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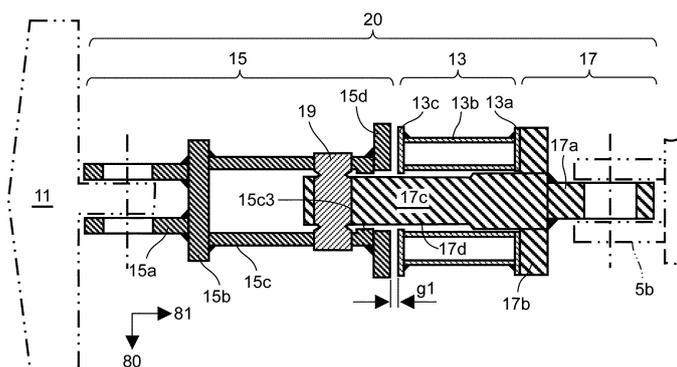
(54) **COWCATCHER AND RAILROAD VEHICLE PROVIDED WITH COWCATCHER**

(57) Proposed are a cowcatcher capable of sufficiently absorbing an impact while reducing the weight and cost and a railway vehicle provided with the cowcatcher.

In a cowcatcher disposed on a lower surface of an underframe of a railroad vehicle, the cowcatcher includes an impact-absorbing mechanism for absorbing an impact applied to a cowcatcher portion. The impact-absorbing mechanism includes an impact-absorbing portion for absorbing an impact, a pressing portion for pressing the impact-absorbing portion, and a guiding portion for guid-

ing a pressing direction of the pressing portion. The impact-absorbing portion is disposed between the pressing portion and the guiding portion. The pressing portion includes a flange for crushing the impact-absorbing portion and a rod connected to the flange. The guiding portion is a cylinder body into which the rod is inserted, and includes suppression members on upper and lower inner walls of the cylinder body. An end of the rod is guided in an axial direction of the cylinder body while a vertical displacement of the rod is suppressed by the suppression members.

**FIG. 3**



## Description

### Technical Field

**[0001]** The present invention relates to a cowcatcher and a railroad vehicle provided with the cowcatcher, and is suitable particularly when being applied to a cowcatcher for eliminating an obstacle on a railway track and a railroad vehicle provided with the cowcatcher on a lower surface of an underframe.

### Background Art

**[0002]** In general, a vehicle body of a railroad vehicle includes an underframe for forming a floor surface, a side structure body disposed perpendicularly to the underframe at both ends of the underframe in a width direction thereof for forming a side surface of the vehicle body, an end structure body disposed perpendicularly to the underframe at both ends of the underframe in a longitudinal direction thereof, and a roof structure body disposed at upper ends of the side structure body and the end structure body for forming a roof of the vehicle body.

**[0003]** A carriage travelling along a track and a coupler for coupling an adjacent vehicle are disposed on a lower surface of each of both ends of the vehicle body (underframe) in a longitudinal direction thereof. A vibration from the track is transmitted to the vehicle body (underframe) via the carriage, and a tensile load caused by a tractive force for organized railroad vehicles, a compression load at the time of braking, or the like is transmitted to the vehicle body (underframe) via the coupler. The underframe has a sufficient strength capable of withstanding the vibration and loads.

**[0004]** By the way, a cowcatcher for eliminating an obstacle on the track is disposed on a lower surface on a side of a driver's seat in a leading vehicle among the organized railway vehicles. PTL 1 discloses a cowcatcher including an impact-absorbing member for absorbing an impact at the time of collision so as not to cause an excessive acceleration on crew and passengers of the railway vehicle when the cowcatcher eliminates an obstacle.

### Citation List

#### Patent Literature

**[0005]** PTL 1: JP 2009-23450 A

### Summary of Invention

#### Technical Problem

**[0006]** The cowcatcher described in PTL 1 includes a cowcatcher member for colliding with an obstacle, a distribution member connected to the cowcatcher member for distributing an impact force in two directions, and two

energy-absorbing members connected to both ends of the distribution member and disposed in a travelling direction of a vehicle (refer to FIG. 3 in PTL 1).

**[0007]** This cowcatcher includes energy-absorbing members for crushing and relieving an impact caused when an obstacle is eliminated to the outside of the track at two positions, and therefore cannot reduce the weight and cost thereof. In order to reduce the weight and cost, when the energy-absorbing members disposed at two positions are disposed at one position, buckling that the energy-absorbing members are bent occurs due to an impact when an obstacle is eliminated, a mounting tolerance when the cowcatcher is mounted on a vehicle body, a vertical vibration caused by travelling of a railroad vehicle, or the like, and an impact cannot necessarily be absorbed sufficiently.

**[0008]** The present invention has been achieved in view of the above points, and proposes a cowcatcher capable of sufficiently absorbing an impact while reducing the weight and cost and a railway vehicle provided with the cowcatcher.

#### Solution to Problem

**[0009]** In order to solve the problem, in the present invention, a cowcatcher disposed on a lower surface of an underframe of a railroad vehicle is characterized by the following. That is, the cowcatcher includes an impact-absorbing mechanism for absorbing an impact applied to a cowcatcher portion. The impact-absorbing mechanism includes an impact-absorbing portion for absorbing an impact, a pressing portion for pressing the impact-absorbing portion, and a guiding portion for guiding a pressing direction of the pressing portion. The impact-absorbing portion is disposed between the pressing portion and the guiding portion. The pressing portion includes a flange for crushing the impact-absorbing portion and a rod connected to the flange. The guiding portion is a cylinder body into which the rod is inserted, and includes suppression members on upper and lower inner walls of the cylinder body. An end of the rod is guided in an axial direction of the cylinder body while a vertical displacement of the rod is suppressed by the suppression members.

**[0010]** In order to solve the problem, in the present invention, a railroad vehicle provided with a cowcatcher disposed on a lower surface of an underframe is characterized by the following. That is, the cowcatcher includes an impact-absorbing mechanism for absorbing an impact applied to a cowcatcher portion. The impact-absorbing mechanism includes an impact-absorbing portion for absorbing an impact, a pressing portion for pressing the impact-absorbing portion, and a guiding portion for guiding a pressing direction of the pressing portion. The impact-absorbing portion is disposed between the pressing portion and the guiding portion. The pressing portion includes a flange for crushing the impact-absorbing portion and a rod connected to the flange. The guiding portion

is a cylinder body into which the rod is inserted, and includes suppression members on upper and lower inner walls of the cylinder body. An end of the rod is guided in an axial direction of the cylinder body while a vertical displacement of the rod is suppressed by the suppression members.

#### Advantageous Effects of Invention

**[0011]** According to the present invention, an impact can be absorbed sufficiently while the weight and cost are reduced.

