

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number:

0 221 667
A2

(12)

EUROPEAN PATENT APPLICATION

(21) Application number: 86307468.8

(51) Int. Cl. 4: B61F 5/38 , B61F 5/52

(22) Date of filing: 30.09.86

(30) Priority: 28.10.85 JP 241836/85

(43) Date of publication of application:
13.05.87 Bulletin 87/20(84) Designated Contracting States:
DE FR GB

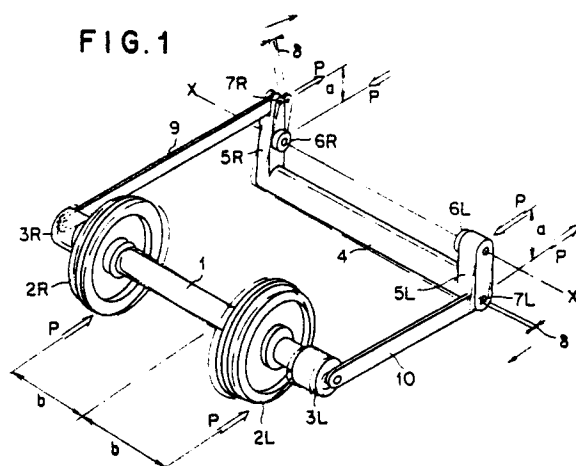
(71) Applicant: **Kawasaki Jukogyo Kabushiki Kaisha**
1-1 Higashikawasaki-cho 3-chome
Chuo-ku Kobe-shi Hyogo-ken(JP)

(72) Inventor: **Uozumi, Yukio**
12-9, Tennoshitacho
Tarumi-ku Kobe-shi Hyogo 655(JP)

(74) Representative: **Mosey, Stephen George et al**
MARKS & CLERK Alpha Tower Suffolk Street
Queensway
Birmingham B1 1TT(GB)

(54) **Railway bogie.**

(57) A railway bogie is provided with an axle supporting device composed of a lateral member (14) in which two axle boxes (3R, 3L) are spaced apart for one axle (1), said axle boxes being moveable in a longitudinal direction in respect to the bogie frame - (12) and restricted in a lateral direction, the axle being rotatable in a horizontal direction and the lateral member being pivoted to and rotatable in respect to the bogie frame in such a way that the horizontal lateral direction is a rotation axis, and connection members (9, 10) connected to each of said axle boxes at one end of said lateral member at a position above the center of the rotation axis and at the other end at a position below the center of the rotation axis.



EP 0 221 667 A2

RAILWAY BOGIE

BACKGROUND OF THE INVENTION

This invention relates to a bogie having one or two axles and a bogie frame and more particularly to a railway bogie exhibiting a self steering characteristic when running on curved rails.

In a general type of bogie, wherein a plurality of axles are held in parallel by a bogie frame, there is a distance between the axles (wheel base) L as shown in Fig. 2. When this bogie runs on a curved line having a radius of R , the direction of a wheel does not coincide with the direction of the curved line, having at least an angle of $L/2R$ with respect to the rail. As a result, when the bogie runs on a curved line having a small radius in particular, a sliding action is generated between the wheel and the rail, resulting in a high lateral force and an excessive creak sound. Consequently, the wheels and rails are both worn to shorten their life, and further due to higher lateral force, there may be a danger of derailment of the bogie. In order to resolve these problems, it has been proposed to cause the axle to steer by itself in such a way that the above-mentioned angle of $L/2R$ is not generated between the wheel and the rail. Self steering of the axle requires a supporting of the axle in such a manner that the axle can be rotated in a horizontal plane. Further, the axle shows that various forces are applied to the right and left wheels from the rails. One of the various forces is a longitudinal force acting in an advancing direction of the bogie caused by a propelling force for a self-running operation and a braking force for deceleration and stopping etc. and the other force is a lateral force which is perpendicular to an advancing direction caused by a force for guiding the vehicle as well as a centrifugal force generated in the case of running on the curved line and a side wind etc. Steering by the axle itself is inconvenient due to the fact that it requires such a structure as the steering to be performed in a direction to cause the generated lateral force to be reduced, and in addition to the occurrence of horizontal rotation of the axle caused by the lateral force, if the axle receives the longitudinal force, the axle may generate a non-required lateral force under the horizontal rotation of the axle. With a normal vehicle, the longitudinal forces applied on the right and left wheels are equal (the propelling force or braking force is a force generated from the wheel in view of a power transmitting path and it is considered that the reaction force may act on the wheels from the rails). In order to prevent the horizontal rotation from being generated at the axle under this condition, a centre

or rotation of the axle to which the longitudinal force is transmitted is arranged directly or indirectly at a point equally spaced apart from the right and left wheels, that is, on a line passing through a central part of the axle. In detail, since equal forces are applied at the equal distances in opposite directions, it requires such a structure showing no momentum of horizontal rotation. In the present invention, such a device having the above-mentioned function shall be referred to as an axle supporting device.

As regard the steering of the axle, it may be considered that an independent steering for each of the axles is carried out only with a taper of the tread of the wheel and that in case of a two-axled bogie, steering amounts of the two axles are made equal, two wheels are rotated in opposite directions to each other and placed on theoretical complete circles so as to have a certain relation with a steering amount of the axle. In the present invention, the device having such a function as described above shall be referred to as an inter-axle connection device.

Objects and effects of the inter-axle connection device will be described in the preferred embodiments later.

There have been proposed some examples in which the steering can be performed:

(a) Gazette of Jap. Pat. Laid-Open No. 55-29692: Railway Vehicle

(b) Gazette of Jap. Pat. Laid-Open No. 57-7756: Railway Vehicle Bogie

(c) Gazette of Jap. Pat. Laid-Open No. 58-183344: Railway Vehicle Tow-Axle Bogie

A schematic illustration of the invention described in Jap. Pat. Laid-Open No. 55-29692 is shown in Fig. 3. It has several hydraulic actuators and the wheels are forcedly controlled in such a way that the directions of the wheels coincide with the directions of the curved lines, and it requires some higher function parts and so a high reliability may not be attained unless a sufficient repair is performed. It has a further disadvantage that the manufacturing cost is high.

The axle supporting device is made such that each of the axles has its center of rotation on a center line of the axle directly and the inter-axle connection device is a hydraulic cylinder.

Fig. 4 shows a partial section of a top plane view of the bogie structure shown in Jap. Pat. Laid-Open No. 57-7756. The axle is directly pivoted at a point C in such a way as it may be rotated in a horizontal plane, wherein a longitudinal member 101 and T-shaped member 102 are connected to an axle box 100, a member is extended up to the

pivoted part C, and an extension beam 104 is arranged from a bogie frame 103 so as to construct the pivoted part. Arrangement of the structural member which is not applied to the general type of bogie constitutes the axle supporting device. The corresponding portions are illustrated by hatched lines.

Since a propelling force or a braking force is applied to the members 101 to 104, the result is the production of a large sized structural member, with the disadvantages that this device is large in size, heavy in weight and requires a high manufacturing cost. An inter-axle connection device in which amounts of horizontal rotation of two axles are equal to each other and their rotational directions are opposite to each other is composed of a connection member 105 and a small lever member 106, and this structure is simple. A central part of the lever 106 is pivotally connected to the bogie frame 103.

The structure of Jap. Pat. Laid-Open No. 58-183344 is shown in Fig. 5 and is made such that the bogie frame itself is bent at its central part, acts as both the function required for the axle supporting device and the function required for the inter-axle connection device. Therefore, although the constitution is simple, the bearing at the bent part or its constitution is simple, the bearing at the bent part or its constituting member is large in size and heavy in weight.

