US012384332B2

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

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(45) **Date of Patent: Aug. 12, 2025**

(54) **PEDAL DEVICE**

(71) Applicant: **DENSO CORPORATION**, Kariya (JP)

(72) Inventors: **Yasuhisa Fukuda**, Kariya (JP); **Etsugo Yanagida**, Kariya (JP); **Daisuke Hokuto**, Kariya (JP); **Takao Yamamoto**, Kariya (JP)

(73) Assignee: **DENSO CORPORATION**, Kariya (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 11 days.

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(22) Filed: **Aug. 17, 2023**

(65) **Prior Publication Data**

US 2023/0391298 A1 Dec. 7, 2023

Related U.S. Application Data

(63) Continuation of application No. PCT/JP2022/005053, filed on Feb. 9, 2022.

(30) **Foreign Application Priority Data**

Feb. 25, 2021 (JP) 2021-029093

(51) **Int. Cl.**
B60T 7/04 (2006.01)
G05G 1/30 (2008.04)
(Continued)

(52) **U.S. Cl.**
CPC ***B60T 7/04*** (2013.01); ***G05G 1/44*** (2013.01); ***G05G 1/46*** (2013.01); ***G05G 5/03*** (2013.01); *G05G 1/50* (2013.01)

(58) **Field of Classification Search**
CPC .. G05G 1/30; G05G 1/44; G05G 1/46; G05G 1/50; G05G 5/03; B60T 7/04; B60K 26/021
See application file for complete search history.

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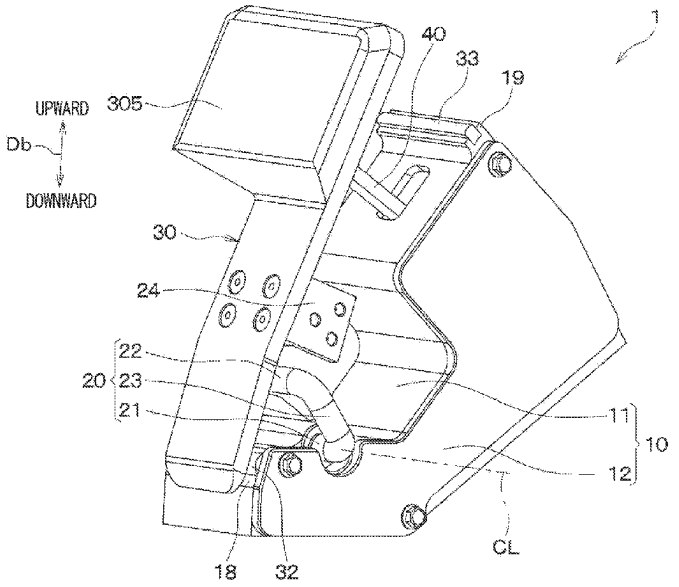
Primary Examiner — Adam D Rogers
(74) *Attorney, Agent, or Firm* — Nixon & Vanderhye P.C.

(57) **ABSTRACT**

An arm includes an arm one end and an arm body extended from the arm one end. The arm is coupled with a pedal pad at the arm one end and is coupled with a reaction force generation mechanism on an counter-operation side. A stopper part is a component separate from the pedal pad and fixed to the pedal pad. One part, which is one of the pedal pad and the stopper part, includes a first arrangement section, and the other part, which is the other of the pedal pad and the stopper part, includes a second arrangement section. The first arrangement section and the second arrangement section interpose the arm one end therebetween and hold the arm one end against the pedal pad.

17 Claims, 25 Drawing Sheets



(51) **Int. Cl.**

G05G 1/44	(2008.04)
G05G 1/46	(2008.04)
G05G 5/03	(2008.04)
G05G 1/50	(2008.04)

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WO	WO-2007003810	A2 *	1/2007	G05G 1/44
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WO	2022181326	A1	9/2022	
WO	2022181329	A1	9/2022	
WO	2022181330	A1	9/2022	
WO	2022181331	A1	9/2022	

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FIG. 1

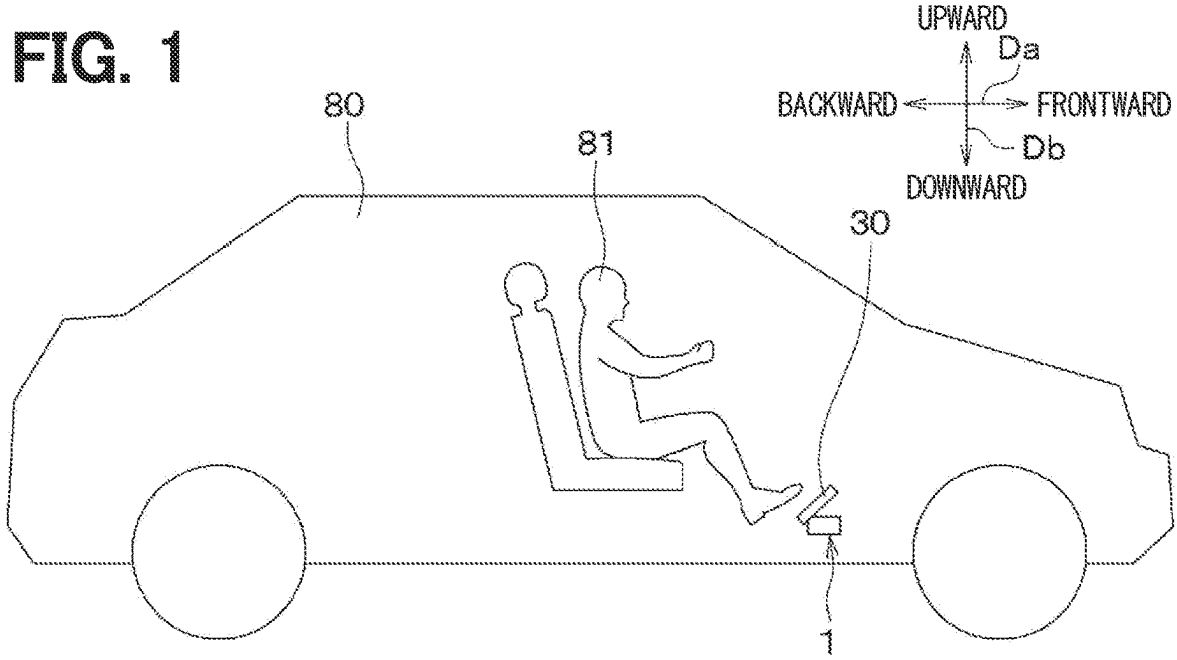

UPWARD
Da
BACKWARD
FRONTWARD
Db
DOWNWARD
80
81
30
1

FIG. 2

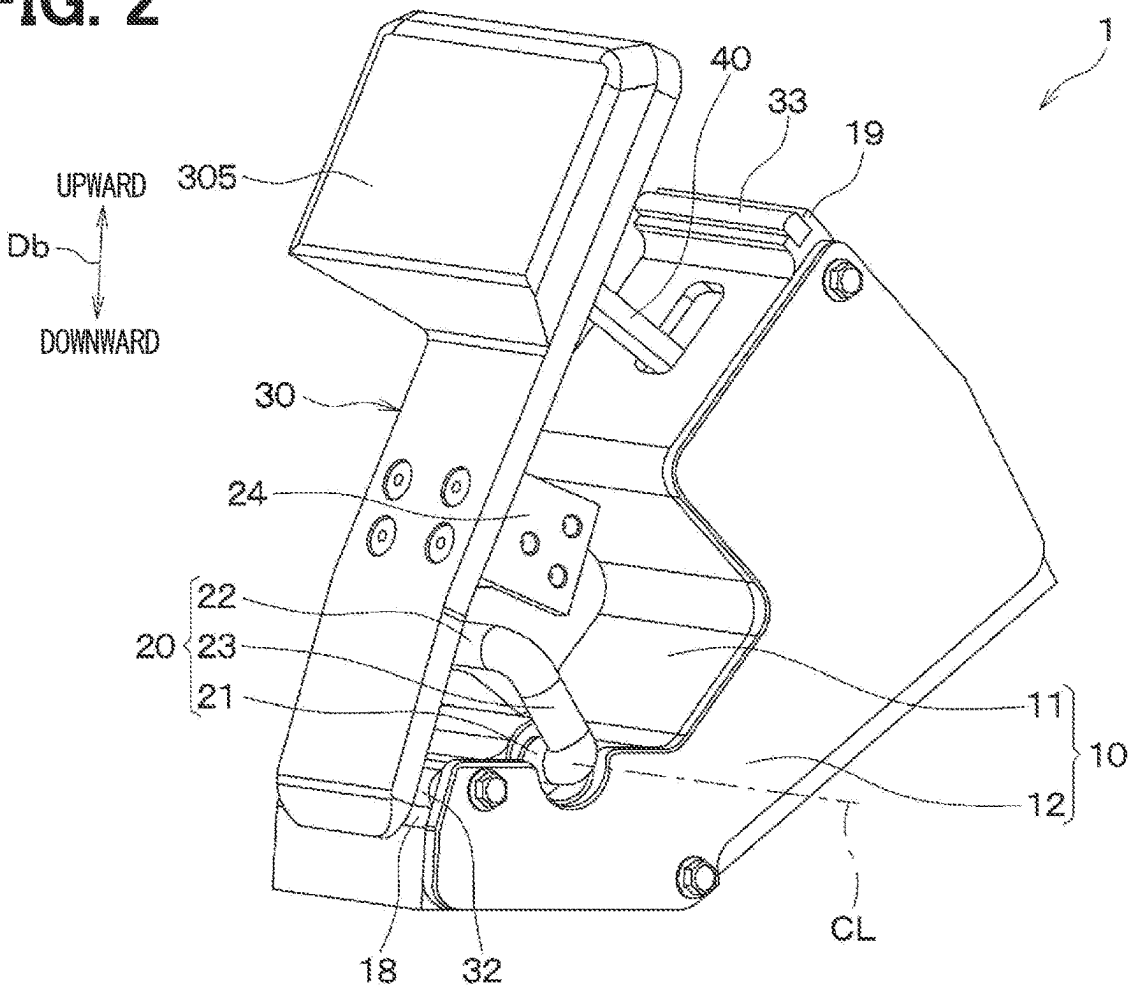

1
40
33
19
UPWARD
305
Db
DOWNWARD
30
24
22
20
23
21
11
10
12
CL
18
32

FIG. 3

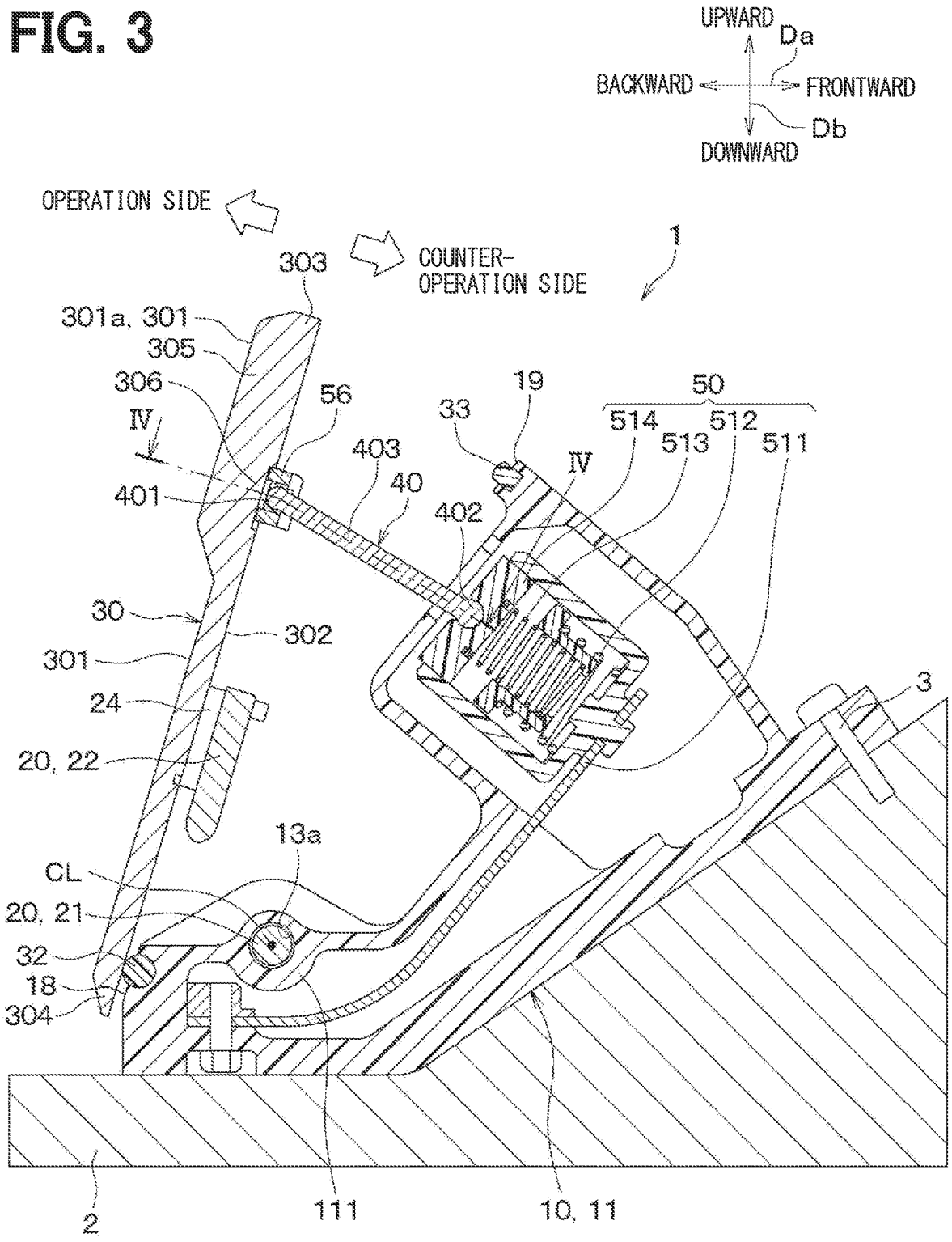

UPWARD
Da
BACKWARD
FRONTWARD
Db
DOWNWARD
OPERATION SIDE
COUNTER-
OPERATION SIDE
1
303
301a, 301
305
306
IV
401
56
403
40
402
33
19
IV
50
514
513
512
511
30
302
301
24
20, 22
13a
CL
20, 21
32
18
304
3
2
111
10, 11

FIG. 4

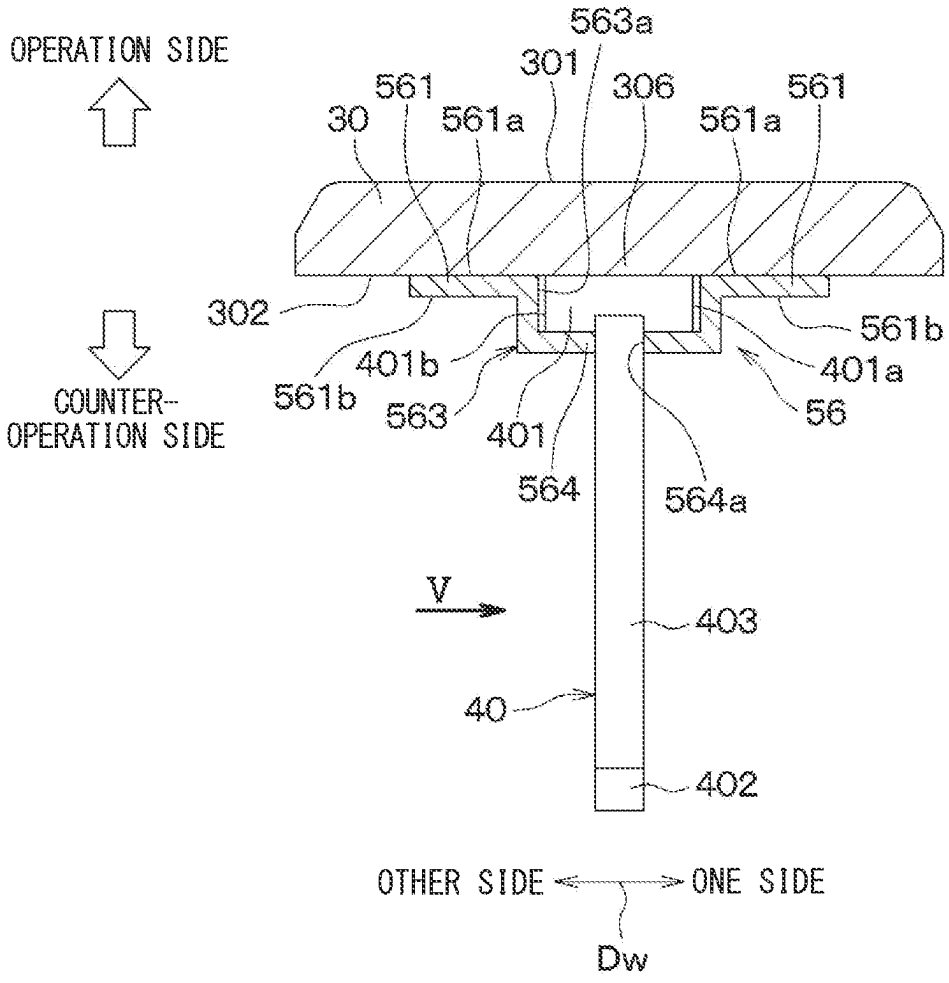

OPERATION SIDE
COUNTER-OPERATION SIDE
563a
301
306
561
561a
30
561a
561
302
561b
401b
563
401
564
564a
401a
56
561b
V
403
40
402
OTHER SIDE
ONE SIDE
Dw

FIG. 5

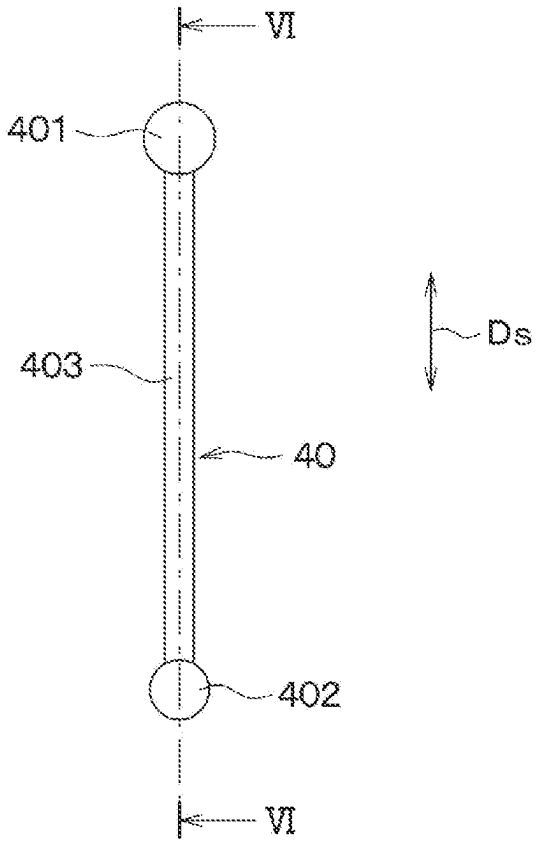


FIG. 6

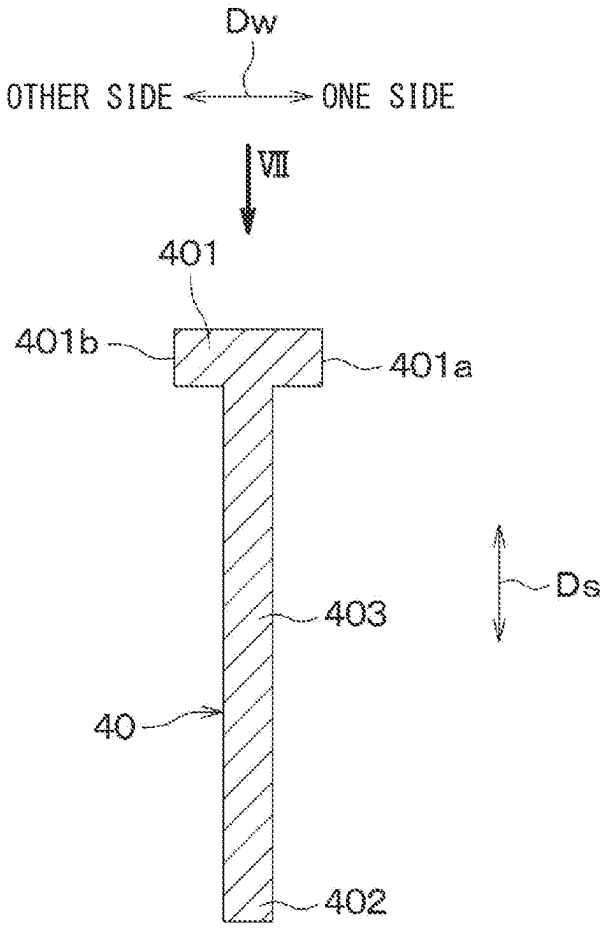

Dw
OTHER SIDE
ONE SIDE
VII
401
401b
401a
403
Ds
40
402

FIG. 7

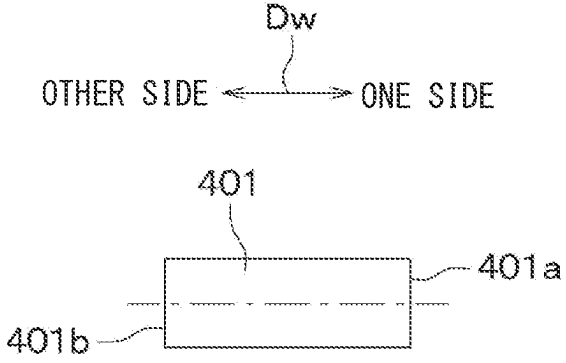

Dw
OTHER SIDE
ONE SIDE
401
401a
401b

FIG. 8

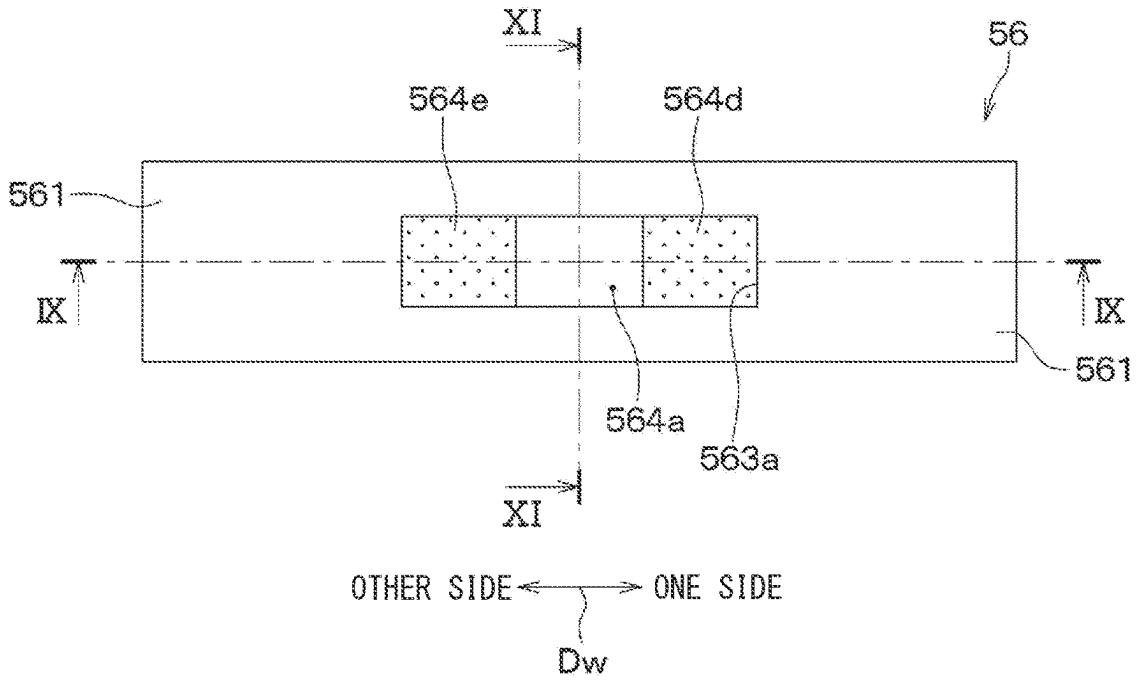

XI
56
564e
564d
561
IX
IX
561
564a
563a
XI
OTHER SIDE
ONE SIDE
Dw

FIG. 9

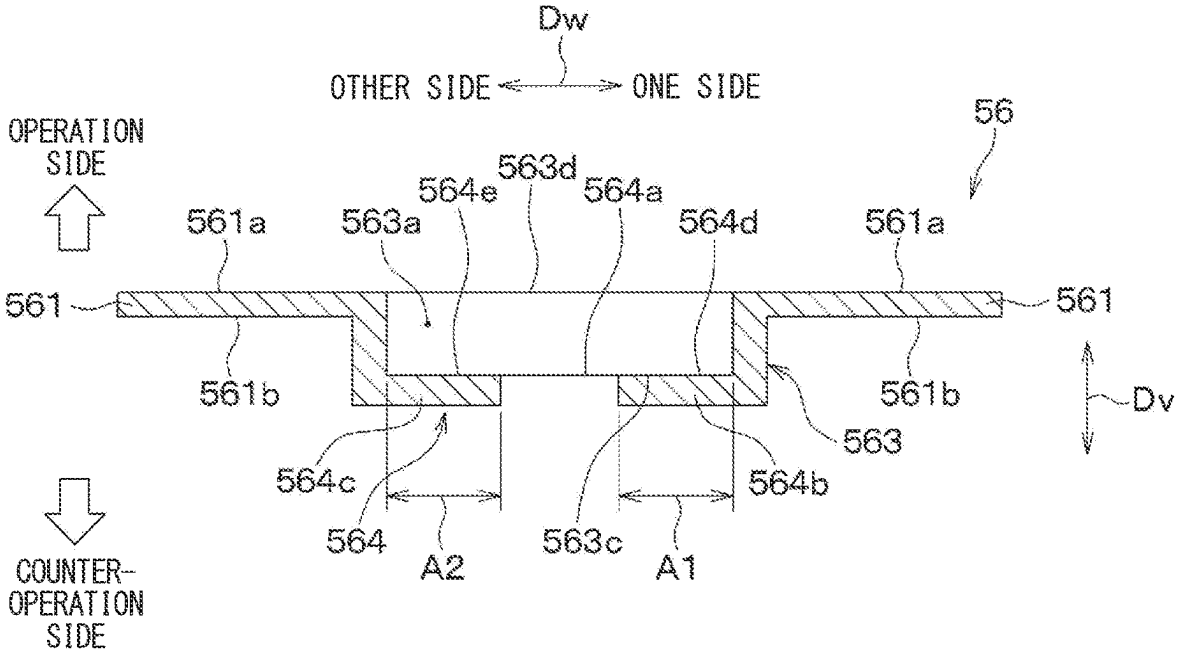

Dw
OTHER SIDE
ONE SIDE
OPERATION SIDE
56
561a
563a
564e
563d
564a
564d
561a
561
561
561b
561b
Dv
563
564c
564b
564
A2
563c
A1
COUNTER-OPERATION SIDE