#### Brief Description of Drawings

##### **[0012]**

[FIG. 1] FIG. 1 is a side view of a railroad vehicle provided with a cowcatcher in the present embodiment.

[FIG. 2] FIG. 2 is a side view of an impact-absorbing mechanism disposed in the cowcatcher.

[FIG. 3] FIG. 3 is a cross sectional view cut along A-A of the impact-absorbing mechanism.

[FIG. 4] FIG. 4 is a side view of a pressing portion in the impact-absorbing mechanism.

[FIG. 5] FIG. 5 is a cross sectional view cut along B-B of a guiding portion of the impact-absorbing mechanism.

[FIG. 6] FIG. 6 is a cross sectional view cut along C-C of an impact-absorbing portion of the impact-absorbing mechanism.

[FIG. 7] FIG. 7 is a cross sectional view cut along B-B of a guiding portion of an impact-absorbing mechanism according to another embodiment.

[FIG. 8] FIG. 8 is a schematic view (side view) illustrating a buckled conventional cowcatcher.

#### Description of Embodiments

**[0013]** An embodiment of the present invention will be described in detail with reference to the drawings.

**[0014]** FIG. 1 is a side view of a railroad vehicle provided with a cowcatcher in the present embodiment.

**[0015]** The railroad vehicle includes a carriage (not illustrated) for supporting the railroad vehicle and traveling on a track 1 and a coupler (not illustrated) for coupling an adjacent railroad vehicle below each of both ends of an underframe 5 forming a floor surface of the railroad vehicle in a longitudinal direction thereof.

**[0016]** The underframe 5 has a high rigidity capable of withstanding an exciting force from a wheel shaft 9 disposed in the carriage, or a tensile load or a compression load from the coupler during acceleration and deceleration of the railroad vehicle. A cowcatcher 30 for eliminating an obstacle on the track 1 is disposed below the underframe 5 on a side of a driver's seat in a leading vehicle.

**[0017]** The cowcatcher 30 includes a cowcatcher por-

tion 11 for colliding with an obstacle on a railway track and an impact-absorbing mechanism 20 provided with an impact-absorbing portion 13 for absorbing an impact by being crushed (plastic deformation) when eliminating the obstacle. The impact-absorbing mechanism 20 has a structure in which a guiding portion 15, the impact-absorbing portion 13, and a pressing portion 17 are connected in series, and absorbs an impact in a process in which the impact-absorbing portion 13 disposed between the guiding portion 15 and the pressing portion 17 is crushed (plastic deformation).

**[0018]** A bracket 5a and a bracket 5b are disposed in a central portion of the underframe 5 in a width direction 80 thereof (refer to FIG. 3) on a lower surface of the underframe 5 with a gap in a longitudinal direction 81. The bracket 5a is rotatably connected to an upper end of the central portion of the cowcatcher portion 11 in the width direction 80 with a pin 7a.

**[0019]** The other end of the cowcatcher portion 11 is rotatably connected to one end of the impact-absorbing mechanism 20 with a pin 7b. The other end of the impact-absorbing mechanism 20 is rotatably connected to the bracket 5b with a pin 7c. That is, the impact-absorbing mechanism 20 is disposed on a lower surface of the underframe 5 in a form along the longitudinal direction 81 of the underframe 5.

**[0020]** When a relatively light obstacle is present on the track 1, the obstacle is eliminated to the outside of the track 1 by the cowcatcher portion 11, and the impact-absorbing mechanism 20 does not act. When a relatively heavy obstacle is present on the track 1 and a large impact is applied to a railway vehicle, the impact-absorbing mechanism 20 acts to absorb and relieve the impact.

**[0021]** When the impact-absorbing mechanism 20 absorbs an impact, the cowcatcher portion 11 rotates counterclockwise around the pin 7a, and the impact-absorbing mechanism 20 on a side of the pin 7b (guiding portion 15) is lifted up in a height direction 82. Then, the impact-absorbing mechanism 20 rotates clockwise around the pin 7c, the impact-absorbing mechanism 20 is compressed in an axial direction thereof, and the impact-absorbing portion 13 is crushed.

**[0022]** FIG. 2 is a side view of the impact-absorbing mechanism 20 disposed in the cowcatcher illustrated in FIG. 1.

**[0023]** FIG. 3 is a cross sectional view cut along A-A of the impact-absorbing mechanism 20 illustrated in FIG. 1.

**[0024]** The impact-absorbing mechanism 20 includes the impact-absorbing portion 13 crushed to absorb an impact, the pressing portion 17 for pressing and crushing the impact-absorbing portion 13, and the guiding portion 15 into which a rod 17c of the pressing portion 17 is inserted and which guides progress of the rod 17c in the inside thereof.

**[0025]** The pressing portion 17 includes a bracket 17a connected to the bracket 5b on a lower surface of the underframe 5 with the pin 7c, a plate-like flange 17b to

which the bracket 17a is fixed and which presses the impact-absorbing portion 13, and the rod 17c disposed in a central portion of the flange 17b.

**[0026]** The impact-absorbing portion 13 includes a flange 13a and a flange 13c each provided with an opening through which the rod 17c penetrates in a central portion thereof, and a crushing portion 13b for connecting the flanges 13a and 13c.

**[0027]** The crushing portion 13b is a cylinder body having a double skin structure in which two face plates facing each other are connected with a rib (refer to FIG. 6). The flange 13a is fixed to the flange 17b with a bolt. An opening 13d is formed along the flange 13c on a side surface (face plate) of the crushing portion 13b near the flange 13c. A strength of a portion where the opening 13d is formed is locally small, and therefore the crushing portion 13b starts to be crushed from the opening 13d and collapses in a bellows shape.

**[0028]** The guiding portion 15 includes a bracket 15a connected to the bracket 5a on a lower surface of the underframe 5 with the pin 7a, a flange 15b to which the bracket 15a is fixed, a guiding cylinder 15c connected to the flange 15b, and a flange 15d connected to the guiding cylinder 15c.

**[0029]** The guiding cylinder 15c is a rectangular square tube in which a cross sectional shape intersecting with the longitudinal direction 81 has a long side in the height direction 82. In a process in which the impact-absorbing portion 13 is crushed to absorb an impact, the guiding cylinder 15c guides progress of the rod 17c in the inside thereof. Therefore, the flange 15d is provided with an opening into which the rod 17c is inserted in a central portion thereof.

**[0030]** In the impact-absorbing mechanism 20, the guiding cylinder 15c is connected to the rod 17c with a break pin 19 while an end of the rod 17c is inserted by a size L1 toward an inside of the guiding cylinder 15c from a side of the flange 15d and a gap g1 is disposed between the flange 13c of the impact-absorbing portion 13 and the flange 15d of the guiding portion 15. At this time, the flanges 17b, 15d, 13a, and 13c form the impact-absorbing mechanism 20 while being almost parallel to one another.

