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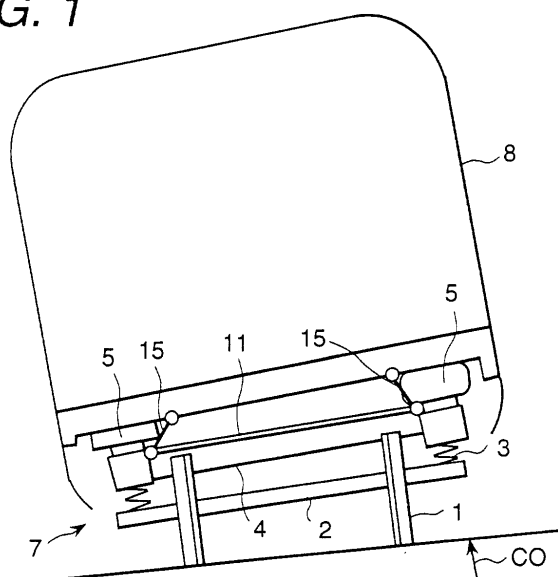
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(54) **Transverse tilting mechanism for railway vehicle**

(57) A car body (8) is supported on a bogie frame (4) through an air spring (5). Along the width direction of the car body (8), a torsion bar (11) is provided on the bogie frame (4). At both ends of the torsion bar (11), links (15) for inclining the car body (8), through levers (13) are provided. Accordingly, a rolling displacement of the car body is restricted and a vertical displacement is not

restricted. Due to the inclined geometry of the levers (13) towards the center longitudinal plane of the car body (8), the car body is tilted in the proper direction when an excessive centrifugal acceleration occurs. An inclination device having a light weight structure, a good riding comfort, and a high failsafe characteristic can be obtained.

FIG. 1



Description

[0001] The present invention relates to a railway rolling stock and relates to a device for inclining a car body to improve a riding feeling during a curvature passage running time in the railway rolling stock.

[0002] As a car body inclination device in a railway rolling stock, as shown in Japanese application patent laid-open publication No. Hei 6-56034, the car body inclination device is one in which a torsion bar is used. The car body inclination device comprises a first torsion bar which is provided in a left and right direction of the car body, a second torsion bar which is provided respectively on both ends thereof, an actuator for connecting respectively each end of the first torsion bar and one end of the second torsion bar, and a rod for connecting another end of the second torsion and the car body. The actuator is installed in a front and rear direction of the car body. By the expanding and contracting of the actuator, and the rod is moved an upper and down direction, as a result, the car body is inclined.

[0003] According to the above stated car body inclination construction in the railway rolling stock, the gravity of the car body is moved in an inner side of the curvature passage, an increase of the force added to the car wheels at an outside of the curvature passage can be prevented and the safety can be attained.

[0004] As another prior art relating to a car body inclination construction in a railway rolling stock, a torsion bar is provided on a bogie frame is provided along to along to a width direction of the bogie, through a lever at both end portions of the torsion bar and a link the torsion bar is connected to the car body. The link is not substantially inclined against the bogie and the car body. This car body inclination construction is used to restrain a rolling phenomenon of the car body.

[0005] According to Japanese application patent laid-open publication No. Hei 6-56034, the increase of the force added to the car wheels at an outside of the curvature passage can be prevented and the safety can be attained.

[0006] However, it is necessary to provide the three torsion bars and the two actuators and the link for necessary to connect the torsion bars and the actuators, the construction becomes the complex one and this invites high cost structure.

[0007] Further, according to the actuators, since the car body is inclined, it is necessary to take fully into consideration about an abnormality of the controlling system.

[0008] Preferably, an object of the present invention is to provide a railway rolling stock wherein a car body inclination device having a simple construction can be obtained.

[0009] Preferably, another object of the present invention is to provide a railway rolling stock wherein a car body inclination device having a light weight structure can be attained.

[0010] Preferably, a further object of the present invention is to provide a railway rolling stock wherein a car body inclination device having a left and right riding good feeling can be obtained.

[0011] Preferably, a further object of the present invention is to provide a railway rolling stock wherein a car body inclination device having a high fail-safe characteristic can be attained.

[0012] According to the present invention a railway rolling stock, characterized in that a torsion bar is installed to a bogie or a car body along to a width direction of the bogie, at both ends of the torsion bar respective levers is provided, between the car body and the bogie to which the torsion bar is not installed and an end portion of the respective levers are connected together with a link, a first distance from a connection point between one of the link and the lever to a connection point between another link and the lever is larger than a second distance from a connection point between another end of the link and the car body or the bogie and a connection point between another link and the car body and the bogie, and the first distance is formed in a side of the bogie and the second distance is formed in a side of the car body.

[0013] Preferably, according to the present invention, in accordance with the action of the excess centrifugal acceleration, it can obtain the free pendulum and the car body inclination device having the high fail-safe characteristic can be obtained.

