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**Tsuguma**

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(54) **OPERATION PEDAL DEVICE FOR VEHICLE**

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(2013.01)

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G05G 1/327; G05G 1/44; B60T 7/065

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,970,817 A \* 10/1999 Ichiba ..... G05G 1/46  
74/513

6,176,340 B1 \* 1/2001 Mizuma ..... B60T 7/065  
180/274

(Continued)

FOREIGN PATENT DOCUMENTS

CN 105905084 A 8/2016  
JP H11198776 A 7/1999

(Continued)

OTHER PUBLICATIONS

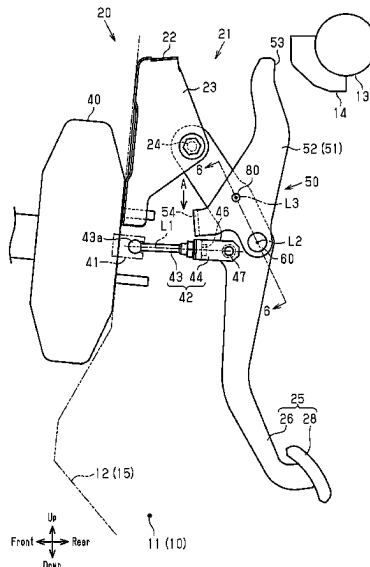
First Office Action dated Apr. 19, 2025 issued in the Chinese Patent  
Application No. 202380036653.2 with English machine translation.

*Primary Examiner* — Adam D Rogers

(57) **ABSTRACT**

A vehicle operation pedal device includes a pedal bracket, an operation pedal, a rotation lever, and a shear portion. The rotation lever includes a contact portion and a pressing portion. The rotation lever is configured to, by receiving a load greater than or equal to a threshold when the contact portion comes into contact with the vehicle body structural member, rotate about the rotation shaft such that the pressing portion presses the input shaft. The shear portion is configured to fix the rotation lever to the pedal arm when the load applied to the rotation lever from the vehicle body structural member is less than the threshold, and cancel the fixation by being broken when the load is greater than or equal to the threshold.

**4 Claims, 9 Drawing Sheets**



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**G05G 1/323** (2008.04)

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,178,846 B1 \* 1/2001 Specht ..... G05G 1/327  
74/513  
6,279,417 B1 \* 8/2001 Mizuma ..... B60T 7/065  
180/274  
6,655,489 B2 \* 12/2003 Kawai ..... B60T 7/065  
180/274  
9,376,094 B2 \* 6/2016 Kitano ..... B60T 7/065  
2001/0027696 A1 10/2001 Mizuma et al.  
2016/0244033 A1 8/2016 Uchida et al.

FOREIGN PATENT DOCUMENTS

JP 2005231547 A 9/2005  
JP 2012128659 A \* 7/2012  
JP 2015072504 A 4/2015  
JP 2017024584 A 2/2017  
JP 2017199199 A \* 11/2017  
KR 20080048279 A \* 6/2008  
KR 20080053619 A \* 6/2008