SUMMARY OF THE INVENTION

There have been proposed arrangements in the above-described three examples where the function for steering the axle (composed of the axle and wheels fixed to the axle) is provided so as to perform a running on the curved line having a small radius. However, these prior art proposals have practical problems in reliability, manufacturing cost and heavy weight etc. The present invention is provided in order to resolve these problems. It is an object of the present invention to provide a device in which a slight mechanism is merely added to a quote general type of bogie, so that thereby a low lateral force is generated even at a curved line having a small radius, a creaking sound is not generated and the wear between the wheels and the rails can be reduced. It is another object of the present invention to improve the stability of the bogie during a high speed running of the vehicle. It is a still further object of the present invention to simplify the structure of the bogie by applying one lateral member in common to two axles.

A railway bogie of the present invention is made such that the axle is supported to the bogie frame in such a way that it may be rotated in a horizontal plane by providing an axle supporting device which is composed of a lateral member in which two axle boxes are spaced apart in a lateral direction in respect of one axle, said axle boxes being moveable in a longitudinal direction in respect to the bogie frame and restricted in their lateral directions, the axle being capable of rotating in a horizontal plane and the lateral member being pivotally supported in the bogie frame around a rotating axis of its horizontal direction, and of connector members one of which is connected at one end of said lateral member at a position above the center of the rotating axis to each of said axle boxes and the other of which is connected at the other end of said lateral member at a position below the center of the rotating axis to each of said axle boxes.

According to another arrangement of the present invention a railway bogie is made such that two sets of axle supporting devices are provided in the bogie, which has two axles, an inter-axle connection device being provided to connect two lateral members in such a manner that amounts of horizontal rotation of the two axles are equal to each other and their rotational directions are opposite to each other.

According to a still further arrangement of the present invention a railway bogie consists of a structure in which two axles are provided in one bogie, two axle boxes are arranged in spaced-apart relation for one axle, said axle boxes are moveable in a longitudinal direction in respect to the bogie frame and restricted in a lateral direction, each of the axles can be rotated in a horizontal plane and one lateral member which is pivotally and rotatably supported at the bogie frame around the rotating axis of horizontal lateral direction is provided, the axle supporting device for the two axles is composed of connection members for connecting said lateral member to each of said axles boxes and the connection between said lateral member and the connection member for each of the axle boxes is made such that the amounts of horizontal rotation of the two axles are equal and their rotational directions are opposite to each other.

The present invention may provide means for resolving all the problems described above.

In general, the railway wheel is provided with a taper at its tread surface. If the axle composed of two wheels and axle is displaced laterally in respect to the center of the rail, the tread of the wheel displaced in such a direction where the flange and the rail approach each other contacts the rail at its large diameter part, the tread of the other wheel contacts the rail at its small diameter

part and thereby a force pulling back the axle is applied between both axles. The axles are displaced from the centre of the rail when they enter from a straight line to a curved line, displaced toward the outer rail of the curved line, a diameter of the outer wheel of the curved line is large and a diameter of the inner wheel is small. The manner of operation of the wheels is illustrated in Fig. 6b, a relation between the two diameters being $D_2 < D_1$. Since the wheels fixed to the same axle show the same rotation to each other, the outer wheel of the curved line advances forward more than the inner wheel of the curved line, and the axle may steer the vehicle and act such that the direction of the wheel is coincided with the tangential direction of the curved line.

In this way, in order to perform an automatic steering with the axle by itself, it requires a condition in which the axle boxes of the connection part are moved in a longitudinal direction in such a manner that a horizontal rotation of the axle can be performed in respect to the bogie frame, and in the present invention, the axle boxes are supported in the bogie frame in such a way that they are moveable in a longitudinal direction and restricted in a lateral direction so that the axes may automatically steer the bogie. The steered condition is illustrated in Fig. 6a. Longitudinal spacing between the axle boxes is varied and the spacing value at the outer part of the curved line shows E and similarly the spacing value at the inner part shows F, resulting in that the wheels are moved along the curved lines. However, a mere free movement of the axles in a longitudinal direction in respect to the bogie frame does not cause a horizontal force acting on the wheels, such as a braking force etc., to be transmitted to the bogie frame and so the bogie may not act as is required by a bogie.

In the present invention, this problem is resolved by connecting the lateral member and the axles.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be now be described, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 is a perspective view showing a mechanism for transmitting an acting force of a major component of a railway bogie of a first invention.

Fig. 2 is an illustrative view showing a condition in a conventional type of bogie run on a curved line having a radius of R.

Fig. 3 to 5 are respective illustrative views showing some examples of the prior art.

Fig. 6a is an illustrative view showing a condition in which the axle of the railway bogie steers the vehicle.

Fig. 6b is an illustrative view showing a relation between the wheels at the curved lines and the rails.

Fig. 7 is a top plan view partly broken away showing the bogie of a preferred embodiment of the present invention.

Fig. 8 is a top plan view partly away showing a preferred embodiment of a second invention.

Fig. 9 is a front elevational view partly broken away showing one example of a linkage device.

Fig. 10 is a front elevational view partly broken away showing another device to be installed in the embodiment of Fig. 8.

Fig. 11 is a front elevational view showing a rubber bushing.

Fig. 12 is a perspective view showing a preferred embodiment of a third invention.

Fig. 13 is a top plan view showing another preferred embodiment of the third invention.

Fig. 14 is a side elevational view of Fig. 13.

Fig. 15 is a sectional view showing axle boxes, and

Fig. 16 is a schematic perspective view showing a preferred embodiment utilizing the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figure 1 shows an axle 1 and wheels 2R and 2L. Axle boxes 3R and 3L are arranged at both ends of the axle, and a lateral member 4 is arranged such that both of its ends 5R and 5L are pivotally supported by pivot points 6R and 6L arranged at the bogie frame and are rotated around a rotating axis of the horizontal lateral direction X-X. A connection part 7R is placed at a location spaced apart by 'a' above the pivot point 6R, and a connection part 7L is placed at a point spaced apart by 'a' below the pivot point 6L. The connection part 7R is connected to the axle box 3R through a beam-like connection member 9, and the connection part 7L is connected to the axle box 3L through a beam-like connection member 10. When horizontal forces P such as braking forces etc. are applied to the treads of the wheels 2R and 2L, one of the horizontal forces P is transmitted to the connection member 9 and the other horizontal force is transmitted to the connection part 7L through the axle box 3L and the connection member 10.

Although the lateral member 4 is pivotally supported by the pivot points 6R and 6L, since the horizontal forces in the same direction act upon the connection part 7R at the position 'a' above the pivot point 6R and act upon the connection part 7L at the position 'a' below the pivot point 6L, a moment $P \times a$ for rotating the lateral member 4 is balanced at the connection part 7R and the connection part 7L due to its opposite acting direction. Therefore, the lateral member 4 keeps stability, forces P of reaction forces for producing this momentum act on each of the pivots 6R, 6L and the forces from the wheels are transmitted to the bogie frame.

Transmission of this force and a balanced force with the momentum is the same as the case where the axle steers on curved lines, and as shown in Fig. 1 by two-dot lines the lateral member 4 is rotated and inclined. Even in this condition, momentums caused by the horizontal forces from the tread of the wheel are balanced and then the forces are transmitted to the bogie frame in a stable manner. This figure shows that the wheel 2R faces the inner side of the curved line.