Brief Description of the Drawings:

[0014]

Fig. 1 is a front view showing an inclination device of a car body of a railway rolling stock one embodiment according to the present invention;
 Fig. 2 is a front view of an essential part of Fig. 1;
 Fig. 3 is a front view showing a condition in which the car body is inclined in Fig. 2;
 Fig. 4 is a right side view of Fig. 2;
 Fig. 5 is v-v cross-sectional view of Fig. 4;
 Fig. 6 is VI-VI cross-sectional view of Fig. 4;
 Fig. 7 is a side cross-sectional view showing a car body inclination device of a railway rolling stock of another embodiment according to the present invention;
 Fig. 8 is a front view showing a car body inclination device of a railway rolling stock of a further embodiment according to the present invention; and
 Fig. 9 is a front view showing a car body inclination device of a railway rolling stock of a further embodiment according to the present invention.

Description of the Invention:

[0015] A car body inclination device of a railway rolling stock of one embodiment according to the present invention.

vention will be explained referring to form Fig. 1 to Fig. 6. Fig.6 show only a left half part but omits a right half part. Wheel axles 2 having car wheels 1 are fixed to a bogie frame 4 through an axle spring member 3. A lower face of a car body 8 is supported through an air spring member 5 which is mounted on the bogie frame 4. At the lower face of the car body 8 a center pin is provided and this center pin is connected to the bogie frame 4 through a traction device. To each of bogies 7, a following construction is installed.

[0016] A torsion bar 11 is installed rotatably freely to a vicinity of an upper portion of the bogie frame 4 along to a width direction (a rectangular direction of a running direction) of the bogie 7. Both ends of the torsion bar 11 are installed to the bogie frame 4 through bearing members 12. The bearing member 12 is fixed to the bogie frame 4 through rubber seats etc.. The bearing member 12 is a thrust bearing member. To both ends of the torsion bar 11, levers 13 and 13 which project in a radial direction are arranged. The torsion bar 11 and the lever 13 are connected through an involute gear shape mechanism. The levers 13 and 13 and the links 15 and 15 are connected through pins. Another end of the links 15 and 15 and a lower face of the brackets 17 and 17 are connected through pins.

[0017] A distance L1 from a connection point between the lever 13 at the one end of the torsion bar 11 and the link 15 to a connection point between the lever 13 at the another end of the torsion bar 11 and the link 15 is larger than a distance L2 between from a connection point between the one link 15 and the bracket 17 of the car body 8 to a connection point between the other link 15 and the bracket 17 of the car body 8. In other words, the links 15 and 15 are installed in an inner side of the car body 8. The link 15 is installed incliningly with an angle against a horizontal face. The angle θ is about from 50 degrees to 80 agrees. Preferably, the angle θ is 60 degrees.

[0018] When the car body 8 is inclined, the respective angles θ of the respective links 15 and 15 is varied. According to this, the link 15 is formed to rotate the lever 13. The rotation direction of the link 15 and the rotation direction of the lever 13 are substantially orthogonal. For this reason, the link 15 is connected to the lever 13 through the rubber bush member or a spherical face bearing member. Further, the link 15 and the car body 8 are connected by a spherical face bearing member.

[0019] To the lower face of the car body 8, a stopper 21 is lifted down. To oppose to this stopper 21, stoppers 22 and 22 in a side of the bogie 7 are projected to an upper side portion from the bogie frame 4. The stopper 22 is arranged in both sides (the both sides of the car body 8 in the width direction). In commonly, between the stopper 21 and the stoppers 22 and 22, a predetermined space is established.

[0020] Further, the stopper 21, and the stoppers 22 and 22 can be employed the members of the already provided. From the connection member such as a center pin from the car body 8 is lifted down. A lower end of

the connection member and the bogie frame 4 are connected with the link which is along to the running direction. This center pin can work as a role of the stopper 21.

[0021] An intersection point P of an extension line of the links 15 and 15 under the condition in which a car body 6 is not inclined is a center of the inclination of the car body 6. The extension line of the links 15 and 15 during the inclination time is not arranged to the intersection point P. The center of the car body 6 passes through the intersection point P. A gravity G of the car body 6 is arranged in the lower portion of the intersection point P.

[0022] With the above stated construction, in a case where the rolling stock runs a linear interval, it will be shown under the condition shown in Fig. 2. To the upper and lower movement of the bogie 7, the change of the inclination angle θ of the links 15 and 15 is substantially the same. For this reason, the torsion bar 11 can rotate, to the torsion bar 11 the twist is not generated. Accordingly, the upper and lower movement of the bogie 7 can be permitted. In other words, the air spring 5 can be operated. As a result, the upper and lower displacement of the same phase at the both ends of the car body is not restricted, but a rolling displacement at the both ends of the car body is restricted.

[0023] The inclination motion of the car body during the curvature passage running time will be explained. To the curvature portion, a cant angle CO is provided. According to the cant angle CO, the curvature radius, and the running speed, the excess centrifugal acceleration are determined. In this time, in accompany with the increase of the running speed in the curvature passage, the excess centrifugal acceleration increases also, to the passenger the acceleration in the left and right generates, the left and right riding feeling will be bad. The left and right ordinary acceleration degree is 0.08 g as a rough standard value of a left and right normal acceleration.