FIG. 10

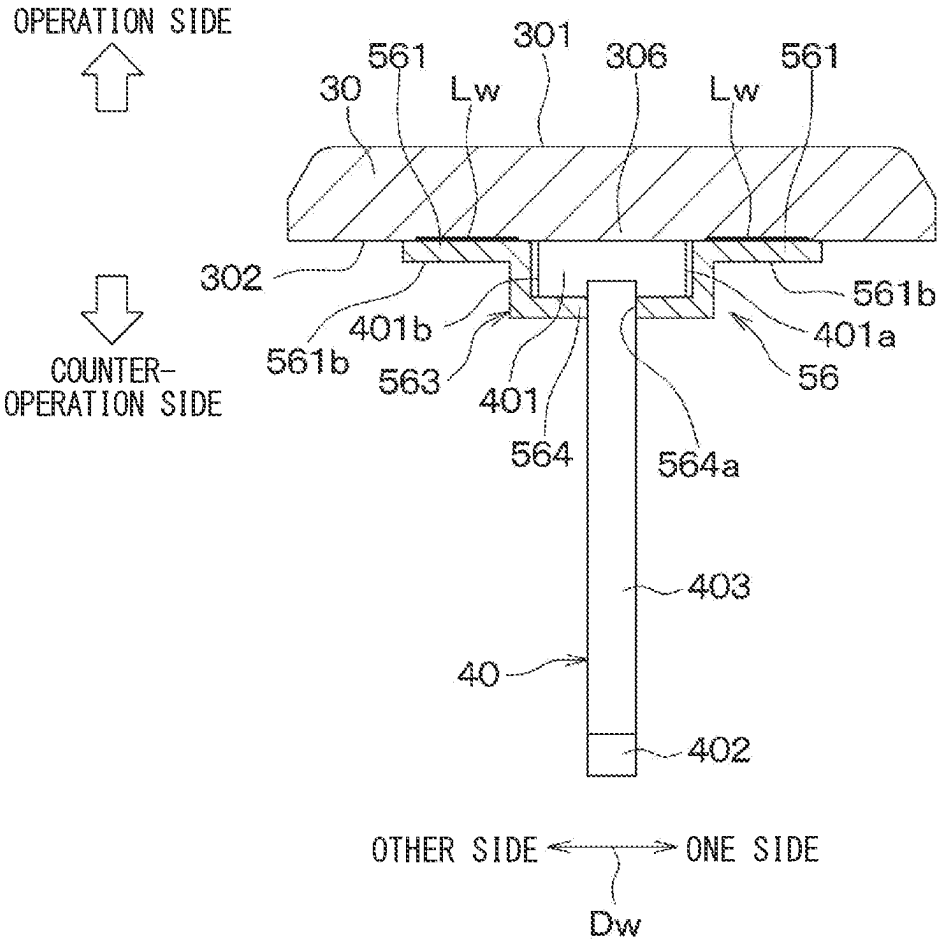

OPERATION SIDE
COUNTER-
OPERATION SIDE
30
561
Lw
301
306
Lw
561
302
561b
401b
563
401
564
564a
56
401a
561b
403
40
402
OTHER SIDE
ONE SIDE
Dw

FIG. 11

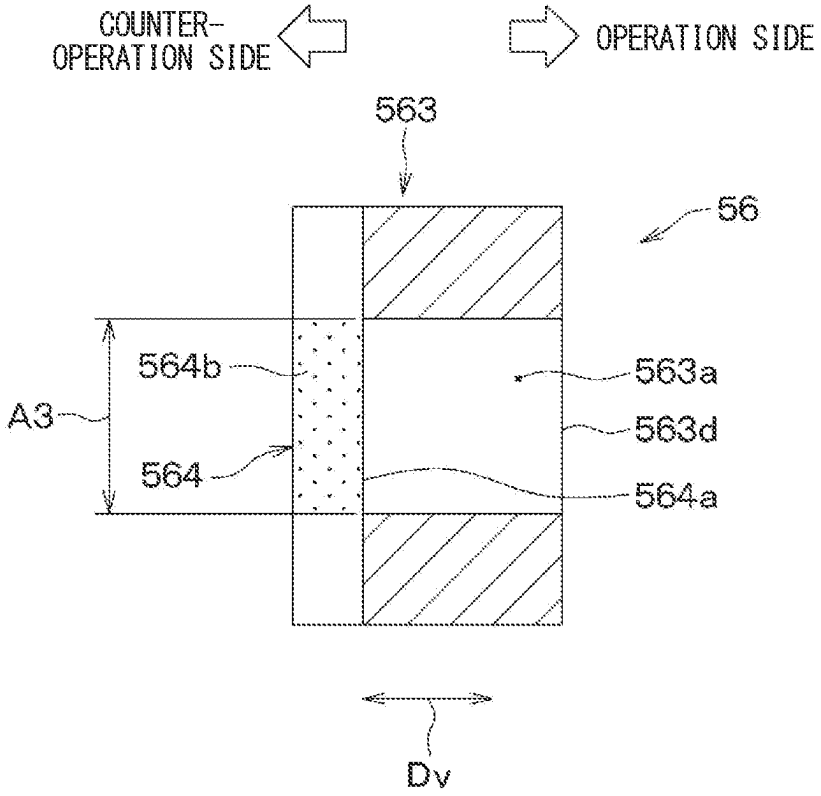

COUNTER-
OPERATION SIDE
OPERATION SIDE
563
56
564b
563a
A3
563d
564
564a
Dv

FIG. 12

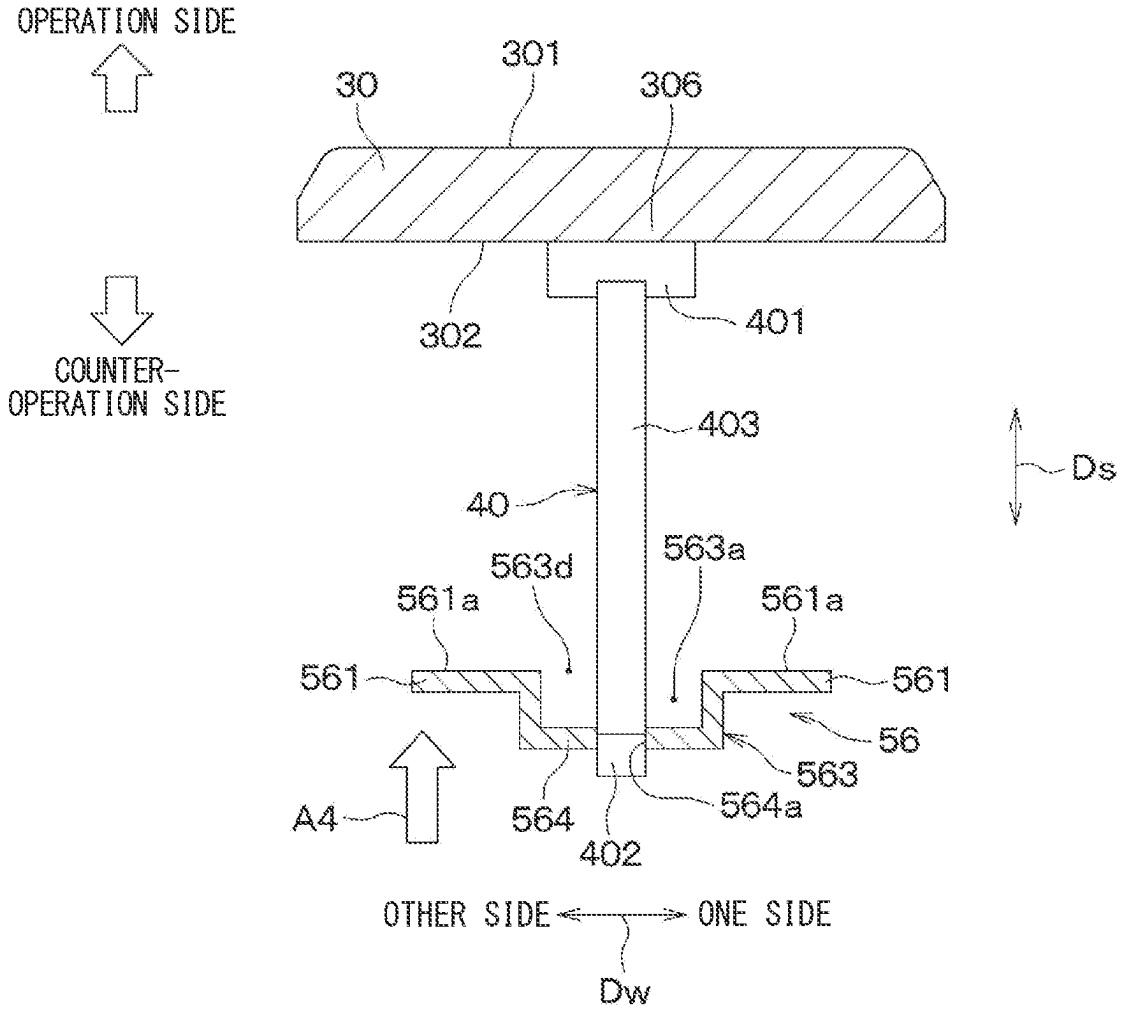

OPERATION SIDE
COUNTER-
OPERATION SIDE
30
301
306
302
401
403
40
Ds
563d
563a
561a
561a
561
561
56
563
564
564a
402
A4
OTHER SIDE
ONE SIDE
Dw

FIG. 13

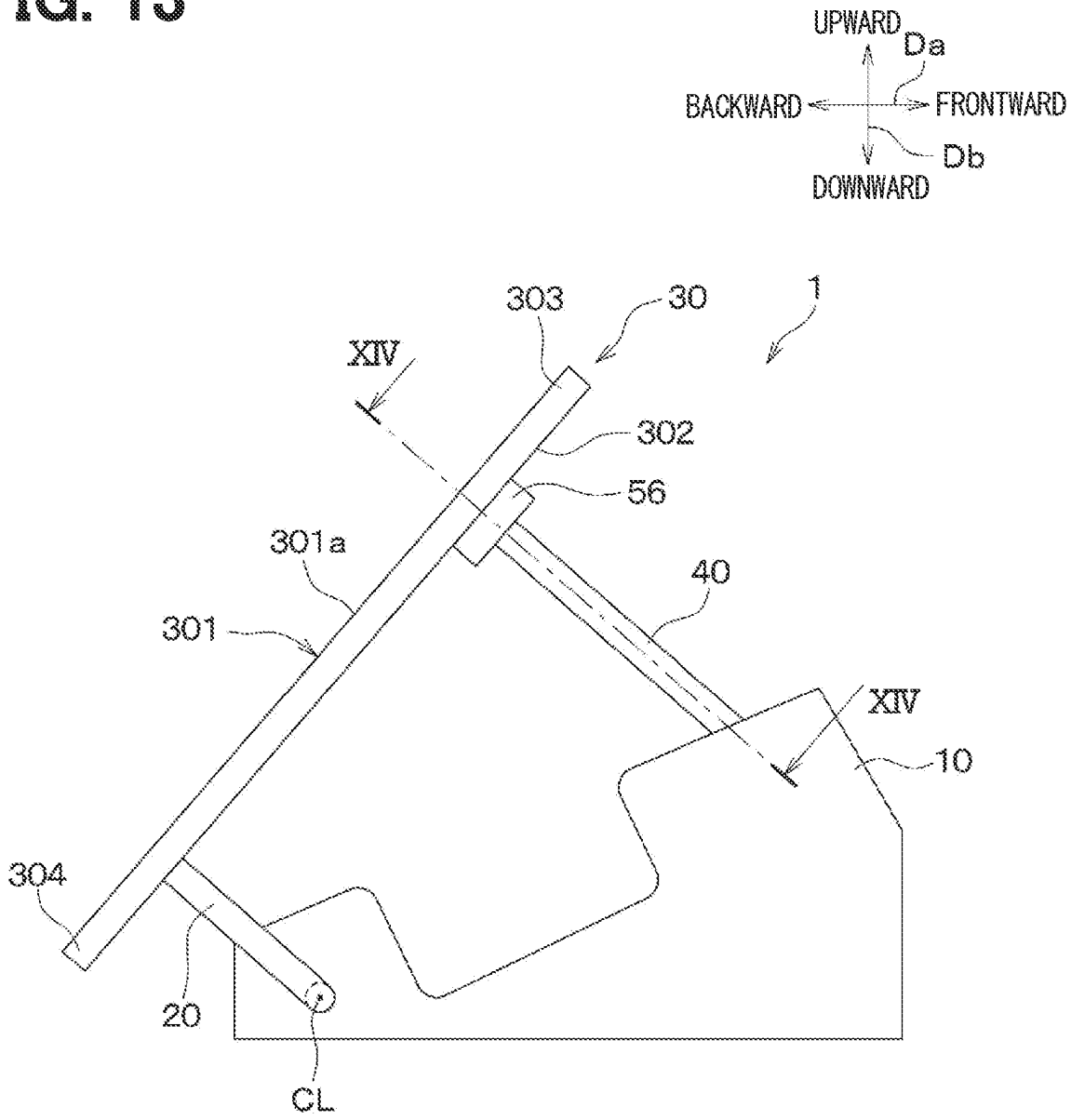

UPWARD
Da
BACKWARD
FRONTWARD
Db
DOWNWARD
303
30
1
XIV
302
56
301a
40
301
XIV
10
304
20
CL

FIG. 14

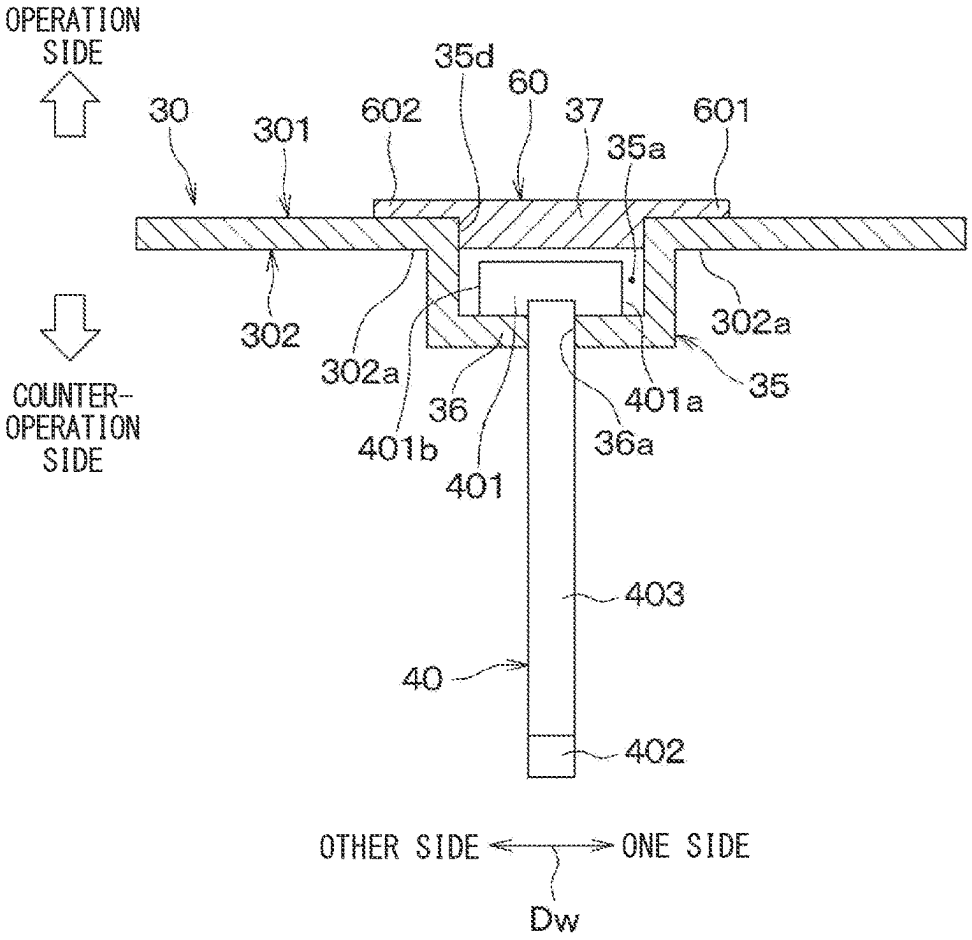

OPERATION SIDE
COUNTER-OPERATION SIDE
30
301
602
35d
60
37
35a
601
302
302a
36
401b
401
401a
35
36a
403
40
402
OTHER SIDE
ONE SIDE
Dw

FIG. 15

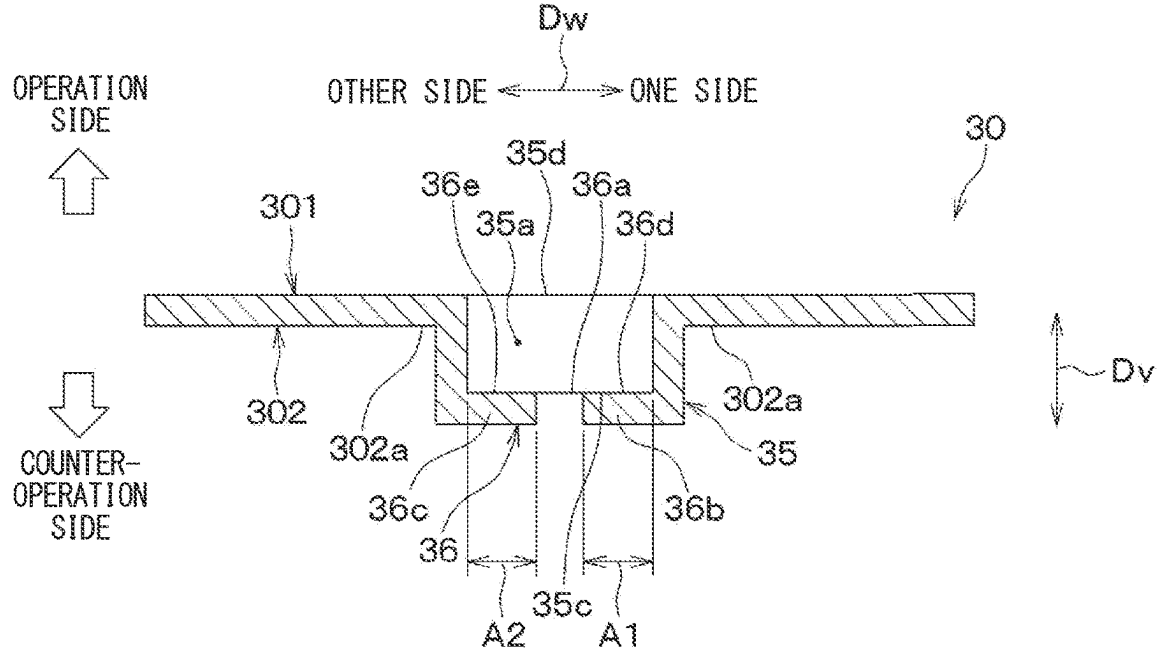

Dw
OTHER SIDE
ONE SIDE
OPERATION SIDE
COUNTER-OPERATION SIDE
30
301
36e
35d
36a
35a
36d
302
302a
36c
36
35c
A2
A1
36b
35
Dv

FIG. 16

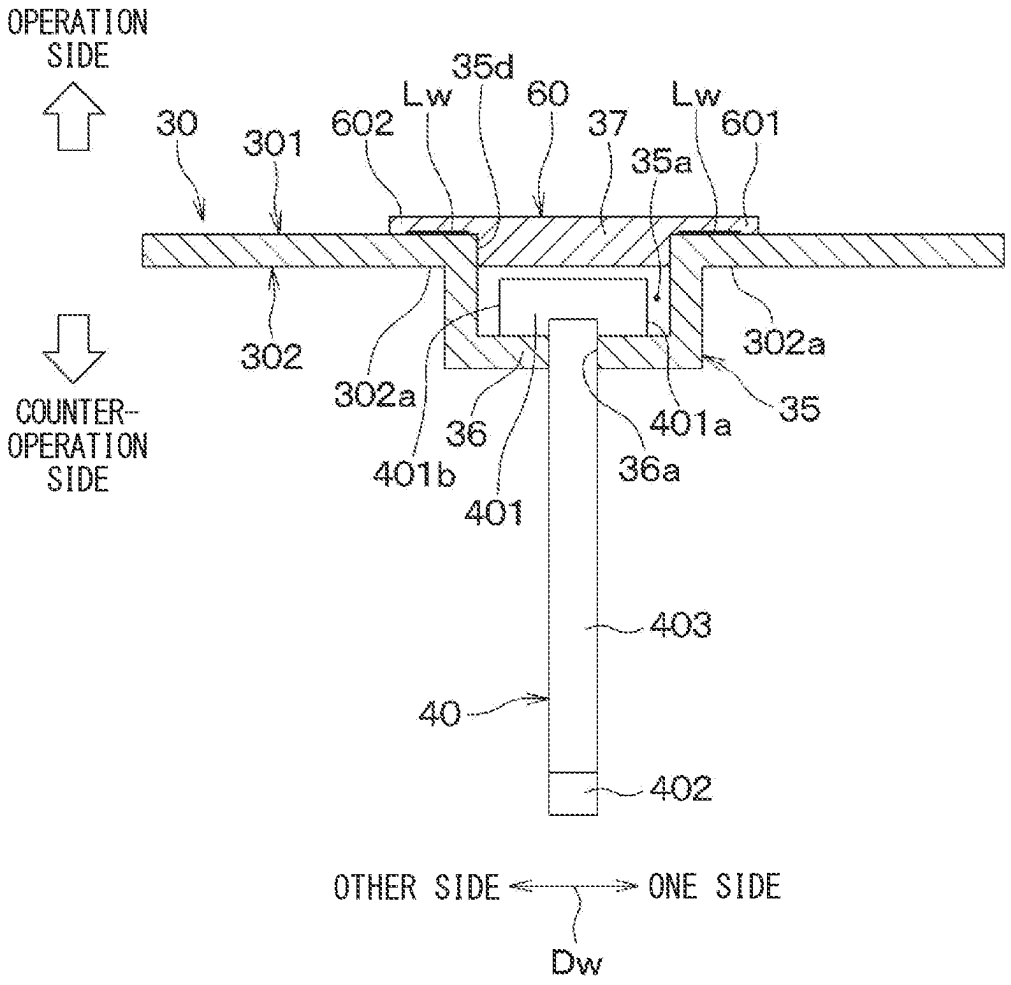

OPERATION SIDE
COUNTER-OPERATION SIDE
30
301
602
Lw
35d
60
37
Lw
601
35a
302
302a
302a
36
401b
401
401a
36a
35
403
40
402
OTHER SIDE
ONE SIDE
Dw