In the preferred embodiment, the main lateral member 4 passes through the position below the center of rotation X-X. This is the shape in which the main member of the bogie frame is avoided. The object of this lateral member 4 is to transmit the twisting momentum between the right end and the left end, and the upper and lower positions of the lateral member at its ends exhibit the same function wherever they may be located up side down and their relative positions are selected in view of the constitution of the entire bogie frame.

In the case of the condition shown by the two-dot line, the connection part 7R placed above the pivot 6R is displaced by δ in a direction away from the axle under a rotation of the lateral member 4 so as to pull the extremity end of the axle, and the connection part 7L placed below the pivot 6L is displaced by δ in a direction towards the axle so as to push the axle. In this way, since both ends of the axle are displaced by the same amount in an opposite direction, the axle may result in showing a horizontal rotation around its longitudinal center and thus a railway bogie in which the steering is automatically performed.

In addition to such an axle supporting device, the connection device between the axles relating the steering of two axles is added, and the case in which the railway bogie having a self-steering characteristic with a high stability is obtained and another case in which one lateral member of the main member in the two axles is corresponded to two

axles, are described in detail in the following preferred embodiments. The structure is simplified to provide a railway bogie having a self-steering characteristic.

Fig. 7 is a top plan view for showing a first preferred embodiment of the present invention in which an axle 1 with wheels 2 is connected to the lateral members 4a and 4b through the axle boxes 3R and 3L and the connection members 9 and 10. This structure is the same as that shown in Fig. 1 and the connection member 9 is connected above the lateral members 4a and 4b and the connection member 10 is connected below the lateral members 4a and 4b. The axle boxes 3R and 3L are supported on the bogie frame 12 by axle box holders 11 in such a way that projection 3P of the axle boxes are moveable in a longitudinal direction and restricted against lateral displacement.

Thus, the present invention is made such that two sets of axle supporting devices shown in Fig. 1 are arranged in one bogie without being related to each other and each of the axles may perform a steering operation. Even in the case where the size of the wheel tread or shape is made different between the two axles, a natural and proper steering operation is performed and it has a feature which does not generate any overwork. As a result, a slight difference is produced in the amount of steering of each of the axles. A steering condition of the bogie is indicated in the figure with two-dot line. The connection member 9 connected to the lateral member 4a is displaced in a leftward direction under a pivotal movement of the lateral member 4a in a direction indicated by the arrow, the connection member 10 is displaced in a rightward direction and along with these displacements, the axle box 3R is moved in a leftward direction, the axle box 3L is moved in a rightward direction, and the axle 1 performs a horizontal rotation around the central point 0 so as to perform the steering action. The member related to the lateral member 4b performs an action opposite to the former action. In this case, the planer shape formed by the axles and the connection members, and the lateral member is displaced slightly from its parallelogram. However, resilient bushings and spherical joints and the like are selected for each of the connection parts in their design.

Although a slight difference is made in the structure to be applied in the axle box, it is necessary to provide a light clearance between the axle box holders 11 and the projection 3P of the axle box. It is also possible to make axle box holders having no clearance to be described later in reference to Fig. 15.

Figs. 8 to 11 illustrate the preferred embodiment of the present invention.

Fig. 8 is a top plan view for showing an entire bogie, wherein the devices shown in Figs. 9 and 10 are installed at the part shown by A.

Fig. 9 is a longitudinal section for showing one example of the linkage device, the lateral members 4a and 4b being provided with each of arms 17a and 17b, and these extremity ends of the arms being connected by a linkage 18. Arrangement of such a structure as above causes the rotational angles of the lateral members 4a and 4b to be equal and faced in an opposite direction and thus the steering amounts of both axles become equal to each other. With this arrangement, it has an effect that the equal steered conditions of both axles on the circle curved line can easily be accomplished.

Fig. 10 is a longitudinal section for showing another mechanism having the same objects and effects as those of Fig. 9 and which is installed at the part A of Fig. 8, wherein the lateral members 4a and 4b are provided with each of arms 19a and 19b and the extremity ends of these arms are directly connected through a rubber bushing 20 composed of a rubber 21, outer cylinder 22 and inner cylinder 23 shown in Fig. 11. A relative displacement between the outer cylinder and the inner cylinder of the rubber bushing 20 as an arcuate movement of the extremity ends of the arms is performed is $100 \text{ mm} \times (1 - \cos 3^\circ) = \text{approx. } 0.4 \text{ mm}$, if it is assumed that for example a length of arm is 100 mm, a rotational angle is 3° and the lateral member is arranged at the center of the rotation axis to have no relative displacement, resulting in that the relative displacement of the arms 19a and 19b becomes $0.14 \times 2 = 0.28 \text{ mm}$ and a strain of the rubber in the case of a rubber thickness of 10 mm becomes $0.28/10 = 0.28/10 = 0.028 \%$ and so the deformation can be attained without overwork. Further, if the rubber having a side shape as shown in Fig. 11 is applied in which its vertical direction, i.e. z-z direction shows a hard condition and its horizontal direction, i.e. y-y direction shows a soft condition, the result enables the influence of strain to be reduced. The rubber bushing is connected to one of the arms at its outer cylinder and further its inner cylinder is connected to the other arm by pins etc.

In the case where a general type of railway axle having wheels with spherical tread surfaces arranged at right and left sides thereof is displaced from the center part of the linear rails, for example, when it is displaced to a rightward part in Fig. 6 - (b), the wheels run with the acting diameter of D_1 of the displaced right wheel being larger than the acting diameter of D_2 of the left wheel, whereby the right wheel advances forward and the steering of the axle is naturally carried out and the axle may move toward the center of the rails. When the wheels are returned to the center of the rails, their

steering action is left and their inertia force directed toward the steered direction is also left, so that the wheels may run over the center and are displaced toward the left side. Then, the acting radius of the left wheel becomes large to perform an opposite steering action and then the left wheel is moved toward the right. In this way, this operation is continuously repeated. This is a steering action which occurs when only one axle is freely rotated. In turn, when a plurality of axles are present and their steerings are related to each of them, their manner of operations will be varied.

For example, as in case of the preferred embodiment shown in Fig. 8, if the two axles are provided and the equal amounts of steering of the two axles are related to each other under their opposite phases and if the front axle is steered in a rightward direction, the rear axle may steer in a leftward direction and a zig-zag movement is restricted to each other, so that an amount of lateral movement of an entire bogie is less than the zig-zag movement of the free rotation of one axle and the wave length of the zig-zag movement is extended. As regards the wave length of the zig-zag movement, refer to "Vibration of Electric Car and New Bogie" page 23 published by Institute of Electric Car.

If the wave length of the zig-zag movement is elongated, it may coincide with a natural frequency in a lateral direction of the vehicle and a running speed for generating an excessive vibration is increased and if the wave length is set at a value other than that of the real running, no unstable condition may occur under a real running action. Numerical examples show that if the maximum value in the case of actual running is 100 Km/h and further if the coincident speed of the wave length of the zig-zag movement and the natural frequency of the vehicle in the lateral direction is about 150 Km/h, it shows a relation of value of $150 \text{ Km/h} > 100 \text{ Km/h} \times \sqrt{2}$ and a resonance can be avoided. (It is known that a response against a vibration amplitude when a vibration frequency is varied in a vibration system of one degree of freedom is theoretically infinity at the resonance point, this value is more than 1 in a range from the resonance point to $\sqrt{2}$ times of the resonance frequency and is less than 1 in case of a value more than $\sqrt{2}$ and this value is decreased as the vibration frequency is increased more than the value. Refer to "Basic Vibration" page 49 published by Kyoritsu Shuppan).

