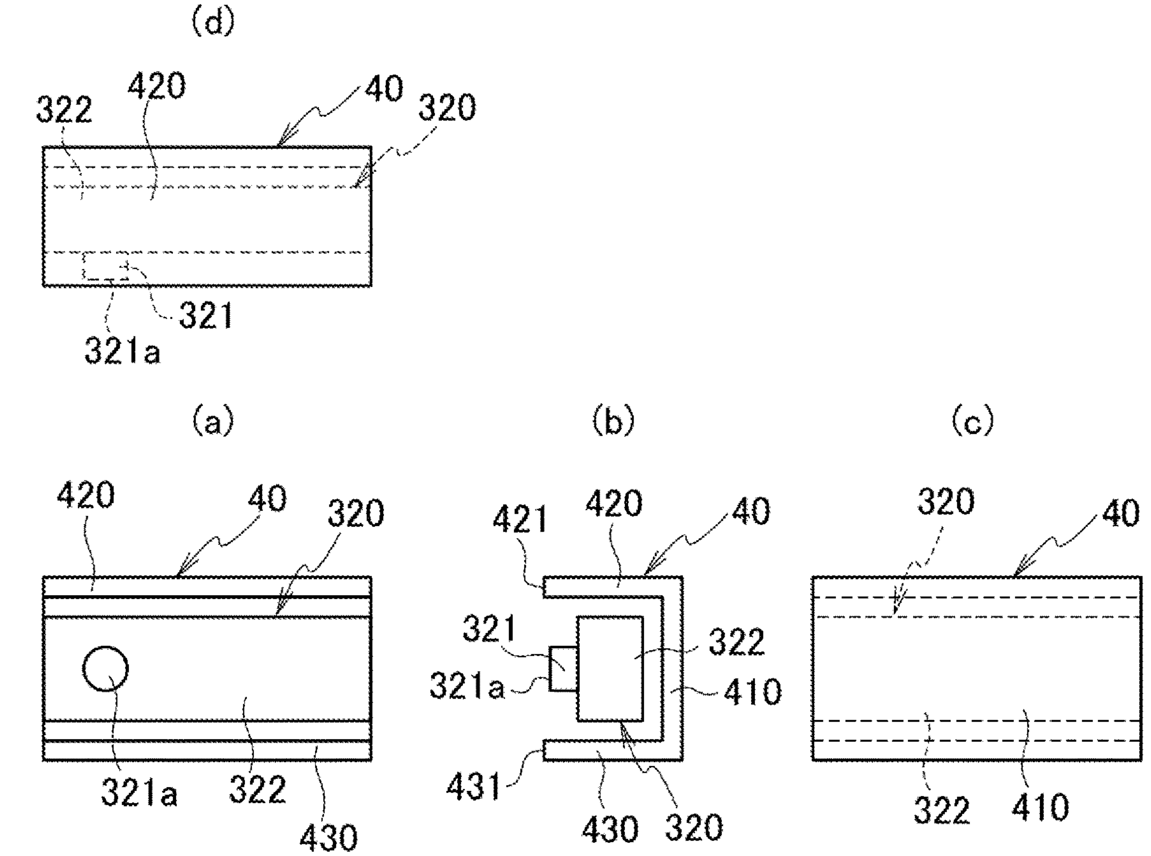
40
322
410

FIG. 45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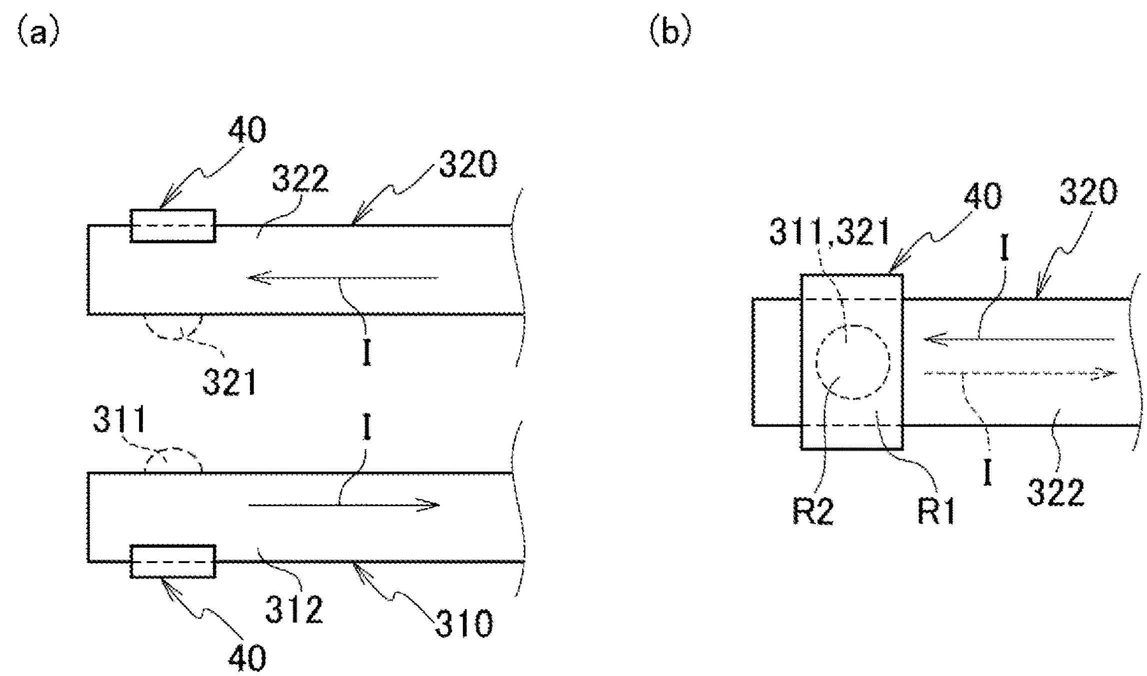
322
410

FIG. 46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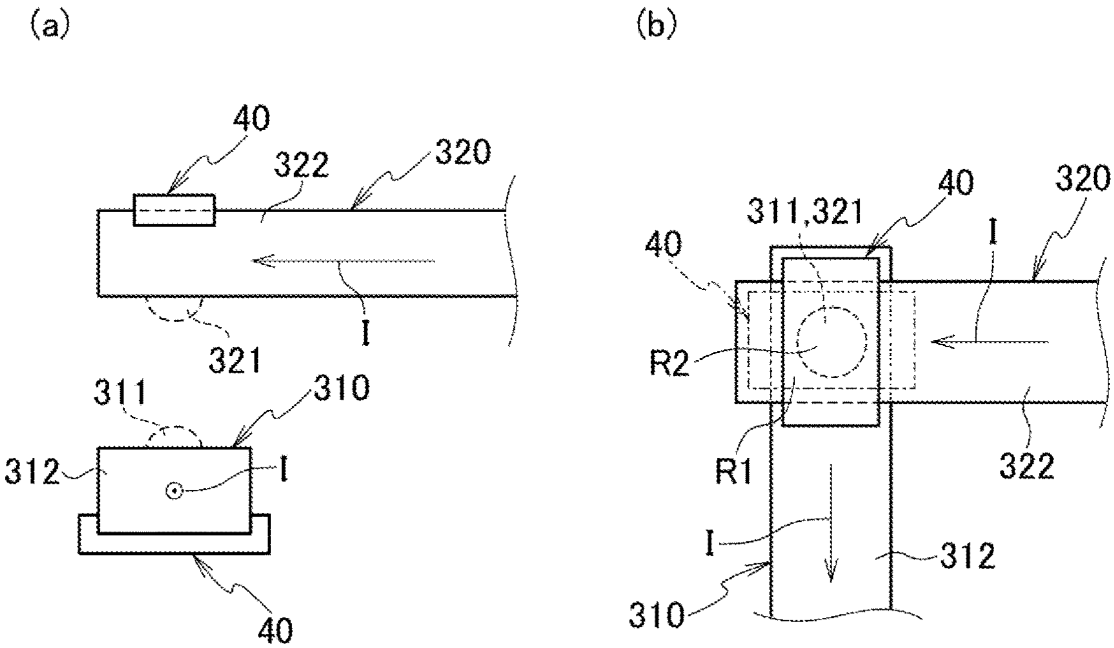
320
I
I
R2
R1
322

FIG. 47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R2
R1
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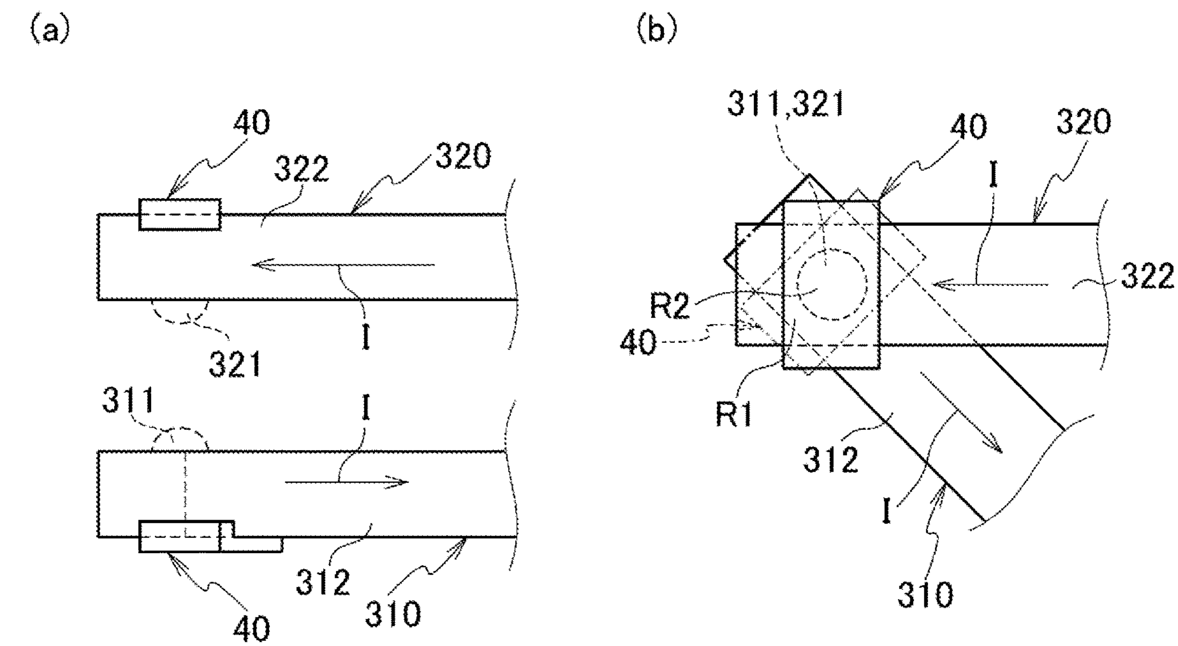
310

FIG. 48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R2
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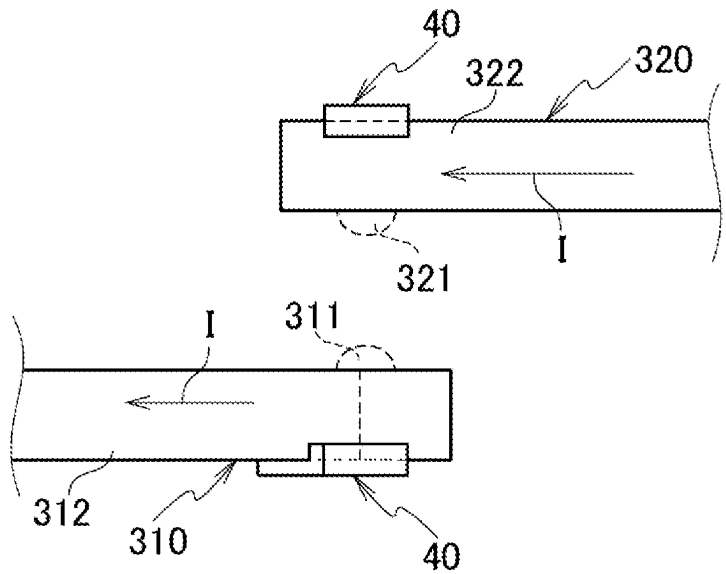
R1
312
I
310

FIG. 49

(a)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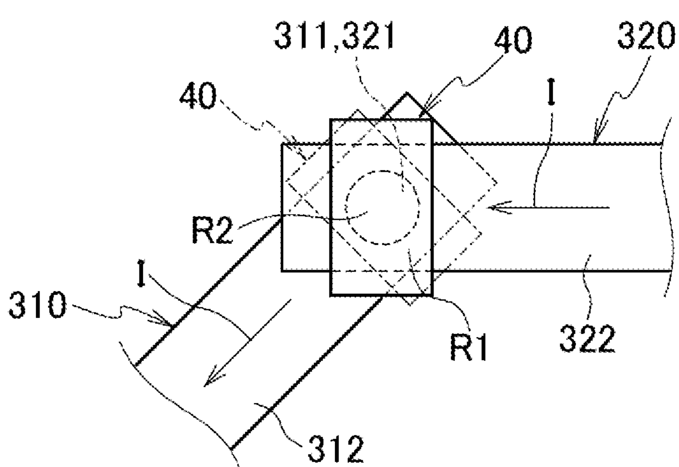
321
311
I
312
310
40

(b)


311,321
40
320
40
I
R2
I
310
R1
322
312

CONTACT DEVICE AND ELECTROMAGNETIC RELAY EQUIPPED WITH SAME

CROSS-REFERENCE OF RELATED APPLICATIONS

This application is the U.S. National Phase under 35 U.S.C. § 371 of International Patent Application No. PCT/JP2021/006959, filed on Feb. 25, 2021, which in turn claims the benefit of Japanese Patent Application No. 2020-036026, filed on Mar. 3, 2020, the entire disclosures of which Applications are incorporated by reference herein.

TECHNICAL FIELD

The present invention relates to a contact device and an electromagnetic relay equipped with the contact device.

BACKGROUND ART

A conventional contact device is known to include a fixed contact portion having a fixed contact, and a movable contact portion having a movable contact which moves relative to the fixed contact and can be brought into contact with or separated from the fixed contact, as disclosed in Patent Literature 1.