FIG. 17

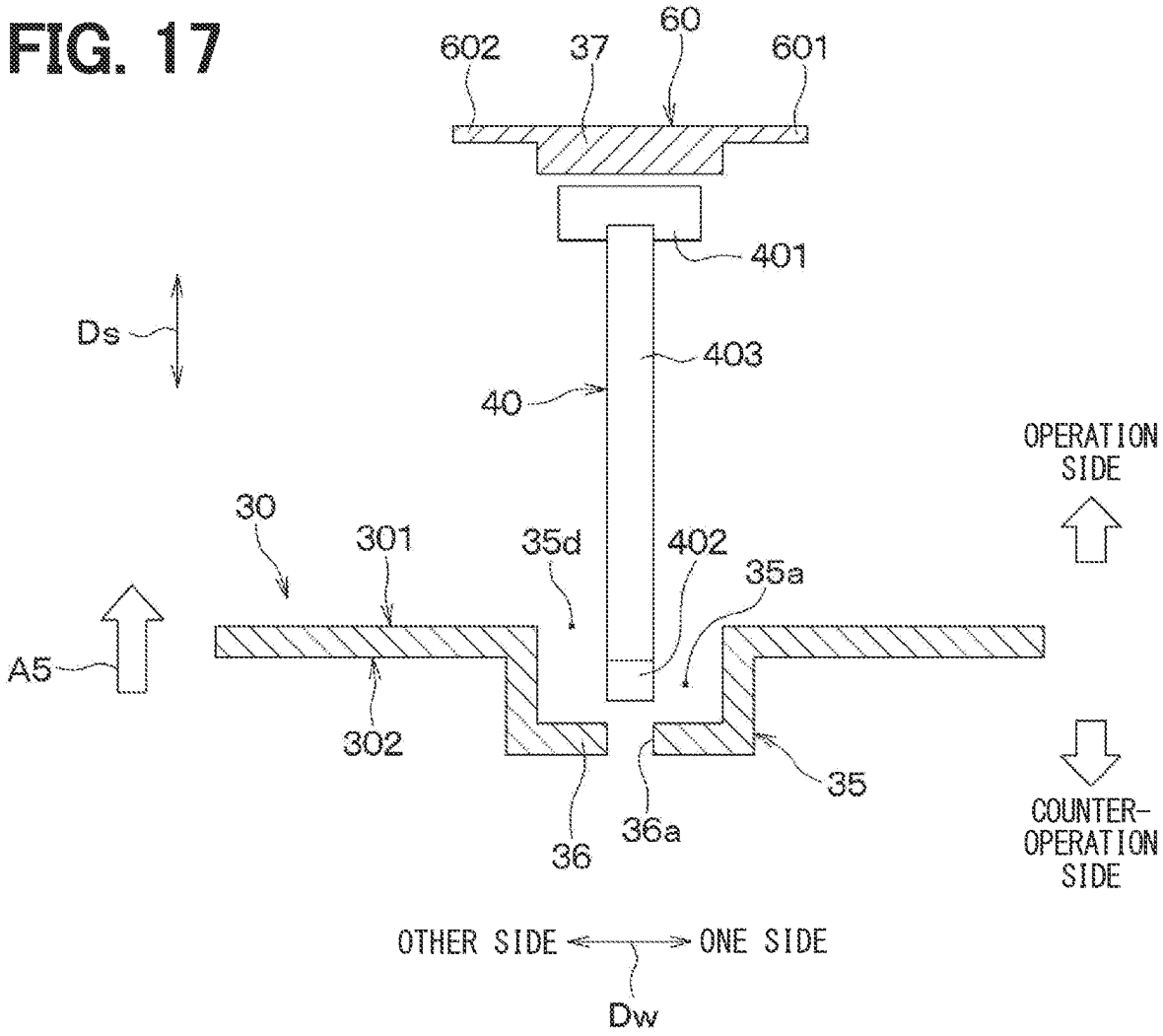

602
37
60
601
401
Ds
403
40
OPERATION SIDE
30
301
35d
402
35a
A5
302
35
36
36a
COUNTER-OPERATION SIDE
OTHER SIDE
ONE SIDE
Dw

FIG. 18

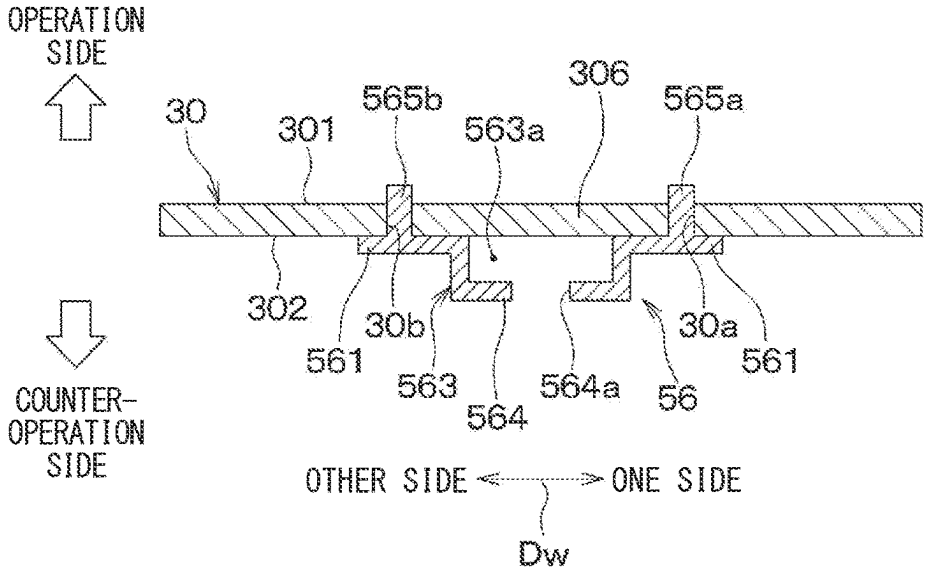

OPERATION SIDE
30
301
565b
563a
306
565a
302
561
30b
563
564
564a
56
30a
561
COUNTER-OPERATION SIDE
OTHER SIDE
ONE SIDE
Dw

FIG. 19

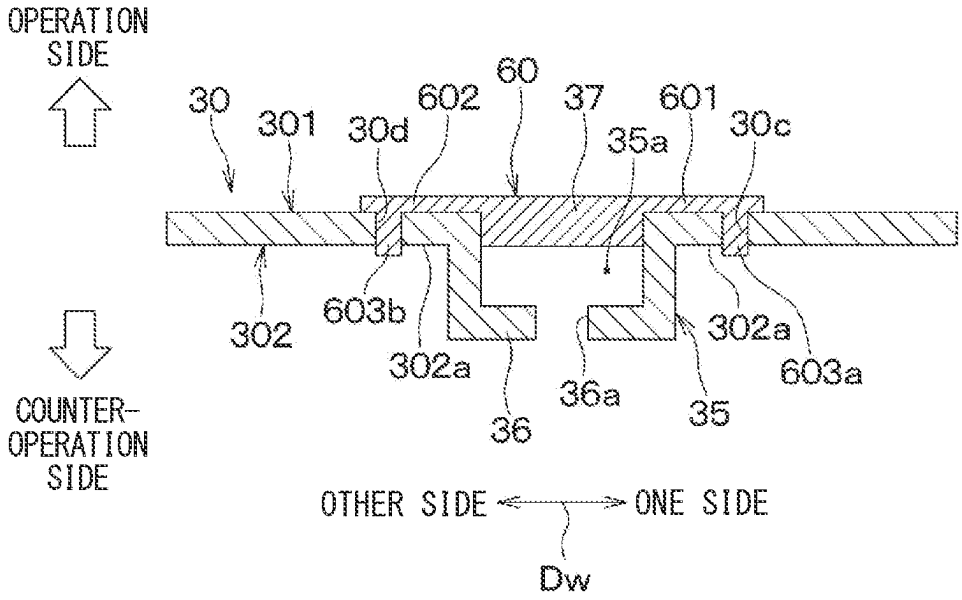

OPERATION SIDE
COUNTER-OPERATION SIDE
30
301
30d
602
60
37
601
35a
30c
302
603b
302a
36
36a
35
302a
603a
OTHER SIDE
ONE SIDE
Dw

FIG. 20

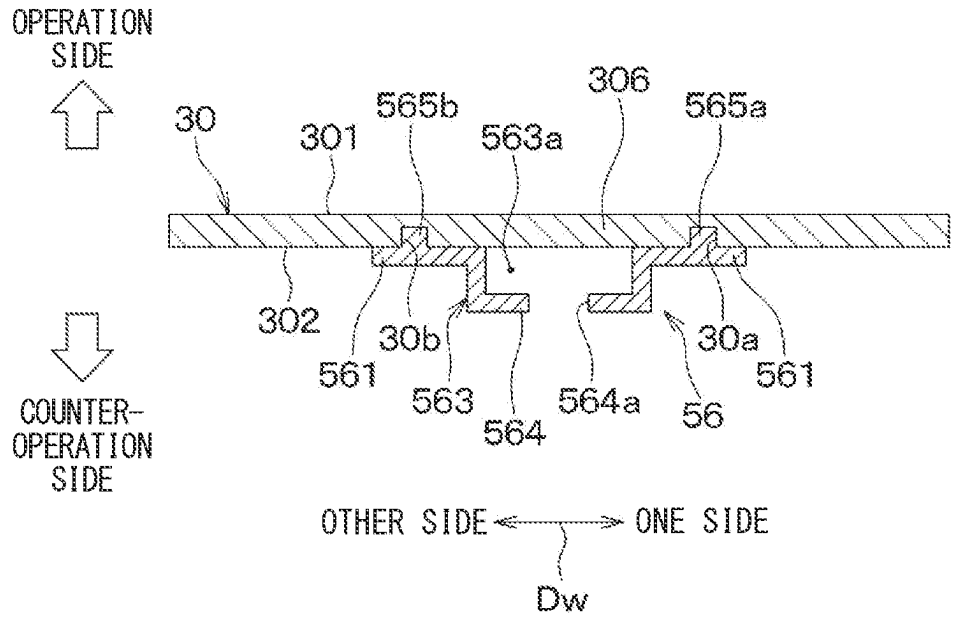

OPERATION SIDE
COUNTER-OPERATION SIDE
30
301
565b
563a
306
565a
302
561
30b
563
564
564a
56
30a
561
OTHER SIDE
ONE SIDE
Dw

FIG. 21

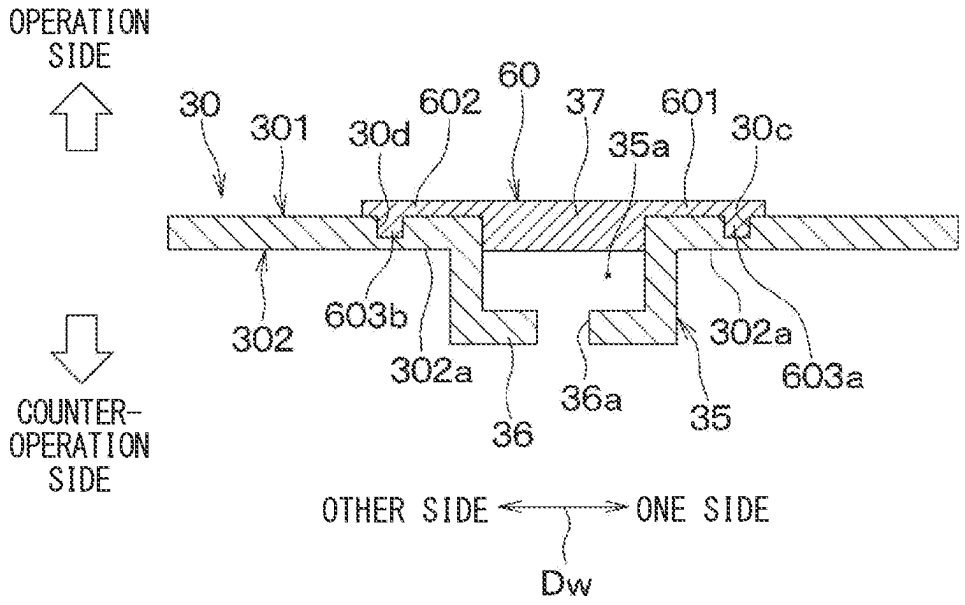

OPERATION SIDE
COUNTER-OPERATION SIDE
30
301
30d
602
60
37
601
30c
35a
302
603b
302a
36
36a
35
302a
603a
OTHER SIDE
ONE SIDE
Dw

FIG. 22

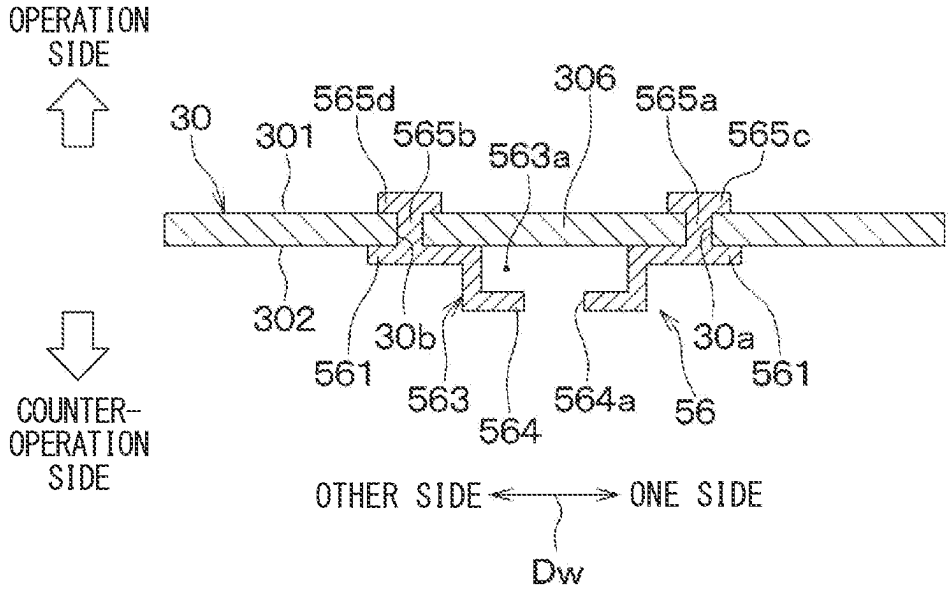

OPERATION SIDE
COUNTER-OPERATION SIDE
30
301
565d
565b
563a
306
565a
565c
302
561
30b
563
564
564a
56
30a
561
OTHER SIDE
ONE SIDE
Dw

FIG. 23

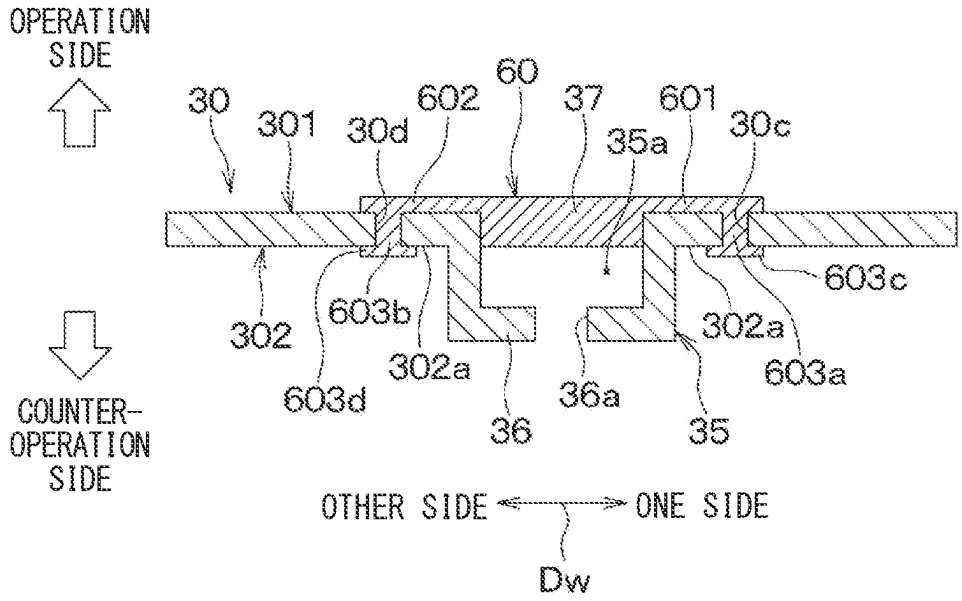

OPERATION SIDE
COUNTER-OPERATION SIDE
30
301
30d
602
60
37
601
30c
35a
603c
603b
302
302a
603a
603d
36a
36
35
OTHER SIDE
ONE SIDE
Dw

FIG. 24

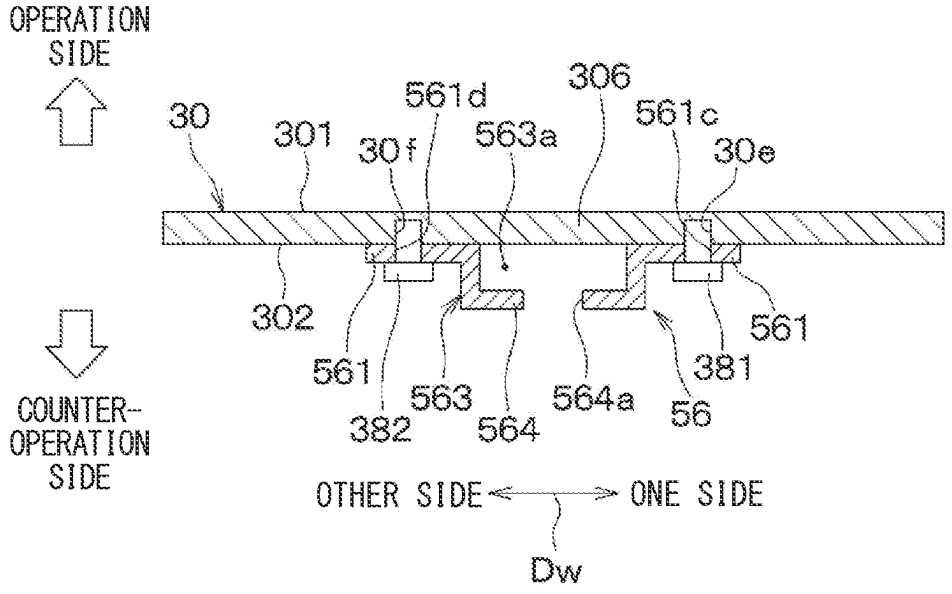

OPERATION SIDE
COUNTER-OPERATION SIDE
30
301
30f
561d
563a
306
561c
30e
302
561
381
563
564a
56
382
564
OTHER SIDE
ONE SIDE
Dw

FIG. 25

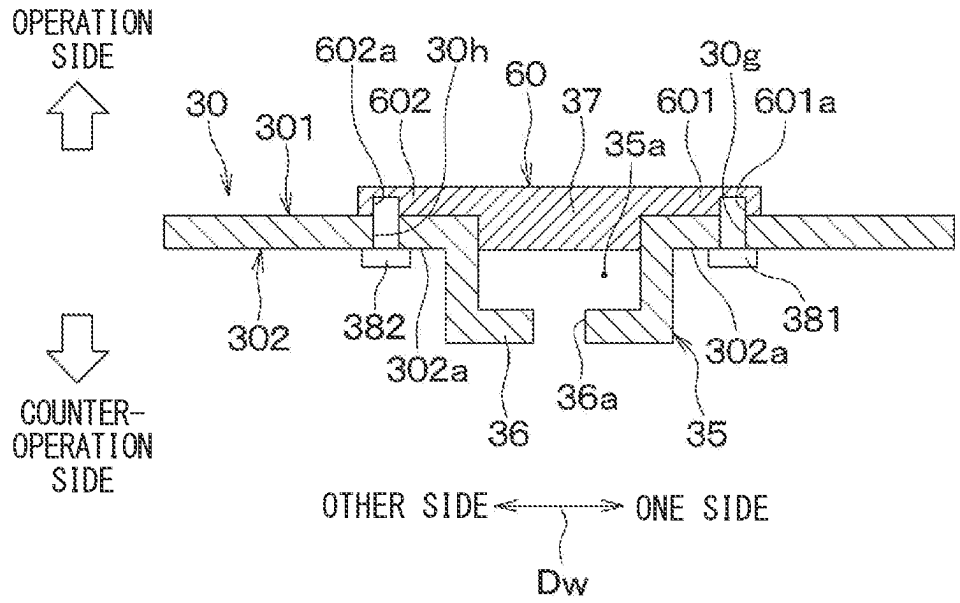

OPERATION SIDE
COUNTER-OPERATION SIDE
30
301
602a
30h
602
60
37
35a
601
30g
601a
302
382
302a
36
36a
35
302a
381
OTHER SIDE
ONE SIDE
Dw

FIG. 26

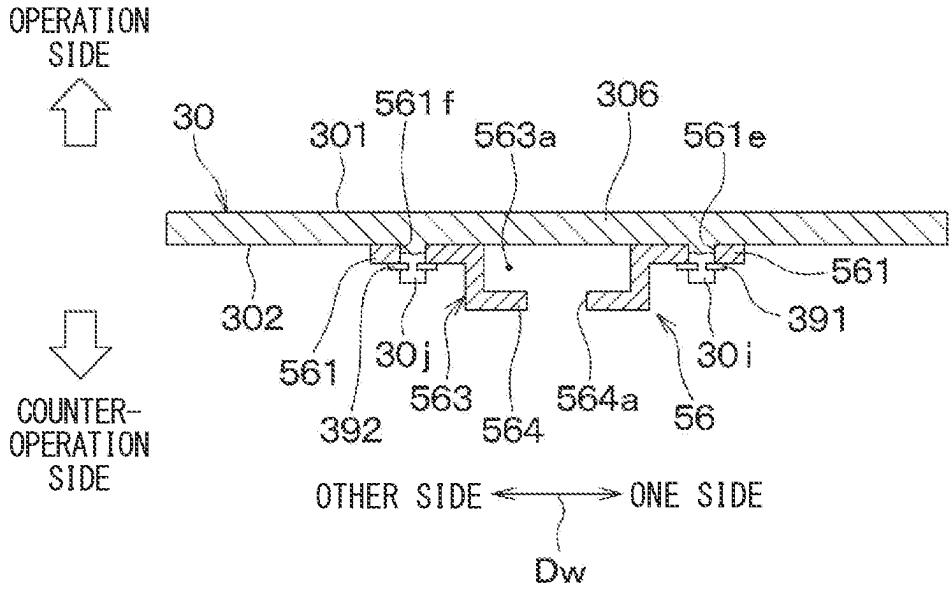

OPERATION SIDE
COUNTER-OPERATION SIDE
30
301
561f
563a
306
561e
302
561
30j
563
564
564a
392
56
30i
391
561
OTHER SIDE
ONE SIDE
Dw

FIG. 27

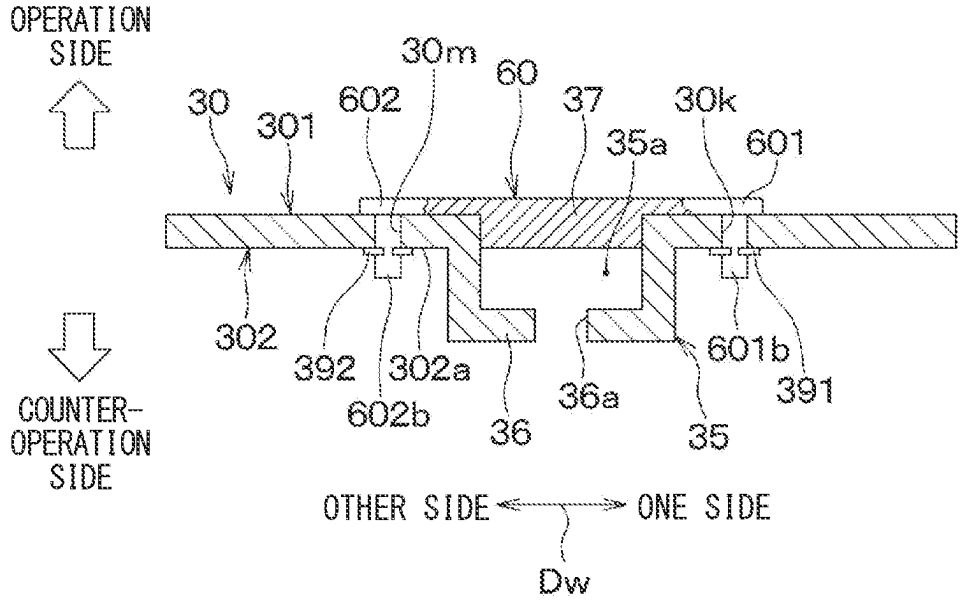

OPERATION SIDE
COUNTER-OPERATION SIDE
30
301
602
30m
60
37
35a
30k
601
302
392
302a
602b
36
36a
35
601b
391
OTHER SIDE
ONE SIDE
Dw