[0024] When the rolling stock urns more than a balancing speed which is determined by the cant angle CO, the curvature radius and the running speed, as shown in Fig.3, according to the excess centrifugal acceleration, the car body 8 moves in the outer side of the curvature passage. A center position of the car body 8 is moved from a point A to a point A'. The gravity of the car body moves from the point G to a point G'. The movement of the car body 8 is stopped by the contact to the stoppers 21 and 22. According to the links 15 and 15 the car body 8 is inclined. The inclination angle θ of the link 15 in the inner side becomes θ_1 and the inclination angle of the link 15 in the outer side becomes θ_2 . The inclination angle of the car body 8 becomes θ_3 . Since the car body 8 is inclined by the movement in the width direction, as a result the smooth inclination can be obtained.

[0025] According to the above stated construction, the upper and lower movement of the bogie 7 can be permitted, according to the excess centrifugal accel-

ation the inclination of the car body 8 can be permitted. Further, the constitution members are the torsion bar 11, the bearing members 12 and 12, the levers 13 and 13, and the links 15 and 15. It is unnecessary to provide an actuator for inclining the car body 8. For this reason, the construction of the inclination device can be formed easily, the construction can be formed with a light weight structure and a low cost structure. Further, it is possible to form the inclination of the car body in response to the curvature passage and further by corresponding the excess centrifugal acceleration since the inclination motion is carried out, accordingly the inclination device having the high fail-safe characteristic can be attained.

[0026] When the excess centrifugal acceleration is fallen away, since the twist, etc., which are given to the left and right air springs 5 and 5 during the inclination time, are fallen away, the restoring force can be obtained, as a result the car body 8 can return smoothly from the inclination condition.

[0027] When the rolling stock runs the curvature passage, the leveling adjustment function for adjusting the height of the air springs 5 and 5 using the leveling adjustment valve for setting constant the height of the air springs 5 and 5 is formed to stop.

[0028] An embodiment shown in Fig. 7 according to the present invention will be explained. In this figure, the same reference numerals shown in the above stated embodiment indicate the same members. The difference between this embodiment and the above stated embodiment is that actuators 30 and 30 are installed in a midway of the links 15 and 15. Accordingly, the link 15 can be expanded and contracted freely. A control device is formed to retard a rod of the actuator 30 which is arranged an inner side of the curvature passage and the actuator 30 arranged in an outer side is projected. As a result, a length of the link 15 arranged in the inner side of the curvature passage becomes short and a length of the link 15 arranged in the outer side of the curvature passage becomes long.

[0029] According this construction, using the inclination target values executed under the basis of the curvature information which are stored in advance (the curvature radius, the cant angle CO, etc.) and the running speed, the left and right displacement between the bogie 7 and the car body 8 or an actual measured left and right vibration acceleration which is installed to the car body floor face and the bogie frame 4 and the inclination angle, the actuators 30 and 30 can be expanded and contracted. Accordingly, even when the movement amount is little, the car body can be inclined smoothly. Further it is possible to carry out a preview control.

[0030] When according to a malfunction of the control device a reverse inclination command is outputted and the car body 8 is formed to inclined in a reverse direction, since the car body is reversed to a natural inclination according to the link 15 etc., it is difficult to carry out the inclination in the reverse direction, as a result a fail-safe characteristic can be obtained easily.

[0031] According to the failure of the actuators 30 and 30 and the control device, when the expansion and the contraction of the actuators 30 and 30 are not carried out, it presents the embodiment shown in Fig. 1, as a result the car body 8 can be inclined according to the excess centrifugal acceleration.

[0032] Using a detection means for detecting the expansion amount and the contraction amount of the actuator 30, this detected value is feed-backed and is made to be a control amount, and then the inclination motion can be carried out smoothly. Further, as the actuator 30, a motor and a ball screw, and a mechanism of an air pressure system and a hydraulic pressure system can be employed.

[0033] When the cant Co is less than an assumed running speed, the actuators 30 and 30 can be expanded and contracted in the reverse direction.

[0034] An embodiment shown in Fig. 8 according to the present invention will be explained. In this figure, the same reference numerals shown in the above stated embodiment shown in Fig. 1 indicate the same members. The difference between this embodiment and the above stated embodiment is that control devices 40L and 40R for controlling an inner pressure of the air spring 5 are installed. According this construction, with the control devices 40L and 40R, similarly to the control device of the above stated embodiment shown in Fig. 7, using the inclination target values executed under the basis of the curvature information which are stored in advance (the curvature radius, the cant angle CO, etc.) and the running speed, the left and right displacement between the bogie 7 and the car body 8 or the actual measured left and right vibration acceleration which is installed to the car body floor face and the bogie frame 4 and the inclination angle, the air springs 5 and 5 can be expanded and contracted.

