PNEUMATIC RAILWAY CAR SUSPENSION

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ABSTRACT

The pneumatic springs of the resilient suspensions at each supporting position are interconnected via ducts and stop valves such that, with respect to the direction of travel, the two forward suspensions are coupled together to achieve an equalization of the supporting forces therebetween while the rear suspension remains independent of the coupling. The coupling is reversible by opening and closing of the stop valves when the direction of travel is reversed, so that the two forward suspensions in the reversed direction of travel are coupled together while the rear suspension is independent.

7 Claims, 3 Drawing Figures
PNEUMATIC RAILWAY CAR SUSPENSION

This invention relates to a powered rail vehicle and a suspension therefor.

Heretofore, powered rail vehicles have been known to consist of a rigid box which can be supported on a track by means of resilient suspensions on bogies or individual axles at at least three supporting positions, at each of which a driving force is also applied to the track. However, these rail vehicles have suffered from the disadvantage that the supporting means are statically undefined and that a uniform blending of all the supporting positions has therefore not been possible. Such vehicles had to apply traction it would therefore be difficult for the adhesion between the axles and the rails to be adequately utilized.

It is therefore common practice to construct rail vehicles having three supporting positions with three bogies and with a two-section box. Both halves of the box have been coupled to each other by means of links and supported on a middle bogie or each has been provided with a pivoting stub and all are surrounded independently of each other on the middle bogie. The articulated manner of construction permits uniform loading of the bogies and enables the vehicle to be adapted to the rail geometry and the design profile. However, this two-section manner of construction suffers from the disadvantage that it is relatively complicated and heavy. Also, the middle bogie must be constructed differently from the remaining bogies, a feature resulting in complications of design and difficulties in maintenance. Furthermore, any sub-dividing of the box results in additional uncontrolled vibration which may have an unpleasant consequence during travelling.

Accordingly, it is an object of the invention to provide a powered rail vehicle with at least three supporting positions wherein the supporting means are statically defined.

It is another object of the invention to achieve a uniform loading at all the supporting positions of a rail vehicle having at least three supporting positions.

It is another object of the invention to provide a simple light-weight suspension system for a powered rail vehicle having at least three support positions.

It is another object of the invention to provide a powered rail vehicle supported on at least three supporting positions which permits the use of identical bogies or axle systems at the supporting points and thus achieves an efficient utilization of the adhesion forces when traction is applied.

Briefly, the invention is directed to a rail vehicle which has a rigid box and a plurality of resilient suspensions for supporting the rigid box via wheels on a track at at least three supporting positions. The resilient suspensions located at a plurality of supporting positions at the forward end of the vehicle relative to the direction of travel are each provided with a controllable spring. The number of supporting positions which include the springs is equal to at least one half the total number of positions but smaller than the total number less one. These controllable springs are coupled to each other by a coupling means so that the supporting forces at the respective supporting positions are identical, i.e., equalized, and that the resilience of the remaining supporting positions depends thereon.

The remaining supporting positions at the rear of the rail vehicle can also be provided with similar controllable springs which are coupled to each other so that the supporting forces thereat are identical.

The controllable springs are preferably springs which can be actuated by pressure media and, to this end, include pressure chambers which communicate with each other through a connecting duct. A gas, such as air, or a fluid or a combination of both may function as the pressure medium.

In one embodiment of the vehicle, all the supporting positions are provided with controllable springs, all of which communicate with each other through a connecting duct or element. In this case, at least one isolating element is provided in the connecting element to separate the springs of the individual supporting points relative to the travelling direction. An embodiment is thus obtained in which a particularly good utilization of the adhesion between the wheels of the vehicle and the rail is made possible in both directions of travel.

These and other objects and advantages of the invention will become more apparent from the following detailed description and appended claims taken in conjunction with the accompanying drawings in which:

FIG. 1 diagrammatically illustrates a powered rail vehicle with three bogies constructed in accordance with the invention;

FIG. 2 illustrates a diagrammatic cross section of FIG. 1; and

FIG. 3 diagrammatically illustrates a powered vehicle with three driven individual axles according to the invention.

Referring to FIG. 1, a powered rail vehicle is provided with an integral rigid box 1 which is supported at three supporting positions via six pneumatic springs 2 on bogie frames 3 of three bogies I, II, III. The individual bogies are, in turn, supported on axles 3′ with wheels. These wheels are, as is known, driven by driving means (not shown), for example, electric motors disposed in the bogies. The required movability of the bogies 3 relative to the box 1 in the event of transverse deflection and curve deflections being imposed thereon, is made possible by means of radius rods 4, as is known, while underslung tie rods 5 are provided for the transmission of tractive and braking forces from the bogies 3 to the box 1. The functions of the underslung tie rods 5 may also be carried out in known manner by pivoting pins which are not shown.

Referring to FIGS. 1 and 2, each pneumatic spring 2 includes an air, or pressure chamber which communicates with the others through connecting ducts 6. In order to allow for motion of the pneumatic springs 2 relative to the box 1, the connecting ducts 6 are each provided with a flexible hose 7 as shown. In addition, a coupling means in the form of stop or check valves 8 and 9, preferably suitable for remote operation and adapted for alternate opening and closing by suitable means (not shown) relative to the travelling direction, are provided in the connecting ducts 6 to opposite sides of the duct leading to the centrally located spring 2. The position of the check valves 8 and 9 as shown corresponds to a travelling direction of the vehicle to the left as indicated by an arrow A. In this case, the valves 8 are open to selectively connect the air chambers of the two forward springs 2 and the valves 9 are closed to selectively isolate the air chamber of the rear spring 2 from the two forward springs 2. If the vehicle in the illustration were to travel to the right, the valves 9 would be opened and the valves 8 would be closed.
The pneumatic springs 2 on each side of the vehicle as shown are supplied with compressed air from a compressed air source (not shown) through a non-return valve 10, a storage vessel 11, a non-return valve 12 and a distribution duct 13. A compensating duct 14 also connects the distribution ducts 13 on both sides of the vehicle so as to compensate for a variation in pressure therebetween.