In Patent Literature 1, bringing the fixed contact and the movable contact into contact with each other and separating them from each other switches between conduction and non-conduction between the fixed contact portion and the movable contact portion.

CITATION LIST

Patent Literature

Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2012-104277

SUMMARY OF THE INVENTION

As in the prior art, when switching between conduction and non-conduction between the fixed contact portion and the movable contact portion by bringing the fixed contact and the movable contact into contact with and separating them from each other, it is preferable to prevent the movable contact and the fixed contact from being affected by an arc generated at contact parting.

It is thus an object of the present disclosure to obtain a contact device capable of preventing contacts from being affected by arcs in a more reliably manner, and an electromagnetic relay equipped with the contact device.

A contact device according to the present disclosure includes a first contact, a second contact that is movable relative to the first contact and is brought into contact with or separated from the first contact, a first body part including the first contact, a second body part including the second contact, and a yoke arranged adjacent to at least one of the first body part or the second body part. At least a part of the yoke is arranged along magnetic flux generated by a current flowing through one body part of the first body part and the second body part that is adjacent to the yoke, in a region where the first body part and the second body part overlap each other when viewed along a axis in which the first contact and the second contact move relative to each other while the first contact and the second contact are in contact with each other.

Advantageous Effects

The present disclosure makes it possible to obtain a contact device capable of preventing contacts from being affected by arcs in more reliable manner, and an electromagnetic relay equipped with the contact device.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** includes schematic diagrams illustrating an electromagnetic relay according to one embodiment, where (a) is a perspective view viewed from one axis and (b) is a perspective view viewed from another axis.

FIG. **2** includes schematic diagrams illustrating the electromagnetic relay according to one embodiment with a cover removed, where (a) is a perspective view viewed from one axis and (b) is a perspective view viewed from another axis.

FIG. **3** is a diagram illustrating the electromagnetic relay according to one embodiment when exploded, which is an exploded perspective view viewed from one axis.

FIG. **4** is a diagram illustrating the electromagnetic relay according to one embodiment when exploded, which is an exploded perspective view viewed from another axis.

FIG. **5** is a rear schematic diagram illustrating a contact device according to one embodiment with contacts in a second position.

FIG. **6** is a rear schematic diagram illustrating a contact device according to one embodiment with contacts in a first position.

FIG. **7** includes diagrams illustrating a fixed contact portion according to one embodiment, where (a) is a perspective view viewed from one axis, (b) is a perspective view viewed from another axis, and (c) is a plan view.

FIG. **8** includes diagrams illustrating a fixed contact portion according to one embodiment, where (a) is a rear view, (b) is a side view, and (c) is a front view.

FIG. **9** includes schematic diagrams illustrating a movable contact maker according to one embodiment before a yoke is attached thereto, where (a) is a perspective view viewed from one axis, (b) is a perspective view viewed from another axis, and (c) is a side view.

FIG. **10** includes schematic diagrams illustrating the movable contact maker according to one embodiment with the yoke attached thereto, where (a) is a plan view and (b) is a rear view.

FIG. **11** includes schematic diagrams illustrating the movable contact maker according to one embodiment with the yoke attached thereto, where (a) is a front view, (b) is a rear view, and (c) is a side view.

FIG. **12** includes diagrams illustrating magnetic flux generated by a current flowing through the movable contact maker according to one embodiment, where (a) is a diagram illustrating magnetic flux generated by a current flowing to one side and (b) is a diagram illustrating magnetic flux generated by a current flowing to the other side.

FIG. **13** includes diagrams illustrating the fixed contact portions, the movable contact maker, and the yoke according to one embodiment, where (a) is a plan view illustrating the contacts in a first position, and (b) is a plan view illustrating the contacts in a second position.

FIG. **14** is a diagram illustrating the fixed contact portions, the movable contact maker, and the yoke according to one embodiment with the contacts in the first position, as viewed along a movement axis of the movable contact maker.

FIG. **15** is a diagram illustrating how an arc moves toward a protrusion part in the contact device according to one embodiment.

FIG. **16** is a diagram illustrating a relationship between a direction in which an arc moves and a base in the contact device according to one embodiment.

FIG. **17** is a diagram illustrating how an arc moves toward the protrusion part in a contact device according to a modification.

FIG. **18** includes schematic diagrams illustrating a yoke according to a first modification arranged adjacent to the movable contact maker, where (a) is a front view, (b) is a side view, (c) is a rear view, and (d) is a plan view.

FIG. **19** includes schematic diagrams illustrating a yoke according to a second modification arranged adjacent to the movable contact maker, where (a) is a front view, (b) is a side view, (c) is a rear view, and (d) is a plan view.

FIG. **20** includes schematic diagrams illustrating a yoke according to a third modification arranged adjacent to the movable contact maker, where (a) is a front view, (b) is a side view, (c) is a rear view, and (d) is a plan view.

FIG. **21** includes schematic diagrams illustrating a yoke according to a fourth modification arranged adjacent to the movable contact maker, where (a) is a front view, (b) is a side view, (c) is a rear view, and (d) is a plan view.

FIG. **22** includes schematic diagrams illustrating a yoke according to a fifth modification arranged adjacent to the movable contact maker, where (a) is a front view, (b) is a side view, (c) is a rear view, and (d) is a plan view.

FIG. **23** includes schematic diagrams illustrating a yoke according to a sixth modification arranged adjacent to the movable contact maker, where (a) is a front view, (b) is a side view, (c) is a rear view, and (d) is a plan view.

FIG. **24** includes schematic diagrams illustrating a yoke according to a seventh modification arranged adjacent to the movable contact maker, where (a) is a front view, (b) is a side view, (c) is a rear view, and (d) is a plan view.

FIG. **25** includes schematic diagrams illustrating a yoke according to an eighth modification arranged adjacent to the movable contact maker, where (a) is a front view, (b) is a side view, (c) is a rear view, and (d) is a plan view.

FIG. **26** includes schematic diagrams illustrating a yoke according to a ninth modification arranged adjacent to the movable contact maker, where (a) is a front view, (b) is a side view, (c) is a rear view, and (d) is a plan view.

FIG. **27** includes schematic diagrams illustrating a yoke according to a tenth modification arranged adjacent to the movable contact maker, where (a) is a front view, (b) is a side view, (c) is a rear view, and (d) is a plan view.

FIG. **28** includes schematic diagrams illustrating a yoke according to a eleventh modification arranged adjacent to the movable contact maker, where (a) is a front view, (b) is a side view, (c) is a rear view, and (d) is a plan view.

FIG. **29** includes schematic diagrams illustrating a yoke according to a twelfth modification arranged adjacent to the movable contact maker, where (a) is a front view, (b) is a side view, (c) is a rear view, and (d) is a plan view.

FIG. **30** includes schematic diagrams illustrating a yoke according to a thirteenth modification arranged adjacent to the movable contact maker, where (a) is a front view, (b) is a side view, (c) is a rear view, and (d) is a plan view.

FIG. **31** includes schematic diagrams illustrating a yoke according to a fourteenth modification arranged adjacent to the movable contact maker, where (a) is a front view, (b) is a side view, (c) is a rear view, and (d) is a plan view.

FIG. **32** includes schematic diagrams illustrating a yoke according to a fifteenth modification arranged adjacent to the movable contact maker, where (a) is a front view, (b) is a side view, (c) is a rear view, and (d) is a plan view.

FIG. **33** includes schematic diagrams illustrating a yoke according to a sixteenth modification arranged adjacent to a body part having one contact, where (a) is a front view, (b) is a side view, (c) is a rear view, and (d) is a plan view.

FIG. **34** includes schematic diagrams illustrating a yoke according to a seventeenth modification arranged adjacent to the body part having one contact, where (a) is a front view, (b) is a side view, (c) is a rear view, and (d) is a plan view.

FIG. **35** includes schematic diagrams illustrating a yoke according to an eighteenth modification arranged adjacent to the body part having one contact, where (a) is a front view, (b) is a side view, (c) is a rear view, and (d) is a plan view.

FIG. **36** includes schematic diagrams illustrating a yoke according to a nineteenth modification arranged adjacent to the body part having one contact, where (a) is a front view, (b) is a side view, (c) is a rear view, and (d) is a plan view.

FIG. **37** includes schematic diagrams illustrating a yoke according to a twentieth modification arranged adjacent to the body part having one contact, where (a) is a front view, (b) is a side view, (c) is a rear view, and (d) is a plan view.

FIG. **38** includes schematic diagrams illustrating a yoke according to a twenty-first modification arranged adjacent to the body part having one contact, where (a) is a front view, (b) is a side view, (c) is a rear view, and (d) is a plan view.

FIG. **39** includes schematic diagrams illustrating a yoke according to a twenty-second modification arranged adjacent to the body part having one contact, where (a) is a front view, (b) is a side view, (c) is a rear view, and (d) is a plan view.

FIG. **40** includes schematic diagrams illustrating a yoke according to a twenty-third modification arranged adjacent to the body part having one contact, where (a) is a front view, (b) is a side view, (c) is a rear view, and (d) is a plan view.

FIG. **41** includes schematic diagrams illustrating a yoke according to a twenty-fourth modification arranged adjacent to the body part having one contact, where (a) is a front view, (b) is a side view, (c) is a rear view, and (d) is a plan view.

FIG. **42** includes schematic diagrams illustrating a yoke according to a twenty-fifth modification arranged adjacent to the body part having one contact, where (a) is a front view, (b) is a side view, (c) is a rear view, and (d) is a plan view.

FIG. **43** includes schematic diagrams illustrating a yoke according to a twenty-sixth modification arranged adjacent to the body part having one contact, where (a) is a front view, (b) is a side view, (c) is a rear view, and (d) is a plan view.

FIG. **44** includes schematic diagrams illustrating a yoke according to a twenty-seventh modification arranged adjacent to the body part having one contact, where (a) is a front view, (b) is a side view, (c) is a rear view, and (d) is a plan view.

FIG. **45** includes schematic diagrams illustrating a yoke according to a twenty-eighth modification arranged adjacent to the body part having one contact, where (a) is a front view, (b) is a side view, (c) is a rear view, and (d) is a plan view.

FIG. **46** includes schematic diagrams illustrating a state in which an angle formed by a direction of a current flowing through a body part on which a yoke is arranged and a direction of a current flowing through a movable contact maker on which another yoke is arranged becomes 180 degrees, where (a) is a diagram viewed along an axis crossing a movement axis of the movable contact maker, and (b) is a diagram viewed along the movement axis of the movable contact maker.

FIG. **47** includes schematic diagrams illustrating a state in which an angle formed by a direction of a current flowing through a body part on which a yoke is arranged and a direction of a current flowing through a movable contact maker on which another yoke is arranged becomes 90 degrees, where (a) is a diagram viewed along an axis crossing a movement axis of the movable contact maker, and (b) is a diagram viewed along the movement axis of the movable contact maker.

FIG. **48** includes schematic diagrams illustrating a state in which an angle formed by a direction of a current flowing through a body part on which a yoke is arranged and a direction of a current flowing through a movable contact maker on which another yoke is arranged becomes an obtuse angle, where (a) is a diagram viewed along an axis crossing a movement axis of the movable contact maker, and (b) is a diagram viewed along the movement axis of the movable contact maker.

FIG. **49** includes schematic diagrams illustrating a state in which an angle formed by a direction of a current flowing through a body part on which a yoke is arranged and a direction of a current flowing through a movable contact maker on which another yoke is arranged becomes an acute angle, where (a) is a diagram viewed along an axis crossing a movement axis of the movable contact maker, and (b) is a diagram viewed along the movement axis of the movable contact maker.

DESCRIPTION OF EMBODIMENTS

Referring to the drawings, a detailed description is given below of embodiments according to the present disclosure. Note that the longitudinal axis of a movable contact maker is described as a Y axis (width axis; direction in which a current flows through the movable contact maker; first axis). An axis in which a fixed contact and a movable contact face each other is described as an X axis (longitudinal axis; second axis), and an axis orthogonal to the X axis and the Y axis is described as a Z axis (vertical axis; third axis).

A direction in which a tip of a terminal part provided in a fixed contact portion protrudes from a case is described as being below in the vertical axis, a side where the fixed contact is arranged is described as being forward in the longitudinal axis, and a side where the movable contact is arranged is described as being backward in the longitudinal axis.

The following embodiments and modifications thereof include similar components. Thus, in the following description, common reference numerals are assigned to these similar components, and redundant descriptions are omitted.

An electromagnetic relay **1** according to the present embodiment is what is called a normally open type in which contacts are initially in an off state, and includes an electromagnet device (driving unit) **20** arranged backward in the X axis (longitudinal axis; second axis) and a contact device **30** arranged forward in the X axis, as illustrated in FIGS. **1** to **4**. The electromagnet device **20** and the contact device **30** are housed in a case **10** formed in a hollow box shape from a resin material. Note that it is also possible to use what is called a normally closed type electromagnetic relay in which the contacts are initially in an on state.

The case **10** includes a base **110** and a cover **120**, and has an outer surface in a substantially rectangular parallelepiped shape. The electromagnet device **20** and the contact device **30** are housed in an internal space **51** of the case **10** formed with the cover **120** attached to the base **110**.

Note that the shape of the outer surface of the case **10** is not limited to a rectangular parallelepiped shape and may be any shape.

The base **110** includes a base part **111** in a rectangular plate shape extending along a substantially horizontal plane (axis crossing Z axis; XY plane). The base **110** includes a peripheral wall **112** extending upward from the peripheral edge of the base part **111**, and a partition wall **113** formed to rise upward from a substantially central part in the X axis (longitudinal axis) (see FIGS. **2** to **4**).

The electromagnet device **20** is arranged behind the partition wall **113**, and the contact device **30** is arranged in front of the partition wall **113** (see FIGS. **2** to **4**).

Meanwhile, the cover **120** has an approximate box shape opened downward, and the cover **120** is attached to the base **110** from above.

As described above, in the present embodiment, the internal space **51** of the case **10** is divided into two sections, front and back, by the partition wall **113** of the base **110**. That is, the internal space **51** of the case **10** is divided into a space S2 formed behind the partition wall **113** and housing the electromagnet device **20**, and a space S3 formed in front of the partition wall **113** and housing the contact device **30** (see FIGS. **5** and **6**).