[0035] With the above stated construction, according to the control devices 40L and 40R for controlling the air spring 5, the inclination action according to the link 15 etc. and the expansion and the contraction of the air spring 5 can be operated at the same time, as a result the inclination motion of the car body 8 can be carried out smoothly.

[0036] When according to a malfunction of the control devices 40L and 40R, a reverse inclination command is outputted and the car body 8 is made to inclined in a reverse direction, since the car body 8 is reversed to a natural inclination according to the link 15 etc., it is difficult to carry out the inclination in the reverse direction, as a result the fail-safe characteristic can be obtained easily.

[0037] When the expansion amount and the contraction amount or the inner pressure etc. of the air springs 5 and 5 are detected, and the detected values are made to feed-back, then it is possible to carry out a good inclination operation.

[0038] Further, during the car body inclination time, when the leveling adjustment function of the air springs

5 and 5 according to the leveling adjustment valve is made to stop, it is unnecessary to perform the leveling adjustment according to the supply and the discharge of the air to the air springs 5 and 5, then it is possible to carry out the good inclination motion.

[0039] When the cant Co is less than assumed running speed, the air springs 5 and 5 can be expanded and contracted in the reverse direction.

[0040] An embodiment shown in Fig. 9 according to the present invention will be explained. In this figure, the same reference numerals shown in the above stated embodiment shown in Fig. 1 indicate the same members. The difference between this embodiment and the above stated embodiment shown in Fig. 1 is that between the stopper 21 and the bogie frame 4 an actuator 50 for expanding and contracting in the width direction of the car body 8 and a control device 51 for controlling the actuator are installed. According to this construction, with the control device 51, similarly to the control device of the above stated embodiment shown in Fig. 7, using the inclination target values executed under the basis of the curvature information which are stored in advance (the curvature radius, the cant angle CO, etc.) and the running speed, the left and right displacement between the bogie 7 and the car body 8 or the actual measured left and right vibration acceleration which is installed to the car body floor face and the bogie frame 4 and the inclination angle, as a result the actuator 50 can be expanded and contracted.

[0041] With the above stated construction, a control for further assisting the inclination motion according to the link 15 can be obtained. Further, it is possible to carry out the preview control system (for giving the inclination command this side of the curvature passage) for reducing a jerk acceleration (an angular acceleration) of the short curvature passage of the transmission curvature passage etc..

[0042] When the cant Co is less than the assumed running speed, the actuator 50 can be expanded and contracted in the reverse direction.

[0043] A technical range according to the present invention is not limited to the wordings stated in the what is claimed is item and the wording stated in the means for solving the invention item but it will refer to the range in which the person who belongs to this technical field.

[0044] According to the present invention, in accordance with the combination of the torsion bar with the link, with the light weight structure inclination mechanism, the left and right riding feeling for the passenger can be secured, and further the inclination device having the high fail-safe characteristic can be attained.

Claims

1. A railway rolling stock, **characterized in that**
a torsion bar is installed to a bogie or a car body along to a width direction of said bogie;

at both ends of said torsion bar a respective levers is provided;

between said car body and said bogie to which said torsion bar is not installed and an end portion of said respective lever are connected together with a link;

a first distance from a connection point between one of said link and said lever to a connection point between another link and said lever is larger than a second distance from a connection point between another end of said link and said car body or said bogie and a connection point between another link and said car body and said bogie; and

said first distance is formed in a side of said bogie and said second distance is formed in a side of said car body.

2. A railway rolling stock according to claim 1, **characterized in that**

said torsion bar is installed to said bogie.

3. A railway rolling stock according to claim 1, **characterized in that**

between said car body and said bogie, said car body provides a stopper for regulating a movement to said width direction against said bogie.

4. A railway rolling stock according to claim 1, **characterized in that**

when the railway rolling stock runs on a curvature passage with more than a balancing speed, a drive device for inclining said car body is provided; and

in said drive device, a height from said bogie frame in an inner side of said curvature passage to said car body is lower than a height from said bogie in a linear passage to said car body, and a level from said bogie frame in an outer side of said curvature passage to said car body is formed high.

5. A railway rolling stock according to claim 4, **characterized in that**

when the railway rolling stock runs on a curvature passage with less than a balancing speed;

in said drive device, said height from said bogie frame in said inner side of said curvature passage to said car body is higher than said height from said bogie in a linear passage to said car body, and said height from said bogie frame in said outer side of said curvature passage to said car body is formed low.

6. A railway rolling stock according to claim 4, **characterized in that**

a control device for controlling said drive device performs to feed-back an expansion and contraction amount of said drive device.

7. A railway rolling stock according to claim 4, **characterized in that**

between said bogie and said car body, a respective air springs is installed in said width direction; and

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when the railway rolling stock runs with more than said balancing speed, a leveling adjustment function for said air springs according to a leveling adjustment valve is formed to stop.