\* cited by examiner

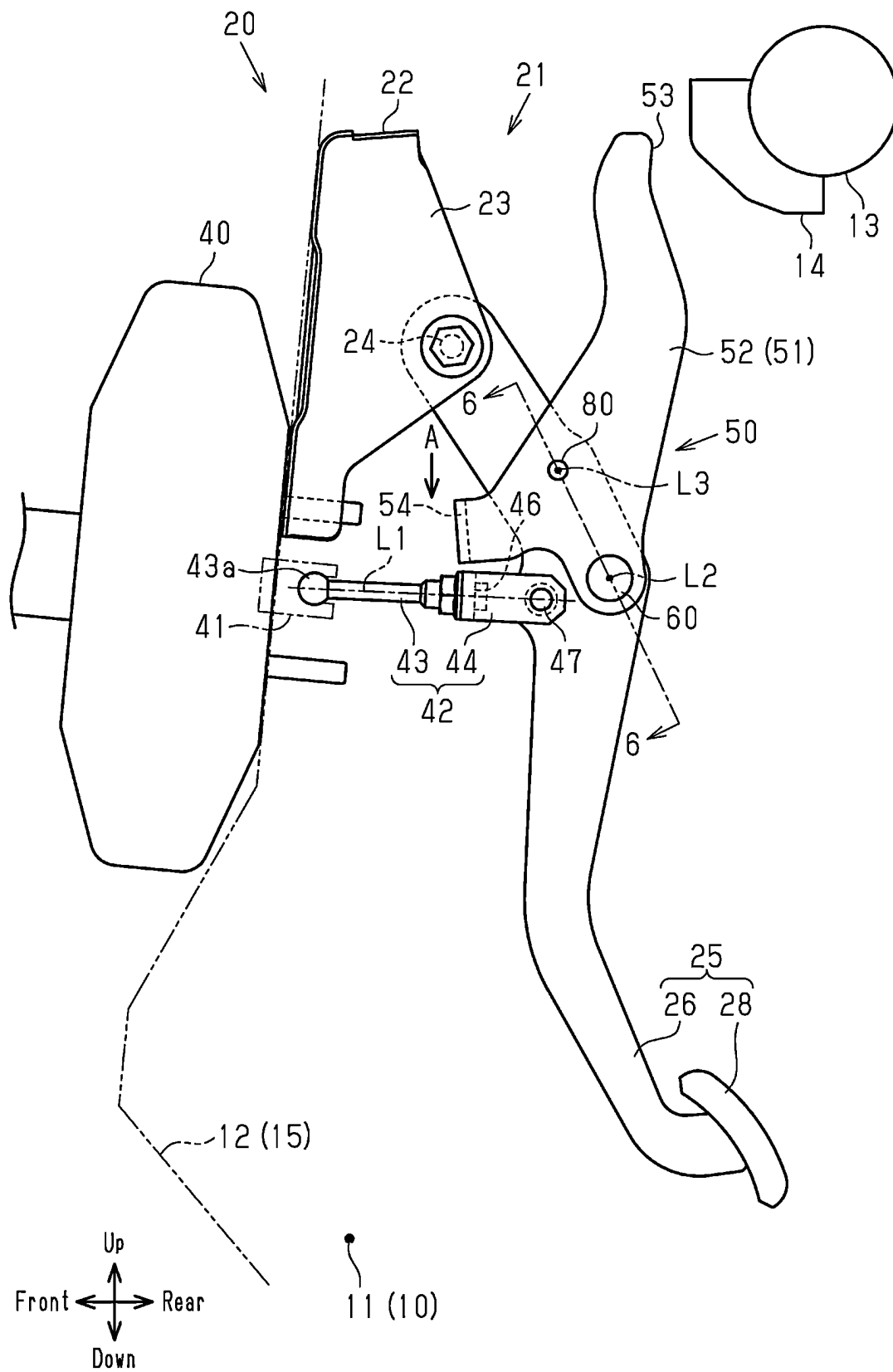


Fig.2

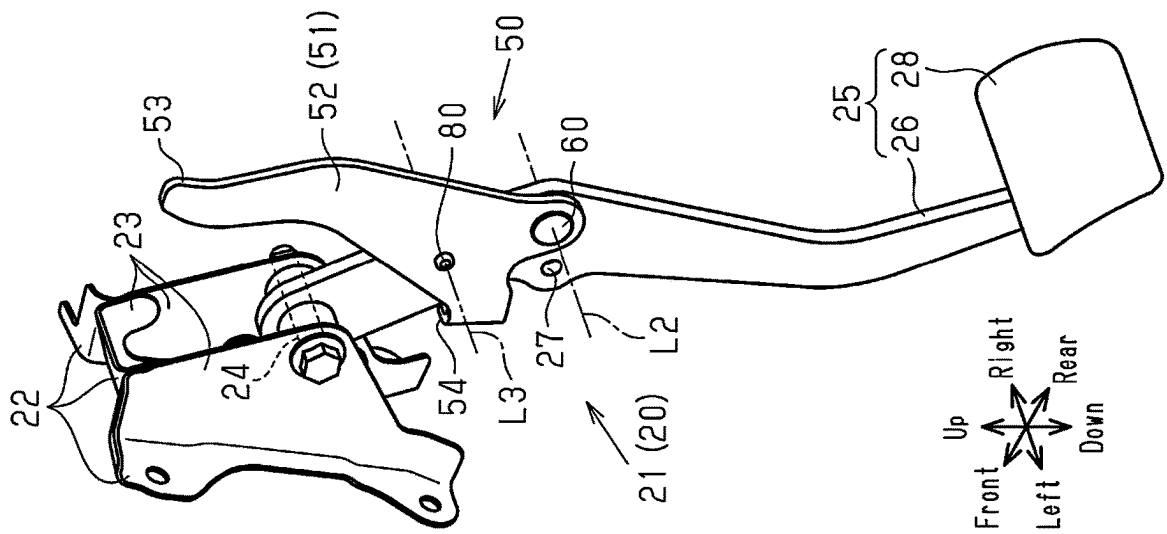


Fig.3

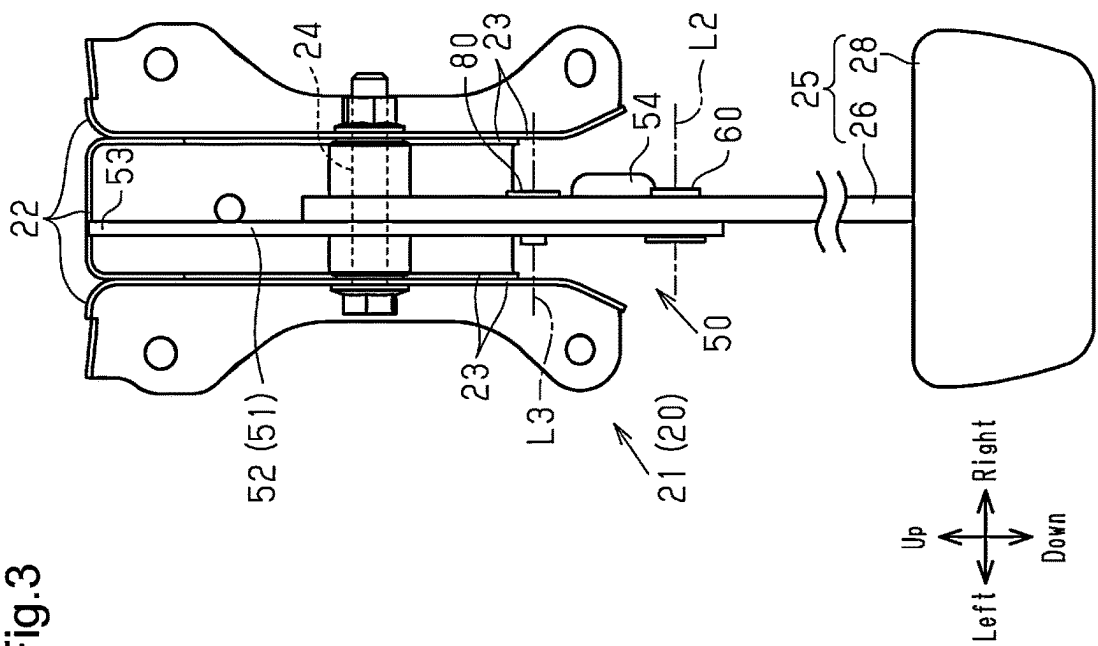


Fig.4

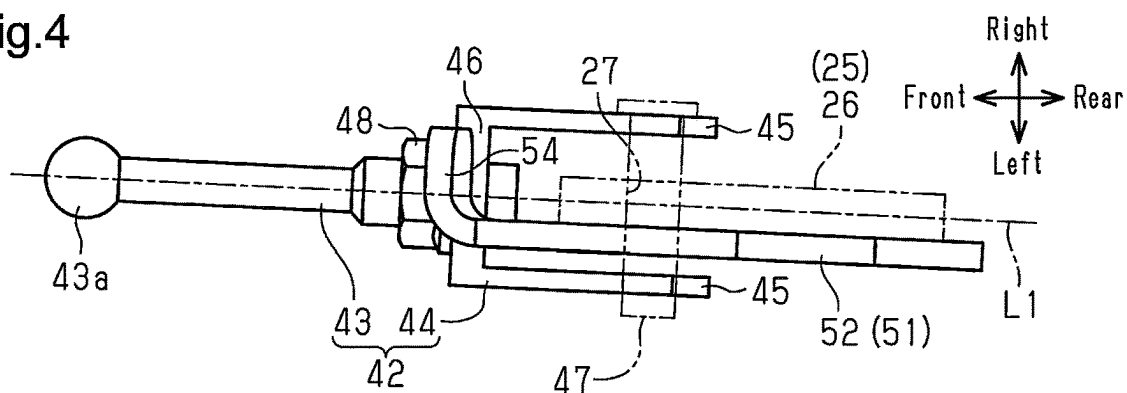


Fig.5

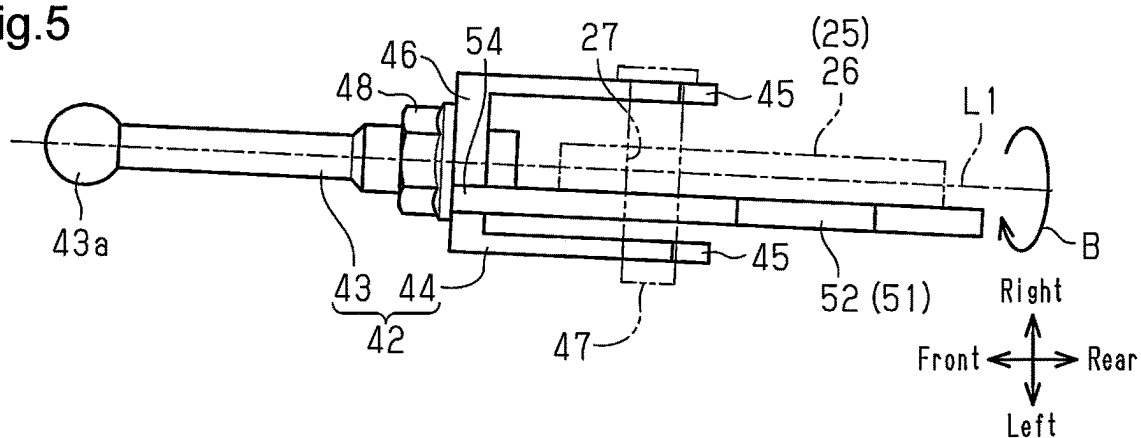


Fig.6

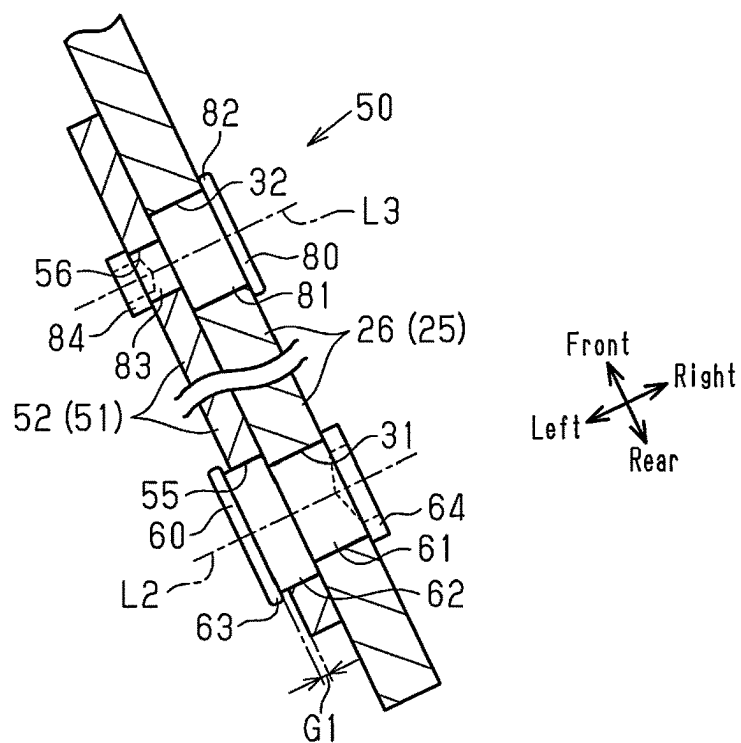


Fig.7

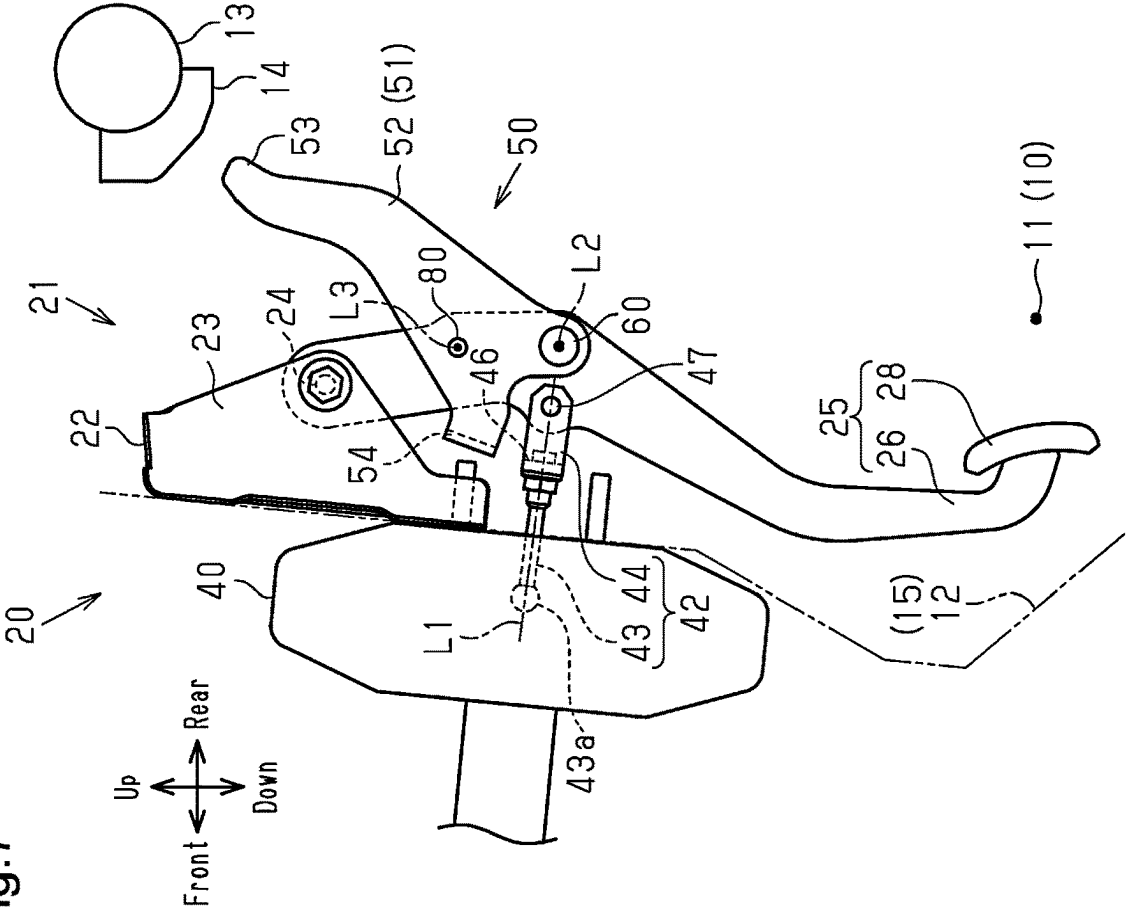