The base **110** includes a separation wall **114** formed in an approximate T-shape in a plan view in front of the partition wall **113**. The separation wall **114** is for securing a creepage distance between a pair of fixed contact portions **310**, **310** described later.

Note that reference numeral **117** in FIGS. **1** to **4** is a raising member for providing a gap between the base **110** and a printed circuit board (not illustrated) when the electromagnetic relay **1** is arranged on the printed circuit board.

The electromagnet device (driving unit) **20** is a device for generating electromagnetic force and includes a coil **210** for generating magnetic flux when energized, and a coil bobbin **220** in a hollow cylindrical shape around which the coil **210** is wound (see FIGS. **2** to **4**).

As the coil **210**, a conductor wire is usable, for example. The coil bobbin **220** is formed from a resin, which is an insulating material, and has an insertion hole penetrating in the Z axis (vertical axis; third axis) formed in a center part of the coil bobbin **220**. The coil bobbin **220** includes a drum part in a substantially cylindrical shape, around which the coil **210** is wound on the outer surface thereof, and an upper flange part **222** in a substantially circular shape, which is provided in continuation from the upper end of the drum part to protrude outward in the radial direction of the drum part. Further, the coil bobbin **220** includes a lower flange part **223** in a substantially circular shape, which is provided in continuation from the lower end of the drum part to protrude outward in the radial direction of the drum part.

The electromagnet device **20** includes an iron core (fixed-side member) **230** inserted in the cylinder of the coil bobbin **220** and magnetized by the energized coil **210** (magnetic flux passes through).

The iron core **230** includes a shaft portion in a substantially cylindrical shape extending in the Z axis (vertical axis), and a head part **232** in a substantially cylindrical shape having a diameter larger than that of the shaft portion and provided in continuation from the upper end of the shaft portion (see FIGS. **3** and **4**).

The electromagnet device **20** further includes an armature (movable-side member) **240** arranged to face the head part **232** of the iron core **230** in the vertical axis (Z axis).

The armature **240** is formed from a conductive metal and is arranged to be swingable in the vertical axis (Z axis) with respect to the head part **232** of the iron core **230**. In the present embodiment, the armature **240** includes a horizontal wall part **241** facing the head part **232** of the iron core **230** in the vertical axis (Z axis), and a vertical wall part **242** extending downward from the front end of the horizontal wall part **241** in the X axis (longitudinal axis) (see FIGS. **5** and **6**).

The electromagnet device **20** includes a heel piece **250** arranged around the coil **210** wound around the drum part. The heel piece **250** is a member in a substantially plate shape made from a magnetic material, and has an approximate L-shape in a side view (in a state viewed along the Y axis). That is, in the present embodiment, the heel piece **250** includes a vertical wall part **251** arranged in front of the coil **210** wound around the drum part to extend along a substantially vertical plane, and a horizontal wall part **252** extending backward from the lower end of the vertical wall part **251** (see FIGS. **5** and **6**). The above-described heel piece **250** is formable through bending a single plate, for example.

The horizontal wall part **241** of the armature **240** is attached to the upper end of the vertical wall part **251** to be swingable in the vertical axis (Z axis). This enables the armature **240** to rotate in the vertical axis (Z axis) about a section supported by the heel piece **250**.

Further, in the present embodiment, the electromagnet device **20** includes a hinge spring **260** mounted over the armature **240** and the heel piece **250** so that the armature **240** is urged by the hinge spring **260** in a direction in which the horizontal wall part **241** separates from the head part **232** of the iron core **230** (see FIGS. **5** and **6**).

The electromagnet device **20** is fixed to the coil bobbin **220** and includes a pair of coil terminals **270** to which both ends of the coil **210** are connected. The electromagnet device **20** is driven by energizing the coil **210** through the pair of coil terminals **270**.

Specifically, the horizontal wall part **241** of the armature **240** is attracted to the head part **232** of the iron core **230** by energizing the coil **210**, and the armature **240** is rotated so that the horizontal wall part **241** approaches the head part **232** of the iron core **230**. That is, energizing the coil **210** through the pair of coil terminals **270** causes the horizontal wall part **241** of the armature **240** to rotate downward in the Z axis (vertical axis). Here, the vertical wall part **242** provided in continuation from the horizontal wall part **241** rotates forward in the X axis (longitudinal axis).

The swing range of the armature **240** is set between a position where the horizontal wall part **241** is farthest from the head part **232** of the iron core **230** and a position where the horizontal wall part **241** is closest to the head part **232** of the iron core **230**.

In the present embodiment, the swinging range of the armature **240** is set between an initial position where the horizontal wall part **241** is arranged above the head part **232** of the iron core **230** with a predetermined gap therebetween and a contact position where the horizontal wall part **241** comes in contact with the head part **232** of the iron core **230**.

Thus, in the present embodiment, when the coil **210** is energized, the armature **240** moves to the contact position where the horizontal wall part **241** comes in contact with the head part **232** of the iron core **230**, and when the energization to the coil **210** is stopped, the armature **240** returns to the initial position with the urging force of the hinge spring **260**.

As described above, the armature **240** according to the present embodiment is arranged to face the head part **232** of the iron core **230** with a predetermined gap therebetween when the coil **210** is not energized, and swings to be attracted toward the head part **232** of the iron core **230** when the coil **210** is energized.

By switching the driving state of the electromagnet device **20**, it is possible to switch between conduction and non-conduction between the fixed contact portions **310** and the movable contact portion **320**, which are paired with each other (having contacts that contact and separate from each other).

In the present embodiment, the contact device **30** is provided in front of the electromagnet device **20** to open and close the contacts as the coil **210** is energized and de-energized.

The contact device **30** includes the fixed contact portions (first contact portion) **310** and the movable contact portion (second contact portion) **320**. The fixed contact portions **310** each include a fixed contact (first contact) **311** and a body part (first body part) **312** having the fixed contact **311**. In contrast, the movable contact portion **320** includes movable contacts (second contact) **321** that move relative to the fixed contacts **311** and are able to contact with and separate from the fixed contacts **311**, and a movable contact maker (second body part) **322** having the movable contacts **321**.

In the present embodiment, the contact device **30** includes only one pair of the fixed contact portions **310** and the movable contact portion **320** paired with each other (having contacts that contact with and separate from each other) (see FIGS. **3** and **4**).

In the present embodiment, the set of the fixed contact portions **310** and the movable contact portion **320** having contacts to be brought into contact with and separated from each other is composed of the pair of fixed contact portions **310** and one movable contact portion **320**.

Specifically, two fixed contact portions **310** having a shape symmetrical to the XZ plane are the pair of fixed contact portions **310**. The paired two fixed contact portions **310** are fixed to the base **110** (case **10**) while being spaced apart in the Y axis (width axis; first axis).

Each of the fixed contact parts **310** includes the body part **312** having one fixed contact **311** (see FIGS. **7** and **8**). In the present embodiment, a member intended to be a fixed contact is inserted in an insertion hole **312***d*, which is formed to penetrate the body part **312** in the plate thickness axis, rivet joining is carried out thereon, and thus the body part **312** has the fixed contact **311** (see FIGS. **5** and **6**). As described above, in the present embodiment, the body part **312** has a function as a fixed-side contact holder for holding the fixed contact **311**.

Note that the formation of the fixed contact **311** on the body part **312** is not limited to using rivet joining and can be performed with various methods. For example, it is possible to make a section, which is made to protrude through a doweling process performed on the body part **312**, function as a fixed contact. It is also possible to make a part of the flat surface of the body part **312** function as a fixed contact by adopting a configuration with which the movable contact **321** is brought into contact with the part of the flat surface of the body part **312**

Each of the fixed contact portions **310** includes a terminal part **313** provided in continuation from the lower end of the body part **312** to be fixed to the base **110** (case **10**) with the tip thereof protruding outward (downward) from the base **110** (case **10**).

In the present embodiment, the base **110** has an insertion hole **115** formed to penetrate in the Z axis (vertical axis). The tip (lower end) of each terminal part **313** is inserted in the insertion hole **115** from above, and each fixed contact portion **310** is fixed to the base **110** (case **10**) with the tip (lower end) of the terminal part **313** protruding outward (downward) from the base **110** (see FIGS. **5** and **6**). In the present embodiment, the fixed contact portions **310** are fixed to the base **110** (case **10**) using an adhesive **116**.

Here, each fixed contact portion **310** is fixed to the base **110** (case **10**) with the fixed contact **311** facing backward in the X axis (longitudinal axis). That is, the fixed contact portion **310** is fixed to the base **110** (case **10**) with a surface **312***a* of the body part **312** on which the fixed contact **311** is formed (rear surface; first surface; surface facing the movable contact **321**) facing backward.

Note that the fixed contacts **311**, the body parts **312**, and the terminal parts **313** are formable from a conductive material, such as a copper-based material.

As described above, in the present embodiment, the two fixed contacts (first contact) **311** are arranged side by side in the Y axis, which is an axis orthogonal to (intersecting with) the axis in which the fixed contacts (first contact) **311** and the movable contact (second contact) **321** move relative to each other. One of the two body parts (first body part) **312** has one of the fixed contacts (first contact) **311**, and the other of the two body parts has the other of the fixed contacts (first contact) **311**.

Meanwhile, the one movable contact portion **320** includes one movable contact maker **322**, and the movable contact maker **322** includes a pair of movable contacts **321** arranged side by side in the Y axis (width axis) (see FIGS. **9** to **11**).

In the present embodiment, a member intended to be a movable contact is inserted in each of insertion holes **322***e* formed on both ends of the movable contact maker **322**, which is in a substantially rectangular plate shape in the longitudinal axis, to penetrate in the thickness axis, rivet joining is carried out thereon, and thus the movable contact maker **322** has the movable contacts **321** (see FIGS. **5** and **6**). As described above, in the present embodiment, the movable contact maker **322** has a function as a movable-side contact holder for holding the movable contacts **321**.

Note that the formation of the movable contacts **321** on the movable contact maker **322** is not limited to using rivet joining and can be formed with various methods. For example, it is possible to make a section, which is made to protrude through a doweling process performed on the movable contact maker **322**, function as a movable contact. It is also possible to make a part of the flat surface of the movable contact maker **322** function as a movable contact by having a configuration to bring the part of the flat surface of the movable contact maker **322** into contact with the fixed contact **311**.

The one movable contact portion **320** is arranged to be positioned behind the paired two fixed contact portions **310** in the X axis (longitudinal axis) with the plate thickness axis substantially aligned in the X axis (longitudinal axis) and with the longitudinal axis substantially aligned in the Y axis (width axis) (see FIGS. **3** to **6**). Here, the movable contact portion **320** is arranged in such a state that the movable contacts **321** are opposed to the fixed contacts **311** in the X axis (longitudinal axis). Specifically, the movable contact maker **322** is arranged such that the movable contact **321** formed on one side in the Y axis (width axis) is opposed in the X axis (longitudinal axis) to the fixed contact **311** of the fixed contact portion **310** arranged on the one side in the Y axis (width axis). In a similar manner, the movable contact maker **322** is arranged such that the movable contact **321** formed on the other side in the Y axis (width axis) is opposed in the X axis (longitudinal axis) to the fixed contact **311** of the fixed contact portion **310** arranged on the other side in the Y axis (width axis). Thus, one movable contact (second contact) **321** is brought into contact with and separated from one fixed contact (first contact) **311** of the two fixed contacts (first contact) **311**, and the other movable contact (second contact) **321** is brought into contact with and separated from the other fixed contact (first contact) **311** of the two fixed contacts (first contact) **311**. One movable contact maker (second body part) **322** is made to have two movable contacts (second contact) **321**.

Note that the movable contacts **321** and the movable contact maker **322** are formable from a conductive material, such as a copper-based material.

The pair of fixed contact portions **310** and one movable contact portion **320**, having the above-described configuration is housed in the above-described space S**3** (see FIGS. **5** and **6**) as a set.

Here, the movable contact portion **320** is arranged in the space S**3** to be swingable in the X axis (longitudinal axis) relative to the pair of fixed contact portions **310**.

Specifically, the contact device **30** includes a movable body **330** that swings in the X axis (longitudinal axis) as the armature **240** swings. The movable body **330** holds the movable contact portion **320**, and thus the movable contact portion **320** swings in the X axis (longitudinal axis) relative to the pair of fixed contact portions **310**.

In the present embodiment, the movable body **330** is formed from an insulating resin material and includes a holder part **331** whose upper part is provided in continuation from the vertical wall part **242** of the armature **240**, a movable plate **332** provided in continuation from the lower part of the holder portion **331**, and a movable spring **333** connecting the movable plate **332** and the movable contact maker **322**.

With such a configuration, the movable contact portion **320** swings in the X axis (longitudinal axis) relative to the pair of fixed contact portions **310** as the armature **240** swings. Thus, the movable contacts **321** pivot in an arc centered on the upper end of the vertical wall part **242**.

Therefore, in the present embodiment, the tangential axis of the arc (movement path of the movable contacts **321**) drawn by the movable contacts **321** while swinging is the axis in which the fixed contacts (first contact) **311** and the movable contacts (second contact) **321** move relative to each other.

Thus, strictly speaking, the axis in which the fixed contacts (first contact) **311** and the movable contacts (second contact) **321** move relative to each other is different between when the armature **240** is in the initial position and when the armature **240** is in the contact position.

However, in the present embodiment, the angle (central angle) of the arc drawn by the movable contacts **321** while swinging is relatively small, and the movable contacts **321** are configured to be positioned at the lowest end between when the armature **240** is in the initial position and when the armature **240** is in the contact position (see FIGS. **5** and **6**). Thus, the tangential axis of the arc drawn by the movable contacts **321** while swinging is substantially parallel to the X axis.

Therefore, in the present embodiment, it is possible for the axis in which the fixed contacts **311** and the movable contacts **321** move relative to each other to be approximated by the X axis (longitudinal axis; axis in which the fixed contact **311** and the movable contact **321** are opposed each other).

Thus, when the axis in which the fixed contacts **311** and the movable contacts **321** move relative to each other is approximated by the X axis, the state seen along the axis in which the fixed contacts (first contact) **311** and the movable contacts (second contact) **321** move relative to each other can also be approximated by the state seen along the X axis. Thus, in the following description, the state seen along the axis in which the fixed contacts (first contact) **311** and the movable contacts (second contact) **321** move relative to each other is in some cases described as the state seen along the X axis.