As found in this preferred embodiment, a relative setting of the steering of both axles results in an elongated wave length of the zig-zag movement in response to a condition in which one axle performs a separate steering action and thus it shows an effect that the stability of running is increased up to a high speed range.

Fig. 12 is a perspective view for showing a practical preferred embodiment of the third invention and the axle is kept at its removed condition.

A trunnion 41 is fixed to the bogie frame 40 and a lateral member 43 is supported with the axis 42 of the trunnion being a pivot point. Each of the axle boxes 44R and 44L is connected to the lateral member 43 by connection members 46B and 46U, and axle boxes 45R and 45L are connected to the lateral member 43 by each of connection member 47U and 47B. The connection member having an apex character U pivotally attached by a rubber bushing 48 above the shaft part 42 of the trunnion of the lateral member 43, and the connection member having an apex character B is pivotally attached by the rubber bushing 49 below the shaft part 42 of the trunnion of the lateral member 43 to allow the displacement of the steering operation to be preformed.

Each of the axle boxes and each of the connection members are integrally connected by each of four bolts 50.

According to the present preferred embodiment, one lateral member is applied to two axles and an entire structure of the bogie is simplified without arranging the inter-axle connection device.

51 designates axle box holder rubbers in which their vertical and longitudinal directions are soft and lateral direction is hard, and they do not hinder the shock absorbing action of an axle spring 52, do not provide a longitudinal resistance against the steering action and do support the axle boxes on the bogie frame in a lateral direction. This has the structure which is similar to that of the preferred embodiment of Fig. 15 and it has an advantage that it has no wear portions.

53 denotes secondary spring seats arranged on the bogie frame 40, and 54 designates a lateral beam forming the bogie frame which is made of pipe material.

Fig. 13 is a top plan view for showing another preferred embodiment of the third invention, wherein axle boxes 31R and 31L, and 32R and 32L may not be arranged symmetrically in view of the arrangement of the driving device or the braking device, a lateral member 33 is arranged at the central part so as to correspond to two axles and is supported on the bogie frame 35 by pivot points 34R and 34L at both ends and connects between

each of the axle boxes by connection members 31S and 31T and 32S and 32T, respectively. The manner of each of the connections is illustrated in Fig. 14.

Fig. 14 is a view which is common in views taken along an arrow M and an arrow N of Fig. 13 and in case of the view taken along an arrow N, the numbers are indicated in (), respectively. The positions of connection are at a distance h_1 above the pivot point 34 and at a distance h_2 below the pivot point 34. The lateral position of the axle is set to have a relation of $b_1 : b_2 = h_1 : h_2$ and the present device is stabled and balanced under the acting forces indicated by P in Fig. 1.

Fig. 15 is a top plan view for showing a preferred embodiment of the axle box holders to be used in the present invention and in other devices. Numeral 36 denotes an axlebox and 37 designates axle box holders arranged in the bogie frame, with vibration-proof rubbers 39 being arranged between the projections 38 of the axle boxes 36. The vibration-proof rubber of the preferred embodiment is of a multi-layer structure and has a characteristic that a compressing direction y -y, that is, a lateral direction shows a quite hard feature, and a shearing direction x -x, that is, a longitudinal direction shows a quite soft feature. The axle boxes can move in the longitudinal direction (x -x) and is substantially restricted and supported in the lateral direction (y -y). Although Figs. 7 and 8 show a rigid contact between the axle box holders 11 and the projections 3P of the axle boxes, this contacted structure can be replaced with the structure shown in Fig. 15.

Fig. 16 is a perspective view for showing the preferred embodiment utilizing the present invention, wherein a two-axle bogie having a large wheel base and a two-axle bogie having a small wheel base are overlapped so as to constitute one four-axle bogie and only one lateral member is applied to four axles, and four axles, denoted 24 to 27 are present in one bogie and are equally spaced apart. Both ends of each of the axles are provided with each of the axle boxes having appendix characters R and L. Only one lateral member 28 is arranged at the center so as to correspond to the above-mentioned four axles 24 to 27 and it is supported at both ends to the bogie frame 30 at pivot points 29R and 29L. The axle box 24R of the axle 24 placed at a position of 1.5 L from the pivot point is connected to the point spaced apart by a distance (i) below the pivot point 29R by the connection member 24S, and the axle box 24L is connected to the point spaced apart by a distance (i) above the pivot point 29L by the connection member 24T. The axle box 25R of the axle 25 positioned at a distance 0.5 L from the pivot point is connected to the point spaced apart by (h) below the pivot point

29R by the connection member 25S, and the axle box 25L is connected to the point spaced apart by a distance (h) above the pivot point 29L by the connection member 25T. The axles 26 and 27 are also similarly connected in a symmetrical manner. In the case of the wheel base of equal distance as found in the preferred embodiment, a relation of $h : i = 1.5L : 0.5L$, that is 3 : 1 is set, so each of the axle boxes of four axles displaces by 1.5δ or $\delta/2$ and each of the axles can steer at the same curved line.

Even if the axles are arranged in non-equally spaced apart, a correction of a relation of (h) and - (i) to a ratio of distances enables the axles to be positioned on the same curved lines under a superior condition. Arrangement of the lateral member for each of the axles in the multi-axle type bogie causes the structure to be complex and in some cases they may not be arranged in view of their capacity. However, utilization of the present invention can avoid the complex arrangement and facilitate the passage of the curved lines and thus enables the above-mentioned essential objects to be accomplished.

As described above in detail, the present invention does not require any high accuracy function parts disclosed in the above-identified Jap. Pat. Laid-Open No. 55-29692, a new arrangement of members for performing a horizontal rotation of the bogie frame and the axles at a place having no structures as a normal bogie frame as disclosed in Jap. Pat. Laid-Open No. 57-7756 and further does not require a wide space or weight for the constituting members to be bent or bearings as disclosed in Jap. Pat. Laid-Open No. 58-183344. According to the present invention, a mere addition of the mechanism composed of the lateral member and the connection member etc. to the general type of bogie enables a self-steering operation to be added and so the present invention is advantageous in that a low lateral force is generated on the curved line of small radius, a creak sound is not generated and a wear of the wheels and the rails can be reduced.

There are also the advantages that a stability in running up to a high speed range can be attained under an addition of the mechanism for making equal steering amounts for two axles, and the structure of the bogie can be simplified by a method wherein one lateral member acting as a steering member is arranged for two axles.

Claims

1. A railway bogie comprising
a bogie frame
a lateral member attached to said bogie frame

rotatable about an axis extending laterally and horizontally;

a pair of wheels;

an axle journaling said pair of wheels and being rotatably in a horizontal plane;

a pair of axle boxes provided on said axle with a spacing therebetween movably in forward and rearward directions and rigidly in lateral direction; and
a pair of connection members connecting said axle boxes and said lateral member, said connection members being pivoted to said lateral member at a position above said axis at one end thereof and below said axis at another end thereof.

2. A railway bogie comprising

a bogie frame;

laterally extending means attached to said bogie frame laterally and horizontally and adapted for axial rotation;

a first pair of wheels provided forwardly of said laterally extending means and a second pair of wheels provided rearwardly of said laterally extending means;

first and second axles journaling said respective first and second pairs of wheels and being rotatable in a horizontal plane;

first and second pairs of axle boxes provided on said respective first and second axles with a spacing therebetween, the axle boxes in each pair being movable in forward and rearward directions and rigid in lateral directions relative to said bogie frame; and

first and second pairs of connection members connecting said first and second pairs of axle boxes to said laterally extending means such that said laterally extending means allows the first and second axles to rotate identical angular distances in different directions,

3. A railway bogie as claimed in claim 2, wherein said laterally extending means includes a first lateral member attached to said bogie frame rotatably about a first axis extending laterally and horizontally and a second lateral member attached to said bogie frame rotatably about a second axis extending laterally and horizontally, said first lateral member and second lateral member being connected by link means for allowing said first and second lateral members to rotate identical angular distances in different directions.