Fig.8

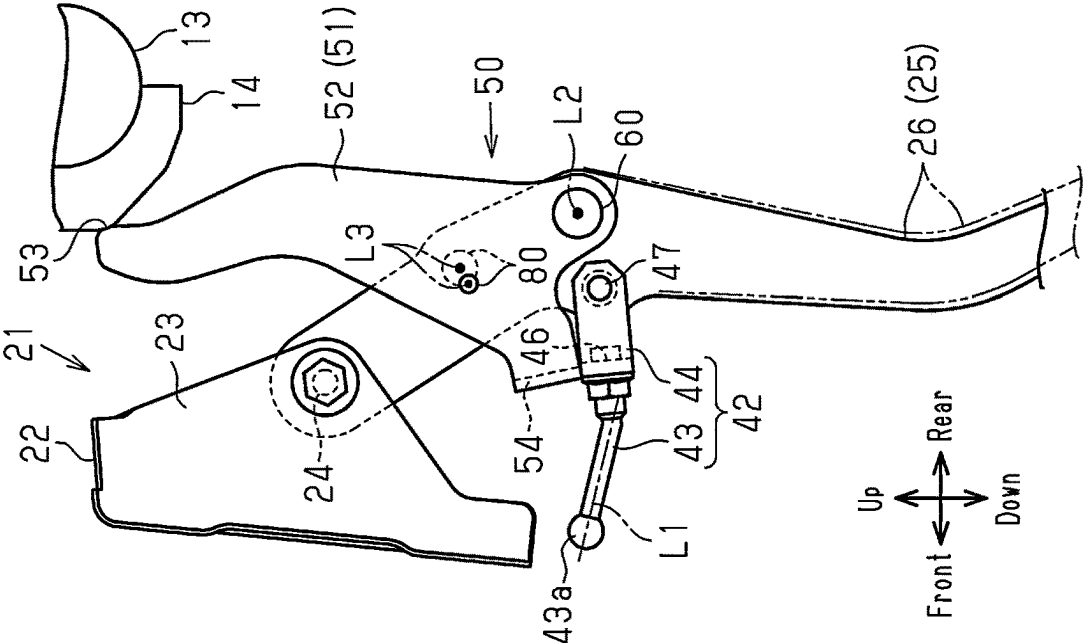


Fig.9

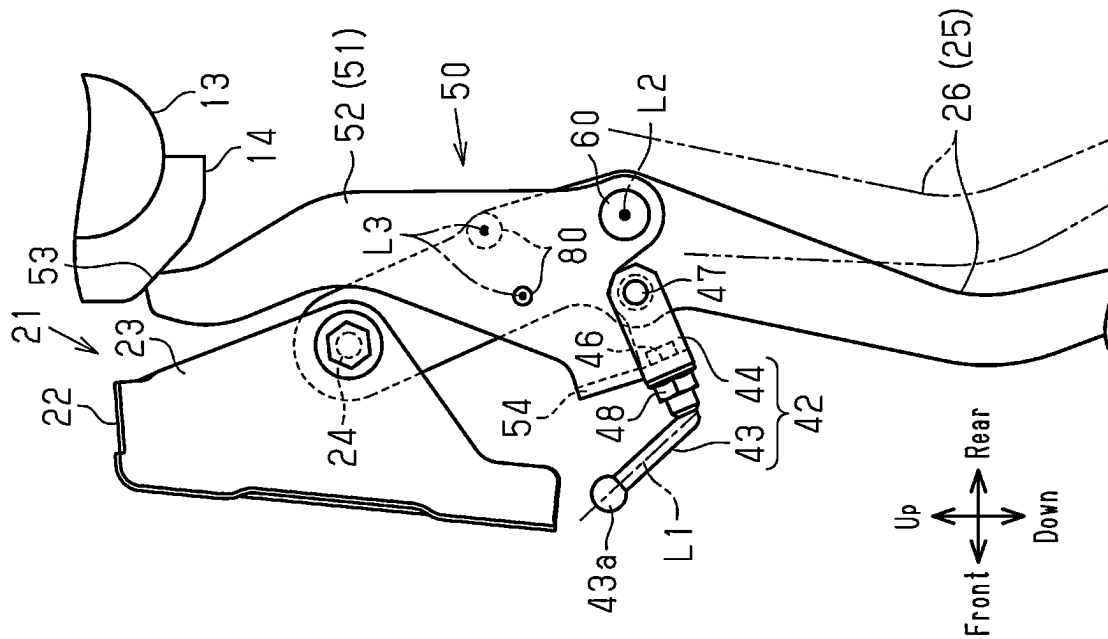


Fig.10

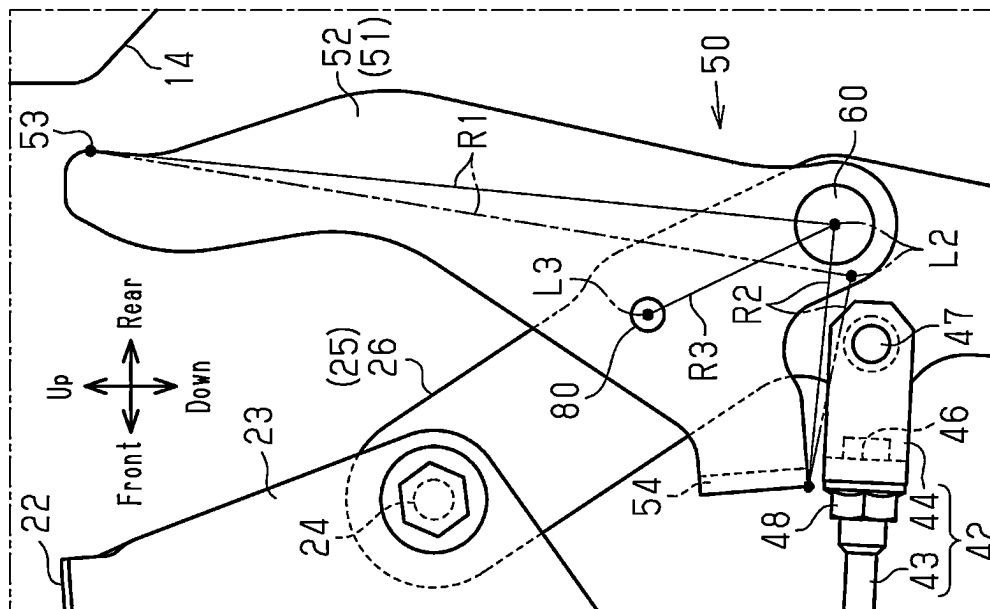


Fig.11

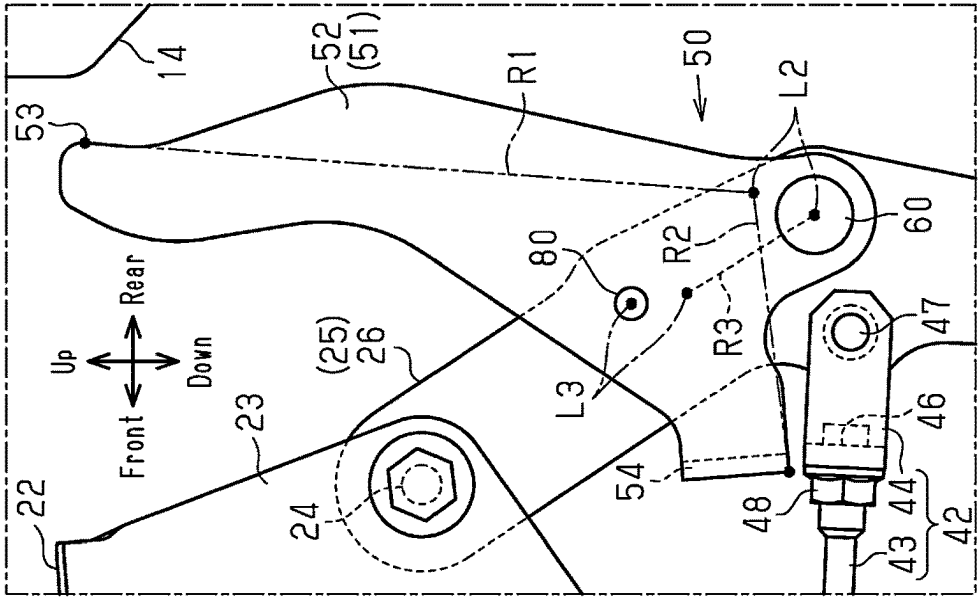


Fig.12

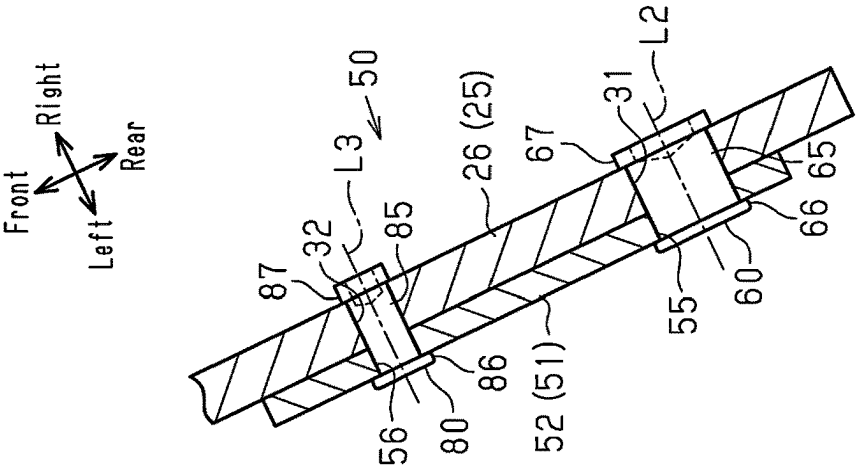
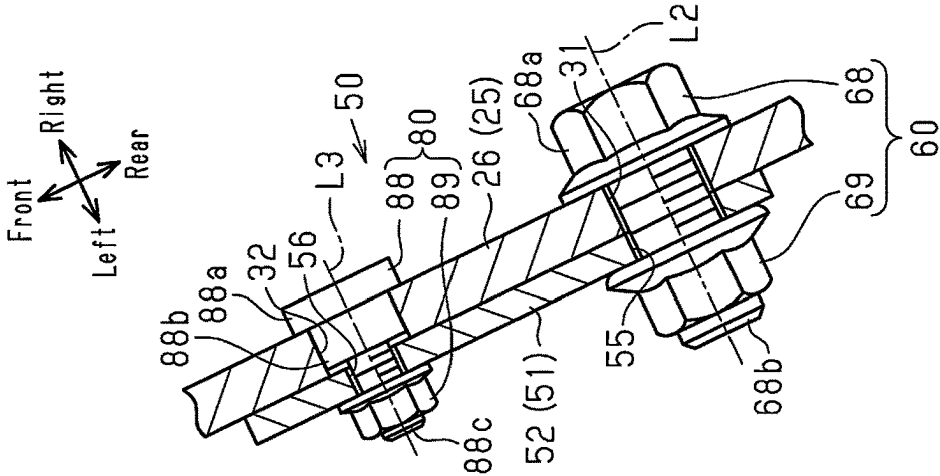
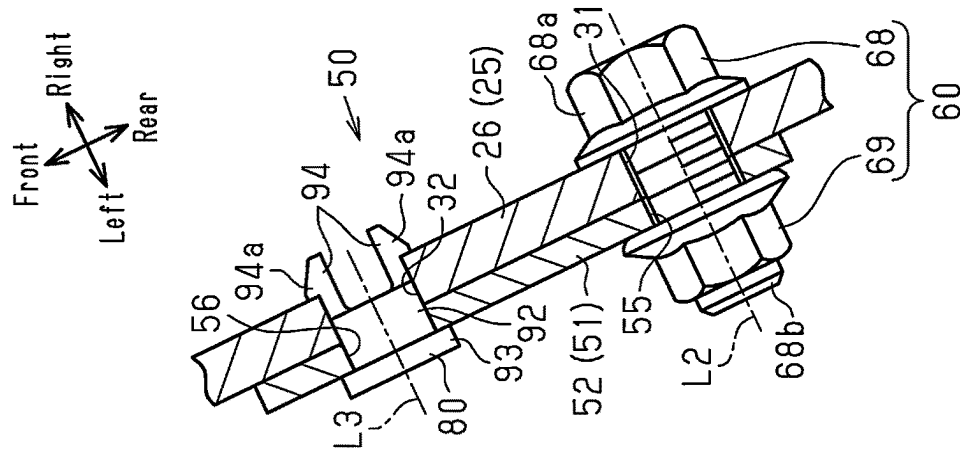