**[0031]** Buckling suppression units 15e are disposed while sandwiching an end of the rod 17c in the height direction 82 in the inside of upper and lower horizontal plates 15c2 (refer to FIG. 5) (on a side of the rod 17c) forming the guiding cylinder 15c. The break pins 19 are inserted into a hole 17e (refer to FIG. 4) disposed at an end of the rod 17c and holes (not illustrated) disposed in vertical plates 15c1 (refer to FIG. 5) on left and right sides of the guiding cylinder 15c to assemble the impact-absorbing mechanism 20.

**[0032]** The break pin 19 is a cylindrical pin provided with a cut portion over an entire circumference at both ends thereof. The break pin 19 is not broken when a small obstacle on the track 1 is eliminated, but is broken in a case where an impact (acceleration) not acceptable to a

railway vehicle occurs when a big obstacle at a certain extent is eliminated. When the break pin 19 is broken, the impact-absorbing mechanism 20 absorbs the impact.

**[0033]** The buckling suppression units 15e guide progress of the rod 17c in the inside of the guiding cylinder 15c while an axial line of the rod 15c in the longitudinal direction 81 maintains a posture along a line connecting a center of a hole 15a1 of the bracket 15a and a center of a hole 17a1 of a flange 17a (hereinafter, referred to as axial line of the impact-absorbing mechanism 20) when the break pin 19 is broken and the rod 17c is guided in the inside of the guiding cylinder 15c.

**[0034]** FIG. 4 is a side view of the pressing portion 17 in the impact-absorbing mechanism 20.

**[0035]** FIG. 5 is a cross sectional view cut along B-B of the guiding portion of the impact-absorbing mechanism 20 illustrated in FIG. 2.

**[0036]** The pressing portion 17 includes the bracket 17a connected to a lower surface of the underframe 5 with the pin 7c, the flange 17b connected in such a form to intersect with the bracket 17a, and the rod 17c formed of a round rod (cylinder) connected to the flange 17b.

**[0037]** The rod 17c is provided with the hole 17e having an axis in the width direction 80 at an end of the round rod, and a side surface 17d is formed by cutting both sides of the round rod in a range from the end to L3 in the longitudinal direction 81 with a milling tool. That is, a cross section of the rod 17c in a range of L2 including the flange 17b has a circular shape. A cross sectional shape of the rod 17c in a range of L3 from a side of the hole 17e to a central portion of the rod 17c is a shape (longitudinal bale shape) obtained by connecting both ends of convex arcs located at upper and lower portions with perpendicular lines.

**[0038]** The hole 17e is a hole into which the break pin 19 for coupling the guiding portion 15 to the pressing portion 17 is inserted. An opening into which the round rod of the rod 17c (range of L2 in FIG. 4) can be inserted is machined in a central portion of the flange 17b. Thereafter, the rod 17c is inserted into the flange 17b, the bracket 17a is positioned, and these three parts 17a, 17b, and 17c are integrated with one another by welding.

**[0039]** The guiding cylinder 15c having a rectangular cross section with a long side in the height direction 82 is manufactured into a square tube by welding the horizontal plates 15c2 facing each other and the vertical plates 15c1 facing each other (refer to FIG. 5). A hole (not illustrated) into which the break pin 19 is inserted is machined in a central portion of each of the vertical plates 15c1 in a height direction thereof (refer to FIG. 2).

**[0040]** The pair of buckling suppression units 15e is disposed so as to face each other in the inside of the horizontal plates 15c2. A pair of guides 15c3 protruding to the inside of the guiding cylinder 15c is disposed in the height direction 82 in the inside of the vertical plates 15c1. A cross section of each of the buckling suppression units 15e intersecting with the longitudinal direction 81 has a rectangular shape having a long side in the width

direction 80. Horizontal surfaces of the buckling suppression units 15e constrain arc surfaces located at upper and lower portions of the rod 17c in the longitudinal direction 81 to guide the rod 17c at a low friction (line contact), and suppresses buckling of the impact-absorbing mechanism 20 (refer to FIG. 8).

**[0041]** Each of the guides 15c3 guides movement of the side surface 17d machined in the rod 17c in an axial direction (longitudinal direction 81) at a low friction, and suppresses rotation of the rod 17c (pressing portion 17) around an axis thereof (longitudinal direction 81) in the guiding cylinder 15c (guiding portion 15). The function of the guides 15c3 may be performed by the vertical plates 15c1 without disposing the guides 15c3.

**[0042]** FIG. 6 is a cross sectional view cut along C-C of the impact-absorbing portion 13 of the impact-absorbing mechanism 20 illustrated in FIG. 2.

**[0043]** The impact-absorbing portion 13 includes the flange 13a and the flange 13c, and the crushing portion 13b for connecting the flanges 13a and 13c. An opening through which the rod 17c penetrates is disposed in a central portion of each of the square-shaped flanges 13a and 13c.

**[0044]** The crushing portion 13b is a hollow extrusion material made of an aluminum alloy including two face plates 13b1 and 13b2 facing each other and a rib 13b3 for connecting the face plates 13b1 and 13b2, and is a cylindrical body having an octagonal cross sectional shape intersecting with an extrusion direction. The flange 13a is welded to one end of the crushing portion 13b in the extrusion direction, and the flange 13c is welded to the other end to form the impact-absorbing portion 13.

**[0045]** The flange 13a is fastened to the flange 17b with a bolt by causing the rod 17c to pass through the flange 13a, the crushing portion 13b, and the flange 13c. The rod 17c having a bale-shaped cross section penetrates through the crushing portion 13b on a side of the flange 13c. The rod 17c having a circular cross section penetrates through the crushing portion 13b on a side of the flange 13a. The crushing portion 13b in the extrusion direction is incorporated in the impact-absorbing mechanism 20 in a form along the longitudinal direction 81 of the rod 17c.

**[0046]** A manner in which the impact-absorbing mechanism 20 acts to absorb an impact when the cowcatcher 30 eliminates a relatively heavy obstacle will be described. When the cowcatcher portion 11 disposed on a lower surface of the underframe 5 on a side of a driver's seat in a leading railroad vehicle collides with an obstacle on the railway track 1, the cowcatcher portion 11 rotates counterclockwise around the pin 7a.

**[0047]** At this time, the pin 7b for connecting the cowcatcher portion 11 and the impact-absorbing mechanism 20 moves upward. Almost at the same time, the impact-absorbing mechanism 20 rotates clockwise around the pin 7c, and a compression load for compressing in the longitudinal direction 81 is applied to the impact-absorbing mechanism 20.