4. A railway bogie as claimed in claim 2, wherein said laterally extending means includes a single lateral member attached to the bogie frame rotatably about an axis extending laterally and horizontally, said first and second pairs of connection members each including a right connection member and a left connection member one of said right connection member and one of said left connection member being pivoted to said single lateral member at a position above said axis, and the other of

said right connection member and the other of said left connection member being pivoted to said single lateral member at a position below said axis.

5. A railway bogie substantially as hereinbefore described with reference and as shown in Figure 1, or Figure 7, or Figures 8 to 11, or Figure 12 or

Figures 13 and 14, or Figure 7 as modified by Figure 15, or Figure 8 as modified by Figure 15, or Figure 16 of the accompanying drawings.

10

15

20

25

30

35

40

45

50

55

FIG. 1

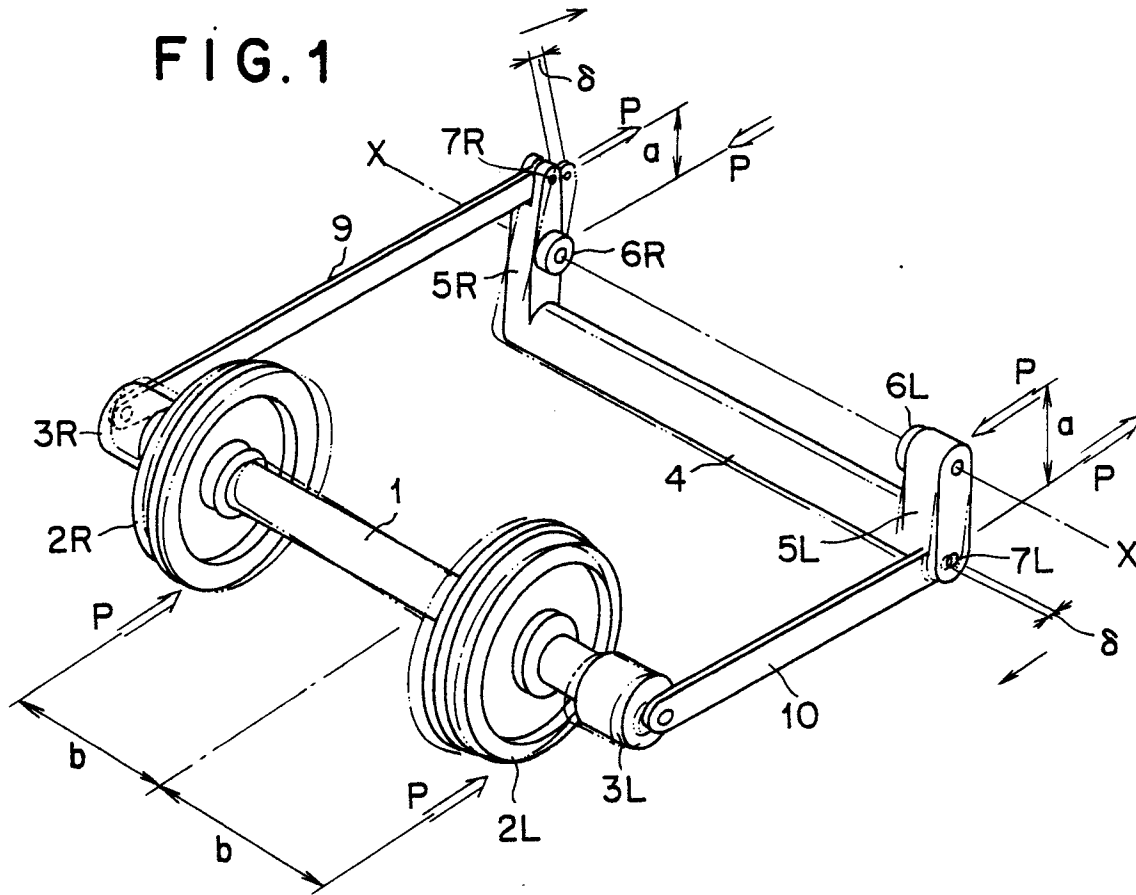


FIG. 5

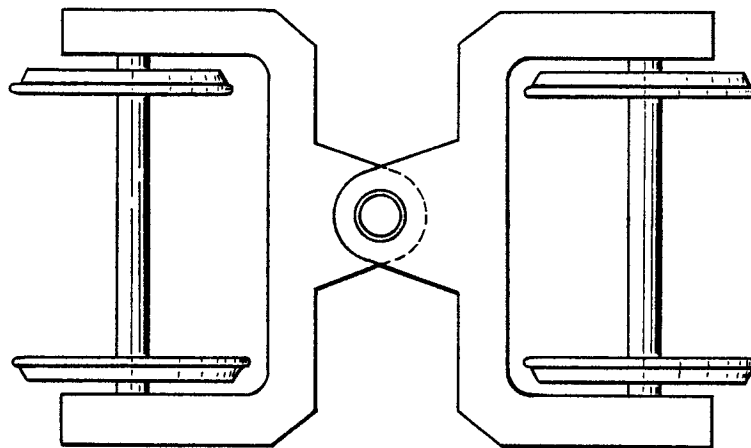


FIG. 2

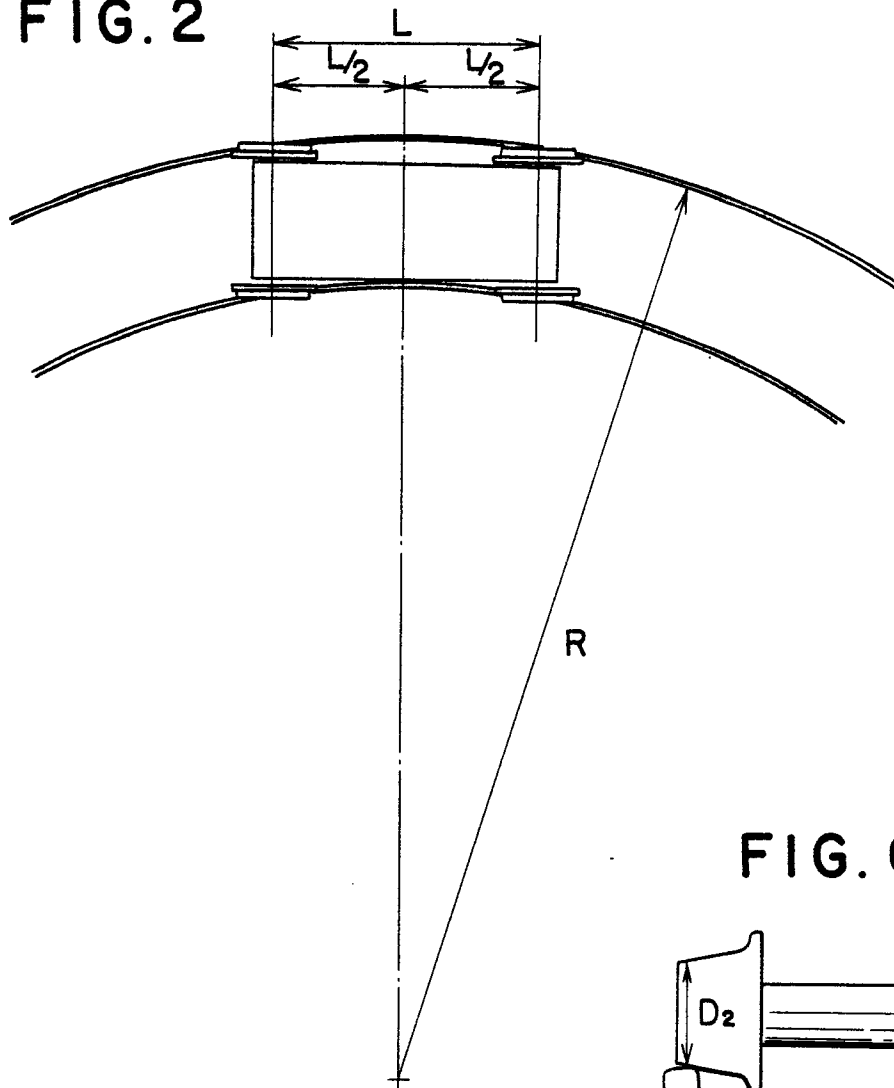


FIG. 6b

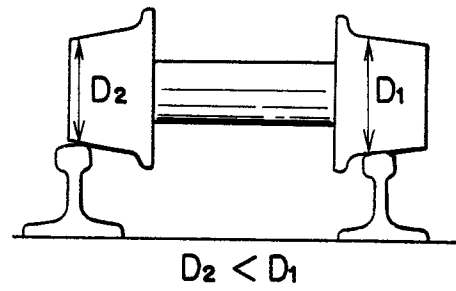


FIG. 6a

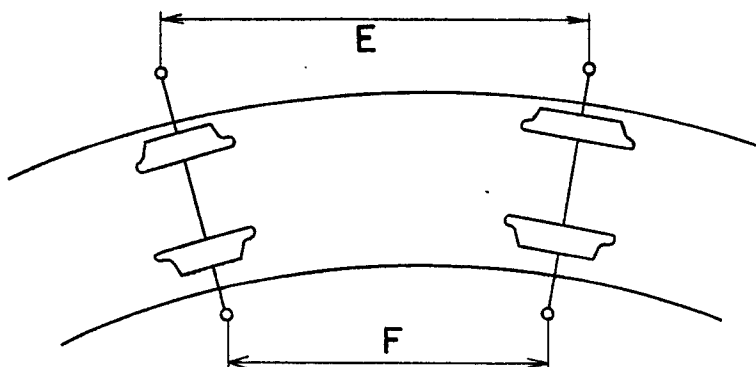
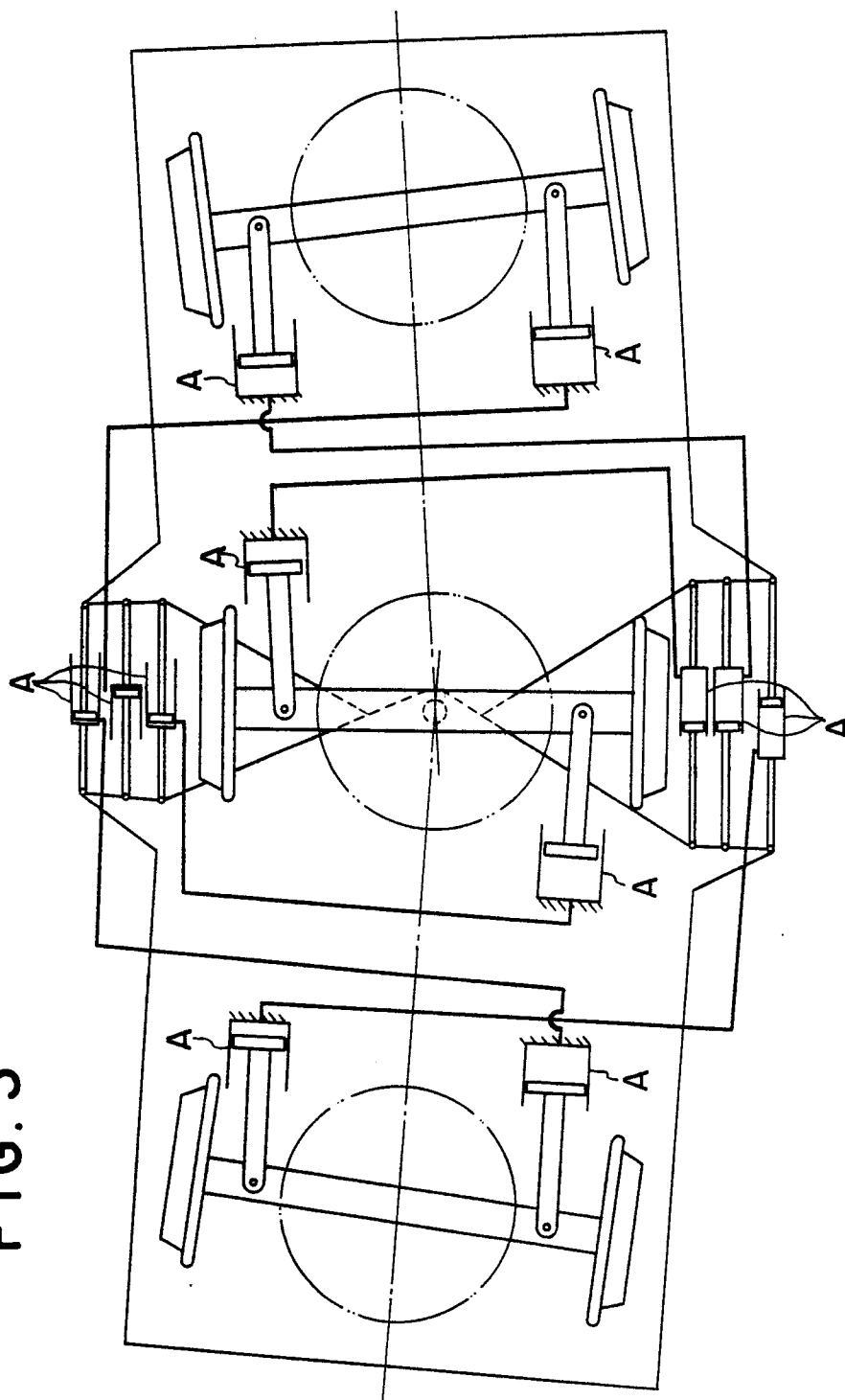


