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(72) Inventors:
• **Diana, Giorgio**
20158 Milano (IT)
• **Galcione, Ferdinando**
10125 Torino (IT)

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(74) Representative: **Buzzi, Franco et al**
c/o Buzzi, Notaro & Antonielli d'Oulx Srl,
Corso Fiume, 6
10133 Torino (IT)

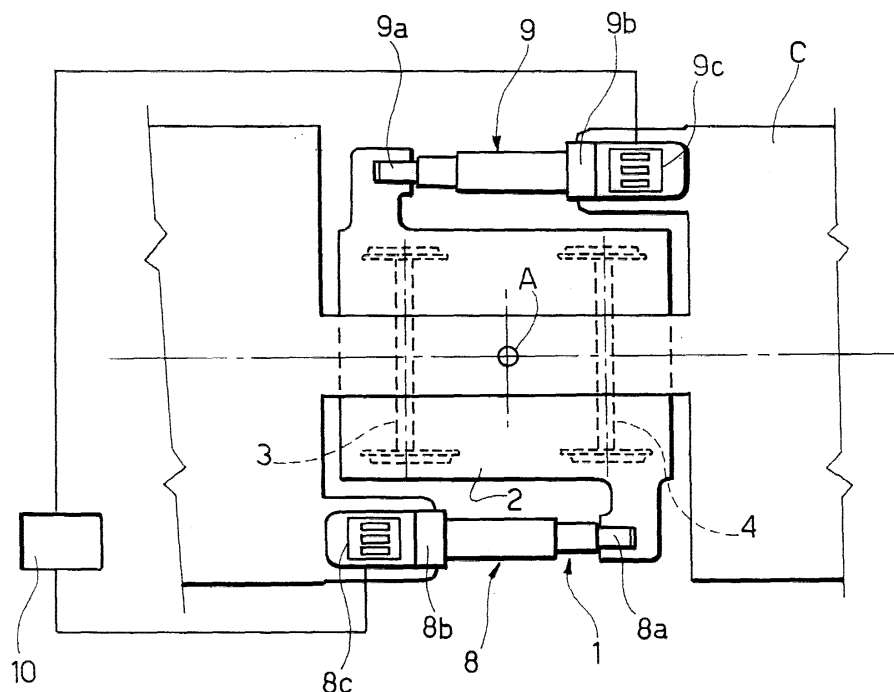
(71) Applicant: **FIAT FERROVIARIA S.p.A.**
10125 Torino (IT)

(54) **Active anti-hunting device for railway vehicles**

(57) An anti-hunting device for railway vehicles including a pair of elongated elements (8, 9) which longitudinally connect the opposite sides of the bogie (1) with the body (C) of the vehicle, and the length of which is variable when there is a relative rotation between the

bogie (1) and the body (C) about the vertical axis (A). The extension and contraction of the elongated elements (8, 9) are positively controlled with a logic such as to enable the anti-hunting device both to improve the lateral stability of the bogie during rectilinear movement and entry of the bogie on a bend.

FIG. 2



EP 1 138 568 A1

Description

[0001] The present invention relates in general to railway vehicles having a body and a pair of bogies, each of which is connected to the body so that the bogie is free to turn about a vertical axis.

[0002] More in particular, the invention relates to an anti-hunting device for the aforesaid railway vehicles, of the type comprising a pair of elongated elements which longitudinally connect the opposite sides of each bogie with the body, and the length of which is variable when there is a relative rotation between the bogie and the body about said vertical axis in one direction or in the opposite direction, in such a way that with the extension of one of said elongated elements there is a corresponding contraction of the other elongated element.

[0003] Such anti-hunting devices perform a dual function: improving the lateral stability of bogies during rectilinear movement of the vehicle and improving entry of the bogies on a bend.

[0004] Traditionally, the aforesaid elongated elements of the anti-hunting device have consisted of dissipative dampers, typically hydraulic ones. In use, these dampers deteriorate relative quickly, so that their proper operation is impaired after a fairly short period of service. In addition, even under optimal operating conditions, their damping characteristic remains constantly the same as the conditions that may determine lateral instability of the bogie vary, i.e., as the mode of entry of the trolley on a bend varies.

[0005] For these reasons, conventional anti-hunting devices are far from reliable and do not make it possible to guarantee the necessary running safety of the vehicle in all conditions. In addition, on account of the ease with which the aforesaid known devices are liable to deteriorate, and hence as a direct consequence of their functional inefficiency, the horizontal forces transmitted between the wheels of the bogie and the rails of the track lead to serious problems of wear.

[0006] The above problems are particularly critical in the case of high-speed rail vehicles and/or at entry of the vehicle on a bend with a high lateral acceleration not offset by the banking of the outer rail of the track.

[0007] The purpose of the present invention is to overcome the above-mentioned drawbacks.

[0008] According to the invention, this purpose is achieved thanks to the fact that, in an anti-hunting device of the type described hitherto, the extension and contraction of the aforesaid elongated elements are controlled positively.