**[0048]** The compression load generated in the impact-absorbing mechanism 20 is specifically a shear load generated between a portion supported by the vertical plates 15c1 and a portion pressed by the rod 17c in the break pin 19. When this shear load exceeds an allowable load of the break pin 19, the break pin 19 is broken, the guiding portion 15 connected to the cowcatcher portion 11 progresses in a direction of the impact-absorbing portion 13, and the flange 15d of the guiding portion 15 collides with the flange 13c of the impact-absorbing portion 13.

**[0049]** A compression load for compressing the longitudinal direction 81 is applied also to the guiding cylinder 15c of the guiding portion 15 until just before the break pin 19 is broken. The gap g1 is disposed between the flange 15d and the flange 13c. Therefore, there is no member for supporting the impact-absorbing mechanism 20 in the longitudinal direction 81 from break of the break pin 19 to collision of the flange 15d with the flange 13c.

**[0050]** Therefore, when the compression load of the guiding cylinder 15c is released, each of the guides 15c3 of the guiding portion 15 is guided to the side surface 17d of the rod 17c to progress, and the flange 15d collides with the flange 13c violently.

**[0051]** The crushing portion 13b near the flange 13 is provided with the opening 13d for locally reducing a strength of the portion. Therefore, the crushing portion 13b starts to be crushed from the portion provided with the opening 13d by a high stress caused by the collision with the flange 15d. The opening 13d becomes a trigger for collapse of the crushing portion 13b. Therefore, the crushing portion 13b starts to be crushed to absorb an impact without generating a large compression load (peak load) which easily becomes an impact on passengers and crew at the time of start of crushing.

**[0052]** The crushing portion 13b starts to be crushed from a side connected to the flange 13c. Therefore, the face plates 13b1 and 13b2 and the rib 13b3 which have been crushed are accumulated in a bellows shape. The rod 17c having a circular cross section penetrates through the crushing portion 13b connected to the flange 13a, and a side surface of the rod 17c is disposed near the face plate 13b2 (refer to FIG. 6).

**[0053]** Therefore, in the face plates 13b1 and 13b2 and the rib 13b3 which have been crushed and accumulated, the rod 17c having a circular cross section suppresses collapse toward an axis thereof, and promotes collapse in a radial direction of the rod 17c (direction away from the axis). There is nothing to inhibit collapse of the crushing portion 13b in the radial direction of the rod 17c. Therefore, axisymmetric crushing of the crushing portion 13b is promoted, and an impact can be absorbed sufficiently.

**[0054]** When the crushing portion 13b continues to be crushed and the guiding portion 15 progresses toward the pressing portion 17 just after the break pin 19 is broken, an end of the rod 17c is constrained vertically by the buckling suppression units 17e, and therefore does not move vertically. Therefore, an axial line of the rod 17c

and an axial line of the guiding portion 15 maintain a posture along an axial line of the impact-absorbing mechanism 20. Therefore, buckling (refer to FIG. 8) that the entire impact-absorbing mechanism 20 is bent in a chevron shape does not occur.

**[0055]** Buckling does not occur. Therefore, the flanges 15d and 13a and the flanges 13c and 17b maintain an approximately parallel positional relation to each other. Therefore, the entire crushing portion 13b can be pressed with a good balance to be crushed. Therefore, the impact-absorbing mechanism 20 can absorb an impact sufficiently. Therefore, it is possible to provide a cowcatcher capable of relieving an excess impact on passengers and crew and a highly safe railroad vehicle provided with the cowcatcher.

**[0056]** Furthermore, the guides 15c3 can guide movement of the side surface 17d machined in the rod 17c in an axial direction thereof (longitudinal direction 81) with a low friction, and can suppress relative rotation of the rod 17c (pressing portion 17) and the guiding cylinder 15c (guiding portion 15) around the axis of the longitudinal direction 81. Therefore, an impact can be absorbed while the crushing portion 13b is not twisted but is crushed with a good balance.

**[0057]** When the impact-absorbing mechanism 20 is manufactured, by disposing the guides 15c3 and the side surface 17d, the break pin 19 can be easily inserted into a hole disposed in each of the vertical plates 15c1 and the rod 17c in a short time. Therefore, the impact-absorbing mechanism 20 can be manufactured in a small number of manufacturing steps.

**[0058]** Even when there is a size tolerance, a mounting error, or the like in parts forming the cowcatcher 30 (refer to FIG. 1), or vertical vibration is applied due to travelling of a railroad vehicle, an impact can be absorbed sufficiently by not applying a bending moment to the impact-absorbing mechanism 20 but applying a compression force in an axial direction dominantly thereto due to the above structure.

**[0059]** Due to having the above structure, it is not necessary to strictly manage the size tolerance, the mounting error, or the like in the parts. Therefore, by reducing the number of manufacturing steps in manufacturing the cowcatcher 30 or the number of attachment working steps in attaching the cowcatcher 30 to a lower surface of the underframe 5, the cowcatcher 30 can be provided at low cost.

**[0060]** FIG. 7 is a cross sectional view cut along B-B of a guiding portion 151a of according to another embodiment.

**[0061]** The buckling suppression units 151e is different from the guiding portion 15a (FIG. 5) described above in that a portion of each of buckling suppression units 151e facing a rod 17c has a concave surface shape along a curved surface of the rod 17c. When a cowcatcher portion 11 eliminates an obstacle on a track 1 at an end in a width direction 80, a bending moment may be generated in a plane of the width direction 80 and a longitudinal direction

81 in an impact-absorbing mechanism 20.

**[0062]** Basically, this bending moment is suppressed by a rigidity of pins 7a to 7c. However, due to the structure illustrated in FIG. 7, the moment can be further suppressed also at an end of each of the buckling suppression units 151e and the rod 17c. Buckling of the impact-absorbing mechanism 20 in the above plane can be suppressed. Therefore, a crushing portion 13b is collapsed in a bellows shape more securely to absorb an impact sufficiently. Therefore, it is possible to provide a cowcatcher capable of relieving an excess impact on passengers and crew and a highly safe railroad vehicle provided with the cowcatcher.

**[0063]** In order to obtain a more smooth impact-absorbing action of the impact-absorbing mechanism 20, a material having a low friction may be disposed between each of the buckling suppression units 15e or 151e and an upper or lower surface of the rod 17c. A material having a low friction may be disposed between the side surface 17d of the rod 17c and each of the guides 15c3. A material having a low friction coefficient such as a Teflon (registered trademark) plate can be used for the material having a low friction.