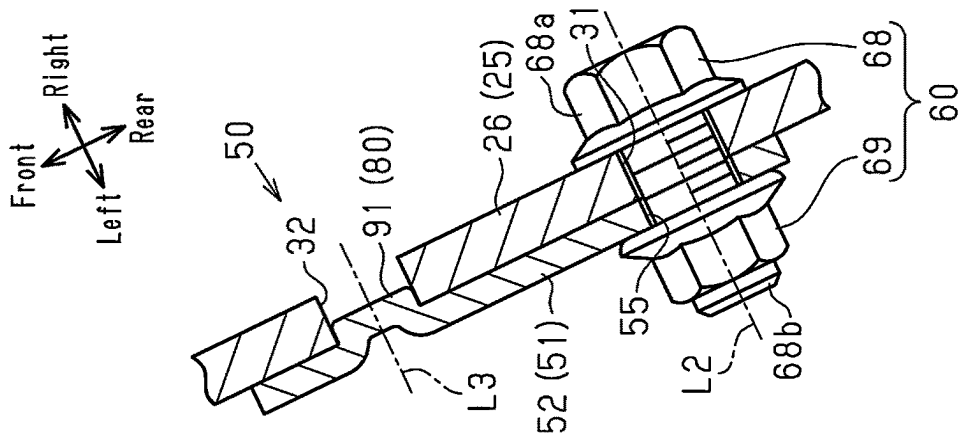
Fig.13



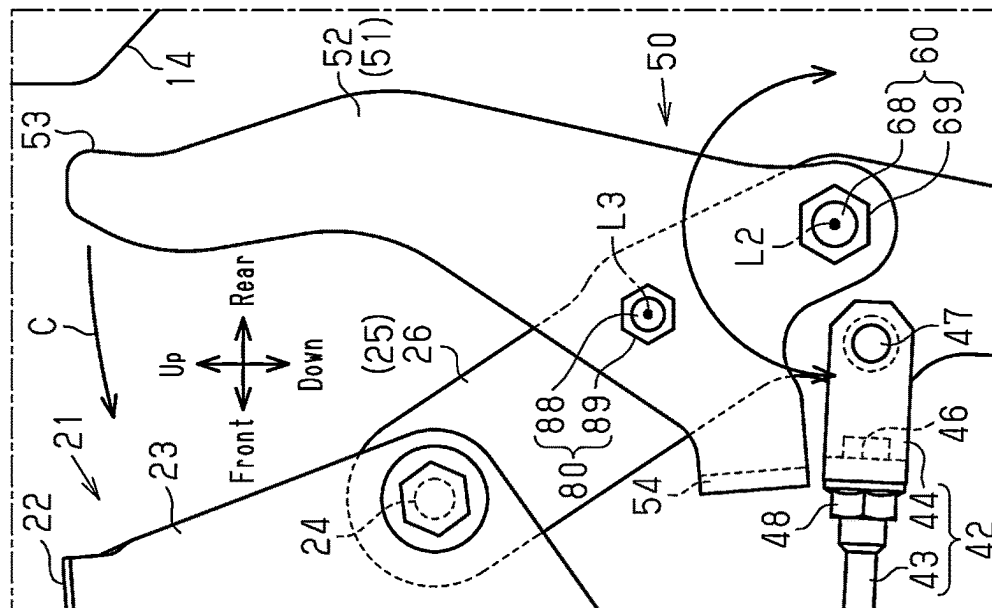




**Fig.16**



**Fig.15**



**Fig.14**

Fig. 17

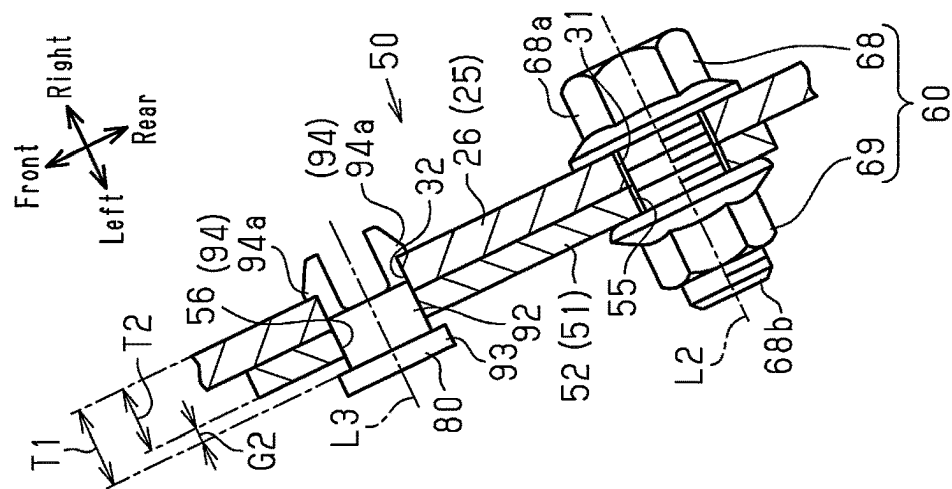
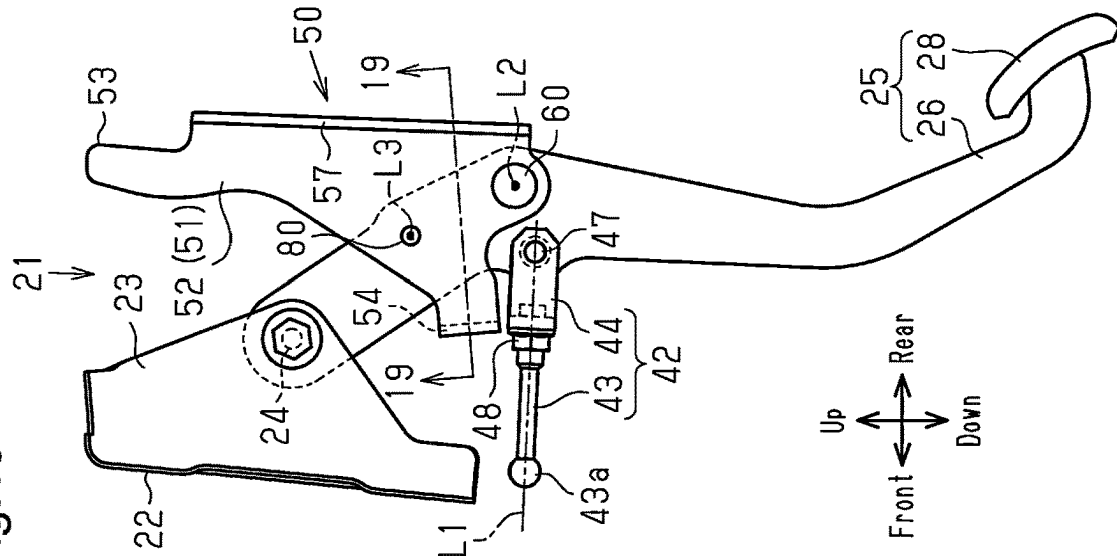


Fig. 18



**Fig. 19**

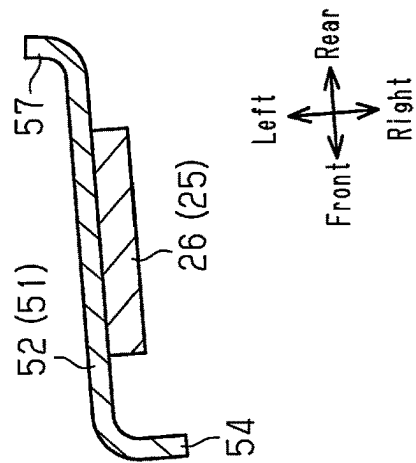
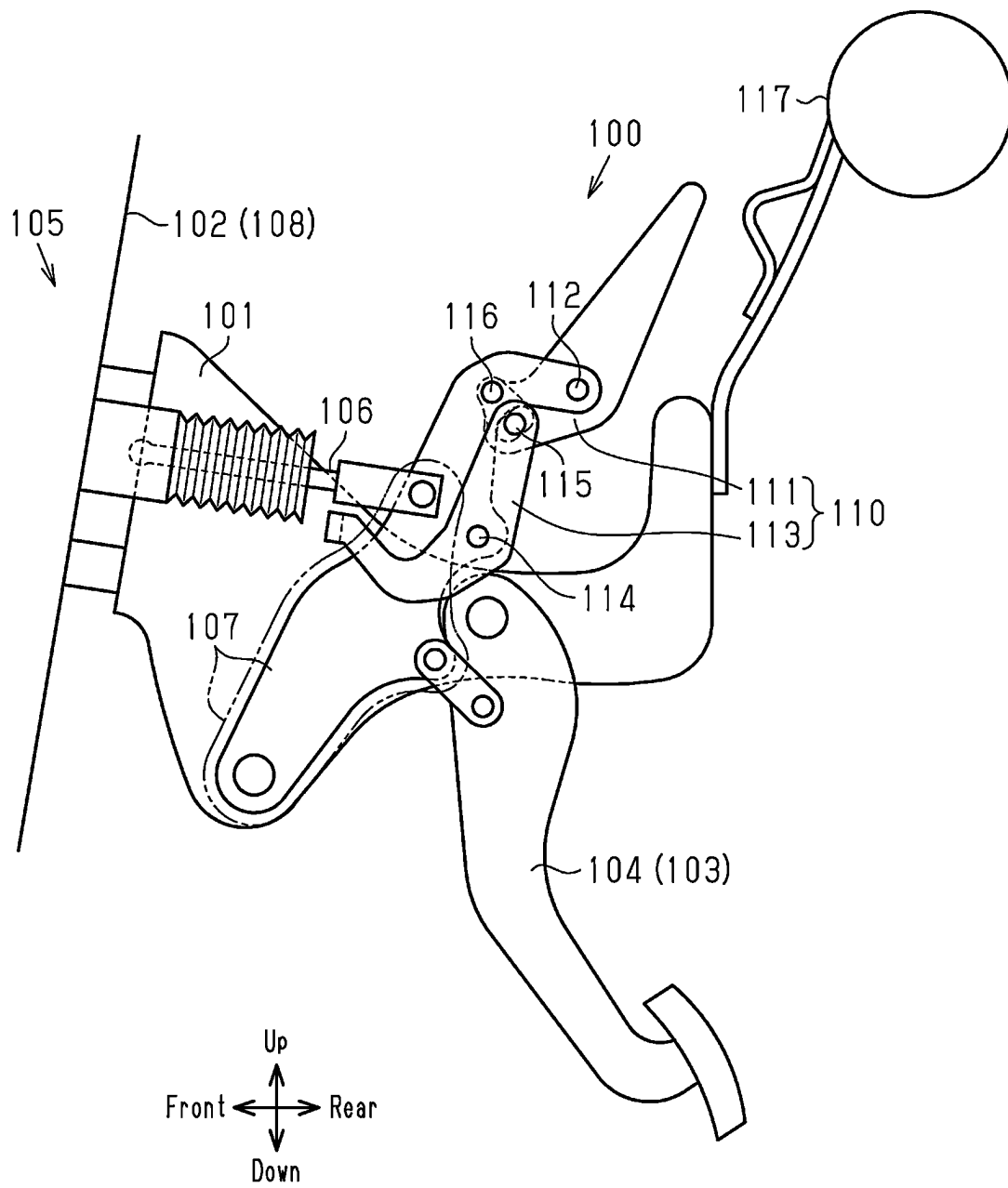


Fig.20



## OPERATION PEDAL DEVICE FOR VEHICLE

## CROSS-REFERENCE TO RELATED APPLICATIONS

This application is national stage application of International Application No. PCT/JP2023/020622, filed on Jun. 2, 2023, which claims the benefit of priority from Japanese Patent Application No. 2022-092267, filed on Jun. 7, 2022, the entire contents of each of which are incorporated herein by reference.

## TECHNICAL FIELD

The present disclosure relates to a vehicle operation pedal device.

## BACKGROUND ART

Vehicles such as automobiles are equipped with vehicle operation pedal devices used in brake devices, clutch devices, or the like. For instance, Patent Literature 1 discloses a brake pedal device **100** used in a brake device of a related art shown in FIG. **20**. The brake pedal device **100** includes a pedal bracket **101** and a brake pedal **103** as its basic structure. The pedal bracket **101** is fixed to the dash panel **102**. The brake pedal **103** includes a brake arm **104** rotatably supported by the pedal bracket **101**. The brake pedal device **100** actuates a brake booster **105** by moving a push rod **106**, which is the input shaft of the brake booster **105**, in conjunction with rotation of the brake arm **104**.

The brake pedal device **100** further includes a mechanism (rearward movement reduction mechanism), which reduces rearward movement of the brake pedal **103** (hereinafter, referred to as “rearward movement”) when an impact is applied to a vehicle body **108** from the front due to a collision of the vehicle. The rearward movement reduction mechanism includes a connecting arm **107**, a rotation arm **110**, and a rivet shaft **116**.

The connecting arm **107** is rotatably supported by the pedal bracket **101**. The connecting arm **107** connects the push rod **106** and the brake arm **104** to each other. The rotation arm **110** includes a first link **111**, which is rotatably supported by the connecting arm **107** via a first connecting shaft **112**, and a second link **113**, which is rotatably supported by the connecting arm **107** via a second connecting shaft **114**. The first link **111** and the second link **113** are connected to each other by a third connecting shaft **115**. The rivet shaft **116** is inserted through the first link **111**, the second link **113**, and the connecting arm **107**.

With the above-described brake pedal device **100**, the dash panel **102** moves rearward together with the brake pedal device **100** during a collision of the vehicle. The first link **111** comes into contact with an instrument panel reinforcement **117**, which is a vehicle body structural member disposed rearward of the dash panel **102**. When the first link **111** receives a load exceeding a threshold from the instrument panel reinforcement **117** due to this contact, the rivet shaft **116** breaks due to shearing or similar forms of stress. This allows both the first link **111** and the second link **113** to be rotatable relative to the connecting arm **107**. Rotation of the first link **111** is transmitted to the second link **113** via the third connecting shaft **115**. When rotating relative to the connecting arm **107**, the second link **113** presses the push rod **106** from below. This pressing action bends the push rod **106**, causing the brake pedal **103** to move forward.

## CITATION LIST

## Patent Literature

Patent Literature 1: Japanese Laid-Open Patent Publication No. 2015-72504

## SUMMARY OF INVENTION

## Technical Problem

However, in the brake pedal device **100** of the related art, in which the push rod **106** is connected to the connecting arm **107**, the following issues may arise during non-collision situations of the vehicle. If the connecting arm **107** is deformed or if the push rod **106** is disconnected from the connecting arm **107**, it becomes difficult to push the push rod **106** when the brake pedal **103** is depressed. This leads to difficulties in achieving a stable pedal operation.

The above-described issue is not limited to the brake pedal device **100**, but can commonly occur in any vehicle operation pedal device that moves the input shaft of a device to which depression force of an operation pedal is transmitted.