FIG. 28

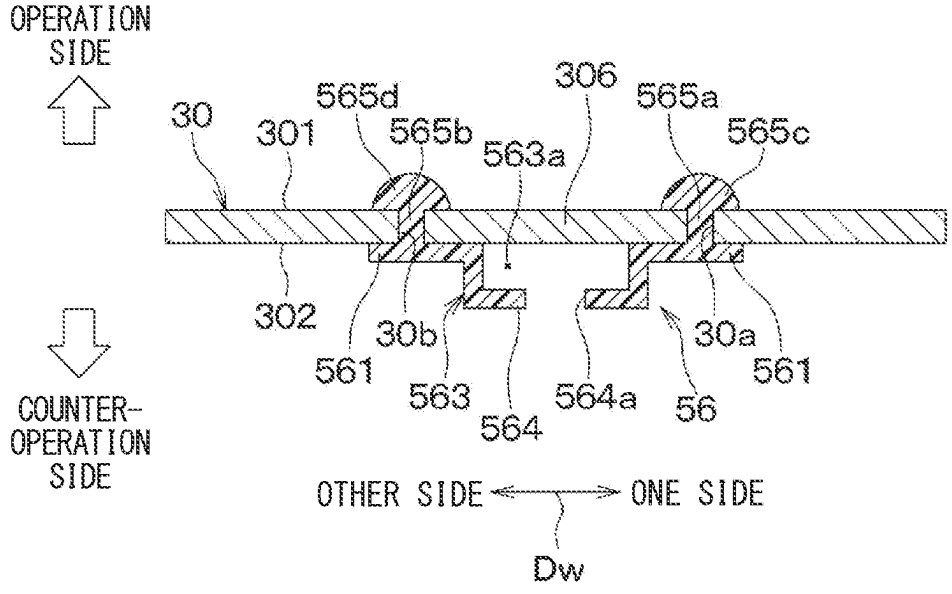

OPERATION SIDE
COUNTER-OPERATION SIDE
30
301
565d
565b
563a
306
565a
565c
302
561
30b
563
564
564a
56
30a
561
OTHER SIDE
ONE SIDE
Dw

FIG. 29

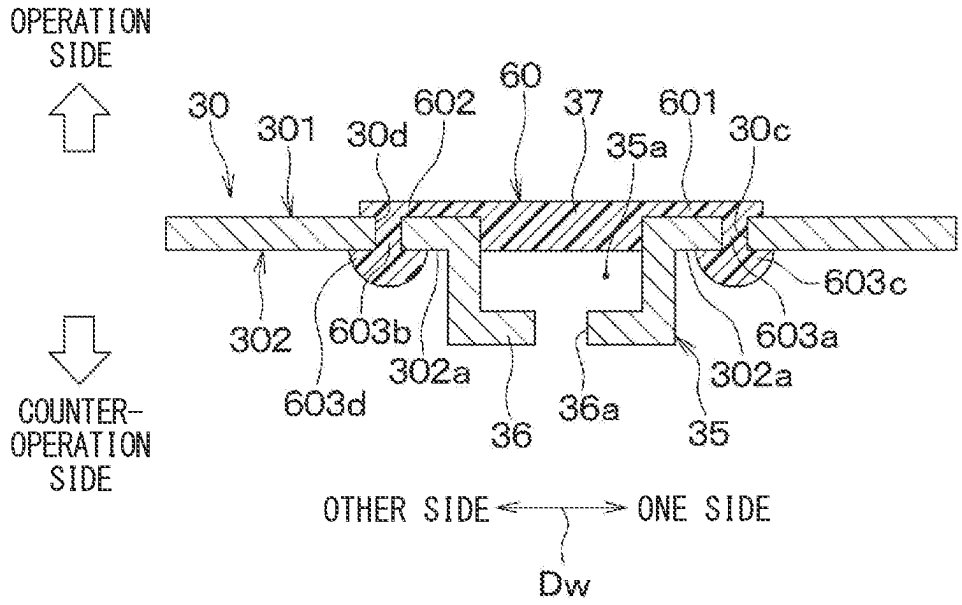

OPERATION SIDE
COUNTER-OPERATION SIDE
30
301
30d
602
60
37
601
35a
30c
603c
302
603b
603d
302a
36
36a
603a
302a
35
OTHER SIDE
ONE SIDE
Dw

FIG. 30

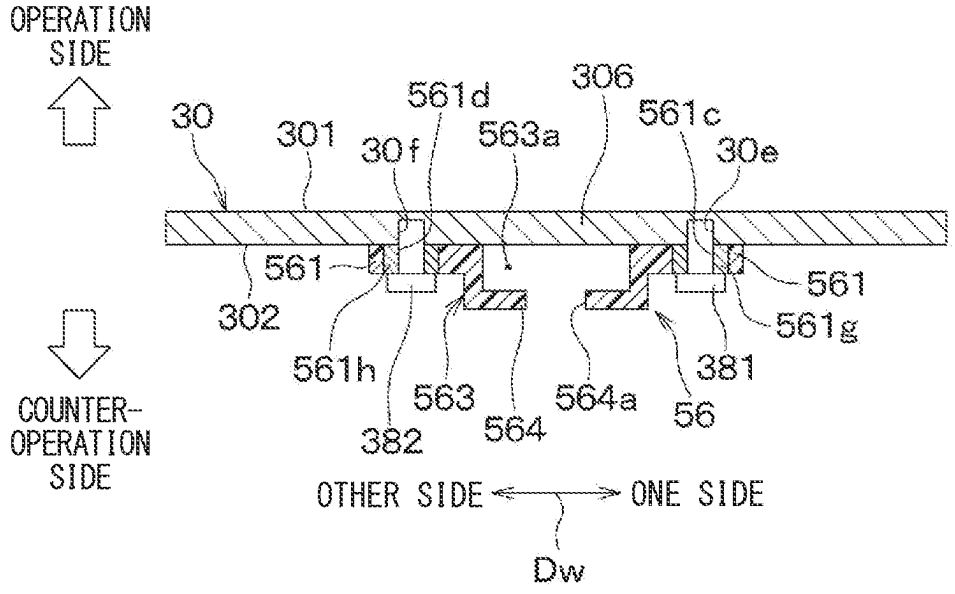

OPERATION SIDE
COUNTER-OPERATION SIDE
30
301
30f
561d
563a
306
561c
30e
561
302
561h
382
563
564
564a
56
381
561
561g
OTHER SIDE
ONE SIDE
Dw

FIG. 31

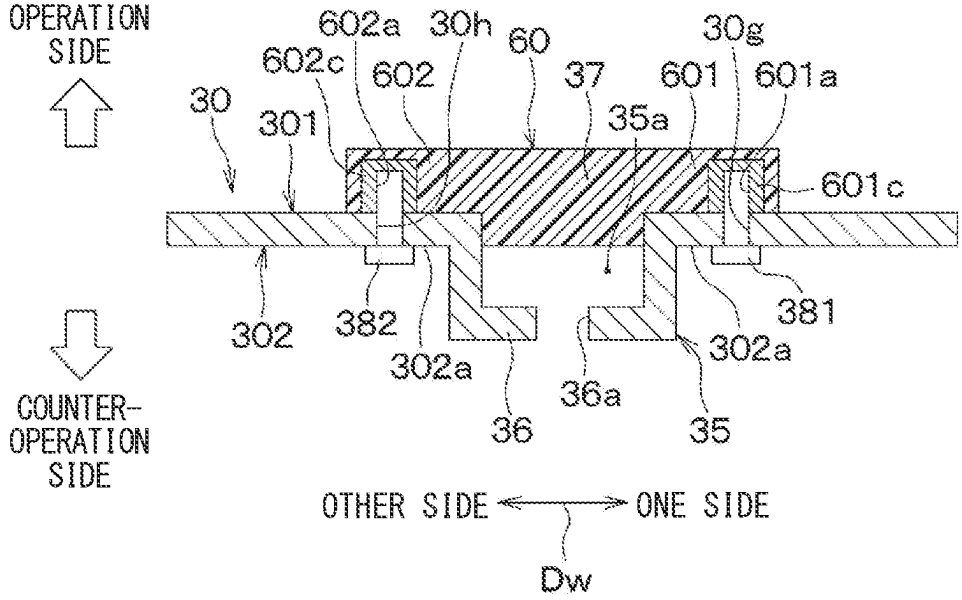

OPERATION SIDE
COUNTER-OPERATION SIDE
602a
30h
60
30g
602c
602
37
601
601a
30
301
35a
601c
302
382
302a
36a
381
302a
36
35
OTHER SIDE
ONE SIDE
Dw

FIG. 32

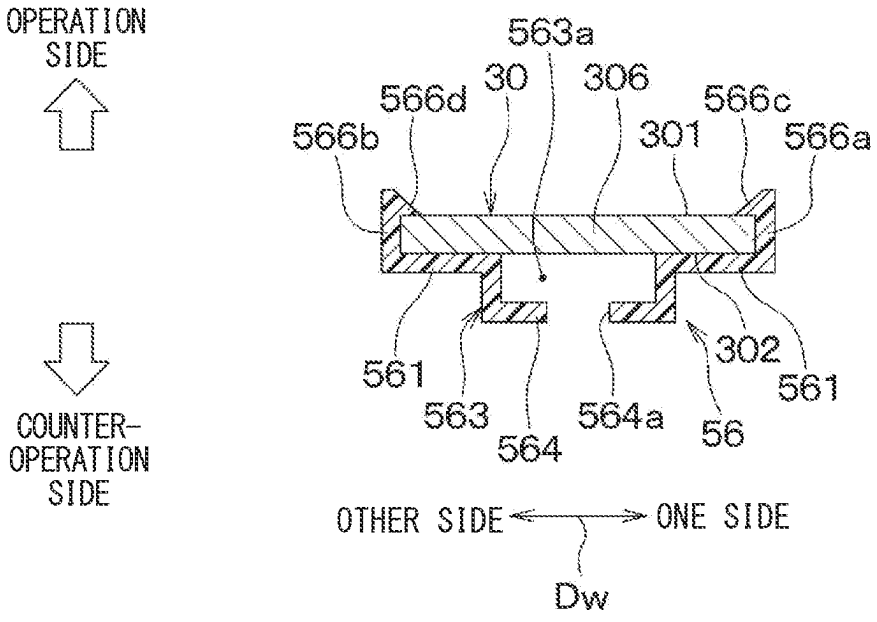

OPERATION SIDE
COUNTER-OPERATION SIDE
563a
30
306
566d
566c
566b
301
566a
561
563
564
564a
302
56
561
OTHER SIDE
ONE SIDE
Dw

FIG. 33

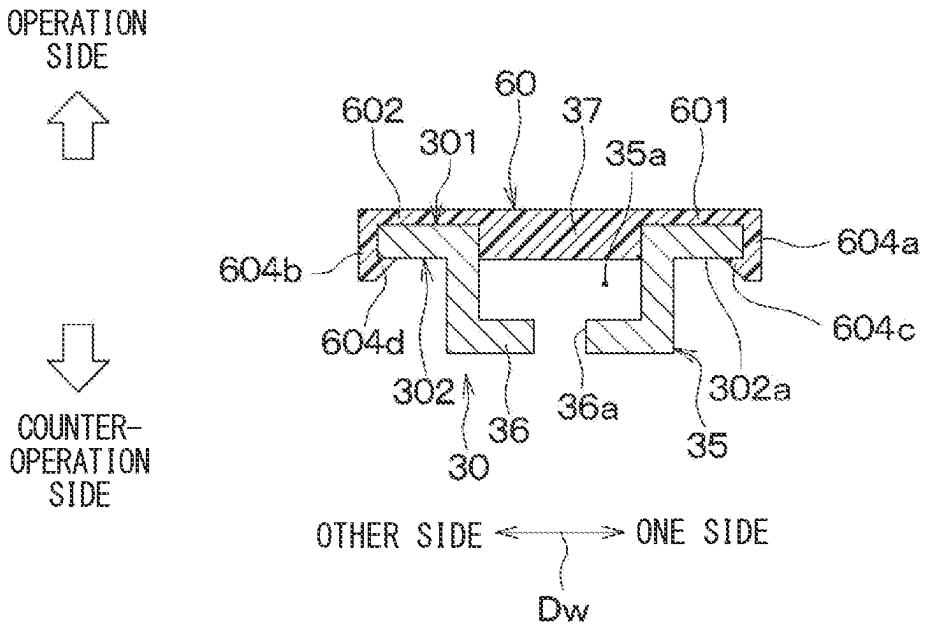

OPERATION SIDE
COUNTER-OPERATION SIDE
602
60
37
601
301
35a
604a
604b
604c
604d
302
36
36a
302a
30
35
OTHER SIDE
ONE SIDE
Dw

FIG. 34

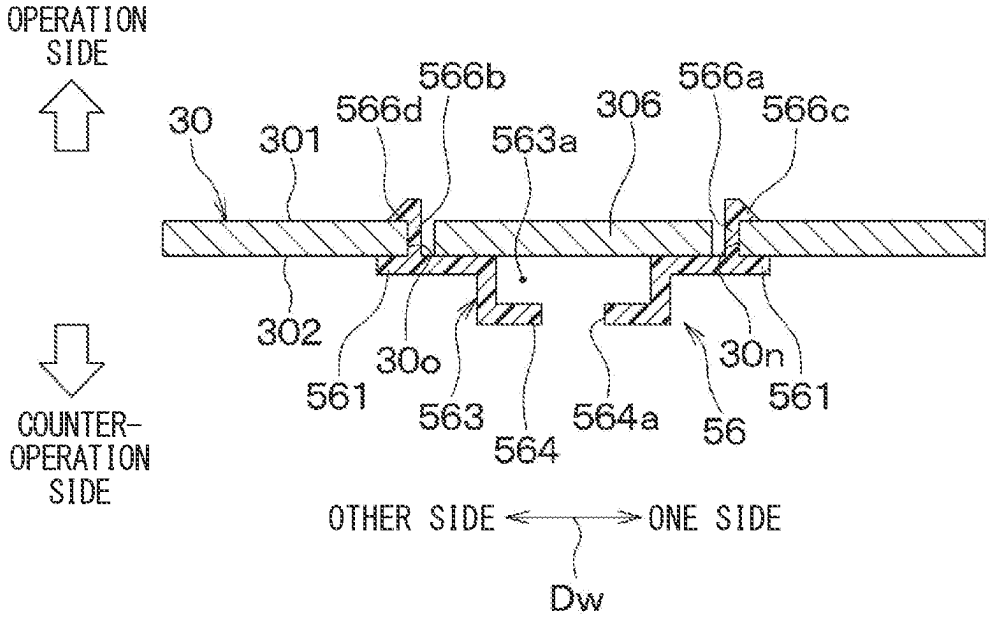

OPERATION SIDE
COUNTER-OPERATION SIDE
566b
566a
30
566d
306
566c
301
563a
302
561
30o
563
564
564a
56
30n
561
OTHER SIDE
ONE SIDE
Dw

FIG. 35

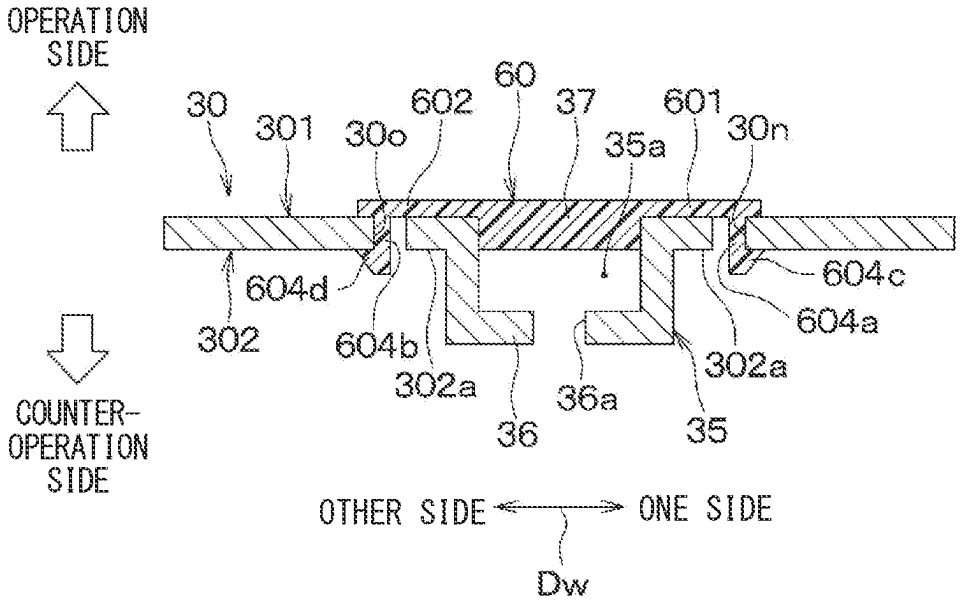

OPERATION SIDE
COUNTER-OPERATION SIDE
30
301
30o
602
60
37
35a
601
30n
604d
604c
604a
302
604b
302a
36
36a
302a
35
OTHER SIDE
ONE SIDE
Dw