Next, an example of the operation of the electromagnetic relay **1** (the electromagnet device **20** and the contact device **30**) having the above-described configuration is described.

First, when the coil **210** is not energized, the horizontal wall part **241** of the armature **240** moves away from the head part **232** of the iron core **230** through the elastic force of the hinge spring **260**. Here, since the vertical wall part **242** of the armature **240** is located behind in the X axis (longitudinal axis), the movable body **330** is also located behind in the X axis (longitudinal axis). That is, the movable contact portion **320** held by the movable body **330** is separated from the fixed contact portions **310**, and the movable contacts **321** are separated from the fixed contacts **311** (see FIG. **5**).

When the coil **210** is energized from this off state, the horizontal wall part **241** of the armature **240** is attracted downward (the iron core **230** side) by the electromagnetic force and moves close to the head part **232** of the iron ore **230** against the elastic force of the hinge spring **260**. The vertical wall part **242** rotates forward with the downward rotation of the horizontal wall part **241** (iron core **230** side), and the movable body **330** rotates forward with the forward rotation of the vertical wall part **242**. As a result, the movable contact maker **322** held by the movable body **330** rotates forward toward the fixed contact portion **310**, and the movable contacts **321** of the movable contact maker **322** are brought into contact with the fixed contacts **311** of the fixed contact portions **310**. Thus, the pair of fixed contact portions **310** are electrically connected by the movable contact portion **320** (see FIG. **6**).

In contrast, when the energization to the coil **210** is stopped, the horizontal wall part **241** of the armature **240** rotates upward (away from the iron core **230**) due to the urging force of the hinge spring **260** and returns to the initial position.

The vertical wall part **242** rotates backward with the upward rotation of the horizontal wall part **241**, and the movable body **330** rotates backward with the backward rotation of the vertical wall part **242**. As a result, the movable contact maker **322** held by the movable body **330** rotates backward away from the fixed contact portions **310**, and the movable contacts **321** of the movable contact maker **322** are separated from the fixed contacts **311** of the fixed contact portions **310**. In this way, the electrical connection between the pair of fixed contact portions **310**, **310** is disconnected.

As described above, in the present embodiment, when the armature **240** is in the initial position, the movable contacts **321** and the fixed contacts **311** are separated from each other in a second position (see FIG. **5**). In contrast, when the armature **240** is in the contact position, the movable contacts **321** and the fixed contacts **311** are in contact in a first position (see FIG. **6**).

Thus, during the period when the coil **210** is not energized, the pair of fixed contact portions **310**, **310** are insulated, and during the period when the coil **210** is energized, the pair of fixed contact portions **310**, **310** are electrically connected. As described above, in the present embodiment, the movable contacts (second contact) **321** are configured to reciprocate (rotate) in the second axis (X axis; longitudinal axis) relative to the fixed contacts (first contact) **311** between the first position and the second position.

Here, when the movable contacts **321** and the fixed contacts **311** are positioned in the first position in contact with each other, a current I flows through the movable contact maker **322** mainly along the longitudinal axis (Y axis).

Here, for example, as illustrated in FIG. **12**(*a*), when the current I flows from the movable contact **321** on the left side (front side in FIG. **12**(*a*)) to the movable contact **321** on the right side (rear side in FIG. **12**(*a*)), magnetic flux B is generated from above to below on a surface (first surface) **322***a* of the movable contact maker **322** on which the movable contacts **321** are formed. Note that the surface **322***a* of the movable contact maker **322** on which the movable contacts **321** are formed is a surface located to face the opposing body part (first body parts **312**) and is referred to as a front surface **322***a* in some cases below.

When the energization to the coil **210** is stopped, contact parting is started in which the movable contacts **321** are separated from the fixed contacts **311** (moved from the state in FIG. **13**(*a*) to the state in FIG. **13**(*b*)).

When the contact parting is started, an arc A is generated between the movable contacts **321** and the fixed contacts **311** in the initial stage of the contact parting, and the arc A causes the current to be continued in the energized state (see FIG. **13**(*b*)).

Here, when the current I flows from the movable contact **321** on the right side to the movable contact **321** on the left side in FIG. **13**(*b*) (when a current flows in the same direction as in FIG. **12**(*a*)), the current I flowing from the movable contact **321** toward the fixed contact **311** on the left side in FIG. **13**(*b*) flows through the arc A generated at the movable contact **321** and the fixed contact **311**.

In contrast, the current I flowing from the fixed contact **311** toward the movable contact **321** on the right side in FIG. **13**(*b*) flows through the arc A generated at the movable contact **321** and the fixed contact **311**.

As described above, magnetic flux B flowing from above to below is generated near the front surface **322***a* of the movable contact maker **322**, that is, in the space where the arcs A exist.

Thus, the current I flowing from the movable contact **321** toward the fixed contact **311** on the left side in FIG. **13**(*b*) and the magnetic flux B flowing from above to below cause a Lorentz force to the left side (outside in the Y axis) to be applied to the arc A generated at the movable contact **321** and the fixed contact **311**.

As a result, the arc A generated at the movable contact **321** and the fixed contact **311** on the left side in FIG. **13**(*b*) is extended to the left side (outside in the Y axis) in FIG. **13**(*b*).

The current I flowing from the fixed contact **311** toward the movable contact **321** on the right side in FIG. **13**(*b*) and the magnetic flux B flowing from above to below causes a Lorentz force to the right side (outside in the Y axis) to be applied to the arc A generated at the movable contact **321** and the fixed contact **311**.

As a result, the arc A generated at the movable contact **321** and the fixed contact **311** on the right side in FIG. **13**(*b*) is extended to the right side (outside in the Y axis) in FIG. **13**(*b*).

Then, the arcs A generated in respective sets of the movable contact **321** and the fixed contact **311** are each extended outward in the Y axis to be extinguished. In this way, the current between the fixed contact portions **310** and the movable contact portion **320** is cut.

Note that although not illustrated, when the current I flows from the movable contact **321** on the left toward the movable contact **321** on the right in FIG. **13**(*b*) (when the current flows in the same direction as in FIG. **12**(*b*)), the current I flowing from the fixed contact **311** toward the movable contact **321** on the left in FIG. **13**(*b*) flows through the arc A generated at the movable contact **321** and the fixed contact **311**.

The current I flowing from the movable contact **321** toward the fixed contact **311** on the right side in FIG. **13**(*b*) flows through the arc A generated at the movable contact **321** and the fixed contact **311**.

In this case, as described above, the magnetic flux B flowing from below to above is generated near the front surface **322***a* of the movable contact maker **322**, that is, in the space where the arcs A exist.

Thus, the current I flowing from the fixed contact **311** toward the movable contact **321** on the left side in FIG. **13**(*b*) and the magnetic flux B flowing from below to above causes a Lorentz force to the left side (outside in the Y axis) to be applied to the arc A generated at the movable contact **321** and the fixed contact **311**.

As a result, the arc A generated at the movable contact **321** and the fixed contact **311** on the left side in FIG. **13**(*b*) is extended to the left side (outside in the Y axis) in FIG. **13**(*b*).

The current I flowing from the movable contact **321** toward the fixed contact **311** on the right side in FIG. **13**(*b*) and the magnetic flux B flowing from below to above causes a Lorentz force to the right side (outside in the Y axis) to be applied to the arc A generated at the movable contact **321** and the fixed contact **311**.

As a result, the arc A generated at the movable contact **321** and the fixed contact **311** on the right side in FIG. **13**(*b*) is extended to the right side (outside in the Y axis) in FIG. **13**(*b*).

Then, the arcs A generated in respective sets of the movable contact **321** and the fixed contact **311** are each extended outward in the Y axis to be extinguished

As described above, the contact device **30** according to the present embodiment is configured such that arcs A generated between the movable contacts **321** and the fixed contacts **311** are extended outward in the Y axis to be extinguished regardless of the direction of the current.

Thus, even when an AC current flows through the contact device **30** as in an AC relay, it is possible to extend the arcs A generated between the movable contacts **321** and the fixed contacts **311** outside in the Y axis and extinguish the arcs.

When an arc A is generated between the movable contact **321** and the fixed contact **311**, the movable contact **321** and the fixed contact **311** may be welded by the arc heat. The movable contact **321** and the fixed contact **311** may be deteriorated by the arc heat.

Thus, when the arcs A are generated between the movable contacts **321** and the fixed contacts **311**, the contacts (the movable contacts **321** and the fixed contacts **311**) may be affected by the arcs. In particular, in an electromagnetic relay in which a large current flows, contacts (movable contacts **321** and fixed contacts **311**) are to be affected to a great extent by the arcs.

Thus, it is preferable to extinguish the arcs A generated between the movable contacts **321** and the fixed contacts **311** in a more reliable and more quick manner and to prevent the contacts (the movable contacts **321** and the fixed contacts **311**) from being affected by the arcs.

Thus, the present embodiment makes it possible to extinguish the arcs A generated between the movable contacts **321** and the fixed contacts **311** in a more reliable and quick manner Specifically, a yoke **40** is arranged adjacent to at least one of the body parts (first body part) **312** or the movable contact maker (second body part) **322**.

Arranging the yoke **40** to face at least one of the body parts **312** or the movable contact maker **322** makes it possible to enhance the intensity of the magnetic flux B generated around the body part adjacent to the yoke **40**, and to extinguish the arcs A in a more reliable and quick manner.

In the present embodiment, as illustrated in FIGS. **9** to **11**, the yoke **40** is arranged adjacent to the movable contact maker (second body part) **322**, which is the body part of at least one of the body parts **312** or the movable contact maker **322**.

At least a part of the yoke **40** is arranged along the magnetic flux B that is generated by the current I flowing through the movable contact maker (the body part adjacent to the yoke **40**) **322** and is generated in the region R**1**.

Note that the region R1 is a region where the body parts (first body part) **312** and the movable contact maker (second body part) **322** overlap each other when the state in which the fixed contacts **311** and the movable contact **321** are in contact with each other is viewed along the X axis (as viewed along the axis in which the fixed contacts **311** and the movable contact **321** move relative to each other) (see FIG. **14**).

As described above, in the present embodiment, at least a part of the yoke **40** is arranged along the magnetic flux B generated around the movable contact maker (second body part) **322** in a space belonging to the region R**1** of the space near the movable contact maker (second body part) **322**.

Arranging the yoke **40** as described above makes it possible to concentrate the magnetic flux B generated around the movable contact maker (second body part) **322** in the yoke **40**. Consequently, it is possible to increase the intensity of the magnetic flux B generated around the movable contact maker (second body part) **322** (the magnetic field around the movable contact maker **322** is strengthened) and to extinguish the arcs A generated between the movable contact **321** and the fixed contacts **311** in a more reliable and quick manner.

Further, in the present embodiment, the yoke **40** includes a section arranged adjacent to a surface (second surface) **322***b* of the movable contact maker **322** opposite to the surface where the movable contacts **321** are formed. Note that the surface of the movable contact maker **322** opposite to the surface where the movable contacts **321** are formed is a surface located on the opposite side to the side facing the opposing body part (first body part **312**) and is referred to as a back surface **322***b* in some cases below.

In the present embodiment, the yoke **40** includes a sidewall **410** in a substantially rectangular shape elongated in the Y axis, a top wall **420** provided in continuation from the upper end of the sidewall **410**, and a bottom wall **430** provided in continuation from the lower end of the sidewall **410** and extending in the same direction as the top wall **420**.

A front surface **411** of the side wall **410** is arranged to face the back surface **322***b* of the movable contact maker **322** with a tip **421** of the top wall **420** and a tip **431** of the bottom wall **430** facing forward in the X axis (longitudinal axis).

Thus, in the present embodiment, the side wall **410** of the yoke **40** is the section arranged adjacent to the surface (second surface) **322***b* of the movable contact maker **322** opposite to the surface where the movable contacts **321** are formed.

Here, the side wall **410** of the yoke **40** is arranged to overlap with the contacts (movable contacts **321**) of the body part (movable contact maker **322**) to face the yoke **40**, when viewed along the X axis (viewed along the axis in which the fixed contacts **311** and the movable contacts **321** move relative to each other). Thus, the side wall **410** of the yoke **40** is arranged to overlap a contact region R**2** where the fixed contacts (first contact) **311** and the movable contacts (second contact) **321** come into contact, when viewed along the X axis (viewed along the axis in which the fixed contacts **311** and the movable contacts **321** move relative to each other).

Thus, in the present embodiment, a section of the side wall **410** of the yoke **40** is a part that overlaps the contact region R**2** where the fixed contacts (first contact) **311** and the movable contacts (second contact) **321** come into contact, when viewed along the axis in which the fixed contacts (first contact) **311** and the movable contacts (second contact) **321** move relative to each other (see FIG. **14**). Here, the side wall **410** is arranged to overlap the entire area of the contact region R**2**.

Here, in the present embodiment, one movable contact maker **322** includes two movable contacts (second contact) **321** arranged side by side in the Y axis (the axis crossing the axis in which the first contact and the second contact move relative to each other). Further, one (for example, on the left side in FIG. **14**) of the two body parts (first body part) **312** has one fixed contact (first contact) **311**, and the other (for example, on the right side in FIG. **14**) of the two body parts **312** has the other fixed contact (first contact) **311**.

One movable contact **321** of the two movable contacts (second contact) **321** contacts with and separates from one fixed contact **311** of the two fixed contacts (first contact) **311**, and the other movable contact **321** contacts with and separates from the other fixed contact **311**.

Thus, in the present embodiment, the yoke **40** includes a first yoke **440** arranged on one end where one fixed contact **311** and one movable contact **321**, which contact with and separate from each other, are located, and a second yoke **450** arranged on the other end where the other fixed contact **311** and the other movable contact **321**, which contact with and separate from each other, are located. The first yoke **440** and the second yoke **450** are connected by a connecting section **460**.

As described above, in the present embodiment, one in which the first yoke **440** and the second yoke **450** are integrated by the connecting section **460** is exemplified as the yoke **40**.

In the present embodiment, the yoke **40** has a shape in which a notch **40***a* is provided at the center part in the Y axis, and the length in the Z axis of the center part in the Y axis is shorter than those of both end parts in the Y axis. The notch **40***a* is provided to prevent the yoke **40** from interfering with the movable body **330**.