## Solution to Problem

In one general aspect of the present disclosure, a vehicle operation pedal device employed in a vehicle includes a partition wall that partitions a passenger compartment from a portion of a vehicle body forward of the passenger compartment, and a vehicle body structural member disposed behind the partition wall. The vehicle operation pedal device includes a pedal bracket fixed to the partition wall, an operation pedal, a rotation lever, and a shear portion. The operation pedal includes a pedal arm rotatably supported by the pedal bracket. An input shaft of a device to which a depression force of the operation pedal is transmitted is connected to the pedal arm. The operation pedal is configured such that the input shaft is moved in conjunction with rotation of the pedal arm. The rotation lever includes a contact portion and a pressing portion, is supported by the pedal arm via a rotation shaft, and is configured to, by receiving a load greater than or equal to a threshold when the contact portion comes into contact with the vehicle body structural member at a collision of the vehicle, rotate about the rotation shaft such that the pressing portion presses the input shaft in a direction intersecting with an axis of the input shaft. The shear portion is configured to fix the rotation lever to the pedal arm when the load applied to the rotation lever from the vehicle body structural member is less than the threshold. The shear portion is also configured to cancel the fixation by being broken when the load is greater than or equal to the threshold.

## BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a side view of a brake pedal device according to an embodiment together with a brake booster.

FIG. **2** is a perspective view of the brake pedal device shown in FIG. **1**.

FIG. **3** is a partial front view of the brake pedal device shown in FIG. **2** in a state in which a part of a pedal arm is omitted.

FIG. **4** is a plan view as seen from the direction of arrow A in FIG. **1**.

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FIG. 5 is a plan view corresponding to FIG. 4, showing a comparative example.

FIG. 6 is a partial cross-sectional view taken along line 6-6 in FIG. 1.

FIG. 7 is a partial side view of the brake pedal device together with the brake booster, in which an operation pedal is depressed from the state shown in FIG. 1.

FIG. 8 is a partial side view of the brake pedal device according to the embodiment of FIG. 1, in which an input shaft is being bent by a pressing portion at the time of collision of the vehicle.

FIG. 9 is a partial side view of the brake pedal device according to the embodiment of FIG. 1, in which the input shaft is further bent from the state of FIG. 8.

FIG. 10 is a partial side view illustrating a lever ratio in the brake pedal device shown in FIG. 1.

FIG. 11 is a partial side view illustrating a lever ratio in the brake pedal device shown in FIG. 1.

FIG. 12 is a partial cross-sectional view corresponding to FIG. 6, showing a rotation shaft and a shear portion according to a first modification.

FIG. 13 is a partial cross-sectional view corresponding to FIG. 6, showing a rotation shaft and a shear portion according to a second modification.

FIG. 14 is a partial side view of a brake pedal device, illustrating advantages of the second modification shown in FIG. 13.

FIG. 15 is a partial cross-sectional view corresponding to FIG. 6, showing a rotation shaft and a shear portion according to a third modification.

FIG. 16 is a partial cross-sectional view corresponding to FIG. 6, showing a rotation shaft and a shear portion according to a fourth modification.

FIG. 17 is a partial cross-sectional view corresponding to FIG. 6, showing a rotation shaft and a shear portion according to a fifth modification.

FIG. 18 is a side view showing a brake pedal device according to modification in which a rib is formed on a rotation lever.

FIG. 19 is a cross-sectional view taken along line 19-19 in FIG. 18.

FIG. 20 is a side view showing a brake pedal device of a related art.

### DESCRIPTION OF EMBODIMENTS

A brake pedal device, which is an example of a vehicle operation pedal device, will now be described with reference to FIGS. 1 to 11.

In the following description, the direction in which a vehicle 10 advances forward will be referred to as the front, and the reverse direction will be referred to as the rear. The vertical direction refers to the vertical direction of the vehicle 10, and the lateral direction refers to the vehicle width direction that corresponds with the lateral direction when the vehicle 10 is advancing forward.

As shown in FIG. 1, the vehicle 10 includes a dash panel 12, which is a partition wall. The dash panel 12 separates a passenger compartment 11 from a portion of a vehicle body 15 forward of the passenger compartment 11; for example, an engine compartment. An instrument panel reinforcement 13 and a collision bracket 14, which are vehicle body structural members, are disposed rearward of the dash panel 12. The instrument panel reinforcement 13 is a pipe-shaped member extending in the lateral direction to reinforce the

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vehicle body 15. The collision bracket 14 is fixed to a front lower portion of the instrument panel reinforcement 13.

### Basic Structure of Brake Device 20

The vehicle 10 is provided with a brake device 20 that applies a braking force to wheels (not shown). The brake device 20 includes a brake pedal device 21 and a brake booster 40, which is a booster device.

As shown in FIGS. 1 to 3, the brake pedal device 21 includes a pedal bracket 22 and an operation pedal 25. The pedal bracket 22 is fixed directly to the dash panel 12 or to a separate member attached to the dash panel 12. The pedal bracket 22 includes two side plate portions 23 disposed in parallel to each other in a state of being spaced apart from each other in the lateral direction. An operation shaft 24 extends between the two side plate portions 23.

The operation pedal 25 includes a pedal arm 26 and a pedal pad 28. The pedal arm 26 is formed from a metal plate. The pedal arm 26 is shaped to be longer in the vertical direction than in the front-rear direction. The pedal arm 26 is rotatably supported by the pedal bracket 22 at its upper end via the operation shaft 24. The pedal pad 28 is a portion to be depressed by the driver, and is fixed to the lower end of the pedal arm 26.

As shown in FIG. 1, the brake booster 40 (booster device) is an example of a device to which the depression force of the operation pedal 25 is transmitted. The brake booster 40 is configured to reduce the amount of depression force applied to the operation pedal 25, and includes a plunger 41 and an input shaft 42. The plunger 41 is movable in the front-rear direction. The input shaft 42 includes a push rod 43 and a clevis 44. An axis L1 of the push rod 43 extends in the front-rear direction and agrees with the axis of the input shaft 42. The push rod 43 has a ball portion 43a at the front end. The ball portion 43a is engaged with the plunger 41. The push rod 43 is swingable relative to the plunger 41 about the ball portion 43a. As shown in FIG. 4, the clevis 44 includes two side plates 45 arranged parallel to each other with a gap between them in the lateral direction. The clevis 44 also includes a connecting plate 46, which links the front ends of the side plates 45. In a top view, the clevis 44 forms a U-shape. A connecting pin 47 extends between rear end portions of the side plates 45. A central portion of the connecting plate 46 in the lateral direction is fixed to the rear end of the push rod 43. This fixation is achieved using fastening members 48 such as a bolt and a nut. Through this fixation, the push rod 43 and the clevis 44 are integrated as a single unit.

As shown in FIG. 1, the brake pedal device 21 actuates the brake booster 40 by moving (pushing) the input shaft 42 in conjunction with rotation of the pedal arm 26.

The brake pedal device 21 further includes a rearward movement reduction mechanism 50, which includes a rotation lever 51, a rotation shaft 60, and a shear portion 80. The axis L2 of the rotation shaft 60 and the axis L3 of the shear portion 80 both extend in the lateral direction. In the present embodiment, the pedal arm 26 has the same or similar external shape as a pedal arm used in a brake pedal device (not shown) that does not include the rearward movement reduction mechanism 50. No significant changes have been made to the shape of the pedal arm due to the addition of the rearward movement reduction mechanism 50.

### Rotation Lever 51

As shown in FIGS. 2 and 6, the rotation lever 51 is made of metal such as iron and is formed of a plate having a

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thickness smaller than that of the pedal arm 26. The lateral direction, which is a direction along the axis L2 of the rotation shaft 60, is a thickness direction of the rotation lever 51. The core structure of the rotation lever 51 is a plate-shaped lever main body 52, which is longer in the vertical direction than in the front-rear direction. As shown in FIGS. 1 and 2, the upper end of the lever main body 52 is positioned at about the same height as an intermediate portion of the collision bracket 14 in the vertical direction. The front lower end of the lever main body 52 is located below the operation shaft 24. The lever main body 52 is disposed in a state of being overlapped with one side in the thickness direction of the pedal arm 26, that is, on the left side in the present embodiment, but may be disposed in a state of being overlapped with the right side.

The rotation lever 51 further includes a contact portion 53 and a pressing portion 54. The contact portion 53 is formed on the rear surface of the upper end of the lever main body 52 at a position forward of the collision bracket 14.

As shown in FIGS. 2 and 4, the pressing portion 54 protrudes from the front edge of the front lower end of the lever main body 52 toward the pedal arm 26 in the thickness direction of the lever main body 52. In this example, the pressing portion 54 protrudes rightward. The pressing portion 54 has the shape of a plate that extends vertically. The pressing portion 54 has a lateral dimension larger than the thickness of the lever main body 52. In the present embodiment, the dimension of the pressing portion 54 in the lateral direction is set to a dimension close to the distance between the side plates 45 of the clevis 44. The pressing portion 54 is formed integrally with the lever main body 52 by bending the front lower end of the plate used to form the lever main body 52.

As shown in FIGS. 1 and 4, the pressing portion 54 is disposed below the instrument panel reinforcement 13 and the collision bracket 14 and above the input shaft 42. In addition, the pressing portion 54 is disposed such that an intermediate portion thereof in the lateral direction is located above the axis L1.

The rotation lever 51 is supported by the pedal arm 26 via the rotation shaft 60 at a rear lower end of the lever main body 52, the rear lower end being different from the contact portion 53 and the pressing portion 54.

The rotation lever 51 rotates about the rotation shaft 60 so that the pressing portion 54 presses the connecting plate 46 in a direction intersecting with (in the present embodiment, orthogonal to) the axis L1 when the following condition is met. The condition is that the rotation lever 51 receives a load greater than or equal to a predetermined threshold from the collision bracket 14 when the contact portion 53 comes into contact with the collision bracket 14 due to a collision of the vehicle 10.

As shown in FIG. 6, in order for the rotation lever 51 to be supported by the pedal arm 26 via the rotation shaft 60, an arm hole 31 is formed in the pedal arm 26 at a position rearward of the input shaft 42. A lever hole 55 having a larger diameter than the arm hole 31 is formed in the lever main body 52 at a position rearward of the input shaft 42. Rotation Shaft 60

The rotation shaft 60 is a metal stepped pin that includes a small diameter portion 61, a large diameter portion 62, and a flange 63. The small diameter portion 61 is fitted into the arm hole 31. An end of the small diameter portion 61 on the side farther from the lever main body 52 (on the right side) is exposed from the arm hole 31. An upset portion 64, which is larger in the radial direction than the small diameter portion 61, is formed at the exposed end by upsetting the

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end. The large diameter portion 62 has a larger diameter than the small diameter portion 61 and is fitted into the lever hole 55. The small diameter portion 61 is fixed to the pedal arm 26 by sandwiching the pedal arm 26 from the left and right sides by the large diameter portion 62 and the upset portion 64. An end of the large diameter portion 62 on the side farther from the pedal arm 26 (on the left side) is exposed from the lever hole 55. The flange 63 is formed at the end of the large diameter portion 62, and has a larger diameter than the lever hole 55. The flange 63 is separated from the lever main body 52 in a direction away from the pedal arm 26 (to the left side) by a gap G1. The rotation shaft 60 has the shear strength to withstand the load received by the rotation lever 51 from the collision bracket 14 during a collision of the vehicle 10 without breaking.

#### Shear Portion 80

The shear portion 80 has a function similar to that of what is generally called a shear pin. Specifically, the shear portion 80 fixes the rotation lever 51 to the pedal arm 26 when the load applied to the rotation lever 51 from the collision bracket 14 is less than the threshold. When the load applied to the rotation lever 51 is greater than or equal to the threshold, the shear portion 80 is broken to cancel the fixation. The fixation by the shear portion 80 refers to restriction of rotation of the rotation lever 51 about the rotation shaft 60 with respect to the pedal arm 26. This fixation includes not only a state in which the rotation lever 51 cannot move in the thickness direction of the rotation lever 51 with respect to the pedal arm 26, but also a state in which the rotation lever 51 can move in that direction.