FIG. 36

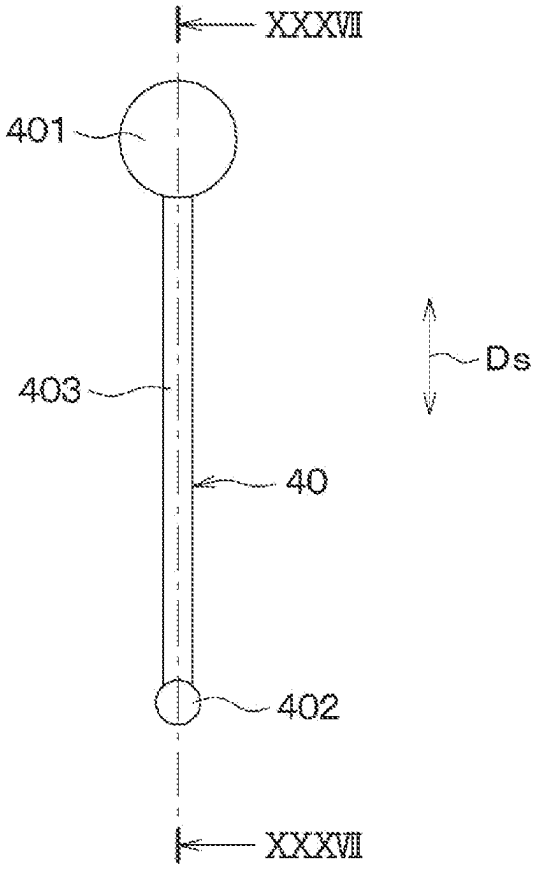

XXXVII
401
403
Ds
40
402
XXXVII

FIG. 37

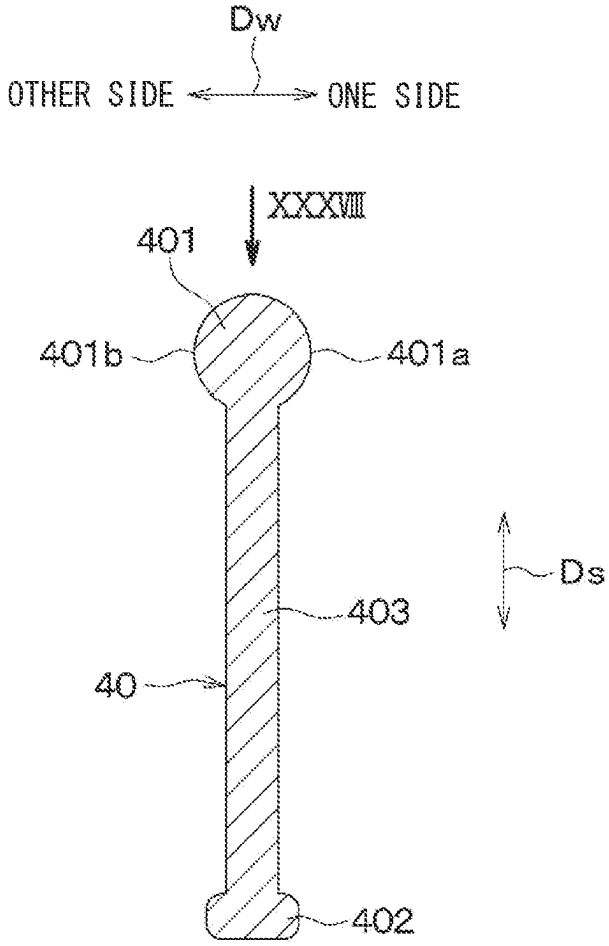

Dw
OTHER SIDE
ONE SIDE
XXXVIII
401
401b
401a
Ds
403
40
402

FIG. 38

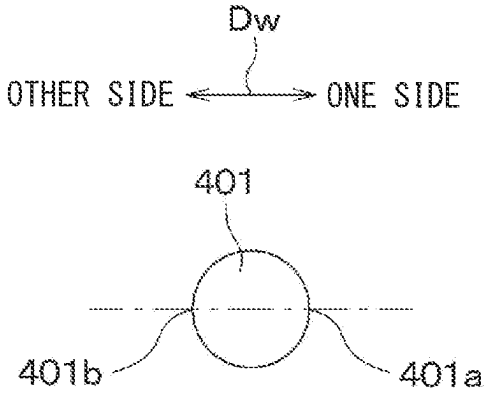

Dw
OTHER SIDE
ONE SIDE
401
401b
401a

FIG. 39

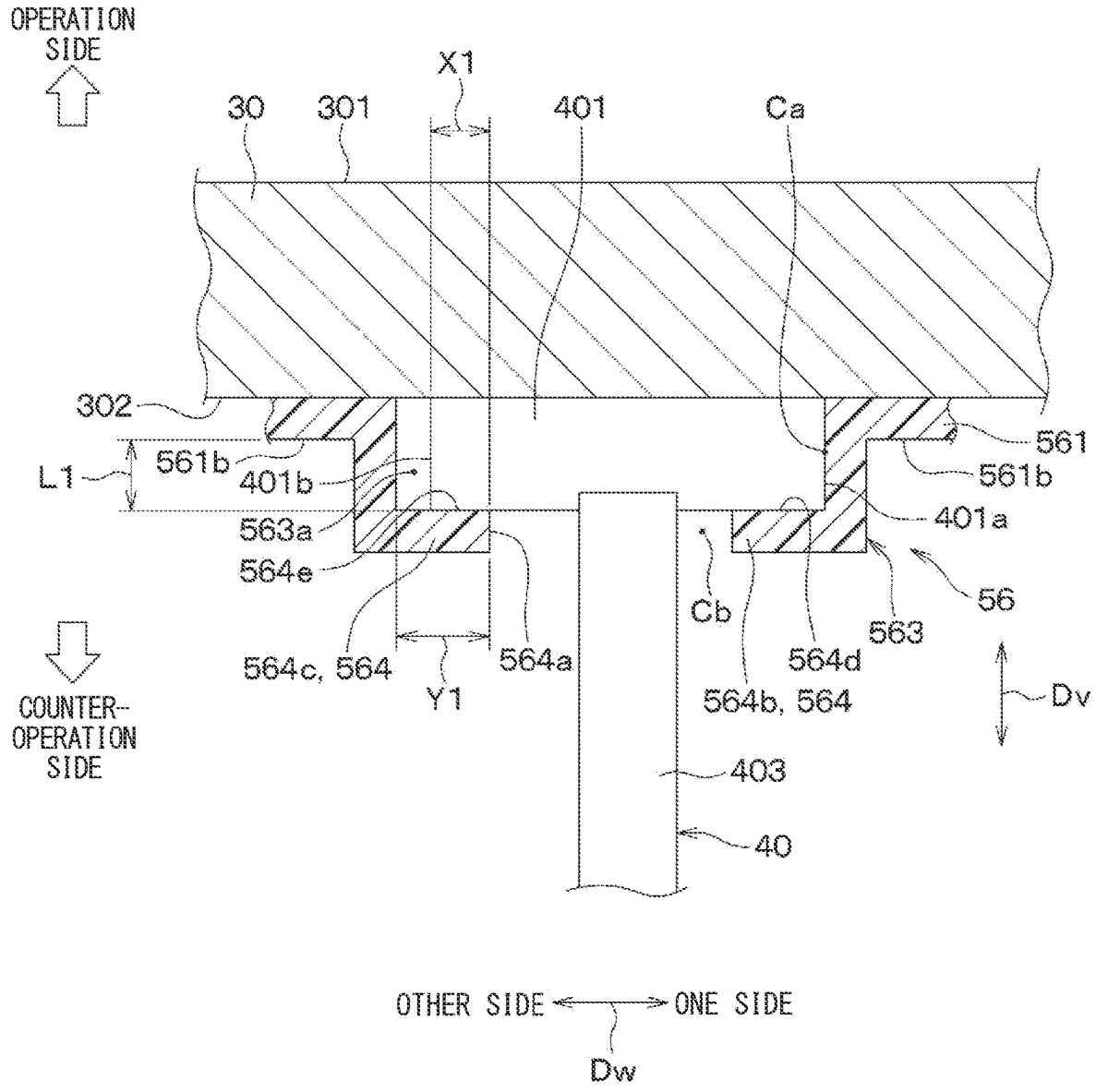
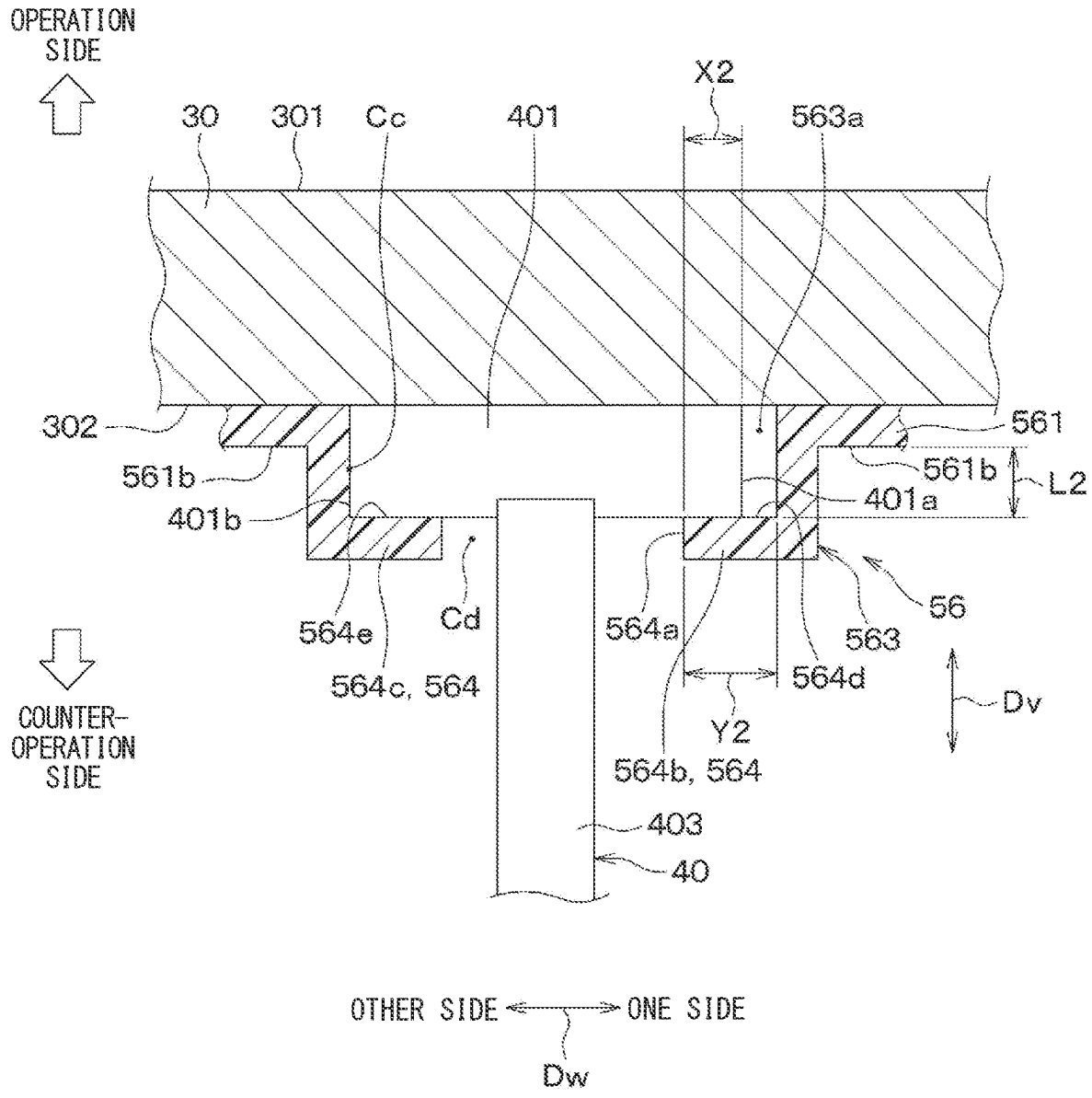

OPERATION SIDE
X1
30
301
401
Ca
302
561
561b
L1
561b
401b
401a
563a
564e
56
Cb
563
564d
564c, 564
Y1
564a
564b, 564
Dv
COUNTER-OPERATION SIDE
403
40
OTHER SIDE
ONE SIDE
Dw

FIG. 40


OPERATION SIDE
X2
30
301
Cc
401
563a
302
561
561b
561b
L2
401b
401a
56
564e
Cd
564a
563
564c, 564
564d
Dv
COUNTER-OPERATION SIDE
Y2
564b, 564
403
40
OTHER SIDE
ONE SIDE
Dw

PEDAL DEVICE

CROSS REFERENCE TO RELATED APPLICATION

The present application is a continuation application of International Patent Application No. PCT/JP2022/005053 filed on Feb. 9, 2022, which designated the U.S. and claims the benefit of priority from Japanese Patent Application No. 2021-029093 filed on Feb. 25, 2021. The entire disclosures of all of the above applications are incorporated herein by reference.

TECHNICAL FIELD

The present invention relates to a pedal device provided in a vehicle.

BACKGROUND

A known pedal device is operated when stepped by an operator.

SUMMARY

According to an aspect of the present disclosure, a pedal device for a vehicle comprises a pedal pad and an arm coupled to the pedal pad.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the present disclosure will become more apparent from the following detailed description made with reference to the accompanying drawings. In the drawings:

FIG. **1** is a schematic diagram showing a vehicle equipped with a pedal device in a first embodiment;

FIG. **2** is a perspective view of a pedal device in the first embodiment;

FIG. **3** is a sectional view showing a section perpendicular to the pedal axial center of a pedal device in the first embodiment;

FIG. **4** is a sectional view schematically showing a section taken along line IV-IV of FIG. **3**;

FIG. **5** is an arrow view taken in a direction of V of FIG. **4**, illustrating an arm as a single component;

FIG. **6** is a sectional view showing a section taken along line VI-VI of FIG. **5**;

FIG. **7** is an arrow view taken in a direction of VII of FIG. **6**;

FIG. **8** is a plan view illustrating a stopper part as a single component in the first embodiment, as viewed in a direction going from the operation side toward the counter-operation side;

FIG. **9** is a sectional view showing a section taken along line IX-IX of FIG. **8**;

FIG. **10** is a sectional view showing the same section as in FIG. **4**, indicating a point of welding between a stopper part and a pedal pad;

FIG. **11** is a sectional view showing a section taken along line XI-XI of FIG. **8**;

FIG. **12** is a sectional view showing a dismantled stopper part and pedal pad in the same section as in FIG. **4**, illustrating how to attach an arm and the stopper part to the pedal pad;

FIG. **13** is a drawing schematically showing a pedal device as viewed in a direction along a pedal axial center in a second embodiment;

FIG. **14** is a sectional view showing a section (specifically, a section equivalent to a section taken along line XIV-XIV of FIG. **13**) along an arm extending direction in a third embodiment, equivalent to FIG. **4**;

FIG. **15** is a sectional view showing a section obtained by cutting a pedal pad as a single component as in FIG. **9** in the third embodiment;

FIG. **16** is a sectional view showing the same section as in FIG. **4**, indicating a point of welding between a stopper part and a pedal pad;

FIG. **17** is a sectional view showing a dismantled arm, stopper part, and pedal pad in the same section as in FIG. **14**, illustrating how to attach the arm and the stopper part to the pedal pad;

FIG. **18** is a drawing selectively showing a stopper part and a pedal pad and schematically showing the stopper part as is assembled to the pedal pad in a fourth embodiment, equivalent to FIG. **10**;

FIG. **19** is a drawing selectively showing a stopper part and a pedal pad and schematically showing the stopper part as is assembled to the pedal pad in a fifth embodiment, equivalent to FIG. **16**;

FIG. **20** is a drawing selectively showing a stopper part and a pedal pad and schematically showing the stopper part as is assembled to the pedal pad in a sixth embodiment, equivalent to FIG. **18**;

FIG. **21** is a drawing selectively showing a stopper part and a pedal pad and schematically showing the stopper part as is assembled to the pedal pad in a seventh embodiment, equivalent to FIG. **19**;

FIG. **22** is a drawing selectively showing a stopper part and a pedal pad and schematically showing the stopper part as is assembled to the pedal pad in an eighth embodiment, equivalent to FIG. **18**;

FIG. **23** is a drawing selectively showing a stopper part and a pedal pad and schematically showing the stopper part as is assembled to the pedal pad in a ninth embodiment, equivalent to FIG. **19**;

FIG. **24** is a drawing selectively showing a stopper part and a pedal pad and schematically showing the stopper part as is assembled to the pedal pad in a tenth embodiment, equivalent to FIG. **18**;

FIG. **25** is a drawing selectively showing a stopper part and a pedal pad and schematically showing the stopper part as is assembled to the pedal pad in an eleventh embodiment, equivalent to FIG. **19**;

FIG. **26** is a drawing selectively showing a stopper part and a pedal pad and schematically showing the stopper part as is assembled to the pedal pad in a twelfth embodiment, equivalent to FIG. **18**;

FIG. **27** is a drawing selectively showing a stopper part and a pedal pad and schematically showing the stopper part as is assembled to the pedal pad in a thirteenth embodiment, equivalent to FIG. **19**;

FIG. **28** is a drawing selectively showing a stopper part and a pedal pad and schematically showing the stopper part as is assembled to the pedal pad in a fourteenth embodiment, equivalent to FIG. **18**;

FIG. **29** is a drawing selectively showing a stopper part and a pedal pad and schematically showing the stopper part as is assembled to the pedal pad in a fifteenth embodiment, equivalent to FIG. **19**;

FIG. **30** is a drawing selectively showing a stopper part and a pedal pad and schematically showing the stopper part as is assembled to the pedal pad in a sixteenth embodiment, equivalent to FIG. **18**;

FIG. **31** is a drawing selectively showing a stopper part and a pedal pad and schematically showing the stopper part as is assembled to the pedal pad in a seventeenth embodiment, equivalent to FIG. **19**;

FIG. **32** is a drawing selectively showing a stopper part and a pedal pad and schematically showing the stopper part as is assembled to the pedal pad in an eighteenth embodiment, equivalent to FIG. **18**;

FIG. **33** is a drawing selectively showing a stopper part and a pedal pad and schematically showing the stopper part as is assembled to the pedal pad in a nineteenth embodiment, equivalent to FIG. **19**;

FIG. **34** is a drawing selectively showing a stopper part and a pedal pad and schematically showing the stopper part as is assembled to the pedal pad in a twentieth embodiment, equivalent to FIG. **18**;

FIG. **35** is a drawing selectively showing a stopper part and a pedal pad and schematically showing the stopper part as is assembled to the pedal pad in a twenty-first embodiment, equivalent to FIG. **19**;

FIG. **36** is a drawing showing an arm as a single component as viewed in the same direction as in FIG. **5** in a twenty-second embodiment, equivalent to FIG. **5**;

FIG. **37** is a sectional view showing a section taken along line XXXVII-XXXVII of FIG. **36** in the twenty-second embodiment, equivalent to FIG. **6**;

FIG. **38** is an arrow view as viewed in a direction of XXXVIII of FIG. **37** in the twenty-second embodiment, equivalent to FIG. **7**;

FIG. **39** is a sectional view showing one side eccentricity state in which an arm is biased to one side in an arm end widening direction and is abutted against a stopper part in the arm end widening direction in a twenty-third direction, showing a section in the same orientation as in FIG. **4**; and

FIG. **40** is a drawing showing the other side eccentricity state in which an arm is biased to the other side in an arm end widening direction and is abutted against a stopper part in the arm end widening direction in the twenty-third embodiment, showing the same section as in FIG. **39**.

DETAILED DESCRIPTION

Hereinafter, examples of the present disclosure will be described.

According to an example of the present disclosure, a pedal device includes a pedal housing, a pedal pad rotatably coupled with the pedal housing, and a connection link. The connection link is comprised of a connection head and a connection body. The connection head of the connection link is rotatably fit into a connection recessed portion located on a pedal back side of the pedal pad, provided on the counter-operation side opposite to the operation side on which the pedal pad is stepped on by an operator. The connection body of the connection link is extended from the connection head to the counter-operation side and is inserted into the pedal housing.

In a pedal device according to an example, a connection head of a connection link is rotatably joined to a connection recess of a pedal pad. When the connection head and the connection recess are joined each other, the connection recess of the pedal pad and a peripheral part thereof may be elastically deformed and the connection head may be thereby inserted into the connection recess.

For this reason, a sufficient width of an overlap between the connection recess of the pedal pad and the connection head of the connection link may be difficult to ensure to maintain the joining between the connection recess and the connection head. As a result, for example, when external force is accidentally applied to the pedal pad, it is assumed that the connection recess and the connection head are prone to disjoin. That is, it is guessed that the connection link is difficult to join to the pedal pad with sufficient strength. As a result of detailed consideration by the present inventors, the foregoing has been found.

According to an example of the present disclosure, a pedal device is to be provided in a vehicle. The pedal device comprises:

- a pedal pad configured to be stepped on by an operator from a predetermined operation side;
- an arm including an arm one end and an arm body extended from the arm one end to a reaction-operation side, which is opposite to the operation side, the arm coupled with the pedal pad at the arm one end and coupled on a counter-operation side with a reaction force generation mechanism, the reaction force generation mechanism configured to generate a reaction force against a stepping force applied to the pedal pad by the operator; and
- a stopper part that is a component separate from the pedal pad and fixed to the pedal pad.

The arm one end is widened from the arm body in a widening direction, which is perpendicular to an extending direction, in which the arm body is extended. One part, which is one of the pedal pad and the stopper part, includes a first arrangement section that has an insertion hole, into which the arm body is inserted, and located on the counter-operation side relative to the arm one end. An other part, which is an other of the pedal pad and the stopper part, includes a second arrangement section located on an operation side of the first arrangement section across the arm one end. The first arrangement section and the second arrangement section hold the arm one end against the pedal pad in a state where the arm one end is interposed between the first arrangement section and the second arrangement section.

Thus, the first arrangement section and the second arrangement section respectively belong to different components; therefore, when external force is applied in such a direction that the arm end pushes the first arrangement section, a width sufficient for the first arrangement section to receive the arm end against the external force can be ensured. For this reason, an arm equivalent to the above-mentioned connection link can be coupled with the pedal pad with sufficient strength.

Hereafter, a description will be given to each embodiment with reference to the drawings. Among the following individual drawings, an identical or equivalent element will be marked with an identical numeral or symbol in each drawing.

First Embodiment

As shown in FIG. **1**, a pedal device **1** in the present embodiment is a device mounted in a vehicle **80** and is stepped on by an operator **81** as an occupant of the vehicle **80** through stepping force. The pedal device **1** is provided in the vehicle **80** as a brake pedal device for performing braking operation to apply brake to the vehicle **80**.

In detail, the vehicle **80** in FIG. **1** adopts a brake-by-wire system and the pedal device **1** is a brake pedal device used for the brake-by-wire system. The brake-by-wire system is

a system in which a brake pad of each wheel is driven through a brake circuit by liquid pressure generated at a master cylinder by drive control by an electronic control device mounted in the vehicle **80** based on an electrical signal outputted from the pedal device **1**.

Each of the both-end arrows in FIG. **1** indicates an orientation of the vehicle **80** equipped with the pedal device **1**. That is, in FIG. **1**, a vehicle front-back direction Da, which is the front-back direction of the vehicle **80**, and a vehicle vertical direction Db, which is the up-down direction of the vehicle **80** (in other words, the perpendicular direction of the vehicle **80**) are indicated by the both-end arrows. In the description of the present embodiment, frontward in the vehicle front-back direction Da is also referred to as vehicle front; backward in the vehicle front-back direction Da is also referred to as vehicle back; upward in the vehicle up-down direction Db is also referred to as vehicle upward; and downward in the vehicle up-down direction Db is also referred to as vehicle downward.

As shown in FIG. **2** and FIG. **2**, the pedal device **1** is an organ type pedal device. The pedal device **1** includes a housing **10**, a shaft **20**, a pedal pad **30**, an arm **30**, a reaction force generation mechanism **50**, a stopper part **56**, a rotation angle sensor and the like, not shown. The organ type pedal device **1** is those so configured that a portion of the pedal pad **30** stepped on by an operator **81** is located vehicle upward relative to the rotation center CL of the pedal pad **30** (in other words, upward in the perpendicular direction as is mounted in the vehicle). In the organ type pedal device **1**, the portion of the pedal pad **30** vehicle upward relative to the rotation center CL is rotationally moved to the floor **2** side or the dash panel side in the vehicle compartment according to increase in stepping force applied to the pedal pad **30** by the operator **81**. In the description of the present embodiment, the rotation center CL of the pedal pad **30** is also referred to as pedal axial center CL.

As shown in FIG. **3**, the housing **10** is attached to a part of a vehicle body constituting the vehicle **80**. In detail, the housing **10** is attached to the floor **2**, the dash panel, or the like in the vehicle compartment of the vehicle **80** by a screw **3**. The dash panel is a partition wall separating the vehicle compartment exterior, such as an engine room, and the vehicle compartment interior of the vehicle **80** and is also referred to as bulkhead sometimes. FIG. **2** and FIG. **3** show the pedal device **1** in a non-stepped state in which the pedal pad **30** is not stepped on by an operator **81**.

As shown in FIG. **2** and FIG. **3**, the housing **10** includes a housing body **11** and a housing cover **12**. The housing **10** is provided between the pedal pad **30** as is most deeply stepped on by an operator **81** and the floor **2** constituting a part of the vehicle body. A space for providing the reaction force generation mechanism **50** and the like is formed inside the housing body **11**. The housing body **11** has a shaft receiving portion **111** for rotatably supporting the shaft **20**. The housing cover **12** is provided on a side face of the housing body **11** and closes a side face opening of the space formed inside the housing body **11**.

The shaft **20** is in a shape obtained by bending, for example, a metal column a plurality of time and includes a stem portion **21**, a fixed portion **22**, and a coupling portion **23**. The stem portion **21**, coupling portion **23**, and fixed portion **22** are configured as a single component as a whole and are serially connected in the order of the stem portion **21** and the coupling portion **23** and the fixed portion **22**.

The shaft **20** is a rotation axis constituting member having the stem portion **21** as the rotation axis of the pedal pad **30**. The stem portion **21** forms a columnar stem shape around the pedal axial center CL and is inserted into a shaft hole **13***a* formed inside the shaft receiving portion **111**.

The shaft receiving portion **111** has the rotation angle sensor, not shown, attached thereto. As the rotation angle sensor, for example, a sensor of various types, such as magnetic or optical, can be adopted. The rotation angle sensor provided in the shaft receiving portion **111** detects a rotation angle of the stem portion **21** and outputs an electrical signal indicating the rotation angle of the stem portion **21** to an electronic control device. The pedal pad **20** and the shaft **20** are fixed to each other and are integrally rotated; therefore, a rotation angle of the stem portion **21** of the shaft **20** is identical with a rotation angle of the pedal pad **30**.

The fixed portion **22** of the shaft **20** is a portion unrotatably fixed to the pedal pad **30**. The fixed portion **22** is bent and formed, for example, in an L shape. In the present embodiment, the fixed portion **22** is fixed by a fixing fitting **24** to a pedal back side **302** of the pedal pad **30**, which is a face opposite to a face receiving stepping force from an operator **81**. The coupling portion **23** is a portion coupling the stem portion **21** and the fixed portion **22** with each other.

The shaft **20** is rotatably supported in the shaft receiving portion **111** provided in the housing body **11**. In detail, the stem portion **21** of the shaft **20** is rotatably supported by the shaft receiving portion **111** and thus, the shaft **20** is supported in the housing **10** and is rotatable about the pedal axial center CL relative to the housing **10**. The shaft **20** is supported only by the shaft receiving portion **111** provided in the housing body **11** and is not supported by the housing cover **12**.

The pedal pad **30** is a member of the pedal device **1** stepped on by an operator **81** from the predetermined operation side. The pedal pad **30** in the present embodiment is formed of, for example, metal and is formed in a shape of a plate with a direction perpendicular to the pedal axial center CL taken as thickness direction. The pedal pad **30** is so located that one side in the thickness direction is taken as operation side and the other side in the thickness direction is taken as counter-operation side, which is the side opposite to the operation side. The pedal pad **30** has a pedal front side **301** facing toward the operation side and the pedal back side **302** facing toward the counter-operation side.

The pedal pad **30** is slantly located in the vehicle front-back direction Da. Specifically, the pedal pad **30** is located in such a position that the pedal pad is slanted in the vehicle front-back direction Da so that when the pedal pad **30** is not stepped on, the upper end **303** of the pedal pad **30** is positioned at vehicle front relative to the lower end **304** thereof.

The pedal head **30** includes a thick wall portion **305** located vehicle upward relative to the pedal pad **30**. The thick wall portion **305** is provided as a portion stepped on by an operator **81**, includes the upper end **303** of the pedal pad **30**, and is located vehicle upward relative to the pedal axial center CL. The pedal front side **301** reaches the thick wall portion **305** and a face of the pedal front side **301** formed on the operation side of the thick wall portion **305** functions as a stepping surface **301***a* stepped on by an operator **81**. The stepping surface **301***a* of the pedal pad **30** is a part of the pedal front side **301**. The disposition of the pedal pad **30** is not limited to one shown in FIG. **2** and FIG. **3** and the pedal pad may be located, for example, perpendicularly to the vehicle front-back direction Da.

Since the pedal pad **30** is fixed to the shaft **20**, as mentioned above, the pedal pad **30** is integrally rotated together with the shaft **20**. Therefore, the pedal pad **30** is rotationally moved around the pedal axial center CL in

conjunction with stepping operation by an operator **81**. In detail, since the pedal pad **30** is rotationally moved within a predetermined limited rotation angle range of less than one turn, the pedal pad **30** swings around the pedal axial center CL in conjunction with stepping operation by an operator **81**.

The above-mentioned rotation angle range in the rotational movement of the pedal pad **30** is specifically a range from the minimum rotational position to the maximum rotational position of the pedal pad **30**. That is, when the pedal pad **30** is not stepped on, the rotation angle of the pedal pad **30** corresponds to the minimum rotational position and at the time of maximum stepping when the pedal pad **30** is fully stepped on by an operator **81**, the rotation angle of the pedal pad **30** corresponds to the maximum rotational position.

Within the above-mentioned rotation angle range, for example, the pedal pad **30** rotationally moves so that the upper end **303** of the pedal pad **30** is more displaced vehicle frontward and vehicle downward as stepping force applied to the pedal pad **30** by an operator **81** from the operation side is more increased. Conversely, the pedal pad **30** is rotationally moved by action of the reaction force generation mechanism **50** so that the upper end **303** of the pedal pad **30** is more displaced vehicle backward and vehicle upward as stepping force applied to the pedal pad **30** by an operator **81** from the operation side is more reduced.

In the present embodiment, the minimum rotational position of the pedal pad **30** is defined by a full close stopper **32** as a first stopper and the maximum rotational position of the pedal pad **30** is defined by a full open stopper **33** as a second stopper. Each of the full close stopper **32** and the full open stopper **33** is formed of resin, rubber, or the like.

The full close stopper **32** is provided at a portion of the housing **10** located behind the pedal axial center CL in terms of the vehicle. Specifically, the full close stopper **32** is embedded in a wall surface **18** facing vehicle backward and slantly vehicle upward in a portion of the housing **10** located vehicle backward. The full close stopper **32** is brought into contact with the lower end **304** of the pedal back side **302** or the vicinity thereof when the pedal pad **30** is not stepped on and holds the pedal pad **30** in the minimum rotational position.

The full open stopper **33** is provided in a portion of the housing **10** located vehicle frontward relative to the pedal axial center CL. Specifically, the full open stopper **33** is provided in an upper end **19** of a wall surface of the housing **10** located vehicle frontward. In detail, the full open stopper **33** is embedded in a wall surface facing vehicle backward and slantly vehicle upward in a portion of the housing **10** located vehicle frontward. The full open stopper **33** is brought into contact with the upper end **303** of the pedal back side **302** or the vicinity thereof when the pedal pad **30** is fully stepped on and holds the pedal pad **30** in the maximum rotational position.