A section where the notch **40***a* is formed at the center part in the Y axis serves as the connecting section **460**, and sections at both ends in the Y axis serve as the first yoke **440** and the second yoke **450**. Making the length of the connecting section **460** in the Z axis shorter than those of the first yoke **440** and the second yoke **450** as described above enables the magnetic flux B generated around the movable contact maker **322** to be concentrated toward the first yoke **440** and the second yoke **450** in a more efficient manner, thereby enhancing the intensity of the magnetic flux B generated around the contacts (the fixed contacts **311** and the movable contacts **321** contacting and separating each other).

In the present embodiment, the yoke **40** is fixed to the movable contact maker (the body part adjacent to the yoke **40**) **322**.

Specifically, the movable contact maker **322** is held between the top wall **420** and the bottom wall **430** to fix the yoke **40** to the movable contact maker **322**. Note that the yoke **40** may be fixed to the movable contact maker **322** by means of caulking, brazing, adhesive, or the like.

Then, by holding the movable contact maker **322** between the top wall **420** and the bottom wall **430**, a lower surface **420***a* of the top wall **420** comes in surface contact with an upper surface (third surface) **322***c* provided in continuation from the front surface **322***a* and the rear surface **322***b* of the movable contact maker **322**. The upper surface **430***a* of the bottom wall **430** comes in surface contact with a lower surface (third surface) **322***c* provided in continuation from the front surface **322***a* and the rear surface **322***b* of the movable contact maker **322**.

As described above, in the present embodiment, the top wall **420** and the bottom wall **430** of the yoke **40** constitute a section arranged along the third surface provided in continuation from the front surface **322***a* and the rear surface **322***b* of the movable contact maker **322**.

The tip **421** of the top wall **420** and the tip **431** of the bottom wall **430** are made to protrude forward (outward) from the front surface (first surface) **322***a* of the movable contact maker **322**.

In the present embodiment, since the movable contact **321** is formed in the movable contact maker **322** through rivet joining, a gap is formed between the front surface **411** of the side wall **410** and the back surface (outer surface) **322***b* of the movable contact maker (the body part adjacent to the yoke **40**) **322** with the yoke **40** fixed to the movable contact maker **322**.

Thus, in the present embodiment, the side wall **410** of the yoke **40** is also a section spaced apart from the outer surface (back surface **322***b*) of the body part (movable contact maker **322**) to face the yoke **40**.

Note that in the present embodiment, the yoke **40** is arranged on the movable contact maker (second body part) **322** as an example, but the yoke **40** may be arranged on the body parts (first body part) **312**.

In this case, the front surface **312***a* of the body part **312**, which is a surface to face the opposing body part (second body part **322**), serves as the first surface. The back surface **312***b* of the body part **312**, which is a surface opposite to the surface to face the opposing body part (first body part **312**), serves as the second surface. The upper surface **312***c* provided in continuation from the front surface **312***a* and the rear surface **312***b* of the body part **312** serves as the third surface.

The present embodiment has a configuration that enables the arcs A generated between the movable contacts **321** and the fixed contacts **311** to be moved more quickly away from the movable contacts **321** and the fixed contacts **311**.

Specifically, as illustrated in FIGS. **7**, **8**, and **15**, each body part (first body part) **312** has a first protrusion part **3121** protruding toward the movable contact maker (second body part) **322** formed at an end part of the body part in the Y axis (an axis crossing the axis in which the fixed contacts **311** and the movable contacts **321** move relative to each other).

In the present embodiment, the first protrusion part **3121** is formed on the body part **312** by forming a notch **3122** extending in the Y axis and opening outward in the Y axis below the fixed contact **311**, and by bending the end at the outward side in the Y axis and above the notch **3122** backward (toward the movable contact maker **322**).

Here, the first protrusion part **3121** is formed so that a tip **3121***a* of the first protrusion part **3121** is located to the rear (closer to the movable contact maker **322**) of a tip (top) **311***a* of the fixed contact **311**.

Second protrusion parts **3221** protruding toward the body parts (first body part) **312** are formed at both ends of the movable contact maker (second body part) **322** in the Y axis (an axis crossing the axis in which the fixed contacts **311** and the movable contacts **321** move relative to each other).

In the present embodiment, the second protrusion parts **3221** are formed on the movable contact maker **322** by forming the movable contact maker **322** in a shape in which both ends in the Y axis of a substantially rectangular plate-like member elongated in the Y axis are bent forward (toward the body parts **312**).

Here, the second protrusion parts **3221** are formed so that tips **3221***a* of the second protrusions **3221** are located in front (closer to the body part **312**) of tips (tops) **321***a* of the movable contacts **321**.

In the present embodiment, the tip **3221***a* of the second protrusion part **3221** is positioned more inwardly in the Y axis (the axis crossing the axis in which the fixed contacts **311** and the movable contacts **321** move relative to each other) than the tip **3121***a* of the first protrusion part **3121** (see FIG. **15**).

By forming the body parts (first body part) **312** and the movable contact maker (second body part) **322** in the shape described above, when an arc A is generated between the movable contact **321** and the fixed contact **311**, starting points (discharge point) A1 of the arc A are respectively moved toward the first protrusion part **3121** and the second protrusion part **3221** from the movable contact **321** and the fixed contact **311**.

Specifically, a Lorentz force outwardly in the Y axis acts on the arc A generated between the movable contact **321** and the fixed contact **311**, so that the arc A is elongated outwardly in the Y axis, and thus the arc A generated between the movable contact **321** and the fixed contact **311** moves to the first protrusion part **3121** and the second protrusion part **3221**.

Here, in the present embodiment, the notch **3122** is formed below the fixed contact **311** of the body part **312**, and the first protrusion part **3121** is formed above the notch **3122**.

Thus, by providing the notch **3122** in the body part **312**, the arc A moves outward in the Y axis along the notch **3122** with the Lorentz force acting on the arc A. This enables the arc A to be moved away from the fixed contact **311** more quickly.

In the present embodiment, since the tip **3221***a* of the second protrusion part **3221** is located more inward in the Y axis than the tip **3121***a* of the first protrusion part **3121**, the arc A moved to the first protrusion part **3121** and the second protrusion part **3221** is thus extended outward in the Y axis and backward in the X axis.

Thus, in the present embodiment, as illustrated in FIG. **16**, a space is formed outside the first protrusion parts **3121** and the second protrusion parts **3221** in the Y axis and behind them in the X axis with the body parts **312** and the movable contact maker **322** housed in the case **10**.

In this way, it is possible to prevent in a more reliable manner the case **10** and members housed in the case **10** from being affected by the arc A extended outward in the Y axis and backward in the X axis.

Note that as illustrated in FIG. **17**, the tip of the second protrusion part may be located more outside than the tip of the first protrusion part in the axis crossing the axis in which the first contact and the second contact move relative to each other.

For example, when a space is formed outside the first protrusion part **3121** and the second protrusion part **3221** in the Y axis and in front of them in the X axis with the body parts **312** and the movable contact maker **322** housed in the case **10**, the configuration illustrated in FIG. **17** is preferable.

Note that in the present embodiment, both the body parts (first body part) **312** and the movable contact maker (second body part) **322** are provided with protrusions as an example, but either of them may be provided with protrusions, or no protrusions may be provided.

Next, with reference to FIGS. **18** to **45**, description is given of a various arrangement pattern of the yoke **40**. Note that, FIGS. **18** to **45** are given of the movable contact maker (second body part) **322** as the body part adjacent to the yoke **40**. However, it is also possible to make the body parts (first body part) **312** as the body part adjacent to the yoke **40**.

At least a part of each yoke **40** shown in FIGS. **18** to **45** is arranged along the magnetic flux B that is generated by the current I flowing through the movable contact maker (the body part adjacent to the yoke **40**) **322** and is generated in the region R1.

Here, FIGS. **18** to **32** are given of the arrangement pattern of the yoke **40**, when the movable contact maker (the body part adjacent to the yoke **40**) **322** has two contacts (when one body part has two contacts).

First, it is possible to arrange the yoke **40** shown in FIG. **18** adjacent to the movable contact maker **322** having two contacts.

The yoke **40** shown in FIG. **18** has substantially the same structure as the yoke **40** described in the above embodiment. That is, one in which the first yoke **440** and the second yoke **450** are integrated by the connecting section **460** is exemplified as the yoke **40** shown in FIG. **18**. Note that the yoke **40** shown in FIG. **18** has a shape in which a notch **40***a* is not provided and the length in the vertical axis of the connecting section **460** is the same as that of the first yoke **440** and the second yoke **450**.

Further, the yoke **40** shown in FIG. **18** includes the sidewall **410**, the top wall **420** and the bottom wall **430**, and is fixed to the movable contact maker **322**.

Then, the front surface **411** of the side wall **410** is arranged to face the back surface (second surface) **322***b* of the movable contact maker **322** with the tip **421** of the top wall **420** and the tip **431** of the bottom wall **430** facing the opposing body part (in FIG. **18**, body part **312**).

The side wall **410** is also arranged to overlap the entire area of the contact region R2 where the fixed contacts (first contact) **311** and the movable contacts (second contact) **321** come into contact, when viewed along the axis in which the fixed contacts **311** and the movable contacts **321** move relative to each other.

Here, the yoke **40** shown in FIG. **18** is arranged in such a state that the front surface **411** of the side wall **410** comes in surface contact with the back surface (second surface) **322***b* of the movable contact maker **322**. Thus, when the front surface **411** of the side wall **410** comes in surface contact with the back surface (second surface) **322***b* of the movable contact maker **322**, it is possible to concentrate the magnetic flux B near the outer surface of the movable contact maker **322**, and it is possible to increase the intensity of the magnetic flux B acting on the arc A.

Also, in the yoke **40** shown in FIG. **18**, the tip **421** of the top wall **420** and the tip **431** of the bottom wall **430** are made to protrude outward from the front surface (first surface) **322***a* of the movable contact maker **322**.

Further, in the yoke **40** shown in FIG. **18**, the tip **421** of the top wall **420** and the tip **431** of the bottom wall **430** are made to protrude outward from tips (tops) **321***a* of the movable contacts **321**. This makes it possible to exist the yoke **40** concentrating the magnetic flux B upward and downward of the arc A. Therefore, it is possible to increase the intensity of the magnetic flux B acting on the arc A.

Alternatively, the yoke **40** shown in FIG. **19** may be realized. The yoke **40** shown in FIG. **19** also has substantially the same structure as the yoke **40** shown in FIG. **18**.

Here, in the yoke **40** shown in FIG. **19**, the tip **421** of the top wall **420** and the tip **431** of the bottom wall **430** are not made to protrude outward from the front surface (first surface) **322***a* of the movable contact maker **322**.

Note that, in FIG. **19**, the tip **421** of the top wall **420** and the tip **431** of the bottom wall **430** are substantially flush with the front surface (first surface) **322***a* of the movable contact maker **322** as an example, but at least one of the tip **421** of the top wall **420** or the tip **431** of the bottom wall **430** may be located inside to the front surface (first surface) **322***a* of the movable contact maker **322**.

Alternatively, the yoke **40** shown in FIG. **20** may be realized. The yoke **40** shown in FIG. **20** does not include the top wall **420** and the bottom wall **430**, only includes the sidewall **410**.

That is, the yoke **40** shown in FIG. **20** is only arranged to the back surface (second surface) **322***b* of the movable contact maker **322**. This also makes it possible to concentrate the magnetic flux B near the outer surface of the movable contact maker **322**, and it is possible to increase the intensity of the magnetic flux B acting on the arc A.

Alternatively, the yoke **40** shown in FIG. **21** may be realized. The yoke **40** shown in FIG. **21** has a shape in which the section of the top wall **420** and the bottom wall **430** protruded outward from the movable contact maker **322** extend to the movable contacts **321**.

That is, the yoke **40** shown in FIG. **21** is arranged so as to surround the movable contact maker **322**. This makes it possible to more concentrate the magnetic flux B near the outer surface of the movable contact maker **322**, and it is possible to more increase the intensity of the magnetic flux B acting on the arc A.

Note that, in the yoke **40** shown in FIG. **21**, a section that the movable contacts **321** is formed has a belt-shaped exposed part (part uncovered in the yoke **40**) extended from one end to the other end in the longitudinal axis when viewed from the front surface (first surface) **322***a* of the movable contact maker **322**. That is, the yoke **40** shown in FIG. **21** has an approximate C-shape in a state viewed along the longitudinal axis of the movable contact maker **322**. This makes it possible to fix the yoke **40** to the movable contact maker **322** without interfering with the movable contacts **321**.

Alternatively, the yoke **40** shown in FIG. **22** may be realized. In the yoke **40** shown in FIG. **22**, the tip **421** of the top wall **420** is made to protrude outward from tips (tops) **321***a* of the movable contacts **321**, but the tip **431** of the bottom wall **430** is not made to protrude outward from the front surface (first surface) **322***a* of the movable contact maker **322**.

That is, the yoke **40** shown in FIG. **22** has an asymmetrical shape in the vertical axis when viewed along the longitudinal axis of the movable contact maker **322**.

This also makes it possible to concentrate the magnetic flux B near the outer surface of the movable contact maker **322**, and it is possible to increase the intensity of the magnetic flux B acting on the arc A.

Note that, in the yoke **40** shown in FIG. **22**, the tip **421** of the top wall **420** is made to protrude outward from tips (tops) **321***a* of the movable contacts **321** as an example, but the tip **421** of the top wall **420** may be made not to protrude outward from tips (tops) **321***a* of the movable contacts **321**.

Alternatively, the yoke **40** shown in FIG. **23** may be realized. The yoke **40** shown in FIG. **23** has substantially the same structure as the yoke **40** shown in FIG. **18**.

Here, the yoke **40** shown in FIG. **23** is arranged to overlap the movable contact maker **322** between outer end of one movable contacts **321** and outer end of the other movable contacts **321**, when viewed along the axis in which the fixed contacts **311** and the movable contacts **321** move relative to each other.

That is, in FIG. **23**, the yoke **40** is arranged so as to surround a region where the two movable contacts **321** are formed in the movable contact maker **322**.