In order to allow the shear portion 80 to exhibit the above-described functionality, an arm hole 32 is formed in the pedal arm 26 by pressing at a position obliquely forward and upward with respect to the arm hole 31. A lever hole 56 having a smaller diameter than the arm hole 32 is formed in the lever main body 52 at a position obliquely forward and upward with respect to the lever hole 55.

The shear portion 80 is a metal stepped pin including a large diameter portion 81, a flange 82, and a small diameter portion 83. The large diameter portion 81 is fitted into the arm hole 32. An end of the large diameter portion 81 on the side farther from the lever main body 52 (on the right side) is exposed from the arm hole 32. The flange 82 is formed at the end of the large diameter portion 81 and has a diameter larger than that of the arm hole 32.

The small diameter portion 83 has a smaller diameter than the large diameter portion 81 and is fitted into the lever hole 56. The small diameter portion 83 is formed to have a diameter smaller than that of the small diameter portion 61 of the rotation shaft 60. By setting the diameters as described above, the shear strength of the shear portion 80 is set to be smaller than the shear strength of the rotation shaft 60. An end of the small diameter portion 83 on the side farther from the pedal arm 26 (on the left side) is exposed from the lever hole 56. An upset portion 84, which is larger in the radial direction than the small diameter portion 83, is formed at the exposed end by upsetting the end.

From the perspective of ensuring that the shear portion 80 breaks during a collision of the vehicle 10, it is preferable to use, as the shear portion 80, a straight pin having a relatively small diameter in the large diameter portion 81 as well as in the small diameter portion 83. This would require the diameter of the arm hole 32 to be relatively small like the diameter of the lever hole 56. Nevertheless, the diameter of the arm hole 32 is made larger than the diameter of the lever

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hole 56, and a stepped pin is used for the following reason. As described above, the thickness of the pedal arm 26 is greater than the thickness of the lever main body 52. If an arm hole 32 with a small diameter, similar to the lever hole 56, were formed in the relatively thick pedal arm 26, it would be necessary to perform machining (formation of a pilot hole, reaming, chamfering). This would increase the cost of formation.

In contrast, forming the arm hole 32 through pressing can be done at a lower cost than machining, leading to a reduction in the overall cost of the structure that fixes the rotation lever 51 using the shear portion 80.

Further, in the present embodiment, as shown in FIGS. 1 and 4, the input shaft 42 of the brake booster 40 is connected to the pedal arm 26. Specifically, the pedal arm 26 includes a clevis hole 27 in a part of the front portion, in the present embodiment, at a position forward of the rotation shaft 60 (arm hole 31). The clevis hole 27 and its peripheral portion of the pedal arm 26 are disposed between the side plates 45 of the clevis 44. As described above, the connecting pin 47 extending between the side plates 45 is inserted into the clevis hole 27. The push rod 43 is connected to the pedal arm 26 by the clevis 44 and the connecting pin 47.

Operation of the above-described present embodiment will now be described.

#### Non-Collision State of Vehicle 10

FIG. 1 shows the brake pedal device 21 when the vehicle 10 is not in a collision, and the operation pedal 25 is not being depressed by the driver. The contact portion 53 of the rotation lever 51 is separated forward from the collision bracket 14. The shear portion 80 fixes the rotation lever 51 to the pedal arm 26 together with the rotation shaft 60 in a state in which the position of the rotation lever 51 is determined in the rotation direction around the rotation shaft 60. The pressing portion 54 is separated upward from the connecting plate 46.

FIG. 7 shows the brake pedal device 21 when the vehicle 10 is not in a collision, and the operation pedal 25 is being depressed by the driver, applying force to the pedal pad 28. During this depression operation, the operation pedal 25 rotates forward around the operation shaft 24. This rotation is transmitted to the push rod 43 via the connecting pin 47 and the clevis 44. The push rod 43 is moved (pushed forward) so as to actuate the brake booster 40. The shear portion 80 fixes the rotation lever 51 to the pedal arm 26 together with the rotation shaft 60. Therefore, the rotation lever 51 moves integrally with the operation pedal 25 around the operation shaft 24 at a position away from the collision bracket 14. The pressing portion 54 is separated obliquely rearward and upward from the connecting plate 46.

#### Collision State of Vehicle 10

From the state shown in FIG. 1, when an external force (impact) is applied to the vehicle body 15 from the front due to a collision of the vehicle 10, the dash panel 12 moves rearward together with the brake pedal device 21. This reduces the distance between the dash panel 12 and the collision bracket 14. When the rotation lever 51 comes into contact with the collision bracket 14 at the contact portion 53, the rotation lever 51 receives a load (reaction force) from the collision bracket 14. This load acts on the rotation shaft 60 and the shear portion 80.

When the load received by the rotation lever 51 from the collision bracket 14 is greater than or equal to the threshold,

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the shear portion 80 is broken (cut) due to shearing or similar forms of stress. The rotation shaft 60 is not broken. The fixation of the rotation lever 51 to the pedal arm 26 by the shear portion 80 is cancelled. This allows the rotation lever 51 to rotate around the rotation shaft 60 with respect to the pedal arm 26.

The rotation lever 51 rotates forward, and the pressing portion 54 comes into contact with the connecting plate 46 from above. As shown in FIGS. 8 and 9, the pressing portion 54 presses the connecting plate 46 downward in a direction intersecting with the axis L1 of the push rod 43 (a direction orthogonal to the axis L1 in the present embodiment). This pressing action bends the input shaft 42 downward. Due to the bending action, the operation pedal 25, in particular, the pedal pad 28, moves forward, which is the direction of depression of the pedal pad 28. In FIGS. 8 and 9, the pedal arm 26 indicated by the long-dash double-short-dash lines indicates the position of the pedal arm 26 before the collision of the vehicle 10. In this manner, the rearward movement of the operation pedal 25 at the time of collision of the vehicle 10 is reduced.

The present embodiment has the following advantages.

(1) In the present embodiment, the input shaft 42 of the brake booster 40 is connected to the pedal arm 26 as shown in FIG. 1. The phenomenon in which the push rod 106 connected to the connecting arm 107 of the related art shown in FIG. 20 is detached from the connecting arm 107 does not occur in the present embodiment. Further, as shown in FIG. 1, in the present embodiment, even if the rotation lever 51 is deformed, the connection state of the input shaft 42 to the pedal arm 26 is not affected. Therefore, in a non-collision state of the vehicle 10, the input shaft 42 can be stably moved (pushed) in conjunction with rotation of the pedal arm 26 regardless of the state of the rotation lever 51 in the present embodiment. In a non-collision state of the vehicle 10, the brake booster 40 can be actuated by stably performing the depression operation of the operation pedal 25 similarly to the brake pedal device not provided with a rearward movement reduction mechanism.

(2) If the vehicle body structural members (the instrument panel reinforcement 13 and the collision bracket 14) were positioned at the same height as in the present embodiment, the advantage of item (1) would also be obtained by pressing the input shaft 42 from below with the pressing portion 54. In this case, however, since the pressing portion 54 would need to be located below the input shaft 42, the rotation lever 51 would have a complicated shape and be increased in size. In this regard, in the present embodiment, the pressing portion 54 is disposed below the vehicle body structural member (the collision bracket 14) and above the input shaft 42 as shown in FIG. 1. Therefore, the input shaft 42 can be pressed from above by the pressing portion 54, allowing the rotation lever 51 to have a simple shape and reduced size.

(3) When the shear portion 80 is broken upon a collision of the vehicle 10, the rotation lever 51 becomes rotatable relative to the pedal arm 26 as described above. In this situation, if the flange 63 of the rotation shaft 60 is in contact with the lever main body 52, the rotation lever 51 may resist rotation due to sliding resistance between the flange 63 and the lever main body 52. In this regard, in the present embodiment, the small diameter portion 61 is fixed to the pedal arm 26 by sandwiching the pedal arm 26 from both left and right sides by the large diameter portion 62 and the upset portion 64 as shown in FIG. 6. In this state, the flange 63 is separated from the lever main body 52 by the gap G1. By setting the gap G1, the sliding resistance between the flange 63 and the lever main body 52 is reduced, allowing the

rotation lever **51** to rotate smoothly. This improves the rearward movement reduction performance of the rearward movement reduction mechanism **50**.

(4) In the present embodiment, the pressing portion **54** has the shape of a plate extending in the vertical direction as shown in FIGS. **1** to **4**. This configuration increases the strength of the pressing portion **54** in the vertical direction, which is the bending direction of the input shaft **42**. The pressing portion **54** is thus prevented from being deformed when the input shaft **42** is bent. By designing the shape of the rotation lever **51** in this manner, the strength in the vertical direction of the pressing portion **54** is increased. Thus, there is no need to add separate components for the same purpose.

(5) As shown in FIG. **5**, a part of the front end of the lever main body **52** that is parallel to the axis **L1** of the push rod **43** may be used as the pressing portion **54**. In this case, the dimension of the pressing portion **54** in the lateral direction is the same as the thickness of the lever main body **52**. The contact area of the pressing portion **54** with the connecting plate **46** is relatively small. The input shaft **42** is swingable about the ball portion **43a**. Thus, if the pressing portion **54** presses the connecting plate **46** at a position deviated from the axis **L1** in the lateral direction, the following concern arises. When that deviated position of the connecting plate **46** is pressed by the small contact area of the pressing portion **54**, a force is generated that attempts to rotate the input shaft **42** around the axis **L1**, as indicated by arrow **B**. The pressing portion **54** presses the connecting plate **46** downward in a state in which the balance in the lateral direction is disrupted. In other words, the pressing force of the pressing portions **54** is used to rotate the input shaft **42** about the axis **L1**. Accordingly, the pressing force used to bend the input shaft **42** is reduced, and the bending efficiency may thus be reduced.

In this regard, in the present embodiment, the dimension of the pressing portion **54** in the lateral direction is larger than the thickness of the lever main body **52** as shown in FIG. **4**. The contact area of the pressing portion **54** with the connecting plate **46** is larger than that of the comparative example of FIG. **5**. The pressing portion **54** presses the connecting plate **46** downward in a state in which the balance in the lateral direction is maintained. This restricts rotation of the input shaft **42** about the axis **L1**. The pressing force of the pressing portion **54** is less likely to be used to rotate the input shaft **42** about the axis **L1**. The pressing force of the pressing portion **54** is predominantly used to bend the input shaft **42**, thereby preventing a reduction in bending efficiency. This allows for stable bending of the input shaft **42**.

It is possible to increase the contact area with the connecting plate **46** by adding another component to the rotation lever **51**. However, this would increase the number of components. In the present embodiment, since the pressing portion **54**, which is a part of the rotation lever **51**, has a large contact area with the connecting plate **46**, it is not necessary to add another component.

(6) In the present embodiment, the pressing portion **54** is formed by bending a portion (front end) of the plate used to form the lever main body **52** as shown in FIG. **4**. In other words, the pressing portion **54** is formed integrally with the lever main body **52**. Therefore, a separate member for forming the pressing portion **54** is unnecessary.

(7) The rearward movement reduction mechanism of the related art shown in FIG. **20** includes the connecting arm **107**, the first link **111**, the second link **113**, the first connecting shaft **112**, the second connecting shaft **114**, the third

connecting shaft **115**, and the rivet shaft **116**. The number of parts forming the rearward movement reduction mechanism is large. In particular, there are many shafts for rotation (the first connecting shaft **112** and the second connecting shaft **114**). Therefore, the cost of components and the cost required for assembly increase, and the rearward movement reduction mechanism is relatively large in size.

In contrast, in the present embodiment, the rearward movement reduction mechanism **50** includes a smaller number of components, including the rotation lever **51**, the rotation shaft **60**, and the shear portion **80** as shown in FIG. **1**. There is only one shaft for rotation (the rotation shaft **60**). Further, the lever main body **52**, the contact portion **53**, and the pressing portion **54** are formed as a single component. This configuration reduces the cost of components and the cost required for assembly. Furthermore, the compact design of the rearward movement reduction mechanism **50** allows for space-saving optimization.