As shown in FIG. **2** and FIG. **3**, the reaction force generation mechanism **50** is located on the counter-operation side with respect to the pedal pad **30** and is housed in the housing **10**. The reaction force generation mechanism **50** includes a plurality of spring members **511**, **512**, **513** and generates reaction force against stepping force applied to the pedal pad **30** by an operator **81** by elastic deformation of the spring members **511**, **512**, **513**. The spring members **511**, **512**, **513** are coupled with one another so that, for example, when the reaction force generation mechanism **50** generates reaction force against stepping force, all the spring members **511**, **512**, **513** are elastically deformed.

In the present embodiment, as the spring members **511**, **512**, **513**, the reaction force generation mechanism **50** includes a first spring member **511** that is a leaf spring, a second spring member **512** that is a compression coil spring, and a third spring member **513** that is a compression coil spring One end of the first spring member **511** is fixed to the housing body **11** by a screw or the like and the reaction force generation mechanism **50** is thereby supported in the housing **10**.

As shown in FIG. **3** to FIG. **5**, the arm **40** is provided between the pedal pad **30** and the reaction force generation mechanism **50** and functions as a connection link connecting the pedal pad **30** and the reaction force generation mechanism **50** with each other. The arm **40** transmits stepping force applied to the pedal pad **30** by an operator **81** to the reaction force generation mechanism **50**. In other words, the arm **40** transmits reaction force generated against stepping force of an operator **81** by the reaction force generation mechanism **50** to the pedal pad **30**. That the arm **40** is provided between the pedal pad **30** and the reaction force generation mechanism **50**, cited here, means that in a force transmission path, the arm **40** is provided between the pedal pad **30** and the reaction force generation mechanism **50**.

The arm **40** includes an arm one end **401**, an arm other end **402**, and an arm body **403**. Though FIG. **4** is a sectional view, the figure does not show a section of the arm **40** for the sake of visibility of the illustration.

The arm one end **401** is provided on the operation side of the arm **40** and the arm other end **402** is provided on the counter-operation side of the arm **40**. The arm body **403** is provided between the arm one end **401** and the arm other end **402** and connects the arm one end **401** and the arm other end **402** with each other. That is, the arm body **403** is so formed as to extend from the arm one end **401** to the counter-operation side. In other words, the arm body **403** is so formed as to extend from the arm one end **401** to the arm other end **402**.

The arm **40** is coupled with the pedal pad **30** at the arm one end **401**. Specifically, the arm **40** is coupled with the pedal back side **302** of the pedal pad **30**. As shown in FIG. **3**, for example, the arm **40** is so configured that the arm can be swung about the arm one end **401** relative to the pedal pad **30** as viewed in a direction along the pedal axial center CL.

Meanwhile, the arm **40** is coupled with the reaction force generation mechanism **50** at the arm other end **402**. That is, the arm **40** is coupled with the reaction force generation mechanism **50** on the counter-operation side. In detail, the reaction force generation mechanism **50** includes an arm receiving portion **514** placed between the spring members **511**, **512**, **513** and the arm **40** and the arm other end **402** is fit into a recess formed in the arm receiving portion **514**. As shown in FIG. **3**, for example, the arm **40** is so configured that the arm can be swung about the arm other end **402** relative to the arm receiving portion **514** of the reaction force generation mechanism **50** as viewed in a direction along the pedal axial center CL.

Since the arm **40** couples the pedal pad **30** and the reaction force generation mechanism **50** with each other, as mentioned above, the arm **40** is also more displaced toward the counter-operation side as the upper end **303** of the pedal pad **30** is more displaced toward the counter-operation side in conjunction with stepping operation of an operator **81**. As the arm **40** is more displaced toward the counter-operation side, the spring members **511**, **512**, **513** of the reaction force generation mechanism **50** are more largely elastically deformed; therefore, reaction force generated against step-

ping force of an operator **81** by the reaction force generation mechanism **50** is increased according to the elastic deformation.

A description will be given to a shape of the arm one end **401**. As shown in FIG. **5** to FIG. **7**, the arm one end **401** forms such a shape that the arm one end is widened from the arm body **403** to both sides in a widening direction Dw perpendicular to an extending direction Ds in which the arm body **403** is extended. In the description of the present embodiment, the extending direction Ds of the arm body **403** is also referred to as arm extending direction Ds and the widening direction Dw of the arm one end **401** is also referred to as arm end widening direction Dw.

In the present embodiment, specifically, the arm end widening direction Dw is identical with a direction along the pedal axial center CL, that is, the axial direction of the pedal axial center CL. The arm one end **401** forms a shape of a column having an axial center parallel with the pedal axial center CL. Therefore, as viewed in a direction along the arm end widening direction Dw (for example, as viewed in a direction along arrow V of FIG. **4**), the arm one end **401** forms a circular shape as shown in FIG. **5**.

As shown in FIG. **4** to FIG. **7**, the arm one end **401** includes a widening-direction one end **401***a* provided on one side in the arm end widening direction Dw and a widening-direction other end **401***b* provided on the other side in the arm end widening direction Dw. For example, the widening-direction one end **401***a* is an end face of the columnar shape of the arm one end **401** provided on one side in the arm end widening direction Dw and the widening-direction other end **401***b* is an end face of the columnar shape of the arm one end **401** provided on the other side in the arm end widening direction Dw.

As shown in FIG. **3** and FIG. **4**, the stopper part **56** is configured as a component separate from the pedal pad **30** and is joined and fixed to the pedal pad **30**. The stopper part **56** in the present embodiment is formed of metal and is joined to the pedal pad **30**, for example, by welding. The stopper part **56** is fixed to the pedal pad **30** and thereby maintains the arm **40** in coupling with the pedal pad **30**. In the present embodiment, the stopper part **56** is equivalent to one part that is one of the pedal pad **30** and the stopper part **56** and the pedal pad **30** is equivalent to the other part that is the other of the pedal pad **30** and the stopper part **56**.

As shown in FIG. **4**, FIG. **8**, and FIG. **9**, the stopper part **56** includes a base portion **561** and a protruded portion **563**. The base portion **561** is widened from the protruded portion **563** to both the one side and the other side in the arm end widening direction Dw.

The base portion **561** has on the operation side a joining surface **561***a* opposed to the pedal back side **302** and the joining surface **561***a* and the pedal back side **302** are fixed to each other by welding. That is, the stopper part **56** and the pedal pad **30** are joined to each other by welding together the base portion **561** as a metal part and a metal part of the pedal pad **30** forming the pedal back side **302**. A point of welding between the stopper part **56** and the pedal pad **30** is provided on both one side and the other side in the arm end widening direction Dw relative to the protruded portion **563**. FIG. **10** is a sectional view similar to FIG. **4** and in FIG. **10**, a point of welding between the stopper part **56** and the pedal pad **30** is indicated by a thick solid line Lw.

As shown in FIG. **4**, FIG. **8**, and FIG. **9**, the base portion **561** has a base surface **561***b* provided on the opposite side to the joining surface **561***a* and facing to the counter-operation side and the protruded portion **563** is protruded from the base surface **561***b* in the normal line direction DV of the base surface **561***b*.

As shown in FIG. **4**, FIG. **8**, FIG. **9**, and FIG. **11**, a housing space **563***a* accommodating the arm one end **401** is formed inside the protruded portion **563**. That is, the protruded portion **563** is a housing portion that accommodates the arm one end **401**. The protruded portion **563** has at the top of the protruded shape thereof a first arrangement section **564** located on the counter-operation side relative to the arm one end **401** in the housing space **563***a*. An insertion hole **564***a* connecting to the housing space **563***a* and having the arm body **403** inserted thereinto is formed in the first arrangement section **564**. In the normal line direction Dv of the base surface **561***b* (Refer to FIG. **9**), the housing space **563***a* is so provided as to reach the counter-operation side beyond the base surface **561***b*.

The housing space **563***a* formed in the stopper part **56** will be described in other words; in the stopper part **56**, the housing space **563***a* is so formed as to be recessed from the operation side to the counter-operation side so that the arm one end **401** is accommodated. The housing space **563***a* connects to the insertion hole **564***a* at the bottom **563***c* of the housing space **563***a*. Meanwhile, the housing space **563***a* has a housing space opening **563***d* open to the opposite side to the insertion hole **564***a* side (that is, the operation side). The housing space opening **563***d* is covered with a second arrangement section **306** provided in the pedal pad **30**. The second arrangement section **306** is a portion of the pedal pad **30** located on the operation side of the first arrangement section **564** with the arm one end **401** in between.

Since the first arrangement section **564** and the second arrangement section **306** are located as mentioned above, the first arrangement section **564** and the second arrangement section **306** hold the arm one end **401** against the pedal pad **30** with the arm one end **401** interposed between the first arrangement section **564** and the second arrangement section **306**.

In detail, the first arrangement section **564** includes one side receiving portion **564***b* located on one side of the insertion hole **564***a* in the arm end widening direction Dw and other side receiving portion **564***c* located on the other side of the insertion hole **564***a* in the arm end widening direction Dw. The first arrangement section **564** and the second arrangement section **306** hold the arm one end **401** against the pedal pad **30** with the arm one end **401** interposed between the one side receiving portion **564***b* and the second arrangement section **306** and between the other side receiving portion **564***c* and the second arrangement section **306**.

The one side receiving portion **564***b* has one-side receiving surface **564***d* oriented to the operation side and facing to the housing space **563***a* and the other side receiving portion **564***c* has other-side receiving surface **564***e* oriented to the operation side and facing to the housing space **563***a*. The one-side receiving surface **564***d* is located on one side of the insertion hole **564***a* in the arm end widening direction Dw and the other-side receiving surface **564***e* is located on the other side of the insertion hole **564***a* in the arm end widening direction Dw. Each of the one-side receiving surface **564***d* and the other-side receiving surface **564***e* may be in a flat shape or in a shape of a recess whose radius of curvature is larger than a radius of the columnar shape of the arm one end **401** and curved and recessed toward the counter-operation side in a section perpendicular to the arm end widening direction Dw.

In FIG. **8**, the one-side receiving surface **564***d* and the other-side receiving surface **564***e* are hatched with dots and

in FIG. **9**, the one side receiving portion **564***b* is indicated by arrow A**1** and the other side receiving portion is indicated by arrow A**2**. In FIG. **11**, the one side receiving portion **564***b* is indicated by arrow A**3** and hatched with dots.

FIG. **12** illustrates how to attach the above-mentioned arm **40** and stopper part **56** to the pedal pad **30**. As shown in FIG. **12**, first, the pedal pad **30** is prepared and simultaneously, the arm **40** and the stopper part **56** are respectively prepared as a single component.

Subsequently, the arm **40** is inserted into the insertion hole **564***a* in the first arrangement section **564** included in the stopper part **56**. Specifically, the arm other end **402** of the arm **40** is inserted into the insertion hole **564***a* from the housing space opening **563***d* side and subsequently, the arm body **403** is inserted into the insertion hole **364***a*. Simultaneously, the stopper part **56** is brought close to the pedal pad **30** in a position in which the joining surface **561***a* is opposed to the pedal back side **302**, as indicated by arrow A**4**.

The arm one end **401** is accommodated in the housing space **563***a* of the stopper part **56** and simultaneously, the joining surface **561***a* of the stopper part **56** is brought into contact with the pedal back side **302**; thereafter, the joining surface **561***a* and the pedal bask side **302** are joined to each other by welding.

The arm **40** and the stopper part **56** are attached to the pedal pad **30** as mentioned above. For this reason, as shown in FIG. **4**, the insertion hole **564***a* of the first arrangement section **564** is in such a size that an entirety of a portion of the arm **40** provided on the counter-operation side of the arm one end **401** in the arm extending direction Ds can pass and the arm one end **401** cannot pass. All the parts of the arm **40** provided on the counter-operation side of the arm one end **401** in the arm extending direction Ds are specifically the arm body **403** and the arm other end **402**. The arm one end **401** is not included in an entirety of a portion of the arm **40** provided on the counter-operation side of the arm one end **401** in the arm extending direction Ds.

As shown in FIG. **4** and FIG. **9**, as a single component, the stopper part **56** forms such a shape that the operation side relative to the arm one end **401** is open so that the arm one end **401** can move from a position between the first arrangement section **564** and the second arrangement section **306** to the operation side. In short, the housing space opening **563***d* of the stopper part **56** is in a size sufficient for the arm one end **401** to pass.

Subsequently, a description will be given to the action of the above-mentioned pedal device **1**. As shown in FIG. **1** to FIG. **3**, when an operator **81** steps on the pedal pad **30** and stepping force of the operator **81** is thereby applied to the stepping surface **301***a*, the pedal pad **30** is rotated about the pedal axial center CL to move the upper end **302** to the counter-operation side. At this time, as shown in FIG. **3** and FIG. **4**, the second arrangement section **306** of the pedal pad **30** pushes the arm one end **401** to the counter-operation side; therefore, a rotation angle of the pedal pad **30** is transmitted as a displacement corresponding to the rotation angle to the reaction force generation mechanism **50** via the arm **40**.

For this reason, as the pedal pad **30** is more rotated about the pedal axial center CL to move the upper end **303** to the counter-operation side, the spring members **511**, **512**, **513** of the reaction force generation mechanism **50** are more largely elastically deformed. As a result, as a rotation angle of the pedal pad **30** from the minimum rotational position is more increased by stepping operation of an operator **81**, reaction force generated against the stepping force of the operator **81** by the reaction force generation mechanism **50** is more increased.

The above-mentioned pedal device **1** in the present embodiment brings about the following working-effects:

According to the present embodiment, as shown in FIG. **3** and FIG. **4**, the stopper part **56** is configured as a component separate from the pedal pad **30** and is fixed to the pedal pad **30**. The first arrangement section **564** provided in the stopper part **56** and the second arrangement section **306** provided in the pedal pad **30** hold the arm one end **401** against the pedal pad **30** with the arm one end **401** interposed between the first arrangement section **564** and the second arrangement section **306**.

Therefore, since the first arrangement section **564** and the second arrangement section **306** respectively belong to different parts, when external force is applied in such a direction that the arm one end **401** pushes the first arrangement section **564**, a width sufficient for the first arrangement section **564** to receive the arm one end **401** against the external force can be ensured. For this reason, the arm **40** can be coupled with the pedal pad **30** with sufficient strength. That is, the arm **40** always follows rotational movement of the pedal pad **30** without departing from the pedal pad **30**; therefore, the reliability of the pedal device **1** can be enhanced.

The above-mentioned width for the first arrangement section **564** to receive the arm one end against external force is, for example, a width of the one side receiving portion **564***b* and a width of the other side receiving portion **564***c* and widths indicated by arrow A**1** and arrow A**2** in FIG. **9**.

(1) According to the present embodiment, as shown in FIG. **12**, the insertion hole **564***a* of the stopper part **56** is in such a size that an entirety of a portion of the arm **40** provided on the counter-operation side of the arm one end **401** in the arm extending direction Dx can pass and the arm one end **401** cannot pass. As a single component, the stopper part **56** is in such a shape that the operation side relative to the arm one end **401** is open so that the arm one end **401** can be moved from a position between the first arrangement section **564** and the second arrangement section **306** to the operation side. In other words, the housing space opening **563***d* of the stopper part **56** is in a size sufficient for the arm one end **401** to pass.

Therefore, when the arm **40** and the stopper part **56** are attached to the pedal pad **30**, as shown in FIG. **12**, the arm **40** can be inserted into the insertion hole **564***a* of the stopper part **56** from the operation side relative to the stopper part **56**. For this reason, a width of the one side receiving portion **564***b*, indicated by arrow A**1** in FIG. **9**, and a width of the other side receiving portion **564***c*, indicated by arrow A**2** can be sized sufficiently to prevent a fall of the arm one end **401**. Since the arm **40** can be prevented from departing from the pedal pad **30** due to, for example, elastic deformation of the one side receiving portion **564***b* and the other side receiving portion **564***c*, the reliability of the pedal device **1** can be enhanced.

(2) According to the present embodiment, the stopper part **56** shown in FIG. **4** is formed of metal; therefore, the first arrangement section **564** constituting a part of the stopper part **56** is also formed of metal. Therefore, the rigidity of the first arrangement section **564** for holding the arm one end **401** in the housing space **563***a* can be enhanced and thus, falling-out of the arm **40** due to elastic deformation of the first arrangement section **564** can be prevented to enhance the reliability of the pedal device **1**.

(3) According to the present embodiment, as shown in FIG. **10**, the pedal pad **30** and the stopper part **56** respectively have a metal part and are joined to each other by welding the metal parts together. For this reason, the arm **40**

and the stopper part **56** can be easily assembled to the pedal pad **30**. The stopper part **56** can be fixed to the pedal pad **30** without necessity for a protrusion or the like being protruded from the pedal front side **301**.

(4) According to the present embodiment, as shown in FIG. **1**, the pedal device **1** is provided in a vehicle **80** as a brake pedal device for performing braking operation to apply brake to the vehicle **80**. Therefore, the high reliability of the pedal device **1** owing to the arm **40** being prevented from departing from the pedal pad **30** can be sufficiently utilized in the vehicle **80**.

(5) According to the present embodiment, as shown in FIG. **4** to FIG. **7**, the arm end widening direction Dw is a direction along the pedal axial center LC (Refer to FIG. **3**). As viewed in a direction along the arm end widening direction Dw (for example, as viewed in a direction along arrow V of FIG. **4**), the arm one end **401** is formed in a circular shape. Therefore, as viewed in a direction along the pedal axial center CL, the arm **40** can be swung around the arm one end **401** relative to the pedal pad **30**.

Second Embodiment

A description will be given to a second embodiment. With respect to the present embodiment, a description will be given mainly to a difference from the first embodiment. With respect to an element identical with or similar to one in the above-mentioned embodiment, a description will be omitted or simplified. This is also the case with respect to the embodiments described below. In drawings referred to in relation to the second and following embodiments, each configuration element of the pedal device **1** will be simplified as required.

As shown in FIG. **13**, in the present embodiment, the pedal pad **30** is configured with an equal thickness throughout the pedal pad. For this reason, the whole of the pedal front side **301** of the pedal pad **30** functions as a stepping surface **301***a*.

The present embodiment is identical with the first embodiment except the foregoing. In the present embodiment, the effects brought about by configuration elements common to those in the first embodiment can be obtained as in the first embodiment.

Third Embodiment

A description will be given to a third embodiment. With respect to the present embodiment, a description will be given mainly to a difference from the second embodiment.

As shown in FIG. **14** and FIG. **15**, in the present embodiment, the pedal device **1** is not provided with the stopper part **56** in FIG. **4**. Instead, in the present embodiment, the pedal device **1** is provided with a stopper part **60** and the pedal pad **30** includes a protruded portion **35** in place of the protruded portion **563** (Refer to FIG. **4**) in the second embodiment.

The protruded portion **35** in the present embodiment corresponds to the protruded portion **563** in the second embodiment. That is, the protruded portion **35** in the present embodiment is different from the protruded portion **563** in the second embodiment in that the relevant protruded portion constitutes a part of the pedal pad **30** but is configured similarly to the protruded portion **563** in the second embodiment in the other respects.

Specifically, as shown in FIG. **15** and FIG. **9**, a housing space **35***a* in the present embodiment is similar to the housing space **563***a* in the second embodiment and the bottom **35***c* of the housing space **35***a* in the present embodiment is similar to the bottom **563***c* of the housing space **563***a* in the second embodiment. A housing space opening **35***d* in the present embodiment is similar to the housing space opening **563***d* in the second embodiment and a first arrangement section **36** in the present embodiment is similar to the first arrangement section **564** in the second embodiment. An insertion hole **36***a* of the first arrangement section **36** in the present embodiment is similar to the insertion hole **564***a* of the first arrangement section **564** in the second embodiment. One side receiving portion **36***b* of the first arrangement section **36** in the present embodiment is similar to the one side receiving portion **564***b* of the first arrangement section **564** in the second embodiment and other side receiving portion **36***c* of the first arrangement section **36** in the present embodiment is similar to the other side receiving portion **564***c* of the first arrangement section **564** in the second embodiment. One side receiving surface **36***d* of the first arrangement section **36** in the present embodiment is similar to the one-side receiving surface **564***d* of the first arrangement section **564** in the second embodiment and other-side receiving surface **36***e* of the first arrangement section **36** in the present embodiment is similar to the other-side receiving surface **564***e* of the first arrangement section **564** in the second embodiment. Also, in FIG. **15**, as in FIG. **9**, the one side receiving portion **36***b* of the first arrangement section **36** is indicated by arrow A1 and the other side receiving portion **36***c* of the first arrangement section **36** is indicated by arrow A2.

Therefore, the individual configuration elements included in the protruded portion **35** in the present embodiment respectively correspond to the individual configuration elements included in the protruded portion **563** in the second embodiment. The pedal pad **30** in the present embodiment includes the first arrangement section **564** included in the protruded portion **35**. In the present embodiment, the pedal pad **30** is equivalent to one part having the first arrangement section **564**.

The protruded portion **35** of the pedal pad **30** in the present embodiment is protruded from a base surface **302***a* as a part of the pedal back side **302** in the normal line direction Dv of the base surface **302***a*. The base surface **302***a* in the present embodiment is a portion of the pedal back side **302** provided around the protruded portion **35**. The base surface **302***a* in the present embodiment corresponds to the base surface **561***b* in the second embodiment and is similar to the base surface **561***b* except that the relevant base surface constitutes a part of the pedal pad **30**.

As shown in FIG. **14** and FIG. **15**, the stopper part **60** is formed of, for example, metal and includes a second arrangement section **37**, one side joining portion **601**, and other side joining portion **602**. In the present embodiment, the stopper part **60** is equivalent to other part having the second arrangement section **37**.

The second arrangement section **37** in the present embodiment corresponds to the second arrangement section **306** in the second embodiment. That is, the second arrangement section **37** in the present embodiment is different from the second arrangement section **306** in the second embodiment in that the relevant second arrangement section constitutes a part of the stopper part **60** but is similar to the second arrangement section **306** in the second embodiment in the other respects. For example, the second arrangement section **37** in the present embodiment is located on the operation side of the first arrangement section **36** with the arm one end **401** in between.

One side joining portion **601** of the stopper part **60** is located on one side of the second arrangement section **37** in

the arm end widening direction Dw. Other side joining portion **602** is located on the other side of the second arrangement section **37** in the arm end widening direction Dw. The one side joining portion **601** and the other side joining portion **602** are in contact with the pedal front side **301**. In addition thereto, the one side joining portion **601** and the other side joining portion **602** are joined to the pedal front side **301** by, for example, welding. That is, the pedal pad **30** and the stopper part **60** are joined to each other by welding together a metal part forming the pedal front side **301** and the one side and other side joining portions **601**, **602** as metal parts. FIG. **16** is a sectional view similar to FIG. **14** and in FIG. **16**, a point of welding between the stopper part **60** and the pedal pad **30** is indicated by a thick solid line LW.

FIG. **17** illustrates how to attach the above-mentioned stopper part **60** and arm **40** to the pedal pad **30**. As shown in FIG. **17**, first, the pedal pad is prepared and simultaneously, the arm **40** and the stopper part **60** are respectively prepared as a single component.

Subsequently, the arm **40** is brought into a position in which the arm one end **401** side is oriented to the operation side and then the arm **40** is inserted into the insertion hole **36***a* of the first arrangement section **36**. Specifically, the arm other end **402** of the arm **40** is inserted into the insertion hole **36***a* from the housing space opening **35***d* side and subsequently, the arm body **403** is inserted into the insertion hole **36***a*. Simultaneously, the stopper part **60** is brought into a position in which a face thereof on the side to be joined to the pedal front side **301** is opposed to the pedal front side **301** and the pedal pad **30** and the stopper part **60** are brought close to each other as indicated by arrow A**5**.

The arm one end **401** is accommodated in the housing space **35***a* of the pedal pad **30** and simultaneously, the one side and other side joining portions **601**, **602** of the stopper part **60** are brought into contact with the pedal front side **301**. After the pedal pad **30**, arm **40**, and stopper part **60** are brought into such a state, each of the one side and other side joining portions **601**, **602** of the stopper part **60** is joined to the pedal front side **301** by welding.

The stopper part **60** and the arm **40** are attached to the pedal pad **30** as mentioned above. For this reason, each of the size relation between the insertion hole **36***a* of the first arrangement section **36** and the arm one end **401** and the size relation between the housing space opening **35***d* and the arm one end **401** is the same as in the second embodiment.

Specifically, as shown in FIG. **14**, the insertion hole **36***a* is in such a size that an entirety of a portion of the arm **40** provided on the counter-operation side of the arm one end **401** in the arm extending direction Ds can pass and the arm one end **401** cannot pass. As shown in FIG. **14** and FIG. **15**, as a single component, the pedal pad **30** is in such a shape that the operation side thereof relative to the arm one end **401** is open so that the arm one end **401** can move from a position between the first arrangement section **36** and the second arrangement section **37** to the operation side. In short, the housing space opening **35***d* of the pedal pad **30** is in a size sufficient for the arm one end **401** to pass.