This makes it possible to prevent from concentrating the magnetic flux B outer side of the movable contacts **321** where the arc A is not generated. Therefore, it is possible to more concentrate the magnetic flux B near the outer surface of the movable contact maker **322**, and it is possible to more increase the intensity of the magnetic flux B acting on the arc A.

Note that, the yoke **40** shown in FIG. **23** is arranged to overlap the entire area of the contact region R**2** where the fixed contacts (first contact) **311** and the movable contacts (second contact) **321** come into contact, when viewed along the axis in which the fixed contacts **311** and the movable contacts **321** move relative to each other.

Alternatively, the yoke **40** shown in FIG. **24** may be realized. The yoke **40** shown in FIG. **24** also has substantially the same structure as the yoke **40** shown in FIG. **23**.

Here, the yoke **40** shown in FIG. **24** is arranged to overlap a part of the contact region R**2** where the fixed contacts (first contact) **311** and the movable contacts (second contact) **321** come into contact, when viewed along the axis in which the fixed contacts **311** and the movable contacts **321** move relative to each other.

This also makes it possible to more concentrate the magnetic flux B near the movable contacts **321**, and it is possible to more increase the intensity of the magnetic flux B acting on the arc A.

Note that, in FIG. **24**, only inner ends in the longitudinal axis of the two movable contacts **321** are overlapped to the yoke **40** as an example, but substantially inner half portions in the longitudinal axis of the two movable contacts **321** may be overlapped to the yoke **40**.

Alternatively, the yoke **40** shown in FIG. **25** may be realized. In FIG. **25**, the yoke (yoke separated into two parts) **40** in which the first yoke **440** and the second yoke **450** are not integrated by the connecting section **460** is exemplified.

That is, in the yoke **40** shown in FIG. **25**, the first yoke **440** arranged on the side where one movable contact **321** of the two movable contacts **321** is located and the second yoke **450** arranged on the side where the other movable contact **321** is located are formed separately.

Thus, when the first yoke **440** and the second yoke **450** are not integrated by the connecting section **460**, the magnetic flux B that will be generated around the connecting section **460** can be taken into the first yoke **440** or the second yoke **450**. Therefore, it is possible to more concentrate the magnetic flux B near the movable contacts **321**, and it is possible to more increase the intensity of the magnetic flux B acting on the arc A.

Note that, in FIG. **25**, both the first yoke **440** and the second yoke **450** are arranged to overlap the entire area of the contact region R**2** when viewed along the axis in which the fixed contacts **311** and the movable contacts **321** move relative to each other, but at least one of the first yoke **440** or the second yoke **450** may be arranged to overlap a part of the contact region R**2**.

Alternatively, the yoke **40** shown in FIG. **26** may be realized. In the yoke **40** shown in FIG. **26**, the first yoke **440** and the second yoke **450** are formed separately as in the yoke **40** shown in FIG. **25**.

Here, in FIG. **26**, the shape of the first yoke **440** and the shape of the second yoke **450** are different from each other.

Specifically, the shape of the first yoke **440** is such that the tip **421** of the top wall **420** and the tip **431** of the bottom wall **430** are not made to protrude outward from the front surface (first surface) **322***a* of the movable contact maker **322**. In contrast, the shape of the second yoke **450** is such that the tip **421** of the top wall **420** and the tip **431** of the bottom wall **430** are made to protrude outward from the front surface (first surface) **322***a* of the movable contact maker **322**.

This makes it possible that the magnetic flux B that will be generated around the connecting section **460** can be taken into the first yoke **440** or the second yoke **450**. Therefore, it is possible to more concentrate the magnetic flux B near the movable contacts **321**, and it is possible to more increase the intensity of the magnetic flux B acting on the arc A.

Note that, in FIG. **26**, at least one of the first yoke **440** or the second yoke **450** may be arranged to overlap a part of the contact region R**2**.

Alternatively, the first yoke **440** and the second yoke **450** can be different in shape in various ways.

Alternatively, the yoke **40** shown in FIG. **27** may be realized. The yoke **40** shown in FIG. **27** also has substantially the same structure as the yoke **40** shown in FIG. **21**. That is, the yoke **40** shown in FIG. **27** has a shape in which the section of the top wall **420** and the bottom wall **430** protruded outward from the movable contact maker **322** extend to the movable contacts **321**.

Here, in FIG. **27**, the yoke **40** is composed of two yokes **470**,**480** which are vertically divided into two.

Specifically, the yoke **40** shown in FIG. **27** has a shape such that the sidewall **410** of the yoke **40** shown in FIG. **21** is separated at the central part in the vertical axis.

Then, a section that the movable contact **321** is formed has a belt-shaped exposed part (part uncovered in the yoke **40**) extended from one end to the other end in the longitudinal axis when viewed from the front surface (first surface) **322***a* of the movable contact maker **322** in a state where the two yokes **470**,**480** which are vertically divided into two are fixed to the movable contact maker **322**.

Further, a central part in the vertical axis has a belt-shaped exposed part (part uncovered in the yoke **40**) extended from one end to the other end in the longitudinal axis when viewed from the back surface (second surface) **322***b* of the movable contact maker **322** in a state where the two yokes **470**,**480** which are vertically divided into two are fixed to the movable contact maker **322**.

This also makes it possible to concentrate the magnetic flux B near the outer surface of the movable contact maker **322**, and it is possible to increase the intensity of the magnetic flux B acting on the arc A.

Further, when the yoke **40** which surround the movable contact maker **322** is divided into two in the vertical axis, it is possible that the yoke **40** is fixed to the movable contact maker **322** more easily.

Alternatively, the yoke **40** shown in FIG. **28** may be realized. The yoke **40** shown in FIG. **28** also has substantially the same structure as the yoke **40** described in the above embodiment. That is, one in which the first yoke **440** and the second yoke **450** are integrated by the connecting section **460** is exemplified as the yoke **40** shown in FIG. **28**.

Also, in the yoke **40** shown in FIG. **28**, the notch **40***a* is provided at the connecting section **460**.

Here, in the yoke **40** shown in FIG. **28**, the notch **40***a* is formed not only at the top wall **420** but also at the bottom wall **430**.

That is, in the yoke **40** shown in FIG. **28**, the first yoke **440** and the second yoke **450** are connected only the sidewall **410**.

This makes it possible to become the length of the connecting section **460** in the vertical axis shorter, and to prevent from concentrating the magnetic flux B near the connecting section **460**. Therefore, it is possible to more concentrate the magnetic flux B near the movable contacts **321**, and it is possible to more increase the intensity of the magnetic flux B acting on the arc A.

Alternatively, the yoke **40** shown in FIG. **29** may be realized. In the yoke **40** shown in FIG. **29**, the top wall **420** is arranged on one side in the longitudinal axis and the bottom wall **430** is arranged on the other side in a state of being fixed to the movable contact maker **322**.

Then, the top wall **420** and the bottom wall **430** arranged in an offset state in the longitudinal axis are connected by the side wall **410** on the back surface (second surface) **322***b* side of the movable contact maker **322**.

In FIG. **29**, the side wall **410** is formed so as to extend diagonally along the diagonal line of the movable contact maker **322** when viewed from the back surface (second surface) **322***b* of the movable contact maker **322**.

This also makes it possible to concentrate the magnetic flux B near the outer surface of the movable contact maker **322**, and it is possible to increase the intensity of the magnetic flux B acting on the arc A.

Alternatively, the yoke **40** shown in FIG. **30** may be realized. The yoke **40** shown in FIG. **30** also has substantially the same structure as the yoke **40** shown in FIG. **18**.

Here, in the yoke **40** shown in FIG. **30**, the side wall **410**, the top wall **420**, and the bottom wall **430** are formed as separate parts respectively.

Here, the yoke **40** may be composed of the side wall **410**, the top wall **420**, and the bottom wall **430**, which are separately formed by using the same material, or the side wall **410**, the top wall **420** and the bottom wall **430** may be formed by using different materials respectively. Alternatively, any one of the side wall **410**, the top wall **420** and the bottom wall **430** may be formed by using a material different from the other two.

This also makes it possible to concentrate the magnetic flux B near the outer surface of the movable contact maker **322**, and it is possible to increase the intensity of the magnetic flux B acting on the arc A.

Alternatively, the yoke **40** shown in FIG. **31** may be realized. In the yoke **40** shown in FIG. **31**, the side wall **410**, the top wall **420**, and the bottom wall **430** are formed as separate parts respectively as in the yoke **40** shown in FIG. **30**.

Here, the yoke **40** shown in FIG. **31** is arranged so as to surround the movable contact maker **322** with a gap formed between the top wall **420** and the side wall **410** and between the bottom wall **430** and the side wall **410**.

Specifically, the side wall **410** is arranged so as to be separated from the back surface (second surface) **322***b* of the movable contact maker **322**. By doing so, the gap is formed between the top wall **420** and the side wall **410** and between the bottom wall **430** and the side wall **410**.

This also makes it possible to concentrate the magnetic flux B near the outer surface of the movable contact maker **322**, and it is possible to increase the intensity of the magnetic flux B acting on the arc A.

Further, when the side wall **410** is separated from the back surface (second surface) **322***b* of the movable contact maker **322**, the yoke **40** (side wall **410**) is arranged in a space where the distance from the movable contact maker **322** becomes long and the strength of the magnetic flux B becomes weak. This makes it possible to concentrate the magnetic flux B around the movable contact maker **322** more efficiently.

Note that, in FIG. **31**, the gap is formed between the top wall **420** and the side wall **410** and between the bottom wall **430** and the side wall **410** as an example, but either one of the top wall **420** and the bottom wall **430** may be in contact with the side wall **410**.

Further, any one or more parts selected from the side wall **410**, the top wall **420**, and the bottom wall **430** may be separated from the movable contact maker **322**.

Alternatively, the yoke **40** shown in FIG. **32** may be realized. The yoke **40** shown in FIG. **32** also has substantially the same structure as the yoke **40** shown in FIG. **18**.

Here, in FIG. **32**, the yoke **40** in which the side wall **410**, the top wall **420**, and the bottom wall **430** are integrated is used, and the entire yoke **40** is separated from the outer surface of the movable contact maker **322** in such a state that the yoke **40** is arranged so as to surround the movable contact maker **322**.

That is, in FIG. **32**, a gap is formed between the yoke **40** and movable contact maker **322**.

This also makes it possible to concentrate the magnetic flux B near the outer surface of the movable contact maker **322**, and it is possible to increase the intensity of the magnetic flux B acting on the arc A.

Next, with reference to FIGS. **33** to **45**, description is given of a various arrangement pattern of the yoke **40**.

Here, FIGS. **33** to **45** are given of the arrangement pattern of the yoke **40**, when the movable contact maker (the body part adjacent to the yoke **40**) **322** has one contact (when one body part has only one contact).

First, it is possible to arrange the yoke **40** shown in FIG. **33** adjacent to the movable contact maker **322** having one contact.

The yoke **40** shown in FIG. **33** has substantially the same structure as the yoke **40** shown in FIG. **18**.

Specifically, the yoke **40** shown in FIG. **33** includes the sidewall **410**, the top wall **420** and the bottom wall **430**, and is fixed to the movable contact maker **322**.

Then, the front surface **411** of the side wall **410** is arranged to face the back surface (second surface) **322***b* of the movable contact maker **322** with the tip **421** of the top wall **420** and the tip **431** of the bottom wall **430** facing the opposing body part (in FIG. **33**, body part **312**).

The side wall **410** is also arranged to overlap the entire area of the contact region R2 where the fixed contacts (first contact) **311** and the movable contacts (second contact) **321** come into contact, when viewed along the axis in which the fixed contacts **311** and the movable contacts **321** move relative to each other.

Here, the yoke **40** shown in FIG. **33** is also arranged in such a state that the front surface **411** of the side wall **410** comes in surface contact with the back surface (second surface) **322***b* of the movable contact maker **322**. Thus, when the front surface **411** of the side wall **410** comes in surface contact with the back surface (second surface) **322***b* of the movable contact maker **322**, it is possible to concentrate the magnetic flux B near the outer surface of the movable contact maker **322**, and it is possible to increase the intensity of the magnetic flux B acting on the arc A.

Also, in the yoke **40** shown in FIG. **33**, the tip **421** of the top wall **420** and the tip **431** of the bottom wall **430** are made to protrude outward from the front surface (first surface) **322***a* of the movable contact maker **322**.

Further, in the yoke **40** shown in FIG. **33**, the tip **421** of the top wall **420** and the tip **431** of the bottom wall **430** are made to protrude outward from tips (tops) **321***a* of the movable contacts **321**. This makes it possible to exist the yoke **40** concentrating the magnetic flux B upward and downward of the arc A. Therefore, it is possible to increase the intensity of the magnetic flux B acting on the arc A.

Alternatively, the yoke **40** shown in FIG. **34** may be realized. The yoke **40** shown in FIG. **34** also has substantially the same structure as the yoke **40** shown in FIG. **33**.

Here, in the yoke **40** shown in FIG. **34**, the tip **421** of the top wall **420** and the tip **431** of the bottom wall **430** are not made to protrude outward from the front surface (first surface) **322***a* of the movable contact maker **322**.

Note that, in FIG. **34**, the tip **421** of the top wall **420** and the tip **431** of the bottom wall **430** are substantially flush with the front surface (first surface) **322***a* of the movable contact maker **322** as an example, but at least one of the tip **421** of the top wall **420** or the tip **431** of the bottom wall **430** may be located inside to the front surface (first surface) **322***a* of the movable contact maker **322**.

Alternatively, the yoke **40** shown in FIG. **35** may be realized. The yoke **40** shown in FIG. **35** does not include the top wall **420** and the bottom wall **430**, only includes the sidewall **410**.

That is, the yoke **40** shown in FIG. **35** is only arranged to the back surface (second surface) **322***b* of the movable contact maker **322**. This also makes it possible to concentrate the magnetic flux B near the outer surface of the movable contact maker **322**, and it is possible to increase the intensity of the magnetic flux B acting on the arc A.

Alternatively, the yoke **40** shown in FIG. **36** may be realized. The yoke **40** shown in FIG. **36** has a shape in which the section of the top wall **420** and the bottom wall **430** protruded outward from the movable contact maker **322** extend to the movable contact **321**.