FIG. 3



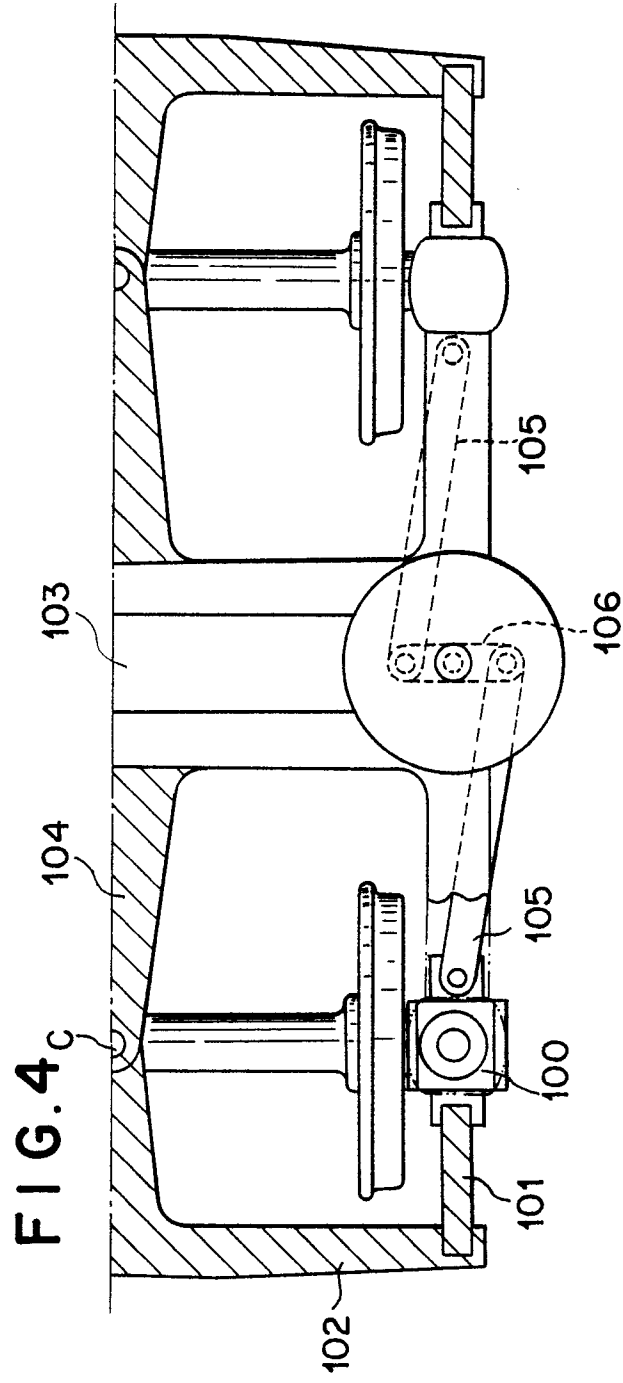


FIG. 11

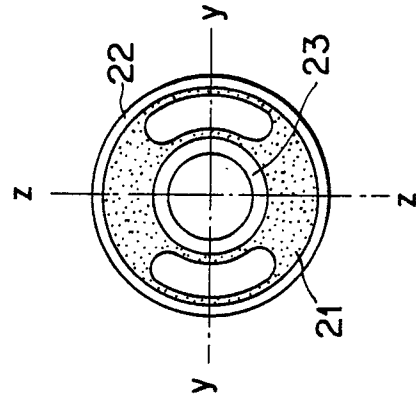


FIG. 10

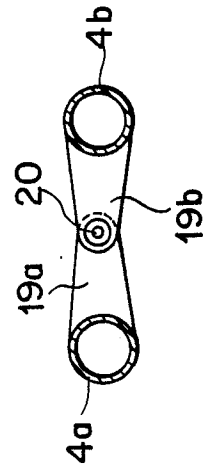


FIG. 9

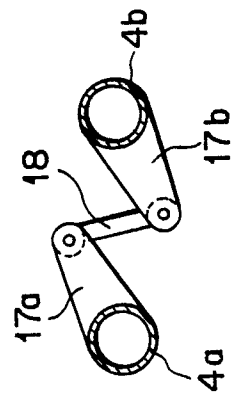


FIG. 7