(8) The rearward movement reduction mechanism **50** is capable of adjusting the load applied from the collision bracket **14** to the contact portion **53** and the force with which the pressing portion **54** bends the input shaft **42** during a collision of the vehicle **10**, by changing the position of at least one of the rotation shaft **60** or the shear portion **80**.

As shown in FIGS. **10** and **11**, the distance from the axis **L2** of the rotation shaft **60** to the contact portion **53** is defined as **R1**. The distance from the axis **L2** to the contact point of the pressing portion **54** with the connecting plate **46** is defined as **R2**. The distance from the axis **L2** to the axis **L3** of the shear portion **80** is defined as **R3**. Distances **R1** to **R3** indicated by solid lines in FIG. **10** indicate the distances **R1** to **R3** in the rearward movement reduction mechanism **50** of the present embodiment.

The ratio of the distance **R1** to the distance **R2** (**R1/R2**) is referred to as a bending lever ratio. By changing the position of the rotation shaft **60**, at least one of the distances **R1** and **R2** is changed, and the bending lever ratio (**R1/R2**) is changed.

By increasing the bending lever ratio (**R1/R2**), the load applied to the contact portion **53** is reduced. For example, when the position of the rotation shaft **60** is changed obliquely forward and downward, the distance **R1** becomes longer and the distance **R2** becomes shorter than those in the present embodiment as indicated by the long-dash double-short-dash lines in FIG. **10**. Accordingly, the bending lever ratio (**R1/R2**) increases as compared to that of the present embodiment, and the load applied to the contact portion **53** decreases.

Conversely, by decreasing the bending lever ratio (**R1/R2**), the amount by which the pressing portion **54** bends the input shaft **42** is increased, enhancing the rearward movement reduction effect. For example, when the position of the rotation shaft **60** is changed obliquely rearward and upward, the distance **R1** becomes shorter and the distance **R2** becomes longer than those in the present embodiment as indicated by the long-dash double-short-dash lines in FIG. **11**. Accordingly, the bending lever ratio (**R1/R2**) decreases as compared to that of the present embodiment, and the amount by which the pressing portion **54** bends the input shaft **42** increases.

Further, as shown in FIGS. **10** and **11**, the ratio of the distance **R1** to the distance **R3** (**R1/R3**) is defined as a shear lever ratio. By changing the position of at least one of the rotation shaft **60** and the shear portion **80**, the distances **R1** and **R3** are changed, so that the shear lever ratio is changed (**R1/R3**).



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By increasing the shear lever ratio ( $R1/R3$ ), the load applied to the contact portion **53** is reduced. For example, when the position of the shear portion **80** is changed downward, the distance  $R3$  becomes shorter than that in the present embodiment as indicated by the broken lines in FIG. **11**. Accordingly, the shear lever ratio ( $R1/R3$ ) increases as compared to that of the present embodiment, and the load applied to the contact portion **53** decreases.

The rearward movement reduction mechanism **50** of the present embodiment uses only one rotation shaft **60** as a shaft for rotation as shown in FIG. **1**. Therefore, in the present embodiment, it is easy to design the positions of the rotation shaft **60** and the shear portion **80**. Consequently, it is easy to achieve the optimal settings needed to meet the target values for the rearward movement reduction performance required for the rearward movement reduction mechanism **50** in each vehicle **10**. Moreover, the operation of each component of the rearward movement reduction mechanism **50** is unlikely to be overly complex.

The rearward movement reduction mechanism of the related art shown in FIG. **20** can also adopt a similar lever ratio design as the present embodiment. However, the mechanism of the related art uses multiple members (the first connecting shaft **112** and the second connecting shaft **114**) as shafts for rotation. Therefore, complex design requirements are imposed, making the design process difficult. Moreover, the operation of each component of the rearward movement reduction mechanism is overly complex.

(9) As shown in FIGS. **1** and **6**, the pedal arm **26** of the present embodiment has the same or a similar external shape as the pedal arm in a brake pedal device (not shown) that does not include the rearward movement reduction mechanism **50**. The shape of the pedal arm has not been significantly altered for the formation of the arm holes **31**, **32**. Therefore, the size of the pedal arm **26** is not increased due to the addition of the rearward movement reduction mechanism **50**.

In contrast, in the related art configuration shown in FIG. **20**, the brake arm **104** and the connecting arm **107** connected to the brake arm **104** correspond to the pedal arm **26** of the present embodiment. If the brake pedal device **100** of the related art did not include the rearward movement reduction mechanism, the connecting arm **107** would have a shape indicated by the long-dash double-short-dash lines in FIG. **20**. In order to form portions through which the first connecting shaft **112**, the second connecting shaft **114**, and the rivet shaft **116** are respectively inserted, the connecting arm **107** would need to be expanded upward as shown by the solid lines in FIG. **20**. Of the brake arm **104** and the connecting arm **107**, which correspond to the pedal arm **26** of the present embodiment, the size of the connecting arm **107** is increased.

The above-described embodiment may be modified as follows. The above-described embodiment and the following modifications can be combined as long as the combined modifications remain technically consistent with each other.

Modifications to Rotation Lever **51**

In a case in which the lever main body **52** is a plate longer in the vertical direction than in the front-rear direction as shown in FIGS. **18** and **19**, a rib **57** extending in the vertical direction may be formed along the rear edge of the lever main body **52**. The rib **57** is formed by bending a plate used for forming the lever main body **52** toward one side in the thickness direction, that is, toward the left side in FIGS. **18**

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and **19**. The formation of the rib **57** increases the stiffness of the rotation lever **51**. This configuration prevents the rotation lever **51** from being deformed or tilted in the lateral direction even if the rotation lever **51** receives a large load from the collision bracket **14**. Additionally, the configuration prevents the rotation lever **51** from being deformed due to the reaction force from the input shaft **42** when the input shaft **42** is bent by the pressing portion **54**. Moreover, it is not necessary to add separate components to increase the stiffness of the lever main body **52**, which reduces the cost of the rotation lever **51**.

The rib **57** may be formed to extend vertically along the front edge of the lever main body **52** instead of or in addition to the rear edge. The rib **57** may also be formed as a separate member from the lever main body **52**.

As shown in FIG. **5**, a part of the lever main body **52** parallel to the axis  $L1$  of the push rod **43** may be the pressing portion **54**. If the pressing portion **54** protrudes to the left or right from the lever main body **52**, the dimension in the lateral direction of the pressing portion **54** may be changed to be larger or smaller than that of the above-described embodiment.

The location at which the pressing portion **54** presses the clevis **44** may be changed to a location different from the connecting plate **46**. Further, the location at which the pressing portion **54** presses the input shaft **42** may be changed to a location different from the clevis **44**.

At least one of the contact portion **53** and the pressing portion **54** may be formed by a member separate from the lever main body **52**.

The pressing portion **54** may press the input shaft **42** in a direction obliquely intersecting with the axis  $L1$ .

Modifications to Rotation Shaft **60** and Shear Portion **80**

As shown in FIGS. **12** to **17**, the rotation shaft **60** and the shear portion **80** may be changed to those having configurations different from those of the above-described embodiment.

In a first modification shown in FIG. **12**, the arm hole **31** and the lever hole **55** are formed to have the same diameter. The rotation shaft **60** may be a metal straight pin that is fitted into the arm hole **31** and the lever hole **55** and includes a shaft **65** having a uniform diameter and a flange **66**. In this case, an end of the shaft **65** on the side farther from the pedal arm **26** (on the left side) is exposed from the lever hole **55**. The flange **66** is formed at the exposed end, and has a larger diameter than the lever hole **55**. An end of the shaft **65** on the side farther from the lever main body **52** (on the right side) is exposed from the arm hole **31**. An upset portion **67**, which is larger in the radial direction than the shaft **65**, is formed at the exposed end by upsetting the end.

Similarly to the above-described embodiment, the rotation shaft **60** fixes the rotation lever **51** to the pedal arm **26** together with the shear portion **80** in a non-collision state of the vehicle **10**, and serves as the center of rotation of the rotation lever **51** at the time of collision. This also applies to the rotation shaft **60** in each of the modifications shown in FIGS. **13** to **17**.

In the first modification shown in FIG. **12**, the arm hole **32** and the lever hole **56** are formed to have the same diameter. The shear portion **80** may be a metal straight pin that is fitted into the arm hole **32** and the lever hole **56** and includes a shaft **85** having a uniform diameter and a flange **86**. In this case, an end of the shaft **85** on the side farther from the pedal arm **26** (on the left side) is exposed from the lever hole **56**.

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The flange **86** is formed at the exposed end, and has a larger diameter than the lever hole **56**. An end of the shaft **85** on the side farther from the lever main body **52** (on the right side) is exposed from the arm hole **32**. An upset portion **87**, which is larger in the radial direction than the shaft **85**, is formed at the exposed end by upsetting the end.

Similarly to the above-described embodiment, in a non-collision state of the vehicle **10**, the shear portion **80** fixes the rotation lever **51** to the pedal arm **26** together with the rotation shaft **60** in a state in which the position of the rotation lever **51** is determined in the rotation direction around the rotation shaft **60**. This also applies to each of the modifications shown in FIGS. **13** to **15**.

As in a second modification shown in FIG. **13**, the rotation shaft **60** may be formed by a combination of a nut **69** and a bolt **68** including a head **68a** and a shaft **68b**. In this case, the arm hole **31** and the lever hole **55** are formed to have the same diameter. The shaft **68b** is inserted through the arm hole **31** and the lever hole **55**. The head **68a** may be disposed on the opposite side (right side) of the pedal arm **26** from the lever main body **52**, or may be disposed on the opposite side (left side) of the lever main body **52** from the pedal arm **26**. The nut **69** is fastened to an end of the shaft **68b** on the side opposite to the head **68a**.

In the rotation shaft **60** of the second modification, the distance between the nut **69** and the head **68a** of the bolt **68** can be changed. Therefore, even when multiple types of pedal arms **26** having different thicknesses are used, the rotation shaft **60** can be applied to each of the pedal arms **26**. By fastening the bolts **68** and the nuts **69**, the difference in thickness can be absorbed, and the manufacturing cost will be reduced.

Further, the modification is expected to provide the following advantages. Since, as shown in FIG. **14**, the rotational direction in which the nut **69** is loosened is the same as the rotational direction of the rotation lever **51** when the rearward movement reduction mechanism **50** is operated, the rotation lever **51** functions as a tool for loosening the nut **69** when the rearward movement reduction mechanism **50** operates. Specifically, when the rotation lever **51** is rotated forward as indicated by arrow C in FIG. **14**, the nut **69** is loosened. In FIG. **14**, the counterclockwise direction of the arrow over the nut **69** is the direction in which the nut **69** is loosened, and the clockwise direction of the arrow is the direction in which the nut **69** is tightened. The fastening force by the bolt **68** and the nut **69** is reduced, and the rotation lever **51** is easily rotated forward. This improves the rearward movement reduction performance of the rearward movement reduction mechanism **50**.

The rotation shaft **60**, which includes the combination of the bolt **68** and the nut **69**, is also used as the rotation shaft **60** in each of the modifications shown in FIGS. **15** to **17**. As shown in FIG. **13**, the shear portion **80** may include a combination of a bolt **88** and a nut **89**, similarly to the rotation shaft **60** in FIG. **13**. In this case, the lever hole **56** is formed to have a diameter smaller than that of the arm hole **32** as in the above-described embodiment. The bolt **88** includes a head **88a**, a large diameter shaft portion **88b**, and a small diameter shaft portion **88c**, which has a smaller diameter than the large diameter shaft portion **88b**. The head **88a** is disposed on the opposite side (right side) of the pedal arm **26** from the lever main body **52**. The large diameter shaft portion **88b** is inserted through a large portion of the arm hole **32**. The small diameter shaft portion **88c** is inserted through the entire lever hole **56** and a part of the arm hole

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**32**. The nut **89** is fastened to an end of the small diameter shaft portion **88c** on the side (left side) opposite to the head **88a**.