That is, the yoke **40** shown in FIG. **36** is arranged so as to surround the movable contact maker **322**. This makes it possible to more concentrate the magnetic flux B near the outer surface of the movable contact maker **322**, and it is possible to more increase the intensity of the magnetic flux B acting on the arc A.

Note that, in the yoke **40** shown in FIG. **36**, a section that the movable contact **321** is formed has a belt-shaped exposed part (part uncovered in the yoke **40**) extended from one end to the other end in the longitudinal axis when viewed from the front surface (first surface) **322***a* of the movable contact maker **322**. That is, the yoke **40** shown in FIG. **36** has an approximate C-shape in a state viewed along the longitudinal axis of the movable contact maker **322**. This makes it possible to fix the yoke **40** to the movable contact maker **322** without interfering with the movable contact **321**.

Alternatively, the yoke **40** shown in FIG. **37** may be realized. In the yoke **40** shown in FIG. **37**, the tip **421** of the top wall **420** is made to protrude outward from tip (top) **321***a* of the movable contact **321**, but the tip **431** of the bottom wall **430** is not made to protrude outward from the front surface (first surface) **322***a* of the movable contact maker **322**.

That is, the yoke **40** shown in FIG. **37** has an asymmetrical shape in the vertical axis when viewed along the longitudinal axis of the movable contact maker **322**.

This also makes it possible to concentrate the magnetic flux B near the outer surface of the movable contact maker **322**, and it is possible to increase the intensity of the magnetic flux B acting on the arc A.

Note that, in the yoke **40** shown in FIG. **37**, the tip **421** of the top wall **420** is made to protrude outward from tip (top) **321***a* of the movable contact **321** as an example, but the tip **421** of the top wall **420** may be made not to protrude outward from tip (top) **321***a* of the movable contact **321**.

Alternatively, the yoke **40** shown in FIG. **38** may be realized.

The yoke **40** shown in FIG. **38** is arranged to overlap the movable contact maker **322** between outer end of the movable contact **321** in the longitudinal axis and an end of center side, when viewed along the axis in which the fixed contact **311** and the movable contact **321** move relative to each other.

This makes it possible to prevent from concentrating the magnetic flux B outer side of the movable contacts **321** where the arc A is not generated. Therefore, it is possible to more concentrate the magnetic flux B near the outer surface of the movable contact maker **322**, and it is possible to more increase the intensity of the magnetic flux B acting on the arc A.

Note that, the yoke **40** shown in FIG. **38** is arranged to overlap the entire area of the contact region R**2** where the fixed contact (first contact) **311** and the movable contact (second contact) **321** come into contact, when viewed along the axis in which the fixed contact **311** and the movable contact **321** move relative to each other.

Alternatively, the yoke **40** shown in FIG. **39** may be realized.

The yoke **40** shown in FIG. **39** is arranged to overlap a part of the contact region R**2** where the fixed contact (first contact) **311** and the movable contact (second contact) **321** come into contact, when viewed along the axis in which the fixed contact **311** and the movable contact **321** move relative to each other.

This also makes it possible to more concentrate the magnetic flux B near the movable contact **321**, and it is possible to more increase the intensity of the magnetic flux B acting on the arc A.

Note that, in FIG. **39**, only end of center side in the longitudinal axis of the movable contact **321** is overlapped to the yoke **40** as an example, but substantially half portion of center side in the longitudinal axis of the movable contact **321** may be overlapped to the yoke **40**.

Alternatively, the yoke **40** shown in FIG. **40** may be realized. The yoke **40** shown in FIG. **40** also has substantially the same structure as the yoke **40** shown in FIG. **36**. That is, the yoke **40** shown in FIG. **40** has a shape in which the section of the top wall **420** and the bottom wall **430** protruded outward from the movable contact maker **322** extend to the movable contact **321**.

Here, in FIG. **40**, the yoke **40** is composed of two yokes **470**,**480** which are vertically divided into two.

Specifically, the yoke **40** shown in FIG. **40** has a shape such that the sidewall **410** of the yoke **40** shown in FIG. **36** is separated at the central part in the vertical axis.

Then, a section that the movable contact **321** is formed has a belt-shaped exposed part (part uncovered in the yoke **40**) extended from one end to the other end in the longitudinal axis when viewed from the front surface (first surface) **322***a* of the movable contact maker **322** in a state where the two yokes **470**,**480** which are vertically divided into two are fixed to the movable contact maker **322**.

Further, a central part in the vertical axis has a belt-shaped exposed part (part uncovered in the yoke **40**) extended from one end to the other end in the longitudinal axis when viewed from the back surface (second surface) **322***b* of the movable contact maker **322** in a state where the two yokes **470**,**480** which are vertically divided into two are fixed to the movable contact maker **322**.

This also makes it possible to concentrate the magnetic flux B near the outer surface of the movable contact maker **322**, and it is possible to increase the intensity of the magnetic flux B acting on the arc A.

Further, when the yoke **40** which surround the movable contact maker **322** is divided into two in the vertical axis, it is possible that the yoke **40** is fixed to the movable contact maker **322** more easily.

Alternatively, the yoke **40** shown in FIG. **41** may be realized.

The yoke **40** shown in FIG. **41** includes the sidewall **410**, the top wall **420** and the bottom wall **430**.

Here, in the yoke **40** shown in FIG. **41**, the top wall **420** and the bottom wall **430** are formed only at the section that the movable contact **321** of the movable contact maker **322** is formed.

That is, the yoke **40** shown in FIG. **41** has a shape in which a section (top wall **420** and bottom wall **430**) arranged on a section of the movable contact maker **322** where the movable contact **321** is not formed is cut off.

In this way, the length of the circumference of the yoke **40** arranged on the section of the movable contact maker **322** where the movable contact **321** is not formed is shorter than the length of the circumference of the yoke **40** arranged on a section of the movable contact maker **322** where the movable contact **321** is formed. Therefore, it is possible to more concentrate the magnetic flux B near the movable contact **321**, and to more increase the intensity of the magnetic flux B acting on the arc A.

Alternatively, the yoke **40** shown in FIG. **42** may be realized. In the yoke **40** shown in FIG. **42**, the top wall **420** is arranged on one side in the longitudinal axis and the bottom wall **430** is arranged on the other side in a state of being fixed to the movable contact maker **322**.

Then, the top wall **420** and the bottom wall **430** arranged in an offset state in the longitudinal axis are connected by the side wall **410** on the back surface (second surface) **322***b* side of the movable contact maker **322**.

In FIG. **42**, the side wall **410** is formed so as to extend diagonally along the diagonal line of the movable contact maker **322** when viewed from the back surface (second surface) **322***b* of the movable contact maker **322**.

This also makes it possible to concentrate the magnetic flux B near the outer surface of the movable contact maker **322**, and it is possible to increase the intensity of the magnetic flux B acting on the arc A.

Alternatively, the yoke **40** shown in FIG. **43** may be realized. The yoke **40** shown in FIG. **43** also has substantially the same structure as the yoke **40** shown in FIG. **33**.

Here, in the yoke **40** shown in FIG. **43**, the side wall **410**, the top wall **420**, and the bottom wall **430** are formed as separate parts respectively.

Here, the yoke **40** may be composed of the side wall **410**, the top wall **420**, and the bottom wall **430**, which are separately formed by using the same material, or the side wall **410**, the top wall **420** and the bottom wall **430** may be formed by using different materials respectively. Alternatively, any one of the side wall **410**, the top wall **420** and the bottom wall **430** may be formed by using a material different from the other two.

This also makes it possible to concentrate the magnetic flux B near the outer surface of the movable contact maker **322**, and it is possible to increase the intensity of the magnetic flux B acting on the arc A.

Alternatively, the yoke **40** shown in FIG. **44** may be realized. In the yoke **40** shown in FIG. **44**, the side wall **410**, the top wall **420**, and the bottom wall **430** are formed as separate parts respectively as in the yoke **40** shown in FIG. **43**.

Here, the yoke **40** shown in FIG. **44** is arranged so as to surround the movable contact maker **322** with a gap formed between the top wall **420** and the side wall **410** and between the bottom wall **430** and the side wall **410**.

Specifically, the side wall **410** is arranged so as to be separated from the back surface (second surface) **322***b* of the movable contact maker **322**. By doing so, the gap is formed between the top wall **420** and the side wall **410** and between the bottom wall **430** and the side wall **410**.

This also makes it possible to concentrate the magnetic flux B near the outer surface of the movable contact maker **322**, and it is possible to increase the intensity of the magnetic flux B acting on the arc A.

Further, when the side wall **410** is separated from the back surface (second surface) **322***b* of the movable contact maker **322**, the yoke **40** (side wall **410**) is arranged in a space where the distance from the movable contact maker **322** becomes long and the strength of the magnetic flux B becomes weak. This makes it possible to concentrate the magnetic flux B around the movable contact maker **322** more efficiently.

Note that, in FIG. **44**, the gap is formed between the top wall **420** and the side wall **410** and between the bottom wall **430** and the side wall **410** as an example, but either one of the top wall **420** and the bottom wall **430** may be in contact with the side wall **410**.

Further, any one or more parts selected from the side wall **410**, the top wall **420**, and the bottom wall **430** may be separated from the movable contact maker **322**.

Alternatively, the yoke **40** shown in FIG. **45** may be realized. The yoke **40** shown in FIG. **45** also has substantially the same structure as the yoke **40** shown in FIG. **33**.

Here, in FIG. **45**, the yoke **40** in which the side wall **410**, the top wall **420**, and the bottom wall **430** are integrated is used, and the entire yoke **40** is separated from the outer surface of the movable contact maker **322** in such a state that the yoke **40** is arranged so as to surround the movable contact maker **322**.

That is, in FIG. **45**, a gap is formed between the yoke **40** and movable contact maker **322**.

This also makes it possible to concentrate the magnetic flux B near the outer surface of the movable contact maker **322**, and it is possible to increase the intensity of the magnetic flux B acting on the arc A.

Note that, in the above embodiment and its modifications, the yoke **40** is arranged adjacent to the body part (first body part) **312** or the movable contact maker (second body part) **322** as an example. That is, the yoke **40** is arranged adjacent to only one of the first body part **312** and the second body part **322** as an example.

However, the configuration of the contact device **30** is not limited to the configuration in which the yoke **40** is arranged adjacent to only one body part, and the yoke **40** may be arranged adjacent to both of the body part (first body part) **312** and the movable contact maker (second body part) **322** (see FIGS. **46** to **49**).

Further, in FIGS. **46** to **49**, the body part (first body part) **312** and the movable contact maker (second body part) **322** are arranged so that the direction in which the current I flows in the region R1 of the body part (first body part) **312** is different from the direction in which the current I flows in the region R1 of the movable contact maker (second body part) **322**. That is, the body part (first body part) **312** and the movable contact maker (second body part) **322** are arranged so that an angle formed between the vector of the current I flowing through the body part (first body part) **312** and the vector of the current I flowing through the movable contact maker (second body part) **322** is larger than 0° and less than or equal to 180°.

Here, the region R**1** is a region where the body part (first body part) **312** and the movable contact maker (second body part) **322** overlap each other when viewed along the axis in which the fixed contact (first contact) **311** and the movable contact (second contact) **321** move relative to each other.

In FIG. **46**, an angle formed between the direction of the current I flowing through the body part (first body part) **312** in which the yoke **40** is arranged and the direction of the current I flowing through the movable contact maker (second body part) **322** in which the other yoke **40** is arranged is 180° as an example. That is, the body part (first body part) **312** and the movable contact maker (second body part) **322** are arranged so that the current I flowing through the body part (first body part) **312** and the current I flowing through the movable contact maker (second body part) **322** flow in opposite directions to each other.

In FIG. **47**, an angle formed between the direction of the current I flowing through the body part (first body part) **312** in which the yoke **40** is arranged and the direction of the current I flowing through the movable contact maker (second body part) **322** in which the other yoke **40** is arranged is 90° as an example. That is, the body part (first body part) **312** and the movable contact maker (second body part) **322** are arranged so that the current I flowing through the body part (first body part) **312** and the current I flowing through the movable contact maker (second body part) **322** flow in orthogonal directions to each other.

In FIG. **48**, an angle formed between the direction of the current I flowing through the body part (first body part) **312** in which the yoke **40** is arranged and the direction of the current I flowing through the movable contact maker (second body part) **322** in which the other yoke **40** is arranged is an obtuse angle (larger than 90° and less than 180°) as an example.

In FIG. **49**, an angle formed between the direction of the current I flowing through the body part (first body part) **312** in which the yoke **40** is arranged and the direction of the current I flowing through the movable contact maker (second body part) **322** in which the other yoke **40** is arranged is an acute angle (larger than 0° and less than 90°) as an example.

In this way, when the direction of the current flowing through each main body parts is different, it is possible to prevent the contact device **30** from increasing in size in one axis (for example, the direction of the current flowing through the first main body part).

Further, when the direction of the current flowing through each main body parts is different, it is preferable that an angle formed between the vectors of the two currents is larger than or equal to 90° and less than or equal to 180°.

This makes it possible to prevent the contact device **30** from increasing in size in one axis more reliably.

Note that, in FIGS. **46** to **49**, the yokes **40** are arranged adjacent to both of the body part (first body part) **312** and the movable contact maker (second body part) **322** as an example, but the yoke **40** may be arranged adjacent to only one of the body part (first body part) **312** and the movable contact maker (second body part) **322**. That is, it is possible that the direction of the current flowing through each main body parts is different, while being arranged the yoke **40** adjacent to only one of the body part (first body part) **312** and the movable contact maker (second body part) **322**. This also makes it possible to prevent the contact device **30** from increasing in size in one axis.

[Action/Effect]

The following describes characteristic configurations of the contact device and the electromagnetic relay illustrated in the above embodiments and its modifications, and the effect obtained by the configurations.

(1) The contact device according to the present embodiment and modifications thereof includes a first contact, a second contact that is movable relative to the first contact and is brought into contact with or separated from the first contact, a first body part including the first contact, a second body part including the second contact, and a yoke arranged adjacent to at least one of the first body part or the second body part.

At least a part of the yoke is arranged along magnetic flux generated by a current flowing through one body part of the first body part and the second body part that is adjacent to the yoke, in a region where the first body part and the second body part overlap each other when viewed along an axis in which the first contact and the second contact move relative to each other while the first contact and the second contact are in contact with each other.