In order to control the static and dynamic spring travel of the pneumatic springs 2 and to compensate for leakage losses in the system, regulating valves 15 are provided between the distribution duct 13 and the ducts 6. Each of these regulating valves 15 incorporates a regulator lever 16 which is connected through a regulating rod 17 to a point 18 of the bogie 3 but which may also be connected to one of the axles of the bogie. Each valve 15 is also provided with a blow-off duct 19 and silencer through which excess air is able to escape to the atmosphere.

In a zone from a zero position upwards and downwards respectively, the regulating valves 15 must either have dead travel or must permit a very small air exchange over this zone. This is necessary in order to maintain air consumption within tolerable limits for the normal spring motions of the box 1 relative to the bogies 3 or when travelling through a curved gradient.

The check valves 8, 9 are positioned and actuated such that the pneumatic springs 2 of the two front bogies 1, II are coupled together in common over the forward regulating valves 15 into the common distribution duct 13. This interconnection of the pneumatic springs 2 of the two front bogies 3 produces a statically defined two-point support as seen along the longitudinal orientation of the vehicle. In mathematical terms, the abutment forces of the two bogies I and II can be replaced by one abutment force which acts in the middle between the two springs 2 below a point 20 (FIG. 1).

Very good utilization of the adhesive force is possible by virtue of the fact that the underslung tie rod system or other axle thrust compensating means, enables all the axles of the front bogies I and II to be equally loaded. If the rail vehicle exerts traction on a hook 21, the front axles will be off-loaded and the rear axles will be additionally loaded. However, in the present case, the axles of the front bogies I, II are all equally off-loaded while both axles of the rear bogie III are loaded by an amount equal to the total value of off-loading of the axles of front bogies I, II. Owing to the fact that the load relief is uniformly distributed over the axles of the front bogies I, II, this may be minimal so that optimum utilization of the adhesion may be obtained.

It is however also possible for the axles 3 of the bogie III to be non-uniformly loaded by a suitable apparatus (not shown) and in the sense that the leading axle is also off-loaded while the trailing axle 3 is under further additional loading. Further reduction of off-loading of the front bogies I, II is thus possible.

Referring to FIG. 3, wherein like reference characters indicate like parts as above, individual axles 30 are used in place of the bogies 3, as above. These axles 30 are guided in axle bearing guides 31 of known construction. As shown, the control rods 17 act at points 18 which are disposed not on the bogie but on the axles 30.

The invention can be equally well applied to rail vehicles having more than three bogies or individual axles, for example, four bogies or individual axles. When four bogies are provided, it is possible for the suspension system of the front three bogies to be coupled to each other and for the bogie which is the last in the travelling direction to be independently and resiliently suspended. Off-loading of the axles of the three leading bogies in such a case is minimal. However, it is possible that the axle pressure of the axles of the last bogie becomes excessive under the effect of the additional loading resulting from the off-loading of the three leading and the two trailing bogies are coupled to each other. Thus, although the off-loading which is distributed over four axles is greater, the additional loading of the axles of the rear bogies is smaller.

It is noted that the control rods 17 and regulating valves 15 are operated so as to maintain the box 1 at a constant height. That is, each regulating valve 15 is adjusted such that, in a medium range of movement of a respective control rod 17, the valve 15 is closed or very much throttled. As soon as a certain upper threshold degree of movement of the rod 17 is exceeded, i.e., when the box 1 moves away from the bogie, air is discharged from the pneumatic spring 2. Conversely, if the box 1 moves toward the bogie, i.e., during unloading of the box 1, so that the lower threshold degree of movement is passed, air is supplied to the pneumatic spring 2. The medium range of movement thus serves as an area of insensitivity to allow for the normal movements of the springs 3 therein.

What is claimed is:
1. A rail vehicle comprising a rigid box; a plurality of bogies for supporting said box on a track at least three supporting positions at which a driving force is applied to the track; a plurality of springs, each respective spring being positioned between a respective one of said bogies and said box; and means coupling said springs at two of said supporting positions together for equalizing the supporting forces at said two supporting positions, said two supporting positions being located at the forward end of the vehicle with respect to the direction of travel.
2. The combination as set forth in claim 1 wherein said means coupling said controllable springs together includes a level regulator.
3. A rail vehicle as set forth in claim 1 wherein said box is supported at three supporting positions and said spring at the rear supporting position with respect to the direction of travel is independent of said coupling means.
4. A rail vehicle as set forth in claim 1 wherein said box is supported at four supporting positions, said coupling means couples said springs at the forward three supporting positions together for equalizing the supporting forces at said three supporting positions and said spring at the rear supporting position is independent of said coupling means.
5. A rail vehicle as set forth in claim 1 wherein said box is supported at four supporting positions and said coupling means couples said springs at the forward two supporting positions together for equalizing the supporting forces at said forward supporting positions, and which further comprises coupling means coupling said springs at the rear two supporting positions together for equalizing the supporting forces at said rear supporting positions.
6. A rail vehicle as set forth in claim 1 wherein each spring is a pneumatic spring having an air chamber and which further includes a compressed air source and ducts connected to each respective air chamber of said springs and to said compressed air source to supply air to each said chamber.

7. A rail vehicle as set forth in claim 6 wherein said coupling means includes a valve in one of said ducts for selectively connecting said air chambers of said springs at said two supporting positions in common and a valve in another of said ducts for selectively isolating said air chambers of said springs at said two supporting positions from at least one of the remainder of said spring air chambers.  

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