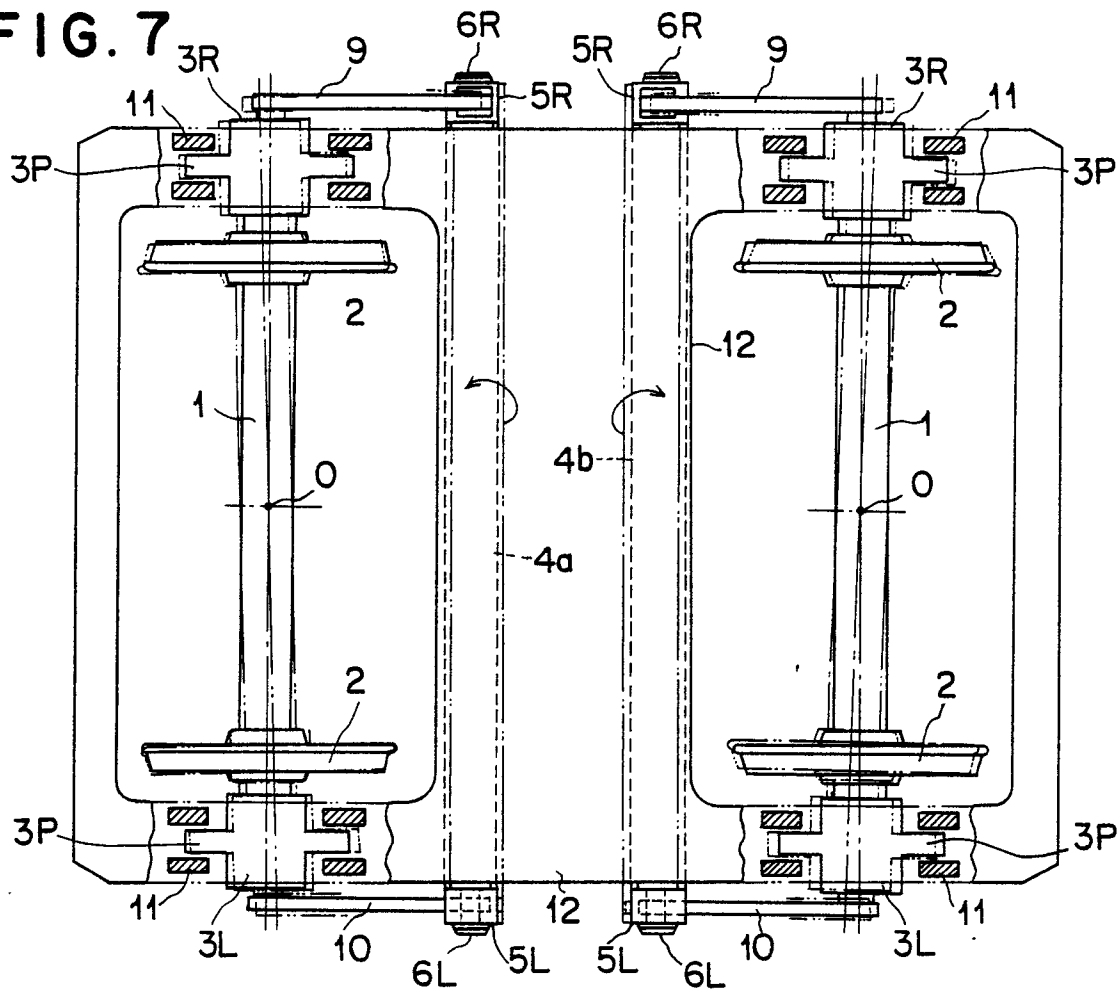


FIG. 13

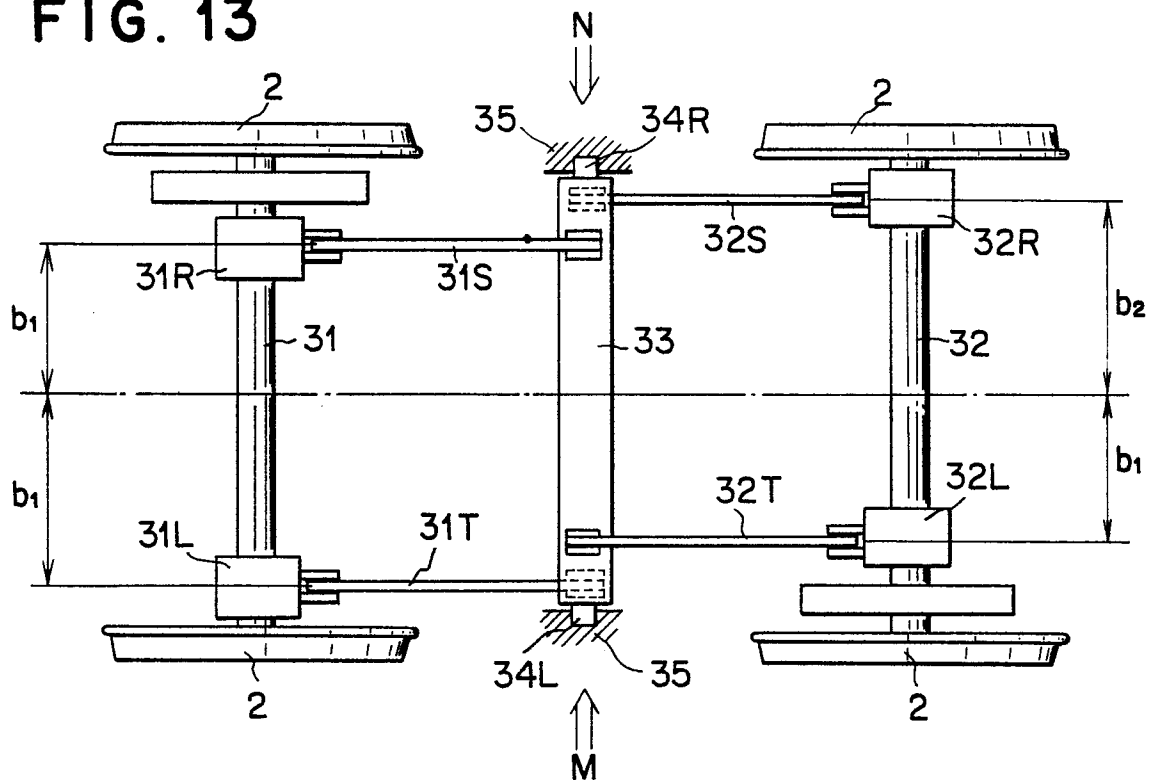


FIG. 8

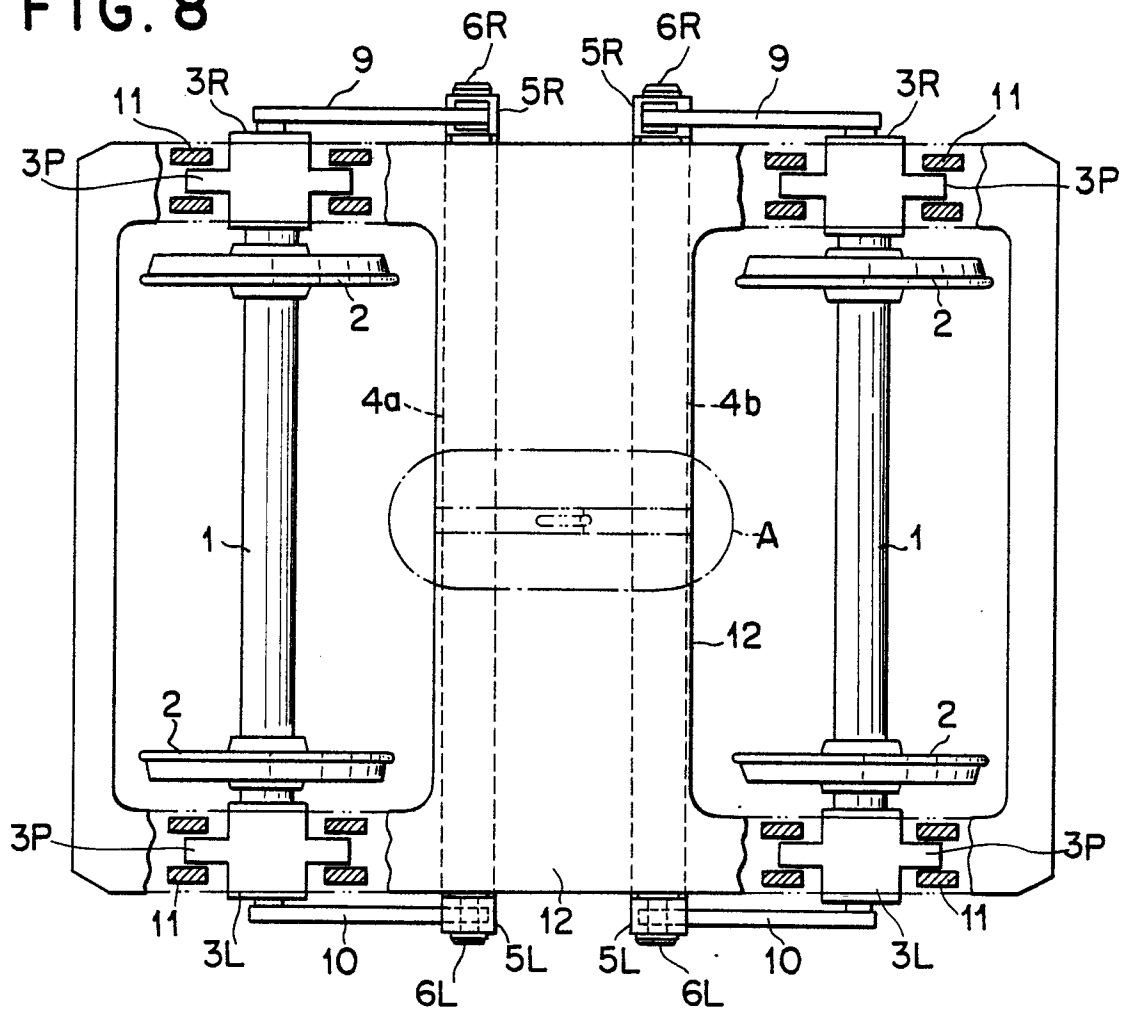


FIG. 14

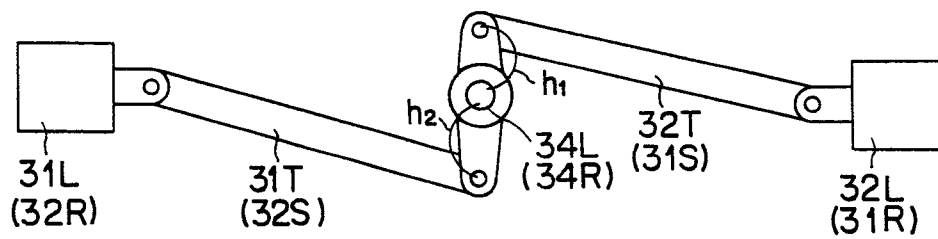


FIG. 15

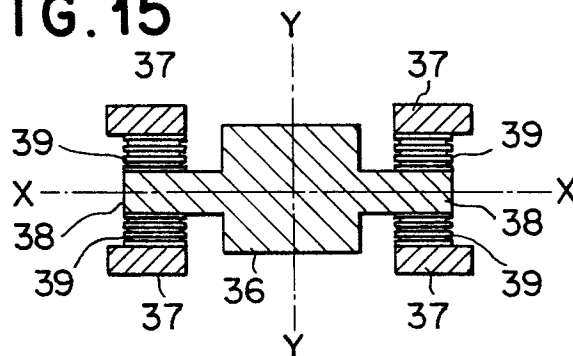


FIG. 12