Thus, it is possible to concentrate the magnetic flux generated around the body part adjacent to the yoke in the yoke. Consequently, it is possible to increase the intensity of the magnetic flux generated around the body part adjacent to the yoke (the magnetic field is strengthened) and to extinguish the arcs generated between the first contact and the second contact in a more reliable and quick manner.

As described above, the present embodiment and its modifications make it possible to obtain a contact device capable of preventing the contacts from being affected by arcs in more reliable manner.

(2) In the contact device according to the above (1), the body part adjacent to the yoke may include a first surface that faces an opposing body part, and a second surface on an opposite side to the first surface that faces the opposing body part. The yoke may include a section arranged adjacent to the second surface.

Thus, it is possible to concentrate the magnetic flux generated around the body part adjacent to the yoke in the yoke in a more efficient manner.

It is possible to arrange the yoke around the body part without disturbing the contact and separation between the first contact and the second contact.

(3) In the contact device according to the above (1) or (2), the yoke may include a section that overlaps with a contact region in which the first contact and the second contact make contact with each other when viewed along the axis in which the first contact and the second contact move relative to each other.

Thus, it is possible to increase the intensity of the magnetic flux generated around the first contact and the second contact (the magnetic field is strengthened) and to extinguish the arcs generated between the first contact and the second contact in a more reliable and quick manner.

(4) In the contact device according to any one of the above (1) to (3), the yoke may be arranged to overlap with a contact of the body part adjacent to the yoke when viewed along the axis in which the first contact and the second contact move relative to each other.

Thus, it is possible to increase the intensity of the magnetic flux generated around the first contact and the second contact (the magnetic field is strengthened) and to extinguish the arcs generated between the first contact and the second contact in a more reliable and quick manner.

(5) In the contact device according to any one of the above (1) to (4), the body part adjacent to the yoke may include a first surface that faces an opposing body part, a second surface on an opposite side to the first surface that faces the opposing body part, and a third surface provided in continuation from the first surface and the second surface. The yoke may include a section arranged along the third surface.

Thus, it is possible to further concentrate the magnetic flux around the body part adjacent to the yoke. Consequently, it is possible to increase the intensity of the magnetic flux generated around the body part adjacent to the yoke (the magnetic field is strengthened) and to extinguish the arcs generated between the first contact and the second contact in a more reliable and quick manner.

(6) In the contact device according to (5), the section arranged along the third surface of the yoke may protrude outward from the first surface.

Thus, it is possible to increase the intensity of the magnetic flux acting on the arcs.

(7) In the contact device according to any one of the above (1) to (6), the yoke may include a section arranged spaced apart from an outer surface of the body part adjacent to the yoke.

Thus, the yoke is arranged in a space that is farther from the body part adjacent to the yoke and has a weaker intensity of the magnetic flux, and thus it is possible to concentrate the magnetic flux around the body part in a more efficient manner.

(8) In the contact device according to any one of the above (1) to (7), the yoke may be fixed to the body part adjacent to the yoke.

Thus, it is possible to prevent the yoke from being displaced from the body part and to concentrate the magnetic flux around the body part in a more reliable manner.

(9) In the contact device according to any one of the above (1) to (8), the first contact may include two first contacts, the second contact includes two second contacts, the first body part includes two first body parts, and the second body part includes one second body part. One second contact of the two second contacts may be brought into contact with and is separated from one first contact of the two first contacts, and the other second contact of the two second contacts is brought into contact with and is separated from the other first contact of the two first contacts, The two first contacts may be arranged side by side in an axis intersecting an axis in which the first contacts and the second contacts, which are brought into contact with and are separated from each other, move relative to each other. One of the two first body parts may have the one first contact, and the other of the two first body parts has the other first contact. The one second body part may include the two second contacts.

Thus, it is possible to obtain a contact device having a plurality of contacts that are brought into contact with and are separated from each other and capable of preventing the contacts from being affected by arcs in a more reliable manner.

(10) In the contact device according to the above (9), the yoke may include a first yoke arranged near where the one first contact and the one second contact, which are brought into contact with and are separated from each other, are located, and a second yoke arranged near where the other first contact and the other second contact, which are brought into contact with and are separated from each other, are located.

Thus, it is possible to concentrate the magnetic flux generated around the body part adjacent to the yoke around contacts on one end and around contacts on the other end.

(11) In the contact device according to the above (10), the yoke may include a connecting section connecting the first yoke and the second yoke.

Thus, even in the contact device including a plurality of contacts to be brought into contact with and be separated from each other, it is possible to arrange the yoke around the body part in an easier manner.

(12) In the contact device according to any one of the above (1) to (11), the first body part may include a first protrusion part that protrudes toward the second body part at an end part of the first body part in an axis crossing the axis in which the first contact and the second contact move relative to each other.

Thus, it is possible to move the discharge point (ignition point) on the first body part of the arc generated between the first contact and the second contact to the first protrusion.

(13) In the contact device according to the above (12), a tip of the first protrusion part may be located closer to the second body part than a tip of the first contact to the second body part.

Thus, it is possible to move the discharge point (ignition point) on the first body part of the arc generated between the first contact and the second contact to the first protrusion in a more reliable manner.

(14) In the contact device according to any one of the above (1) to (11), the second body part may include a second protrusion part that protrudes toward the first body part at an end part of the second body part in an axis crossing the axis in which the first contact and the second contact move relative to each other.

Thus, it is possible to move the discharge point (ignition point) on the second body part of the arc generated between the first contact and the second contact to the second protrusion.

(15) In the contact device according to the above (14), a tip of the second protrusion part may be located closer to the first body part than a tip of the second contact to the first body part.

Thus, it is possible to move the discharge point (ignition point) on the second body part of the arc generated between the first contact and the second contact to the second protrusion in a more reliable manner.

(16) In the contact device according to any one of the above (1) to (11), the first body part may include a first protrusion part that protrudes toward the second body part at an end part of the first body part in an axis crossing the axis in which the first contact and the second contact move relative to each other. The second body part may include a second protrusion part that protrudes toward the first body part at an end part of the second body part in an axis crossing the axis in which the first contact and the second contact move relative to each other.

Thus, it is possible to move the discharge point (ignition point) on the first body part of the arc generated between the first contact and the second contact to the first protrusion, and the discharge point (ignition point) on the second body part to the second protrusion. That is, it is possible to pull away the arcs generated between the first contact and the second contact from the first contact and second contact.

(17) In the contact device according to the above (16), a tip of the second protrusion part may be located outside a tip of the first protrusion part in an axis intersecting the axis in which the first contact and the second contact move relative to each other.

Thus, it is possible to pull away the arcs generated between the first contact and the second contact from the first contact and the second contact while extending outward in an axis intersecting the axis in which the first contact and the second contact move relative to each other and toward the first body.

(18) In the contact device according to the above (16), a tip of the second protrusion part may be located inside a tip of the first protrusion part in an axis intersecting the axis in which the first contact and the second contact move relative to each other.

Thus, it is possible to pull away the arcs generated between the first contact and the second contact from the first contact and the second contact while extending outward in an axis intersecting the axis in which the first contact and the second contact move relative to each other and toward the second body part.

(19) In the contact device according to any one of the above (16) to (18), a tip of the first protrusion part may be located closer to the second body part than a tip of the first contact to the second body part.

Thus, it is possible to move the discharge point (ignition point) on the first body part of the arc generated between the first contact and the second contact to the first protrusion in a more quick and reliable manner.

(20) In the contact device according to any one of the above (16) to (19), a tip of the second protrusion part may be located closer to the first body part than a tip of the second contact to the first body part.

Thus, it is possible to move the discharge point (ignition point) on the second body part of the arc generated between the first contact and the second contact to the second protrusion in a more quick and reliable manner.

(21) In the contact device according to any one of the above (1) to (20), the yoke may be arranged adjacent to only one of the first body part and the second body part.

Thus, it is possible to extinguish the arcs generated between the first contact and the second contact in a more reliable and quick manner with a simpler configuration.

(22) In the contact device according to any one of the above (1) to (20), the yoke may include a plurality of yokes arranged adjacent to the first body part and the second body part.

Thus, it is possible to increase the intensity of the magnetic flux acting on the arcs.

(23) In the contact device according to any one of the above (1) to (22), a direction of a current flowing through the first body part may be different from a direction of a current flowing through the second body part in a region where the first body part and the second body part overlap when viewed along the axis in which the first contact and the second contact move relative to each other.

Thus, it is possible to prevent the contact device from being enlarged in one axis.

(24) An electromagnetic relay according to the present embodiment is an electromagnetic relay including the contact device according to any one of the above (1) to (23).

Thus, it is possible to obtain an electromagnetic relay equipped with the contact device capable of performing the actions and effects described in the above (1) to (23).

[Others]

Although the contents of the contact device and the electromagnetic relay according to the present disclosure have been described above, it is obvious to those skilled in the art that various modifications and improvements are possible without being limited to the description.

For example, configurations illustrated in the above-described embodiment and its modifications may be combined in a suitable manner.

Although the above embodiment and its modifications exemplify a contact device provided with only one pair of the fixed contact portions **310** and the movable contact portion **320** that are paired with each other (having contacts that contact each other and separate from each other), the contact device may be provided with multiple pairs.

The specification of the first body part, the second body part, and other details (shape, size, layout, and the like) can be changed in a suitable manner.

The present application claims priority under Japanese Patent Application No. 2020-036026 filed Mar. 3, 2020, and the entire contents thereof are incorporated herein by reference.

INDUSTRIAL APPLICABILITY

According to the present disclosure, it is possible to obtain a contact device capable of preventing the contacts from being affected by arcs in a more reliable manner, and an electromagnetic relay equipped with the contact device.

The invention claimed is:

1. A contact device, comprising:

an electromagnet device including a coil and an iron core to be magnetized by the coil;

an armature arranged to face the iron core and arranged to be swingable by a magnetic field generated by the coil;

a first contact;

a second contact that is movable relative to the first contact by the armature swings and is brought into contact with or separated from the first contact;

a first body part including the first contact;

a second body part including the second contact; and

a yoke fixed to at least one of a surface of the first body part, which is a surface opposite to the surface to face the second body part or a surface of the second body part, which is a surface opposite to the surface to face the first body part, wherein

at least a part of the yoke is arranged along magnetic flux generated by a current flowing through one body part of the first body part and the second body part that is fixed to the yoke, in a region where the first body part and the second body part overlap each other when viewed along an axis in which the first contact and the second contact move relative to each other while the first contact and the second contact are in contact with each other.

2. The contact device according to claim **1**, wherein

the body part fixed to the yoke includes a first surface that faces an opposing body part, and a second surface on an opposite side to the first surface that faces the opposing body part, and

the yoke includes a section arranged adjacent to the second surface.

3. The contact device according to claim **1**, wherein

the yoke includes a section that overlaps with a contact region in which the first contact and the second contact make contact with each other when viewed along the axis in which the first contact and the second contact move relative to each other.

4. The contact device according to claim **1**, wherein

the yoke is arranged to overlap with a contact of the body part fixed to the yoke when viewed along the axis in which the first contact and the second contact move relative to each other.

5. The contact device according to claim **1**, wherein

the body part fixed to the yoke includes a first surface that faces an opposing body part, a second surface on an opposite side to the first surface that faces the opposing body part, and a third surface provided in continuation from the first surface and the second surface, and

the yoke includes a section arranged along the third surface.

6. The contact device according to claim **5**, wherein

the section arranged along the third surface of the yoke protrudes outward from the first surface.

7. The contact device according to claim **1**, wherein

the yoke includes a section arranged spaced apart from an outer surface of the body part fixed to the yoke.

8. The contact device according to claim **1**, wherein

the first contact includes two first contacts, the second contact includes two second contacts, the first body part includes two first body parts, and the second body part includes one second body part,

one second contact of the two second contacts is brought into contact with and is separated from one first contact of the two first contacts, and the other second contact of the two second contacts is brought into contact with and is separated from the other first contact of the two first contacts,

the two first contacts are arranged side by side in an axis intersecting an axis in which the first contacts and the second contacts, which are brought into contact with and are separated from each other, move relative to each other,

one of the two first body parts has the one first contact, and the other of the two first body parts has the other first contact, and

the one second body part includes the two second contacts.

9. The contact device according to claim **8**, wherein

the yoke includes a first yoke arranged near where the one first contact and the one second contact, which are brought into contact with and are separated from each other, are located, and a second yoke arranged near where the other first contact and the other second contact, which are brought into contact with and are separated from each other, are located.

10. The contact device according to claim **9**, wherein

the yoke includes a connecting section connecting the first yoke and the second yoke.

11. The contact device according to claim **1**, wherein

the first body part includes a first protrusion part that protrudes toward the second body part at an end part of the first body part in an axis crossing the axis in which the first contact and the second contact move relative to each other.

12. The contact device according to claim 11, wherein
a tip of the first protrusion part is located closer to the second body part than a tip of the first contact to the second body part.

13. The contact device according to claim 1, wherein
the second body part includes a second protrusion part that protrudes toward the first body part at an end part of the second body part in an axis crossing the axis in which the first contact and the second contact move relative to each other.

14. The contact device according to claim 13, wherein
a tip of the second protrusion part is located closer to the first body part than a tip of the second contact to the first body part.

15. The contact device according to claim 1, wherein
the first body part includes a first protrusion part that protrudes toward the second body part at an end part of the first body part in an axis crossing the axis in which the first contact and the second contact move relative to each other, and
the second body part includes a second protrusion part that protrudes toward the first body part at an end part of the second body part in an axis crossing the axis in which the first contact and the second contact move relative to each other.

16. The contact device according to claim 1, wherein
the yoke is arranged adjacent to only one of the first body part and the second body part.

17. The contact device according to claim 1, wherein
the yoke includes a plurality of yokes arranged adjacent to the first body part and the second body part.

18. The contact device according to claim 1, wherein
a direction of a current flowing through the first body part is different from a direction of a current flowing through the second body part in a region where the first body part and the second body part overlap when viewed along the axis in which the first contact and the second contact move relative to each other.

19. An electromagnetic relay, comprising:
the contact device according to claim 1.

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