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8. A railway rolling stock according to claim 4, **characterized in that**

as said drive device, an actuator for altering said length to said link is provided respectively; and

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a length of said actuator which is positioned in said inner side of said curvature passage is formed short, and a length of said actuator which is positioned in said outer side of said curvature passage is formed long.

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9. A railway rolling stock according to claim 4, **characterized in that**

between said bogie and said car body, in said width direction, a respective air springs is installed;

said drive device is said air spring; and

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the railway rolling stock runs with more than balancing speed on said curvature passage;

said drive device is said air spring; and

a control device is provided to form a height of said air spring which is positioned in said inner side of said curvature passage smaller than a height of said air spring which is positioned in said outer side of said curvature passage.

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10. A railway rolling stock according to claim 4, **characterized in that**

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as said drive device, between said bogie and said car body, an actuator for moving said car is provided body in said width direction; and

when the railway rolling stock runs on said curvature passage with more than a balancing speed, said actuator moves said connection point between said actuator and said car body to an outer side of said curvature passage.

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11. A railway rolling stock according to claim 1, **characterized in that**

a center pin provided projecting in a lower portion of said car body and said bogie are connected through a link; and

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in a width direction of said car body, to said bogie at both sides of said center pin, a stopper for contacting said center pin is installed.

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FIG. 1

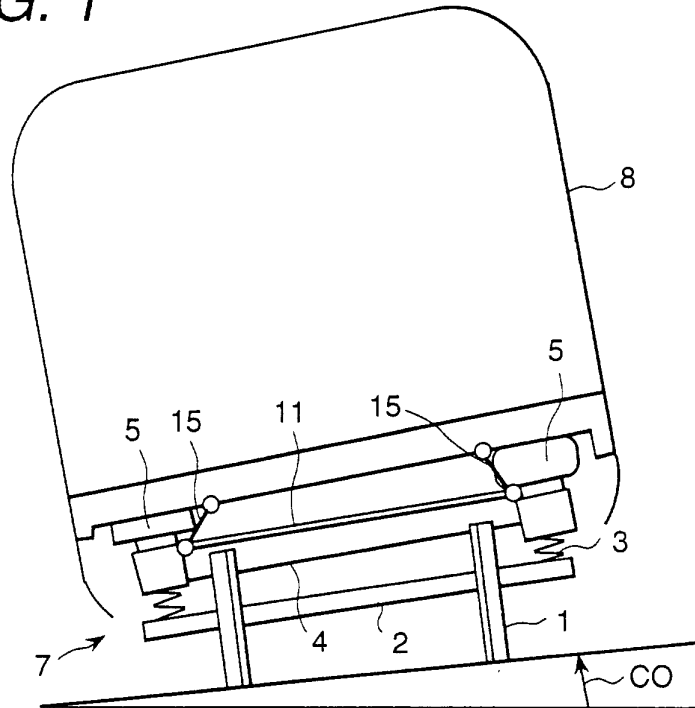


FIG. 2

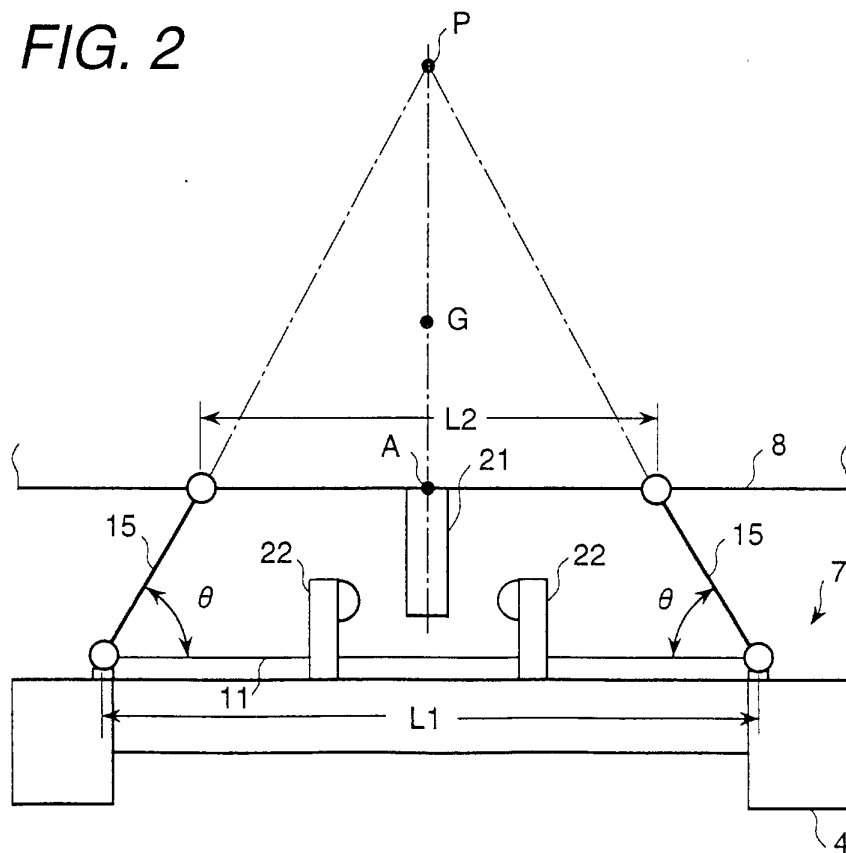


FIG. 3

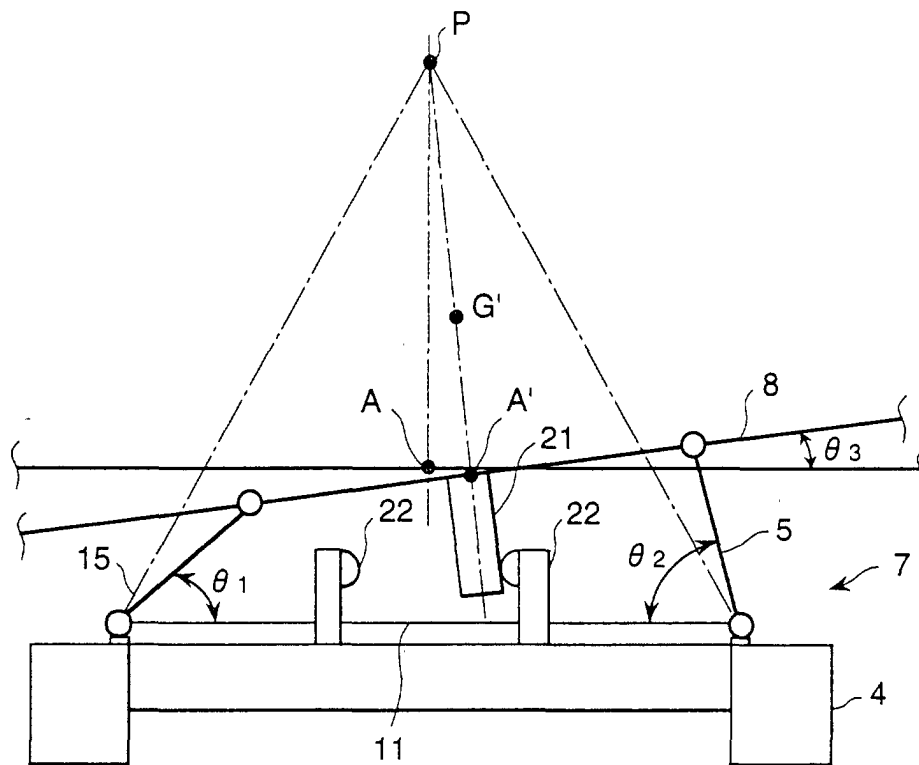


FIG. 4

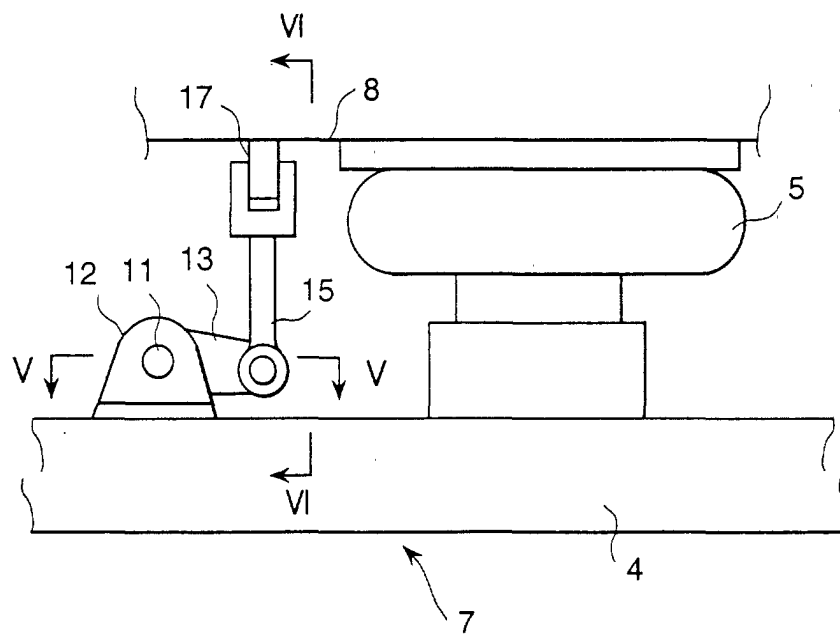