As in the third modification shown in FIG. **15**, the lever main body **52** may include a circular protrusion **91** that is formed by plastically deforming a part of the lever main body **52** by pressing, and the protrusion **91** may be used as the shear portion **80**. The protrusion **91** is engaged with the arm hole **32**. The shear portion **80** does not sandwich the lever main body **52** and the pedal arm **26** from the left and right sides. However, this does not cause any issues because the rotation shaft **60** sandwiches the lever main body **52** and the pedal arm **26** from the left and right sides.

With the third modification, since a part of the lever main body **52** functions as the shear portion **80**, a separate component for fixing such as a stepped pin or a straight pin is not necessary. Further, the lever hole **56** is also unnecessary. In addition, the cost required for forming the shear portion **80** is reduced.

The protrusion **91** may have an outer shape different from a circular shape. In this case, the shape of the arm hole **32** is changed in accordance with the outer shape of the protrusion **91**.

As in a fourth modification shown in FIG. **16**, the shear portion **80** may be formed by plastic molding using a plastic. In this case, the arm hole **32** and the lever hole **56** are formed to have the same diameter. The shear portion **80** includes a shaft **92**, a flange **93**, and multiple locking lugs **94**. The shaft **92** is fitted in the lever hole **56** and at least a portion of the arm hole **32** adjacent to the lever hole **56**. A part of the shaft **92** is inserted into the arm hole **32**. An end of the shaft **92** on the side farther from the pedal arm **26** (on the left side) is exposed from the lever hole **56**. The flange **93** is formed at the exposed end, and has a larger diameter than the lever hole **56**. The locking lugs **94** extend from the outer circumferential portion of the shaft **92** in a direction away from the lever main body **52** (right side) along the axis L3, and are elastically deformable in the radial direction of the shaft **92**. Distal ends of the locking lugs **94** are exposed from the arm hole **32**. Each locking lug **94** includes a hook **94a**, which protrudes outward in the radial direction of the shaft **92**, in the exposed portion. The distance between the shaft **92** and the hook **94a** is less than the thickness of the pedal arm **26**. The hook **94a** of each locking lug **94** is locked to a peripheral portion of the arm hole **32** in the pedal arm **26**.

In a case in which the rotation lever **51** is fixed to the pedal arm **26** by the shear portion **80** of the fourth modification, the shear portion **80** is inserted into the lever hole **56** and the arm hole **32** in that order with the hooks **94a** at the leading end. This insertion is performed in a state in which the locking lugs **94** are elastically deformed inward in the radial direction of the shaft **92**. When the shear portion **80** is inserted to a position where the hooks **94a** are exposed from the arm hole **32**, each of the locking lugs **94** is elastically deformed radially outward by an elastic restoring force. The hook **94a** of each locking lug **94** is locked to a peripheral portion of the arm hole **32** in the pedal arm **26**. In this manner, a method of fixing the rotation lever **51** to the pedal arm **26** by inserting and locking the shear portion **80** into the lever hole **56** and the arm hole **32** using the elasticity of the locking lugs **94** is also referred to as snap-fit fixing.

The fourth modification facilitates the work of fixing the rotation lever **51** to the pedal arm **26** using the shear portion **80**. In addition, the fourth modification has an advantage in that the shear portion **80** can be formed at a lower cost than in a case in which an iron pin is used as the shear portion **80**.

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In addition, the portion of the shaft **92** that extends into the arm hole **32** is used to position the rotation lever **51** in the rotational direction around the rotation shaft **60**. The shear portion **80** fixes the rotation lever **51** to the pedal arm **26** together with the rotation shaft **60** in a state in which the positioning is completed.

In a case in which the shear portion **80** is a pin made of molded plastic, the shear portion **80** can be formed with higher precision than a shear portion **80** that is a protrusion (protrusion **91**) produced by pressing shown in FIG. **15**. This allows for more stable positioning accuracy.

FIG. **17** shows a fifth modification, in which a pedal arm **26** with a smaller thickness than that used in FIG. **16** is employed. Even in this case, since at least a part of the shaft **92** is fitted into the arm hole **32**, the positioning function is maintained. In other words, the shear portion **80** of this modification can be applied to various types of pedal arms **26** with different plate thicknesses. Therefore, it is possible to standardize the component (shear portion **80**).

When the pedal arm **26** having a thickness smaller than that of FIG. **16** is used as shown in FIG. **17**, a total value **T2** of the thicknesses of the pedal arm **26** and the lever main body **52** is smaller than the distance **T1** between the flange **93** and the hook **94a**. In a state in which the pedal arm **26** is in contact with the hook **94a** and the lever main body **52** is in contact with the pedal arm **26**, a gap **G2** is created between the lever main body **52** and the flange **93**. The gap **G2** allows the rotation lever **51** to move in a direction along the axis **L3** of the shear portion **80**. However, the movement is restricted by the flange **93**.

In this case, the force with which the shear portion **80** sandwiches the lever main body **52** and the pedal arm **26** from the left and right sides is relatively small. However, this does not cause any issues because the rotation shaft **60** sandwiches the lever main body **52** and the pedal arm **26** from the left and right sides.

In addition, the strength of a plastic product is generally lower than the strength of a product made of metal such as iron. Therefore, even if the shaft **92** in the modification is made thicker (increased in diameter) than the small diameter portion **83** in the above-described embodiment (see FIG. **6**), the shaft **92** can be broken by shearing or the like.

The combination of the rotation shaft **60** and the shear portion **80** in the rearward movement reduction mechanism **50** may be changed to a combination different from that used in the above-described embodiment and the modifications shown in FIGS. **12** to **17**.

## Other Modifications

The vehicle body structural member with which the rotation lever **51** comes into contact at the time of collision of the vehicle **10** may be the instrument panel reinforcement **13** instead of the collision bracket **14**, or may be a separate member that is fixed to the instrument panel reinforcement **13** and is different from the collision bracket **14**.

The input shaft **42** may be pressed from below by the pressing portion **54**.

The pedal arm **26** may have a shape different from that of a pedal arm in a brake pedal device (not shown) that is not provided with the rearward movement reduction mechanism **50**.

The above-described vehicle operation pedal device can be employed in a wide range of applications, such as a booster device to which the depression force of the operation

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pedal is transmitted. In addition to the brake pedal device **21**, applicable devices include clutch pedal devices and accelerator pedal devices.

The above-described embodiments include configurations described in the following clauses.

## Clause 1

A vehicle operation pedal device employed in a vehicle including a partition wall that partitions a passenger compartment from a portion of a vehicle body forward of the passenger compartment, and a vehicle body structural member disposed behind the partition wall, the vehicle operation pedal device including:

- a pedal bracket fixed to the partition wall;
- an operation pedal that includes a pedal arm rotatably supported by the pedal bracket, in which
  - an input shaft of a device to which a depression force of the operation pedal is transmitted is connected to the pedal arm, and
  - the operation pedal is configured such that the input shaft is moved in conjunction with rotation of the pedal arm;

a rotation lever that

- includes a contact portion and a pressing portion, is supported by the pedal arm via a rotation shaft, and is configured to, by receiving a load greater than or equal to a threshold when the contact portion comes into contact with the vehicle body structural member at a collision of the vehicle, rotate about the rotation shaft such that the pressing portion presses the input shaft in a direction intersecting with an axis of the input shaft; and

a shear portion that is configured to

- fix the rotation lever to the pedal arm when the load applied to the rotation lever from the vehicle body structural member is less than the threshold, and cancel the fixation by being broken when the load is greater than or equal to the threshold.

## Clause 2

The vehicle operation pedal device according to clause 1, in which the pressing portion is disposed below the vehicle body structural member and above the input shaft.

## Clause 3

The vehicle operation pedal device according to clause 1 or clause 2, in which

- a direction along an axis of the rotation shaft is a thickness direction of the rotation lever, and
- the rotation lever includes:
  - a plate-shaped lever main body that is longer in a vertical direction than in a front-rear direction; and
  - a rib that extends in the vertical direction along at least one of a front edge or a rear edge of the lever main body.

## Clause 4

The vehicle operation pedal device according to any one of clauses 1 to 3, in which

- the pedal arm includes an arm hole,
- the rotation lever includes a lever hole having a larger diameter than the arm hole,
- the rotation shaft includes:
  - a large diameter portion fitted in the lever hole;
  - a small diameter portion fitted in the arm hole and fixed to the pedal arm; and
  - a flange located at an end of the large diameter portion exposed from the lever hole, the flange having a larger diameter than the lever hole, and
- the flange is separated from the rotation lever in a direction away from the pedal arm.

## REFERENCE SIGNS LIST

- 10) Vehicle
- 11) Passenger Compartment
- 12) Dash Panel (Partition Wall) 5
- 13) Instrument Panel Reinforcement (Vehicle Body Structural Member)
- 14) Collision Bracket (Vehicle Body Structural Member)
- 15) Vehicle Body
- 21) Brake Pedal Device (Vehicle Operation Pedal Device) 10
- 22) Pedal Bracket
- 25) Operation Pedal
- 26) Pedal Arm
- 31, 32) Arm Holes
- 40) Brake Booster (Device to which Depression Force is Transmitted) 15
- 42) Input Shaft
- 51) Rotation Lever
- 52) Lever Main Body
- 53) Contact Portion
- 54) Pressing Portion
- 55, 56) Lever Holes
- 57) Rib
- 60) Rotation Shaft
- 61) Small Diameter Portion
- 62) Large Diameter Portion
- 63) Flange
- 80) Shear Portion
- L1, L2, L3) Axes

The invention claimed is:

1. A vehicle operation pedal device employed in a vehicle including a partition wall that partitions a passenger compartment from a portion of a vehicle body forward of the passenger compartment, and a vehicle body structural member disposed behind the partition wall, the vehicle operation pedal device comprising:

- a pedal bracket fixed to the partition wall;
- an operation pedal that includes a pedal arm rotatably supported by the pedal bracket, wherein
- an input shaft of a device to which a depression force of the operation pedal is transmitted is connected to the pedal arm, and
- the operation pedal is configured such that the input shaft is moved in conjunction with rotation of the pedal arm;

a rotation lever that includes a contact portion and a pressing portion, is supported by the pedal arm via a rotation shaft, and is configured to, by receiving a load greater than or equal to a threshold when the contact portion comes into contact with the vehicle body structural member at a collision of the vehicle, rotate about the rotation shaft such that the pressing portion presses the input shaft in a direction intersecting with an axis of the input shaft; and

a shear portion that is configured to fix the rotation lever to the pedal arm when the load applied to the rotation lever from the vehicle body structural member is less than the threshold, and cancel the fixation by being broken when the load is greater than or equal to the threshold.

2. The vehicle operation pedal device according to claim 1, wherein the pressing portion is disposed below the vehicle body structural member and above the input shaft.

3. The vehicle operation pedal device according to claim 1, wherein

a direction along an axis of the rotation shaft is a thickness direction of the rotation lever, and the rotation lever includes:

a lever main body that is longer in a vertical direction than in a front-rear direction; and

a rib that extends in the vertical direction along at least one of a front edge or a rear edge of the lever main body.

4. The vehicle operation pedal device according to claim 1, wherein

the pedal arm includes an arm hole,

the rotation lever includes a lever hole having a larger diameter than the arm hole,

the rotation shaft includes:

a first diameter portion fitted in the lever hole;

a second diameter portion fitted in the arm hole and fixed to the pedal arm, the first diameter portion has a larger diameter than the second diameter portion; and

a flange located at an end of the first diameter portion exposed from the lever hole, the flange having a larger diameter than the lever hole, and

the flange is separated from the rotation lever in a direction away from the pedal arm.

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