The present embodiment is identical with the second embodiment except the foregoing. In the present embodiment, the effects brought about by configuration elements common to those in the second embodiment can be obtained as in the second embodiment. The present embodiment is a modification to the second embodiment but the present embodiment can also be combined with the first embodiment.

Fourth Embodiment

A description will be given to a fourth embodiment. With respect to the present embodiment, a description will be given mainly to a difference from the second embodiment.

As shown in FIG. **18**, the present embodiment adopts press fitting of bosses **565***a*, **565***b* instead of welding to join the pedal pad **30** and the stopper part **56** to each other.

Specifically, the stopper part **56** as one part has a plurality of the bosses **565***a*, **565***b* protruded from the base portion **561** to the pedal pad **30** side. One side boss **565***a*, which is one of the bosses **565***a*, **565***b*, is located on one side of the protruded portion **563** in the arm end widening direction Dw. Other side boss **565***b*, which is the other of the bosses **565***a*, **565***b*, is located on the other side of the protruded portion **563** in the arm end widening direction Dw.

In the pedal pad **30** as other part, one side coupling hole **30***a* and other side coupling hole **30***b* penetrating the pedal pad from the pedal front side **301** to the pedal back side **302** are formed. The one side coupling hole **30***a* is coaxially provided with respect to the one side boss **565***a* and the other side coupling hole **30***b* is coaxially provided with respect to the other side boss **565***b*.

The one side boss **565***a* is press fit into the one side coupling hole **30***a* from the pedal back side **302** to the pedal front side **301** and the other side boss **565***b* is press fit into the other side coupling hole **30***b* from the pedal back side **302** to the pedal front side **301**.

As mentioned above, the stopper part **56** and the pedal pad **30** are joined to each other by press fitting the one side boss **565***a* into the one side coupling hole **30***a* and press fitting the other side boss **565***b* into the other side coupling hole **30***b*.

(1) As mentioned above, according to the present embodiment, the stopper part **56** and the pedal pad **30** are joined to each other by press fitting of the bosses **565***a*, **565***b* into the coupling holes **30***a*, **30***b*. Therefore, the arm **40** and the stopper part **56** can be easily assembled to the pedal pad **30**.

The present embodiment is identical with the second embodiment except the foregoing. In the present embodiment, the effects brought about by configuration elements common to those in the second embodiment can be obtained as in the second embodiment. The present embodiment is a modification to the second embodiment but the present embodiment can also be combined with the first embodiment.

Fifth Embodiment

A description will be given to a fifth embodiment. With respect to the present embodiment, a description will be given mainly to a difference from the third embodiment.

As shown in FIG. **19**, the present embodiment adopts press fitting instead of welding to join the pedal and **30** and the stopper part **56** to each other as in the fourth embodiment.

Specifically, the stopper part **60** as other part has one side boss **603***a* protruded from the one side joining portion **601** to the pedal pad **30** side and other side boss **603***b* protruded from the other side joining portion **602** to the pedal pad **30** side. The one side boss **603***a* is located on one side of the second arrangement section **37** in the arm end widening direction Dw and the other side boss **603***b* is located on the other side of the second arrangement section **37** in the arm end widening direction Dw.

In the pedal pad **30** as one part, one side coupling hole **30***c* and other side coupling hole **30***d* penetrating the pedal pad from the pedal front side **301** to the pedal back side **302** are

formed. The one side coupling hole **30***c* is coaxially provided with respect to the one side boss **603***a* and the other side coupling hole **30***d* is coaxially provided with respect to the other side boss **603***b*.

The one side boss **603***a* is press fit into the one side coupling hole **30***c* from the pedal front side **301** to the pedal back side **302** and the other side boss **603***b* is press fit into the other side coupling hole **30***d* from the pedal front side **301** to the pedal back side **302**.

As mentioned above, the stopper part **60** and the pedal pad **30** are joined to each other by press fitting the one side boss **603***a* into the one side coupling hole **30***c* and press fitting the other side boss **603***b* into the other side coupling hole **30***d*.

(1) As mentioned above, according to the present embodiment, the stopper part **60** and the pedal pad **30** are joined to each other by press fitting as in the fourth embodiment. Therefore, the working-effects by the press fitting can be obtained as in the fourth embodiment.

The present embodiment is identical with the third embodiment except the foregoing. In the present embodiment, the effects brought about by configuration elements common to those in the third embodiment can be obtained as in the third embodiment.

Sixth Embodiment

A description will be given to a sixth embodiment. With respect to the present embodiment, a description will be given mainly to a difference from the fourth embodiment.

As shown in FIG. **20**, each of the one side coupling hole **30***a* and the other side coupling hole **30***b* of the pedal pad **30** is not a through hole but is a non-penetrating hole. That is, each of the one side coupling hole **30***a* and the other side coupling hole **30***b* is closed on the pedal front side **301**.

As mentioned above, according to the present embodiment, each of the one side coupling hole **30***a* and the other side coupling hole **30***b* is a non-penetrating hole. Therefore, the stopper part **56** can be fixed to the pedal pad **30** without necessity for a protrusion or the like being produced from the pedal front side **301**, which is a side of the pedal pad **30** to be stepped on by an operator **81**.

The present embodiment is identical with the fourth embodiment except the foregoing. In the present embodiment, the effects brought about by configuration elements common to those in the first embodiment can be obtained as in the first embodiment.

Seventh Embodiment

A description will be given to a seventh embodiment. With respect to the present embodiment, a description will be given mainly to a difference from the fifth embodiment.

As shown in FIG. **21**, each of the one side coupling hole **30***c* and the other side coupling hole **30***d* of the pedal pad **30** is not a through hole but is a non-penetrating hole. That is, each of the one side coupling hole **30***c* and the other side coupling hole **30***d* is closed on the pedal back side **302**.

The present embodiment is identical with the fifth embodiment except the foregoing. In the present embodiment, the effects brought about by configuration elements common to those in the fifth embodiment can be obtained as in the fifth embodiment.

Eighth Embodiment

A description will be given to an eighth embodiment. With respect to the present embodiment, a description will be given mainly to a difference from the fourth embodiment.

As shown in FIG. **22**, the present embodiment adopts caulking of the bosses **565***a*, **565***b* instead of press fitting of the bosses **565***a*, **565***b* to join the pedal pad **30** and the stopper part **56** to each other.

Specifically, since the stopper part **56** is formed of metal, the one side boss **565***a* and the other side boss **565***b* are also formed of metal. The one side boss **565***a* is inserted into the one side coupling hole **30***a* as a through hole from the pedal back side **302** to the pedal front side **301** and then the pedal front side **301** side of the one side boss **565***a* is caulked. That is, one side caulking portion **565***c* wider in diameter than the one side coupling hole **30***a* is formed on the pedal front side **301** side of the one side boss **565***a*.

This is also the case with the other side boss **565***b*. That is, the other side boss **565***b* is inserted into the other side coupling hole **30***b* as a through hole from the pedal back side **302** to the pedal front side **301** and then the pedal front side **301** side of the other side boss **565***b* is caulked. That is, other side caulking portion **365***d* wider in diameter than the other side coupling hole **30***b* is formed on the pedal front side **301** side of the other side boss **565***b*.

As mentioned above, the stopper part **56** and the pedal pad **30** are joined to each other by caulking of the bosses **565***a*, **565***b*.

(1) As mentioned above, according to the present embodiment, the stopper part **56** and the pedal pad **30** are joined to each other by caulking of the bosses **565***a*, **565***b*; therefore, the arm **40** and the stopper part **56** can be easily assembled to the pedal pad **30**.

The present embodiment is identical with the fourth embodiment except the foregoing. In the present embodiment, the effects brought about by configuration elements common to those in the fourth embodiment can be obtained as in the fourth embodiment.

Ninth Embodiment

A description will be given to a ninth embodiment. With respect to the present embodiment, a description will be given mainly to a difference from the fifth embodiment.

As shown in FIG. **23**, the present embodiment adopts the same caulking as the eighth embodiment does instead of press fitting of the bosses **603***a*, **603***b* to join the pedal pad **30** and the stopper part **60** to each other.

Specifically, since the stopper part **60** is formed of metal, the one side boss **603***a* and the other side boss **603***b* are also formed of metal. The one side boss **603***a* is inserted into the one side coupling hole **30***c* as a through hole from the pedal front side **301** to the pedal back side **302** and then the pedal back side **302** side of the one side boss **603***a* is caulked. That is, one side caulking portion **603***c* winder in diameter than the one side coupling hole **30***c* is formed on the pedal back side **302** side of the one side boss **603***a*.

The is also the case with the other side boss **603***b*. That is, the other side boss **603***b* is inserted into the other side coupling hole **30***d* as a through hole from the pedal front side **301** to the pedal back side **302** and then the pedal back side **302** side of the other side boss **603***b* is caulked. That is, other side caulking portion **603***d* wider in diameter than the other side coupling hole **30***d* is formed on the pedal back side **302** side of the other side boss **603***b*.

As mentioned above, the stopper part **56** and the pedal pad **30** are joined to each other by caulking of the bosses **603***a*, **603***b*.

(1) As mentioned above, according to the present embodiment, the stopper part **60** and the pedal pad **30** are joined to each other by the same caulking as in the eighth embodi-

ment. Therefore, the working-effects by the caulking can be obtained as in the eighth embodiment.

The present embodiment is identical with the fifth embodiment except the foregoing. In the present embodiment, the effects brought about by configuration elements common to those in the fifth embodiment can be obtained as in the fifth embodiment.

Tenth Embodiment

A description will be given to a tenth embodiment. With respect to the present embodiment, a description will be given mainly to a difference from the fourth embodiment.

As shown in FIG. **24**, the present embodiment adopts screw fixing instead of press fitting of the bosses **565***a*, **565***b* to join the pedal pad **30** and the stopper part **56** to each other.

Specifically, the base portion **561** of the stopper part **56** is screw fixed to the pedal pad **30** with one side screw **381** on one side of the protruded portion **563** of the stopper part **56** in the arm end widening direction Dw. In detail, the one side screw **381** is inserted into one side screw insertion hole **561***c* that is a through hole formed in the base portion **561** and then screwed into one side screw hole **30***e* with a female screw formed therein provided in the pedal pad **30**.

This is also the case with the other side of the protruded portion **563** of the stopper part **56** in the arm end widening direction Dw. That is, the base portion **561** of the stopper part **56** is screw fixed to the pedal pad **30** with other side screw **382** on the other side of the protruded portion **563** in the arm end widening direction Dw. In detail, the other side screw **382** is inserted into other side screw insertion hole **561***d* that is a through hole formed in the base portion **561** and then screwed into other side screw hole **30***f* with a female screw formed therein provided in the pedal pad **30**.

(1) As mentioned above, according to the present embodiment, the pedal pad **30** and the stopper part **56** are joined to each other by screw fixing; therefore, the arm **40** and the stopper part **56** can be easily assembled to the pedal pad **30**.

The present embodiment is identical with the fourth embodiment except the foregoing. In the present embodiment, the effects brought about by configuration elements common to those in the fourth embodiment can be obtained as in the fourth embodiment.

Eleventh Embodiment

A description will be given to an eleventh embodiment. With respect to the present embodiment, a description will be given mainly to a difference from the fifth embodiment.

As shown in FIG. **25**, the present embodiment adopts the same screw fixing as the tenth embodiment does instead of press fitting of the bosses **603***a*, **603***b* to join the pedal pad **30** and the stopper part **60** to each other.

Specifically, the one side joining portion **601** of the stopper part **60** is screw fixed to the pedal pad **30** with one side screw **381** on one side of the protruded portion **35** of the pedal pad **30** in the arm end widening direction Dw. In detail, the one side screw **381** is inserted into one side screw insertion hole **30***g* that is a through hole formed in the pedal pad **30** and then screwed into one side screw hole **601***a* with a female screw formed therein provided in the one side joining portion **601**.

This is also the case with the other side of the protruded portion **35** in the arm end widening direction Dw. That is, the other side joining portion **602** of the stopper part **60** is screw fixed to the pedal pad **30** with other side screw **382** on the other side of the protruded portion **35** in the arm end widening direction Dw. In detail, the other side screw **382** is inserted into other side screw insertion hole **30***h* that is a through hole formed in the pedal pad **30** and then screwed into other side screw hole **602***a* with a female screw formed therein provided in the other side joining portion **602**.

(1) As mentioned above, according to the present embodiment, the stopper part **60** and the pedal pad **30** are joined to each other by the same screw fixing as in the 1 tenth embodiment. Therefore, the working-effects by the screw fixing can be obtained as in the tenth embodiment.

The present embodiment is identical with the fifth embodiment except the foregoing. In the present embodiment, the effects brought about by configuration elements common to those in the fifth embodiment can be obtained as in the fifth embodiment.

Twelfth Embodiment

A description will be given to a twelfth embodiment. With respect to the present embodiment, a description will be given mainly to a difference from the fourth embodiment.

As shown in FIG. **26**, the present embodiment adopts joining by retaining rings **391**, **392** instead of press fitting of the bosses **565***a*, **565***b* to join the pedal pad **30** and the stopper part **56** to each other.

Specifically, the pedal pad **30** includes one side boss **30***i* and other side boss **30***j* protruded from the pedal back side **302**. The one side boss **30***i* is located on one side of the protruded portion **563** in the arm end widening direction Dw and the other side boss **30***j* is located on the other side of the protruded portion **563** in the arm end widening direction Dw. Since the pedal pad **30** is formed of metal, these bosses **30***i*, **30***j* are also formed of metal.

One side through hole **561***e* with the one side boss **30***i* inserted thereinto and other side through hole **561***f* with the other side boss **30***j* inserted thereinto are formed in the base portion **561** of the stopper part **56**.

The one side retaining ring **391** is fit into an annular groove provided in the periphery of the one side boss **30***i* and the other side retaining ring **392** is fit into an annular groove provided in the periphery of the other side boss **30***j*. In short, the one side retaining ring **391** is locked to the one side boss **30***i* between the base portion **561** of the stopper part **56** and the tip side of the one side boss **30***i* and the other side retaining ring **392** is locked to the other side boss **30***j* between the base portion **561** and the tip side of the other side boss **30***j*.

As mentioned above, the stopper part **56** and the pedal pad **30** are joined to each other by the retaining rings **391**, **392** locked to the bosses **30***i*, **30***j*.

(1) As mentioned above, according to the present embodiment, the stopper part **56** and the pedal pad **30** are joined to each other by the retaining rings **391**, **392** locked to the bosses **30***i*, **30***j*. Therefore, the arm **40** and the stopper part **56** can be easily assembled to the pedal pad **30**.

The present embodiment is identical with the fourth embodiment except the foregoing. In the present embodiment, the effects brought about by configuration elements common to those in the fourth embodiment can be obtained as in the fourth embodiment.

Thirteenth Embodiment

A description will be given to a thirteenth embodiment. With respect to the present embodiment, a description will be given mainly to a difference from the fifth embodiment.

As shown in FIG. **27**, the present embodiment adopts joining by the same retaining rings **391**, **392** as in the 12^{th} embodiment instead of press fitting of the bosses **603***a*, **603***b* to join the pedal pad **30** and the stopper part **60** to each other.

Specifically, the one side joining portion **601** of the stopper part **60** includes one side boss **601***b* protruded to the pedal pad **30** side and the other side joining portion **602** includes other side boss **602***b* protruded to the pedal pad **30** side. The one side boss **601***b* is located on one side of the protruded portion **35** of the pedal pad **30** in the arm end widening direction Dw and the other side boss **602***b* is located on the other side of the protruded portion **35** in the arm end widening direction Dw. Since the stopper part **60** is formed of metal, these bosses **601***b*, **602***b* are also formed of metal.

One side through hole **30***k* with the one side boss **601***b* inserted thereinto and other side through hole **30***m* with the other side boss **602***b* inserted thereinto are formed in the pedal pad **30**.

The one side retaining ring **391** is locked to the one side boss **601***b* in the present embodiment corresponding to the one side boss **30***i* in the 12^{th} embodiment as in the 12^{th} embodiment. The other side retaining ring **392** is locked to the other side boss **602***b* in the present embodiment corresponding to the other side boss **30***j* in the 12^{th} embodiment as in the 12^{th} embodiment.

As mentioned above, the stopper part **60** and the pedal pad **30** are joined to each other by the retaining rings **391**, **392** locked to the bosses **601***b*, **602***b*.

(1) As mentioned above, according to the present embodiment, the stopper part **60** and the pedal pad **30** are joined to each other by the retaining rings **391**, **392** as in the 12^{th} embodiment. Therefore, the working-effects by the retaining rings **391**, **392** can be obtained as in the 12^{th} embodiment.

The present embodiment is identical with the fifth embodiment except the foregoing. In the present embodiment, the effects brought about by configuration elements common to those in the fifth embodiment can be obtained as in the fifth embodiment.

Fourteenth Embodiment

A description will be given to a second embodiment. With respect to the present embodiment, a description will be given mainly to a difference from the eighth embodiment.

As shown in FIG. **28**, the stopper part **56** and the pedal pad **30** are joined to each other by thermal caulking of the one side boss **565***a* and thermal caulking of the other side boss **565***b*. In the present embodiment, the stopper part **56** is formed of thermoplastic resin instead of metal. For this reason, the one side boss **565***a* and the other side boss **565***b* are also formed of thermoplastic resin.

The thermal caulking cited here is not to melt the bosses **565***a*, **565***b* of resin but to plastically deform the bosses **565***a*, **565***b* by applying heat and pressure to the bosses. Caulking portions **565***c*, **565***d* are respectively formed at the tip portions of the bosses **565***a*, **565***b* by this thermal caulking.

(1) As mentioned above, according to the present embodiment, the stopper part **56** is formed of resin and thus, the first arrangement section **564** is also formed of resin. Therefore, wear due to sliding of the first arrangement section **564** and the arm one end **401** can be reduced.

(2) According to the present invention, the stopper part **56** and the pedal pad **30** are joined to each other by thermal caulking of the bosses **565***a*, **565***b*; therefore, the arm **40** and the stopper part **56** can be easily assembled to the pedal pad **30**.

The present embodiment is identical with the eighth embodiment except the foregoing. In the present embodiment, the effects brought about by configuration elements common to those in the eighth embodiment can be obtained as in the eighth embodiment.

Fifteenth Embodiment

A description will be given to a second embodiment. With respect to the present embodiment, a description will be given mainly to a difference from the ninth embodiment.

As shown in FIG. **29**, the stopper part **60** and the pedal pad **30** are joined to each other by thermal caulking of the one side boss **603***a* and thermal caulking of the other side boss **603***b*. In the present embodiment, the stopper part **60** is formed of thermoplastic resin instead of metal. For this reason, the one side boss **603***a* and the other side boss **603***b* are also formed of resin.

Caulking portions **603***c*, **603***d* are respectively formed at the tip portions of the bosses **603***a*, **603***b* by thermal caulking of the bosses **603***a*, **603***b*.

(1) As mentioned above, according to the present embodiment, the stopper part **60** and the pedal pad **30** are joined to each other by the same thermal caulking as in the fourteenth embodiment. Therefore, the working-effects by the thermal caulking can be obtained as in the fourteenth embodiment.

The present embodiment is identical with the ninth embodiment except the foregoing.

Sixteenth Embodiment

A description will be given to a second embodiment. With respect to the present embodiment, a description will be given mainly to a difference from the tenth embodiment.

As shown in FIG. **30**, in the present embodiment, the stopper part **56** is formed of resin instead of metal. For this reason, the base portion **561** is also formed of resin. The stopper part **56** includes one side insert **561***g* and other side insert **561***h* made of metal integrally fixed to the base portion **561** as a resin part by insert molding of the stopper part **56**. To confirmatively describe, the pedal pad **30** in the present embodiment is formed of metal as in the tenth embodiment.

The one side insert **561***g* is located on one side of the protruded portion **563** of the stopper part **56** in the arm end widening direction Dw and the other side insert **561***h* is located on the other side of the protruded portion **563** in the arm end widening direction Dw.

One side screw insertion hole **561***c* into which one side screw **381** is to be inserted is not formed directly in the base portion **561** but is formed in the one side insert **561***g*. Similarly, other side screw insertion hole **561***d* into which other side screw **382** is to be inserted is not formed directly in the base portion **561** but is formed in the other side insert **561***h*.

(1) As mentioned above, the stopper part **56** and the pedal pad **30** are joined to each other by screw fastening the pedal pad **30** to the one side and other side inserts **561***g*, **561***h* of the stopper part **56**. Therefore, the arm **40** and the stopper part **56** can be easily assembled to the pedal pad **30**.

According to the present embodiment, the seat portions of the stopper part **56** pressed against by the heads of the screws **381**, **382** are the inserts **561***g*, **561***h* made of metal;

therefore, the durability of the stopper part **56** can be more enhanced as compared with cases where the seat portions are made of resin.

The present embodiment is identical with the tenth embodiment except the foregoing. In the present embodiment, the effects brought about by configuration elements common to those in the tenth embodiment can be obtained as in the tenth embodiment.

Seventeenth Embodiment

A description will be given to a second embodiment. With respect to the present embodiment, a description will be given mainly to a difference from the eleventh embodiment.

As shown in FIG. **31**, in the present embodiment, the stopper part **60** is formed of resin instead of meal. For this reason, the one side joining portion **601** and the other side joining portion **602** are also formed of resin. The stopper part **60** includes one side insert **601***c* made of metal and other side inset **602***c* made of metal.

The one side insert **601***c* is integrally fixed to the one side joining portion **601** as a resin part by insert molding of the stopper part **60**. The other side insert **602***c* is integrally fixed to the other side joining portion **602** as a resin part by insert molding of the stopper part **60**. To confirmatively describe, the pedal pad **30** in the present embodiment is formed of metal as in the eleventh embodiment.

The one side insert **601***c* is located on one side of the protruded portion **35** of the pedal pad **30** in the arm end widening direction Dw and the other side insert **602***c* is located on the other side of the protruded portion **35** in the arm end widening direction Dw.

The one side screw hole **601***a* into which the one side screw **381** is screwed is not formed directly in the one side joining portion **601** but is formed in the one side insert **601***c*. Similarly, the other side screw hole **602***a* into which the other side screw **382** is screwed is not formed directly in the other side joining portion **602** but is formed in the other side insert **602***c*.

(1) As mentioned above, the stopper part **60** and the pedal pad **30** are joined to each other by screw fastening the pedal pad **30** respectively to the one side and other side inserts **601***c*, **602***c* of the stopper part **60**. Therefore, the arm **40** and the stopper part **60** can be easily assembled to the pedal pad **30**.

According to the present embodiment, the screw holes **601***a*, **602***a* are formed respectively in the inserts **601***c*, **602***c* made of metal; therefore, the durability of the stopper part **60** can be more enhanced as compared with casers where the screw holes **601***a*, **602***a* are formed in a resin part.

The present embodiment is identical with the eleventh embodiment except the foregoing. In the present embodiment, the effects brought about by configuration elements common to those in the eleventh embodiment can be obtained as in the eleventh embodiment.

Eighteenth Embodiment

A description will be given to a second embodiment. With respect to the present embodiment, a description will be given mainly to a difference from the fourth embodiment.

As shown in FIG. **32**, the present embodiment adopts a snap-fit structure instead of press fitting of the bosses **565***a*, **565***b* to join the pedal pad **30** and the stopper part **56** to each other. That is, the pedal pad **30** and the stopper part **56** are joined to each other by a snap-fit structure.

Specifically, in the present embodiment, the stopper part **56** includes one side holding portion **566***a* and other side holding portion **566***b* protruded from the base portion **561** to the pedal pad **30** side.

For example, the stopper part **56** may be formed of either of metal and resin as long as the material has elasticity materializing a snap-fit structure but in the present embodiment, the stopper part is formed of resin having elasticity. Therefore, the one side holding portion **566***a* and the other side holding portion **566***b* are also formed of resin.

The one side holding portion **566***a* is located on one side of the protruded portion **563** in the arm end widening direction Dw and passes through one side of the pedal pad **30** in the arm end widening direction Dw and is extended from the base portion **561** to the opposite side with the pedal pad **30** in between. The one side holding portion **566***a* has at the tip portion of the one side holding portion **566***a* a claw portion **566***c* protruded to the other side in the arm end widening direction Dw.

The other side holding portion **566***b* is located on the other side of the protruded portion **563** in the arm end widening direction Dw and passes through the other side of the pedal pad **30** in the arm end widening direction Dw and is extended from the base portion **561** to the opposite side with the pedal pad **30** in between. The other side holding portion **566***b* has at the tip portion of the other side holding portion **566***b* a claw portion **566***d* protruded to one side in the arm end widening direction Dw.