FIG. 5

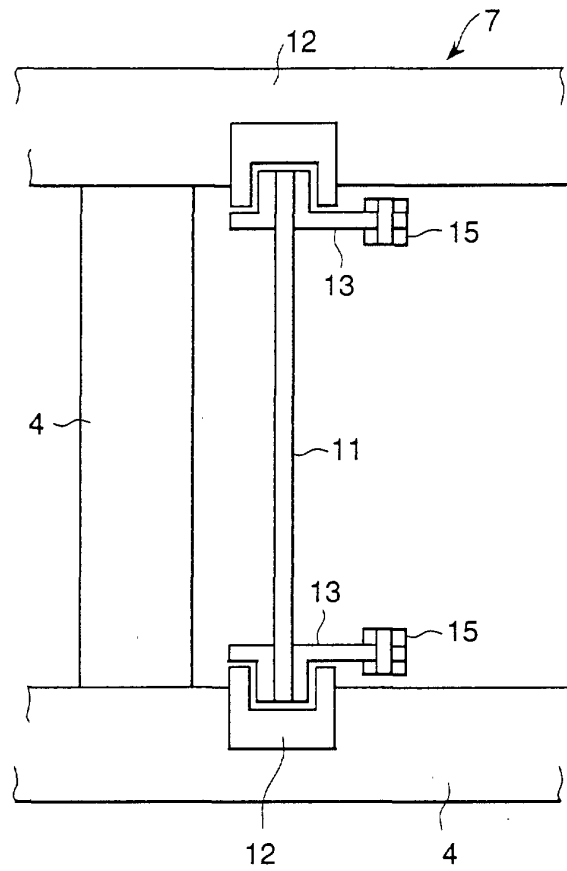


FIG. 6

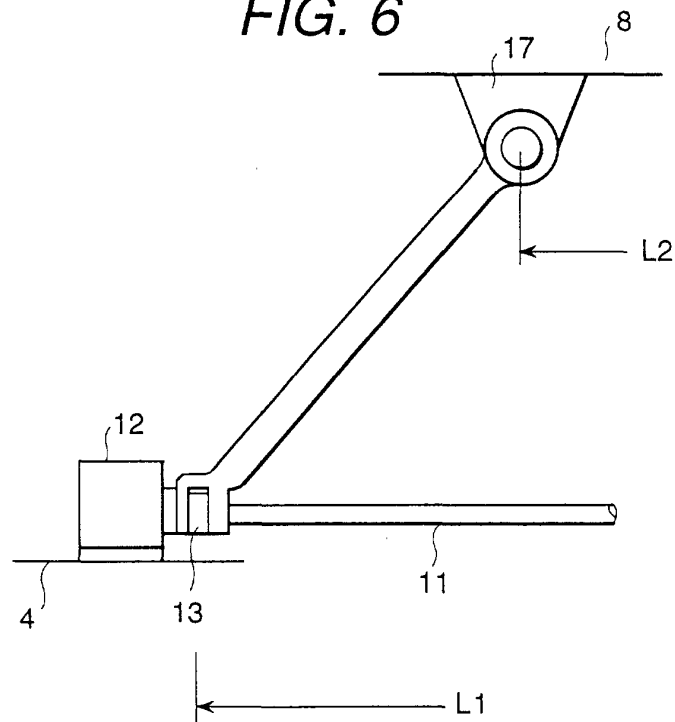


FIG. 7

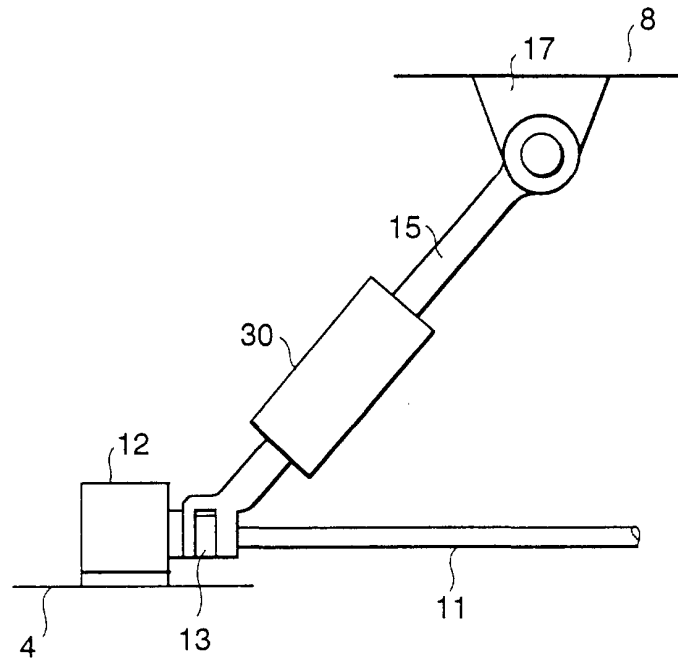


FIG. 8

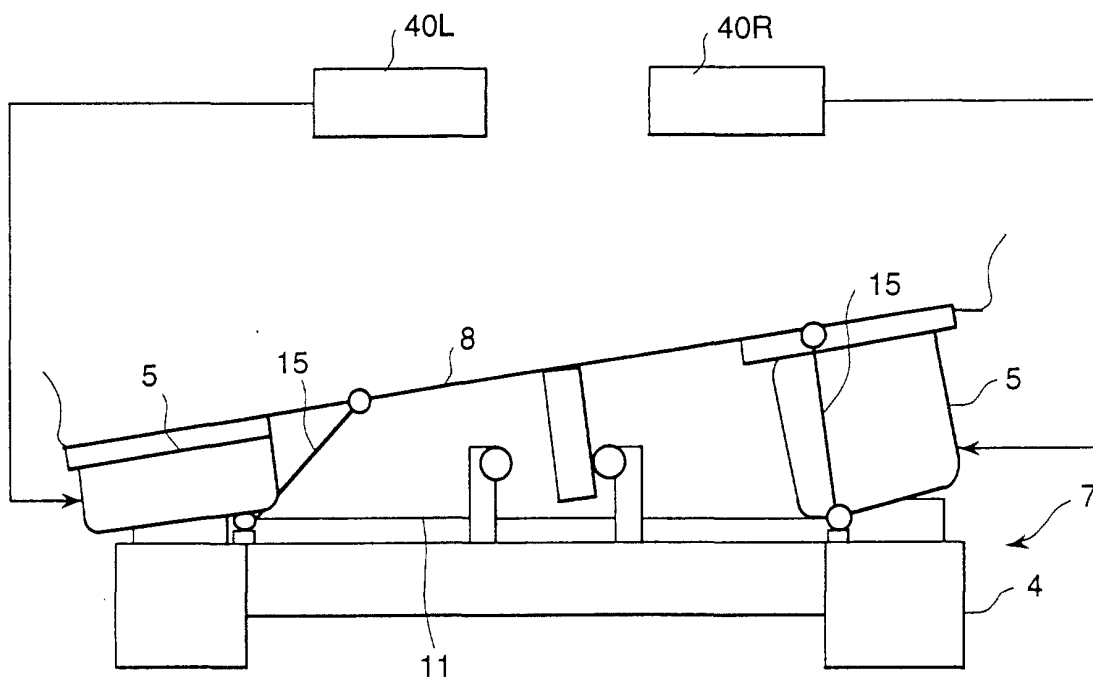
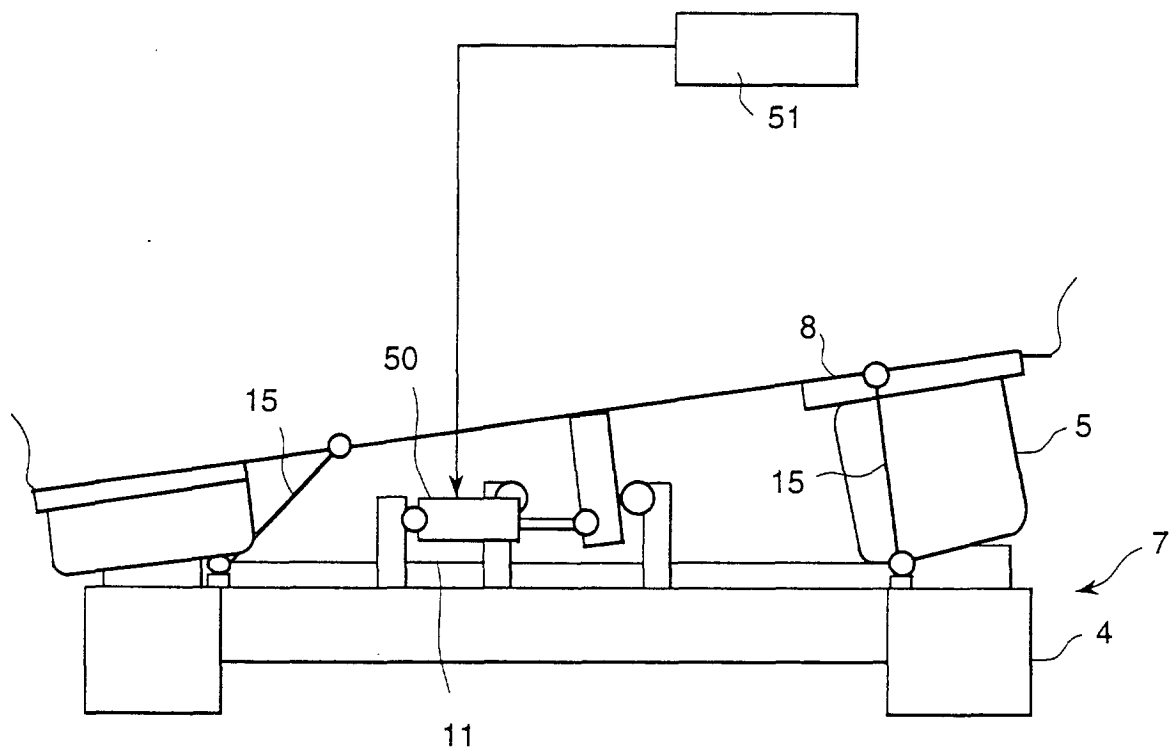


FIG. 9





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
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			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
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The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 7 January 2002	Examiner Fuchs, A
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03 82 (P04001)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 01 30 3228

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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