## 25 Reference Signs List

### [0064]

1	track
5	underframe
7	pin
9	wheel shaft
11	cowcatcher portion
15	guiding portion
13	impact-absorbing portion
17	pressing portion
19	break pin
20	impact-absorbing mechanism
15	guiding portion
15a	bracket
15b	flange
15c	guiding cylinder
15c1	vertical plate
15c2	horizontal plate
15c3	guide
15d	flange
15e	buckling suppression unit
13	impact-absorbing portion
13a	flange
13b	crushing portion
13c	flange
13d	opening
17	pressing portion
17a	bracket
17b	flange
17c	rod
17d	side surface
17e	opening

**Claims**

1. A cowcatcher disposed on a lower surface of an underframe of a railroad vehicle, comprising an impact-absorbing mechanism for absorbing an impact applied to a cowcatcher portion, wherein the impact-absorbing mechanism includes:
- an impact-absorbing portion for absorbing an impact;  
 a pressing portion for pressing the impact-absorbing portion; and  
 a guiding portion for guiding a pressing direction of the pressing portion,  
 the impact-absorbing portion is disposed between the pressing portion and the guiding portion,  
 the pressing portion includes a flange for crushing the impact-absorbing portion and a rod connected to the flange,  
 the guiding portion is a cylinder body into which the rod is inserted, and includes suppression members on upper and lower inner walls of the cylinder body, and  
 an end of the rod is guided in an axial direction of the cylinder body while a vertical displacement of the rod is suppressed by the suppression members.
2. The cowcatcher according to claim 1, wherein the cylinder body is a square tube having a rectangular cross section, and the suppression members are disposed on a pair of upper and lower horizontal plates of the square tube.
3. The cowcatcher according to claim 2, wherein a portion of the rod connected to the flange is a cylinder, an end of the rod has a plane surface obtained by cutting both side surfaces of the cylinder, and a pair of left and right vertical plates of the square tube is disposed at a position facing the plane surface.
4. The cowcatcher according to claim 3, wherein the end of the rod is guided in an axial direction of the cylinder body while a displacement of the rod in a rotational direction is suppressed by the vertical plates.
5. The cowcatcher according to claim 3, wherein each of the vertical plates is provided with a guide protruding from each of the vertical plates toward the rod and disposed in a vertical direction of the vertical plates, and the end of the rod is guided in an axial direction of the cylinder body while a displacement of the rod in a rotational direction is suppressed by the guide.
6. The cowcatcher according to claim 5, wherein a member having a lower friction coefficient than a member of a plane surface of the rod is attached to the guide.
7. The cowcatcher according to claim 1, wherein a portion of each of the suppression members facing the rod has a concave surface shape along a curved surface of the rod.
8. The cowcatcher according to claim 7, wherein a member having a lower friction coefficient than a member of the curved surface of the rod is attached to the concave surface.
9. A railroad vehicle provided with a cowcatcher disposed on a lower surface of an underframe, comprising an impact-absorbing mechanism for absorbing an impact applied to a cowcatcher portion, wherein the impact-absorbing mechanism includes:
- an impact-absorbing portion for absorbing an impact;  
 a pressing portion for pressing the impact-absorbing portion; and  
 a guiding portion for guiding a pressing direction of the pressing portion,  
 the impact-absorbing portion is disposed between the pressing portion and the guiding portion,  
 the pressing portion includes a flange for crushing the impact-absorbing portion and a rod connected to the flange,  
 the guiding portion is a cylinder body into which the rod is inserted, and includes suppression members on upper and lower inner walls of the cylinder body, and  
 an end of the rod is guided in an axial direction of the cylinder body while a vertical displacement of the rod is suppressed by the suppression members.