The claw portion **566***c* of the one side holding portion **566***a* and the claw portion **566***d* of the other side holding portion **566***b* are respectively engaged with the pedal pad **30** at the pedal front side **301**.

(1) As mentioned above, according to the present embodiment, the pedal pad **30** and the stopper part **56** are joined to each other by a snap-fit structure; therefore, the arm **40** and the stopper part **56** can be easily assembled to the pedal pad **30**.

The present embodiment is identical with the fourth embodiment except the foregoing. In the present embodiment, the effects brought about by configuration elements common to those in the fourth embodiment can be obtained as in the fourth embodiment.

Nineteenth Embodiment

A description will be given to a second embodiment. With respect to the present embodiment, a description will be given mainly to a difference from the fifth embodiment.

As shown in FIG. **33**, the present embodiment adopts the same snap-fit structure as in the eighteenth embodiment instead of press fitting of bosses **603***a*, **603***b* to join the pedal pad **30** and the stopper part **60** to each other. That is, the pedal pad **30** and the stopper part **60** are joined to each other by a snap-fit structure.

Specifically, in the present embodiment, the stopper part **60** includes one side holding portion **604***a* protruded from the one side joining portion **601** to the pedal pad **30** side and other side holding portion **604***b* protruded from the other side joining portion **602** to the pedal pad **30** side. The one side holding portion **604***a* and the other side holding portion **604***b* constitute the same snap-fit structure as in the eighteenth embodiment.

For example, the stopper part **60** in the present embodiment may be formed of either of metal and resin as the stopper part **56** in the eighteenth embodiment is but in the present embodiment, the stopper part is formed of resin

having elasticity. Therefore, the one side holding portion **604***a* and the other side holding portion **604***b* are also formed of resin.

The one side holding portion **604***a* is located on one side of the protruded portion **35** in the arm end widening direction Dw and passes through one side of the pedal pad **30** in the arm end widening direction Dw and is extended from the one side joining portion **601** to the opposite side with the pedal pad **30** in between. The one side holding portion **604***a* has at the tip portion of the one side holding portion **604***a* a claw portion **604***c* protruded to the other side in the arm end widening direction Dw.

The other side holding portion **604***b* is located on the other side of the protruded portion **35** in the arm end widening direction Dw and passes through the other side of the pedal pad **30** in the arm end widening direction Dw and is extended from the other side joining portion **602** to the opposite side with the pedal pad **30** in between. The other side holding portion **604***b* has at the tip portion of the other side holding portion **604***b* a claw portion **604***d* protruded to one side in the arm end widening direction Dw.

The claw portion **604***c* of the one side holding portion **604***a* and the claw portion **604***d* of the other side holding portion **604***b* are respectively engaged with the pedal pad **30** at the pedal back side **302**.

(1) As mentioned above, according to the present embodiment, the stopper part **60** and the pedal pad **30** are joined to each other by the same snap-fit structure as in the eighteenth embodiment. Therefore, the working-effects by the snap-fit structure can be obtained as in the eighteenth embodiment.

The present embodiment is identical with the fifth embodiment except the foregoing. In the present embodiment, the effects brought about by configuration elements common to those in the fifth embodiment can be obtained as in the fifth embodiment.

Twentieth Embodiment

A description will be given to a second embodiment. With respect to the present embodiment, a description will be given mainly to a difference from the eighteenth embodiment.

As shown in FIG. **34**, also in the present embodiment, the pedal pad **30** and the stopper part **56** are joined to each other by a snap-fit structure as in the eighteenth embodiment.

In the present embodiment, however, the one side holding portion **566***a* passes through a through hole **30***n* provided in the pedal pad **30** instead of passing through one side of the pedal pad **30** in the arm end widening direction Dw and is extended from the base portion **561** to the opposite side with the pedal pad **30** in between. The claw portion **566***c* provided at the tip portion of the one side holding portion **566***a* is protruded to one side, not to the other side, in the arm end widening direction Dw.

The is also the case with the other side holding portion **566***b*. That is, the other side holding portion **566***b* passes through a through hole **300** provided in the pedal pad **30** instead of passing through the other side of the pedal pad **30** in the arm end widening direction Dw and is extended from the base portion **561** to the opposite side with the pedal pad **30** in between. The claw portion **566***d* provided at the tip portion of the other side holding portion **566***b* is protruded to the other side, not to one side, in the arm end widening direction Dw.

The present embodiment is identical with the eighteenth embodiment except the foregoing. In the present embodiment, the effects brought about by configuration elements common to those in the eighteenth embodiment can be obtained as in the eighteenth embodiment.

Twenty-First Embodiment

A description will be given to a second embodiment. With respect to the present embodiment, a description will be given mainly to a difference from the nineteenth embodiment.

As shown in FIG. **35**, also in the present embodiment, the pedal pad **30** and the stopper part **60** are joined to each other by a snap-fit structure as in the nineteenth embodiment.

In the present embodiment, however, the one side holding portion **604***a* passes through a through hole **30***n* provided in the pedal pad **30** instead of passing through one side of the pedal pad **30** in the arm end widening direction Dw and is extended from the one side joining portion **601** to the opposite side with the pedal pad **30** in between. The claw portion **604***c* provided at the tip portion of the one side holding portion **604***a* is protruded to one side, not to the other side, in the arm end widening direction Dw.

This is also the case with the other side holding portion **604***b*. That is, the other side holding portion **604***b* passes through a through hole **300** provided in the pedal pad **30** instead of passing through the other side of the pedal pad **30** in the arm end widening direction Dw and is extended from the other side joining portion **602** to the opposite side with the pedal pad **30** in between. The claw portion **604***d* provided at the tip portion of the other side holding portion **604***b* is protruded to the other side, not to one side, in the arm end widening direction Dw.

The present embodiment is identical with the nineteenth embodiment except the foregoing. In the present embodiment, the effects brought about by configuration elements common to those in the nineteenth embodiment can be obtained as in the nineteenth embodiment.

Twenty-Second Embodiment

A description will be given to a second embodiment. With respect to the present embodiment, a description will be given mainly to a difference from the first embodiment.

As shown in FIG. **36** to FIG. **38**, in the present embodiment, the arm one end **401** is in such a shape that the arm one end is widened from the arm body **403** to both sides in the arm end widening direction Dw as in the first embodiment.

However, unlike the first embodiment, the arm one end **401** in the present embodiment forms a spherical shape. Therefore, also in the present embodiment, as shown in FIG. **36**, the arm one end **401** forms a circular shape as viewed in a direction along the arm end widening direction Dw (for example, as viewed in a direction along arrow V of FIG. **4**).

The present embodiment is identical with the first embodiment except the foregoing. In the present embodiment, the effects brought about by configuration elements common to those in the first embodiment can be obtained as in the first embodiment.

The present embodiment is a modification to the first embodiment but the present embodiment can also be combined with any of the second to twenty-first embodiments.

Twenty-Third Embodiment

A description will be given to a second embodiment. With respect to the present embodiment, a description will be given mainly to a difference from the first embodiment.

The stopper part **56** in the present embodiment is formed of resin. The dimensional relation between the arm **40** and the stopper part **56** is as described below:

In one side biased state, which is a state shown in FIG. **39**, the widening-direction other end **401***b* of the arm one end **401** is located between the insertion hole **564***a* and the other side in the arm end widening direction Dw and at the same time, the following Formula F1 and the following formula F2 hold:

$$L1<2\times Y1 \quad \text{(Formula F1)}$$

$$L1<2\times Y1 \quad \text{(Formula F2)}$$

The above-mentioned one side biased state in the present embodiment is a state in which the arm **40** is biased to one side in the arm end widening direction Dw and abutted against the stopper part **56** in the arm end widening direction Dw. In other words, the one side biased state is a state in which a clearance Ca between the widening-direction one end **401***a* of the arm one end **401** and an inner wall surface of the protruded portion **563** opposed to the widening-direction one end **401***a* or a clearance Cb between the arm body **403** and the one side receiving portion **564***b* of the first arrangement section **564** is not present. FIG. **39** shows a state in which of the clearances Ca, Cb, the clearance Ca is not present.

In the above-mentioned Formula F1 and Formula F2, L**1** denotes a clearance along the normal line direction Dv of the base surface **561***b* or a clearance between a portion of the other-side receiving surface **564***e* of the stopper part **56** located farthest to the counter-operation side in the normal line direction Dv of the base surface **561***b*. The clearance L**1** is designated, for example, as first-normal-line-direction distance L**1**. X**1** denotes a width from the widening-direction other end **401***b* of the arm one end **401** to the insertion hole **564***a* in the arm end widening direction Dw. Y**1** denotes a width of the other-side receiving surface **564***e* in the arm end widening direction Dw. Since the width X**1** and the width Y**1** are in a relation expressed as "Y**1**≥X**1**" as shown in FIG. **39**, when the Formula F1 holds, the Formula F2 also holds.

The situation in other side biased state, which is a state shown in FIG. **40**, is also similar to the situation in the above-mentioned one side biased state. That is, in the other side biased state, the widening-direction one end **401***a* of the arm one end **401** is located between the insertion hole **564***a* and one side in the arm end widening direction Dw and at the same time, the following Formula F3 and the following Formula F4 hold:

$$L2<2\times X2 \quad \text{(Formula F3)}$$

$$L2<2\times Y2 \quad \text{(Formula F4)}$$

The above-mentioned other side biased state in the present embodiment is a state in which the arm **40** is biased to the other side in the arm widening direction Dw and abutted against the stopper prat **56** in the arm end widening direction Dw. In other words, the other side biased state is a state in which a clearance Cc between the widening-direction other end **401***b* of the arm one end **401** and an inner wall surface of the protruded portion **563** opposed to the widening-direction other end **401***b* or a clearance Cd between the arm body **403** and the other side receiving portion **564***c* of the first arrangement section **564** is not present. FIG. **40** shows a state in which of the clearances Cc, Cd, the clearance Cc is not present.

In the above-mentioned Formula F3 and Formula F4, L**2** denotes a clearance along the normal line direction Dv of the base surface **561***b* or a clearance between a portion of the one-side receiving surface **564***d* of the stopper part **56** located farthest to the counter-operation side in the normal line direction Dv of the base surface **561***b*. The clearance L**2** is designated, for example, as second-normal-line-direction distance L**2**. X**2** denotes a width from the widening-direction one end **401***a* of the arm one end **401** to the insertion hole **564***a* in the arm end widening direction Dw. Y**2** denotes a width of the one-side receiving surface **564***d* in the arm end widening direction Dw. Since the width X**2** and the width Y**2** are in a relation expressed as "Y**2** X**2**" as shown in FIG. **40**, when the Formula F3 holds, the Formula F4 also holds. In the present embodiment, for example, the second-normal-line-direction distance L**2** is identical with the first-normal-line-direction distance L**1** in dimension.

(1) Here, a detachable structure will be assumed as a comparative example, such as a snap-fit structure, in which one member can be detached from the other member by elastic deformation of the one member. In this detachable structure, in general, a length L**3** equivalent to the above-mentioned normal line direction distances L**1**, L**2** and a width X**3** equivalent to the above-mentioned widths X**1**, X**2** are in a relation expressed by Formula F5 below. The length L**3** and a width Y**3** equivalent to the above-mentioned widths Y**1**, Y**2** are in a relation expressed by Formula F6 below.

$$L3\geq 2\times X3 \quad \text{(Formula F5)}$$

$$L3\geq 2\times Y3 \quad \text{(Formula F6)}$$

According to the present embodiment, meanwhile, Formula F1 holds in the one side biased state and Formula F3 holds in the other side biases state. Therefore, the structure in which the stopper part **56** holds the arm one end **401** in the housing space **563***a* is not such a detachable structure as in the above-mentioned comparative example. That is, the arm one end **401** can be prevented from getting out of the housing space **563***a* due to elastic deformation of the one side receiving portion **564***b* or other side receiving portion **564***c* of the first arrangement section **564**; therefore, the reliability of the pedal device **1** can be enhanced.

The present embodiment is identical with the first embodiment except the foregoing. In the present embodiment, the effects brought about by configuration elements common to those in the first embodiment can be obtained as in the first embodiment.

The present embodiment is a modification to the first embodiment but may be combined with any of the above-mentioned other embodiments as long as the protruded portion **35**, **563** housing the arm one end **401** is formed of resin.

When, for example, a modification in which the protruded portion **35** (Refer to FIG. **14**) is formed of resin is assumed as a modification to the third embodiment, the present embodiment can be combined with this modification to the third embodiment. In this case, in the one side biased state, the arm **40** is abutted against the pedal pad **30** (Refer to FIG. **14**), not against the stopper part **56**, in the arm end widening direction Dw. Also in the other side biased state, the arm **40** is abutted against the pedal pad **30**, not against the stopper part **56**, in the arm end widening direction Dw.

Other Embodiments

(1) In each of the above-mentioned embodiments, the pedal device **1** is used as a brake pedal device but this is just

an example. For example, the pedal device **1** may be one that is used as an accelerator pedal deice operated to adjust an output of a driving source of a vehicle **80**.

(2) In each of the above-mentioned embodiments, the pedal device **1** is a brake pedal device used in a brake-by-wire system but this is just an example. For example, the vehicle **80** equipped with the pedal device **1** does not adopt a brake-by-wire system and the pedal device **1** may be so configured that the pedal pad **30** is mechanically coupled with a master cylinder constituting a brake system.

In each of the above-mentioned embodiments, as shown in FIG. **3**, the reaction force generation mechanism **50** includes a plurality of spring members **511**, **512**, **513** but the reaction force generation mechanism **50** may include only one spring member.

The reaction force generation mechanism **50** may generate reaction force against stepping force by any other mechanical configuration than the spring members **511**, **512**, **513**. For example, in a vehicle **80** that does not adopt a brake-by-wire system, a mechanical configuration including a hydraulic cylinder and the like generating liquid pressure for driving a brake pad corresponds to the reaction force generation mechanism **50**.

(4) In each of the above-mentioned embodiments, as shown in FIG. **5**, for example, the arm body **403** in a linearly extended shape but this is just an example. For example, the arm body **403** may be in a curvedly extended shape.

(5) In each of the above-mentioned embodiments, as shown in FIG. **13**, for example, the pedal device **1** is an organ type pedal device but may be a pedal device of any other type than organ type.

For example, in each embodiment, the pedal device **1** is of an organ type; therefore, the pedal axial center CL is provided in a position closer to the lower end **304** of the pedal pad **30** than to the upper end **303** of the pedal pad **30**. Contrarily, as an example of a pedal device of any other type than organ type, a configuration in which the pedal axial center CL is provided in a position closer to the upper end **303** than to the lower end **304** of the pedal pad **30** can be assumed. In the case of such a configuration, for example, the arm **40** is located vehicle downward relative to the pedal axial center CL located close to the upper end **303** of the pedal pad **30**. The pedal pad **30** is rotationally moved so that the lower end **304** of the pedal pad **30** is more displaced vehicle downward or vehicle frontward as stepping force applied to the pedal pad **30** by an operator **81** from the operation side is more increased.

(6) In the first embodiment, as shown in FIG. **3** and FIG. **4**, the arm one end **401** is in such a shape as to be widened from the arm body **403** in the arm end widening direction Dw and the arm end widening direction Dw is a direction along the pedal axial center CL but this is just an example. For example, when the arm **40** is slidably coupled with the pedal pad **30** in the section in FIG. **3**, the arm one end **401** may be in such a shape as to be widened from the arm body **403** to a direction orthogonal to the pedal axial center CL.

(7) In the twenty-third embodiment, Formula F1 holds in the one side biased state shown in FIG. **39** and Formula F3 holds in the other side biased state shown in FIG. **40**. With respect to L**1**, L**2**, this limitation is acceptable; more favorably, for example, the protruded portion **563** may be so configured that a relation expressed as "L**1**<X**1**/2" holds in the one side biased state and a relation expressed as "L**2**<X**2**/2" holds in the other side biased state.

(8) The present disclosure is not limited to the above-mentioned embodiments and may be variously modified. The above-mentioned embodiments are not irrelevant to one another and may be combined as appropriate unless a combination is obviously infeasible.

In each of the above-mentioned embodiments, needless to add, elements constituting an embodiment are not necessarily indispensable unless it is clearly described that some element is especially indispensable or it is supposed in principle that some element is obviously indispensable. When in relation to each of the above-mentioned embodiments, a numerical value, such as a number of pieces, a numeric value, a quantity, a range, or the like of a configuration element of the embodiment is referred to, the specific numerical value is not definite unless it is clearly described that the numerical value is indispensable or the numerical value is obviously definite in principle.

When in relation to each of the above-mentioned embodiments, a material, a shape, a positional relation, or the like of a configuration element or the like is referred to, the material, shape, positional relation, or the like is not definite unless it is especially clearly described that the material, shape, positional relation, or the like is definite or the specific material, shape, positional relation, or the like is definite in principle.

What is claimed is:

1. A pedal device to be provided in a vehicle, the pedal device comprising:

a pedal pad configured to be stepped on by an operator from a predetermined operation side;

an arm including an arm one end and an arm body extended from the arm one end to a counter-operation side, which is opposite to the operation side, the arm coupled with the pedal pad at the arm one end and coupled with a reaction force generation mechanism on the counter-operation side, the reaction force generation mechanism configured to generate a reaction force against a stepping force applied to the pedal pad by the operator; and

a stopper part that is a component separate from the pedal pad and fixed to the pedal pad, wherein

the arm one end is widened from the arm body in a widening direction, which is perpendicular to an extending direction in which the arm body is extended,

one part, which is one of the pedal pad and the stopper part, includes a first arrangement section that has an insertion hole, into which the arm body is inserted, and located on the counter-operation side relative to the arm one end,

an other part, which is an other of the pedal pad and the stopper part, includes a second arrangement section located on the operation side of the first arrangement section across the arm one end,

the first arrangement section and the second arrangement section hold the arm one end against the pedal pad in a state where the arm one end is interposed between the first arrangement section and the second arrangement section,

the pedal pad is rotationally movable about a pedal axial center in conjunction with a stepping operation by the operator,

the widening direction is a direction along the pedal axial center, and

the arm one end is in a solid tubular shape having an axial center parallel with the pedal axial center.

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

the first arrangement section is formed of metal.

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

the first arrangement section is formed of resin.

4. The pedal device according to claim 1, wherein
the one part includes
a base surface facing to the counter-operation side and
a protruded portion formed of resin and protruded from the base surface,
the protruded portion includes the first arrangement section at a top in its protruded shape of the protruded portion,
the protruded portion has a housing space that
accommodates the arm one end,
connects to the insertion hole, and
extends to the counter-operation side beyond the base surface,
the arm one end includes
a widening-direction one end provided on one side in the widening direction and
a widening-direction other end provided on an other side in the widening direction,
the first arrangement section includes
a one-side receiving surface
facing the housing space on the operation side and
located on the one side of the insertion hole in the widening direction and an other-side receiving surface
facing the housing space on the operation side and
located on the other side of the insertion hole in the widening direction,
in a state, in which the arm is biased to the one side in the widening direction and abutted against the pedal pad or the stopper part in the widening direction,
the widening-direction other end is positioned on the other side of the insertion hole in the widening direction, and
a first-normal-line-direction distance is less than twice a width, which is from the widening-direction other end to the insertion hole in the widening direction,
wherein the first-normal-line-direction distance is along a normal line direction of the base surface,
wherein the first-normal-line-direction distance is between the base surface and a portion of the other-side receiving surface, which is farthest on the counter-operation side in the normal line direction, and
in a state, in which the arm is biased to the other side in the widening direction and abutted against the pedal pad or the stopper part in the widening direction,
the widening-direction one end is positioned on the one side of the insertion hole in the widening direction, and
a second-normal-line-direction distance is less than twice a width, which is from the widening-direction one end to the insertion hole in the widening direction,
wherein the second-normal-line-direction distance is along the normal line direction,
wherein the second-normal-line-direction distance is between the base surface and a portion of the one-side receiving surface, which is farthest on the counter-operation side in the normal line direction.

5. The pedal device according to claim 1, wherein
the one part and the other part include metal parts, respectively, and are joined to each other by welding the metal parts.

6. The pedal device according to claim 1, wherein
one of the one part and the other part includes a boss,
an other of the one part and the other part has a hole, and
the one part and the other part are joined to each other by press fitting the boss into the hole.

7. The pedal device according to claim 1, wherein
one of the one part and the other part includes a boss, which is made of metal,
an other of the one part and the other part has a through hole, and
the one part and the other part are joined to each other by caulking the boss, which is inserted into the through hole.

8. The pedal device according to claim 1, wherein
the one part and the other part are joined to each other by screw fixing.

9. The pedal device according to claim 1, wherein
one of the one part and the other part includes a boss,
an other of the one part and the other part has a through hole, in which the boss inserted, and
the one part and the other part are joined to each other by a retaining ring, which is locked to the boss.

10. The pedal device according to claim 1, wherein
one of the one part and the other part includes a boss made of resin,
an other of the one part and the other part has a through hole, and
the one part and the other part are joined to each other by thermal caulking of the boss, which is inserted into the through hole.

11. The pedal device according to claim 1, wherein
one of the one part and the other part includes an insert, which is made of metal and integrally fixed to a resin part by insert molding, and
the one part and the other part are joined to each other by screw fastening the other of the one part and the other part to the insert.

12. The pedal device according to claim 1, wherein
the one part and the other part are joined to each other by a snap-fit structure.

13. The pedal device according to claim 1, wherein
the pedal device is to be provided, as a brake pedal device, in the vehicle to perform a braking operation to apply brake to the vehicle.

14. The pedal device according to claim 1, wherein
the pedal device is a device in which
the pedal axial center is provided in a position closer to a lower end of the pedal pad than to an upper end of the pedal pad.

15. The pedal device according to claim 1, wherein the arm is directly coupled with the reaction force generation mechanism on the counter-operation side.

16. A pedal device to be provided in a vehicle, the pedal device comprising:
a pedal pad configured to be stepped on by an operator from a predetermined operation side;
an arm including an arm one end and an arm body extended from the arm one end to a counter-operation side, which is opposite to the operation side, the arm coupled with the pedal pad at the arm one end and coupled with a reaction force generation mechanism on the counter-operation side, the reaction force generation mechanism configured to generate a reaction force against a stepping force applied to the pedal pad by the operator; and
a stopper part that is a component separate from the pedal pad and fixed to the pedal pad, wherein
the arm one end is widened from the arm body in a widening direction, which is perpendicular to an extending direction in which the arm body is extended,
one part, which is one of the pedal pad and the stopper part, includes a first arrangement section that has an

insertion hole, into which the arm body is inserted, and located on the counter-operation side relative to the arm one end,

an other part, which is an other of the pedal pad and the stopper part, includes a second arrangement section located on the operation side of the first arrangement section across the arm one end,

the first arrangement section and the second arrangement section hold the arm one end against the pedal pad in a state where the arm one end is interposed between the first arrangement section and the second arrangement section,

the insertion hole is in a size that

enables an entirety of a portion of the arm, which includes the arm body and is located on the counter-operation side of the arm one end in the extending direction, to pass through the insertion hole, and

disables the arm one end from passing through the insertion hole, and

the one part, as a single component, is

open on the operation side with respect to the arm one end and

in a shape that enables the arm one end to move from a position between the first arrangement section and the second arrangement section to the operation side.

17. A pedal device to be provided in a vehicle, the pedal device comprising:

a pedal pad configured to be stepped on by an operator from a predetermined operation side;

an arm including an arm one end and an arm body extended from the arm one end to a counter-operation side, which is opposite to the operation side, the arm coupled with the pedal pad at the arm one end and coupled with a reaction force generation mechanism on the counter-operation side, the reaction force generation mechanism configured to generate a reaction force against a stepping force applied to the pedal pad by the operator; and

stopper art that is a component separate from the pedal pad and fixed to the pedal pad, wherein

the arm one end is widened from the arm body in a widening direction, which is perpendicular to an extending direction in which the arm body is extended,

one part, which is one of the pedal pad and the stopper part, includes a first arrangement section that has an insertion hole, into which the arm body is inserted, and located on the counter-operation side relative to the arm one end,

an other part, which is an other of the pedal pad and the stopper part, includes a second arrangement section located on the operation side of the first arrangement section across the arm one end, and

the first arrangement section and the second arrangement section hold the arm one end against the pedal pad in a state where the arm one end is interposed between the first arrangement section and the second arrangement section,

the insertion hole is in a size that

enables an entirety of a portion of the arm, which includes the arm body and is located on the counter-operation side of the arm one end in the extending direction, to pass through the insertion hole, and

disables the arm one end from passing through the insertion hole, and

the one part has a housing space that is recessed and accommodates the arm one end,

the housing space has a housing space opening that

connects to the insertion hole at a bottom of the housing space and

opens on an opposite side of the insertion hole, and

the housing space opening is

in a size that enables the arm one end to pass through the housing space opening and

covered with the second arrangement section.

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