FIG. 1

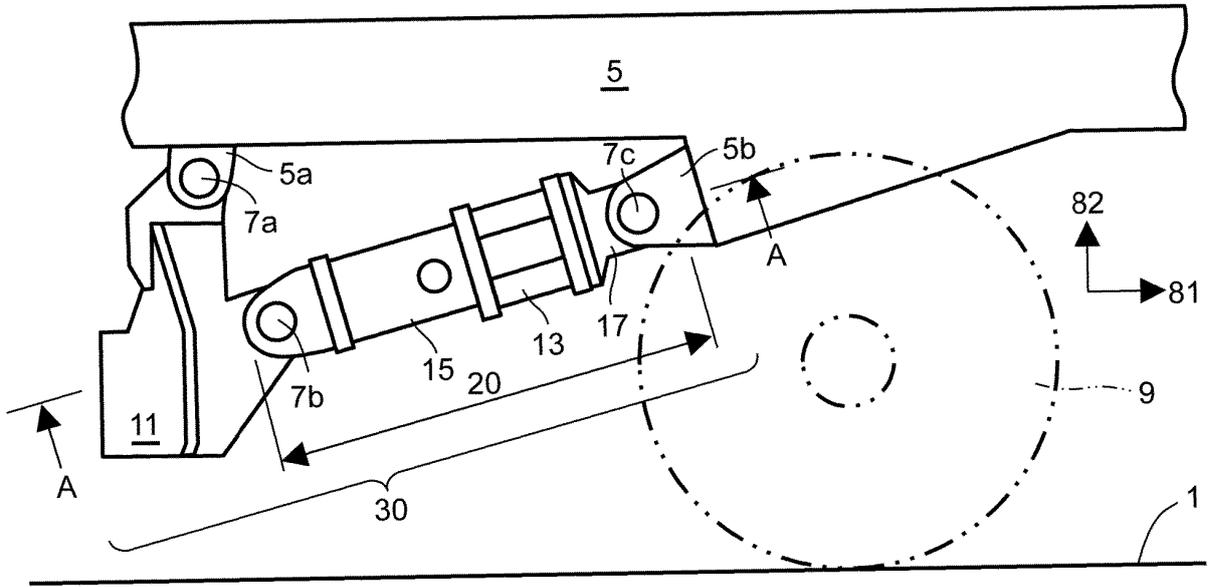


FIG. 2

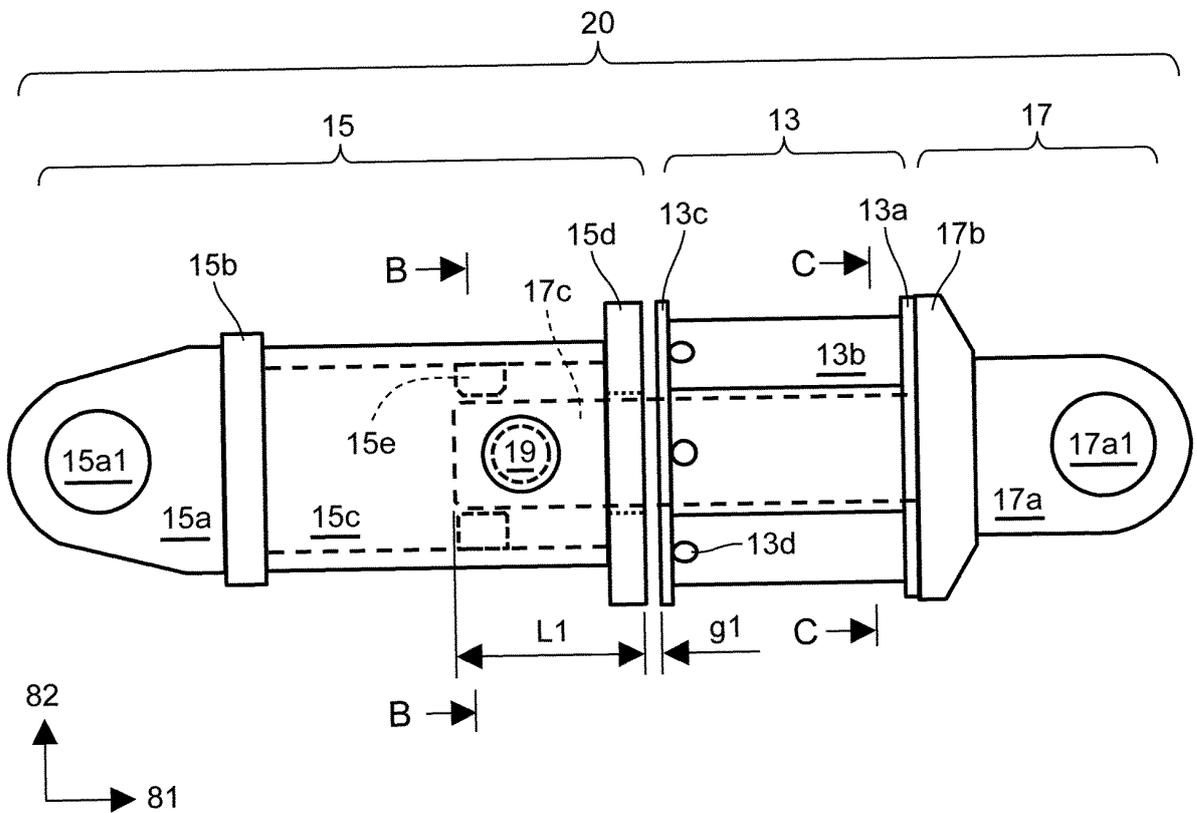


FIG. 3

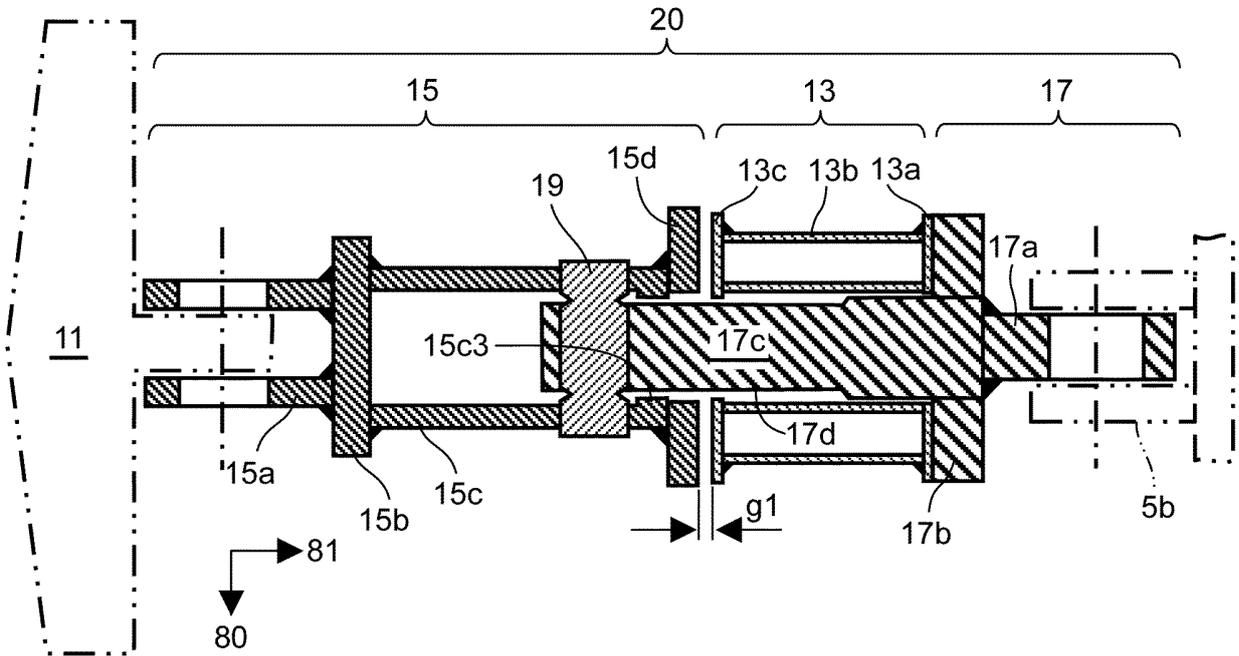


FIG. 4

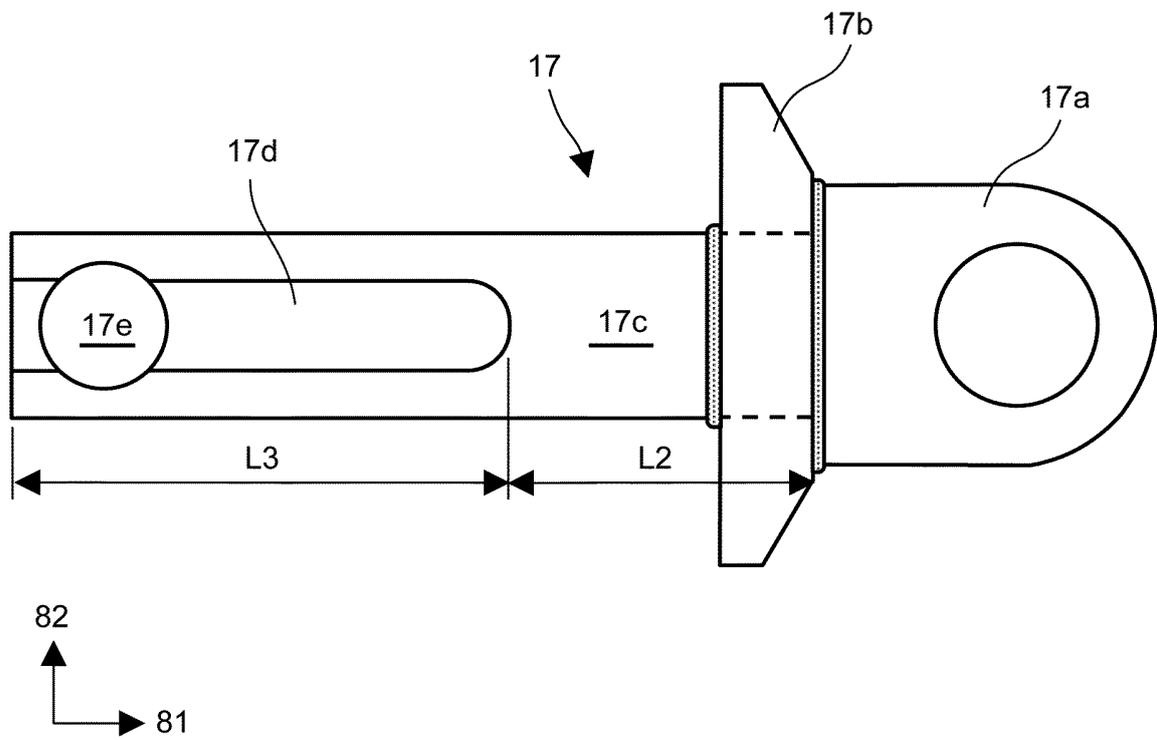


FIG. 5

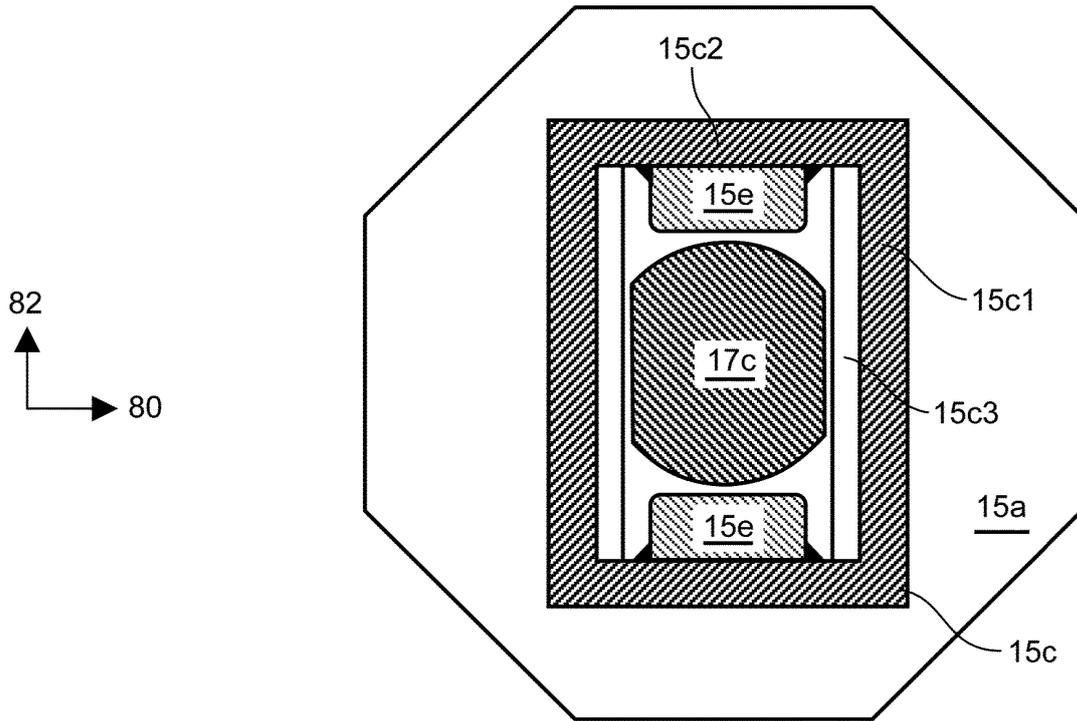


FIG. 6

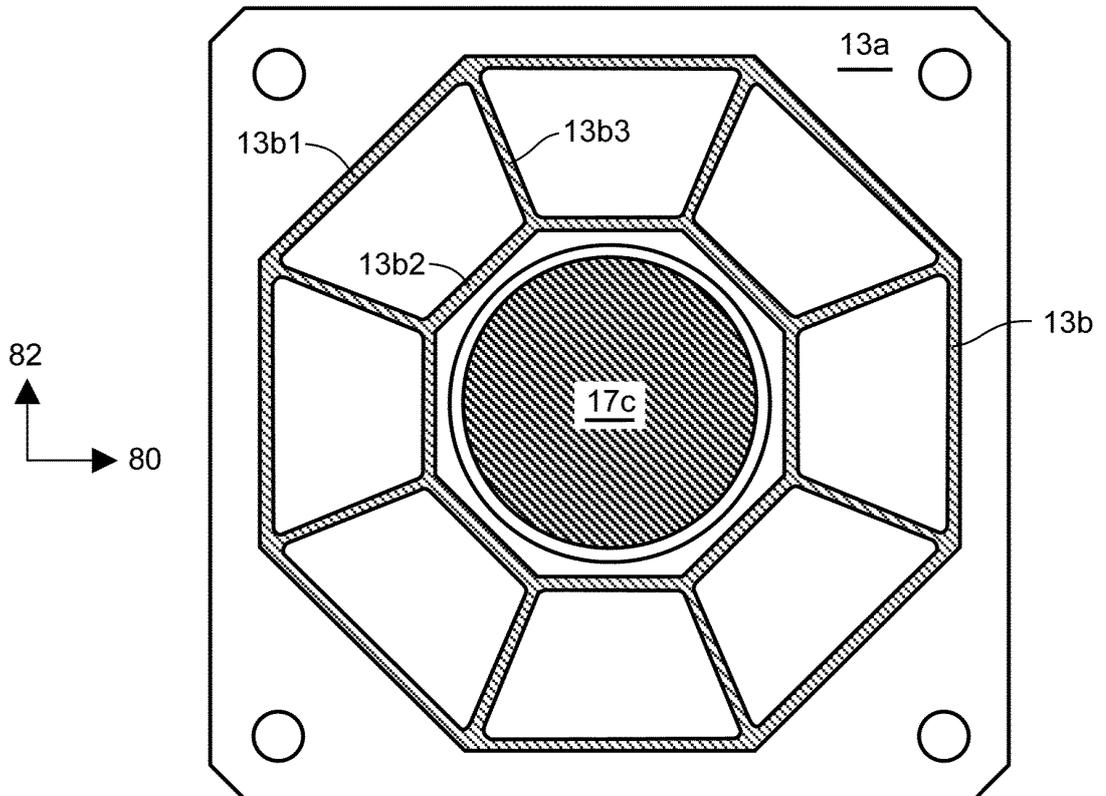


FIG. 7

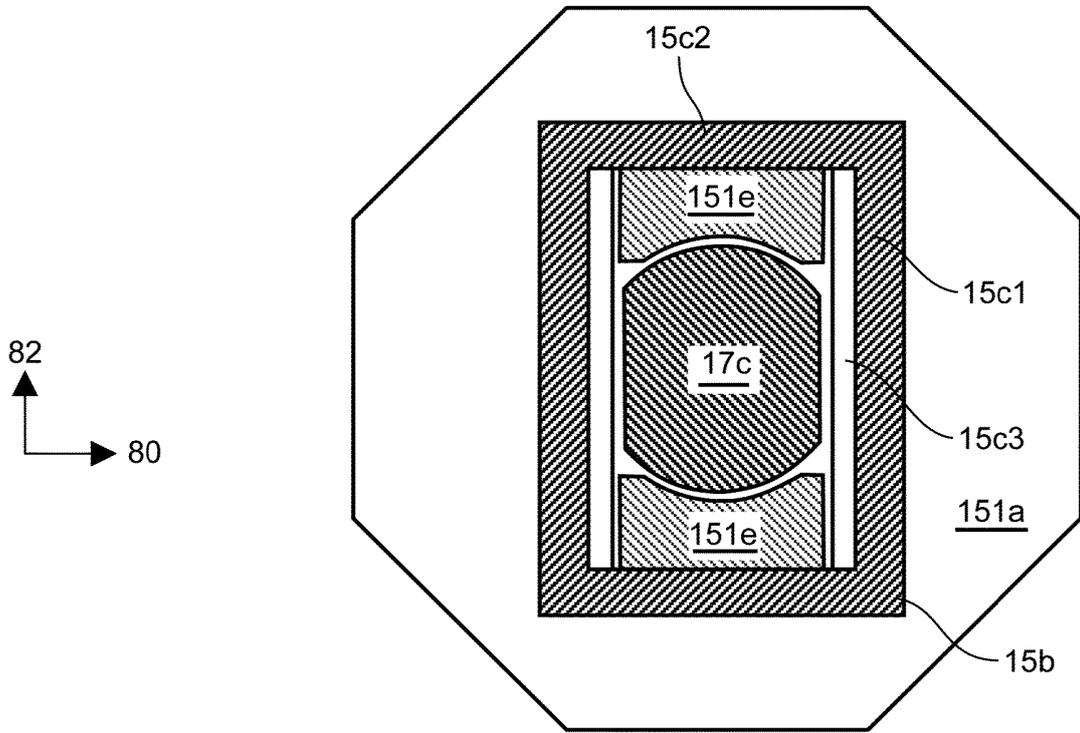
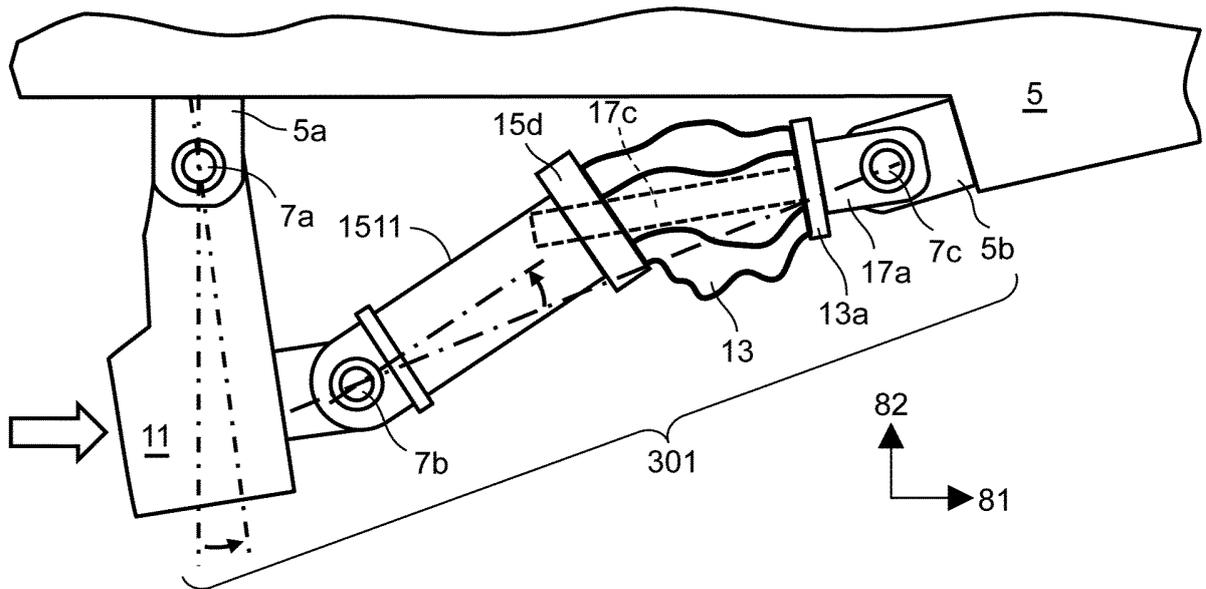


FIG. 8



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/060408

5	A. CLASSIFICATION OF SUBJECT MATTER B61F19/04(2006.01)i, B61G11/16(2006.01)i	
	According to International Patent Classification (IPC) or to both national classification and IPC	
10	B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) B61F19/04, B61G11/16	
15	Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2014 Kokai Jitsuyo Shinan Koho 1971-2014 Toroku Jitsuyo Shinan Koho 1994-2014	
	Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)	
20	C. DOCUMENTS CONSIDERED TO BE RELEVANT	
	Category*	Citation of document, with indication, where appropriate, of the relevant passages
25	Y A	JP 2008-247256 A (Hitachi, Ltd.), 16 October 2008 (16.10.2008), paragraphs [0010] to [0022]; fig. 4 & US 2008/0236440 A1 & EP 1975032 A1 & DE 602007008054 D & KR 10-2008-0089128 A & CN 101274634 A & AT 475573 T
30	Y A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 135306/1975 (Laid-open No. 48289/1977) (Daikure Co., Ltd.), 06 April 1977 (06.04.1977), page 2, lines 15 to 18; page 3, lines 11 to 18; page 4, lines 3 to 5; fig. 2 (Family: none)
35		Relevant to claim No. 1-2, 7-9 3-6  1-2, 7-9 3-6
40	<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.	
45	* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family
50	Date of the actual completion of the international search 05 June, 2014 (05.06.14)	Date of mailing of the international search report 01 July, 2014 (01.07.14)
55	Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
	Facsimile No.	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.  
PCT/JP2014/060408

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 137103/1988 (Laid-open No. 57751/1990) (Mazda Motor Corp.), 25 April 1990 (25.04.1990), page 4, line 19 to page 6, line 18; fig. 1 to 3 (Family: none)	2
Y	JP 2009-1178 A (Nippon Sharyo, Ltd.), 08 January 2009 (08.01.2009), paragraphs [0015] to [0016]; fig. 1 to 4 (Family: none)	8

**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

- JP 2009023450 A [0005]