[0009] In other words, the elongated elements of the anti-hunting device according to the invention are represented by dampers which are rendered active in the plane of hunting of the bogie.

[0010] According to the preferred embodiment of the invention, each one of the above elongated elements includes an external thread-internal thread stem operated by an electric motor and means for controlling the

electric motor according to the running conditions of the railway vehicle.

[0011] Thanks to this idea, the anti-hunting device according to the invention makes it possible to achieve a number of important advantages.

[0012] First of all, the positively controlled elongated elements ensure a much higher operating reliability than do traditional hydraulic dampers, and in any case their efficiency of operation can be easily monitored by the control means themselves.

[0013] In the second place, the intervention of the anti-hunting device, the damping characteristic of which is in any case variable and adjustable in a graded way according to the actual running conditions of the vehicle, can be selectively deactivated when such conditions do not require intervention of the device. For example, at medium-to-low speeds, the deactivation of the anti-hunting device according to the invention, makes it possible, in contrast to conventional hydraulic dampers, to limit transmission of vibrations from the bogie to the body and to ensure better entry on a bend owing to the absence of resisting torque.

[0014] A third advantage lies in the fact that the anti-hunting device may also be activated to improve entry of the bogie on a bend, as a result of the generation of a steering torque between the body and the bogie, also this torque being variable according to the running conditions. This results in a considerable reduction in the horizontal forces transmitted between the wheels and the rails on a bend, and hence in lower skid ratios. This in practice leads to an appreciable improvement in the running safety of the vehicle not only on rectilinear stretches, but also on bends.

[0015] The anti-hunting device according to the invention moreover presents a relatively simple and economical configuration which enables relatively convenient application thereof even to already existing vehicles as an alternative to traditional hydraulic dampers.

[0016] Further characteristics and advantages of the present invention will emerge clearly from the ensuing detailed description, with reference to the attached drawings, which are provided purely to furnish a nonlimiting example and in which:

Figure 1 is a schematic side elevation of a bogie for railway vehicles that is equipped with an anti-hunting device according to the invention; and

Figure two is a plan view from beneath, in the form of a partial and simplified diagram, of the bogie and anti-hunting device shown in Figure 1.

[0017] In the drawings, the reference number 1 designates as a whole a bogie for railway vehicles, which has a generally conventional architecture. As is known, the railway vehicle, the body of which is schematically designated by C in Figure 2, is equipped with a pair of identical bogies 1, one of which is set at the front and the other at the rear with respect to the direction of ad-

vance of the vehicle. The ensuing description applies identically to both bogies.

[0018] The bogie 1 includes a frame 2 with a front axle 3 and a rear axle 4, and their respective wheels 5, 6. At its centre, the frame 2 of the bogie 1 is arranged for connection to the body C, normally by means of a transom 7, in such a way that it is free to turn about a vertical axis A.

[0019] The bogie 1 is moreover provided with primary-suspension and secondary-suspension members, in themselves known, and with an anti-hunting device which forms the specific subject of the present invention.

[0020] The said anti-hunting device comprises a pair of elongated elements 8, 9 which longitudinally connect, in an articulated way, the opposite sides of the frame 2 of the bogie 1 with the body C, i.e., with the transom 7.

[0021] The two elongated elements 8, 9 present a longitudinally extensible and contractable conformation, normally having a telescopic structure, and, as shown in Figure 2, are set in a mutually opposed configuration.

[0022] The above elongated elements 8, 9 consist, according to the invention, of active dampers. In other words, their extension and contraction is positively controlled, according to a logic which will be described in greater detail in what follows.

[0023] Each elongated element 8, 9 is in practice made up, in the case of the example illustrated, of an external thread-internal thread stem, the external thread of which, designated by 8a, 9a, has a translating motion and is connected to the frame 2 of the bogie, and the internal thread of which, designated by 8b and 9b, has a rotating motion and is driven in rotation by a respective electric motor 8c, 9c.

[0024] The electric motors 8c, 9c are conveniently of the low-inertia, asynchronous, brushless type, and actuate their respective internal threads by means of appropriate gear reducers, which are not illustrated in so far as they are known to the person skilled in the branch. The external threads 8a, 9a are conveniently of the ballscrew type.

[0025] The motors 8c, 9c are in turn governed by a control system, designated by 10 in Figure 2.

[0026] The said control system includes a processor and may conveniently use also components already normally available on board the bogie 1 or in any case on board the railway vehicle. In the case of high-speed trains, such components normally include at least one transducer for lateral acceleration of the bogie, a gyroscope, and a speed sensor. The signals from these components are typically sent to the processor which drives the motors 8c, 9c in such a way as to obtain variations in the length of the stems 8, 9 when there occur relative rotations between the bogie 1 and the body C about the vertical axis A in one direction or in the opposite direction, in such a way that the extension of one of the stems 8, 9 is matched by the contraction of the other stem 9, 8.

[0027] The driving logic is the one described below.

[0028] In the case of rectilinear movement of the ve-

hicle, when the bogie 1 approaches instability (oscillatory motion in the horizontal plane at a frequency of approximately 4-6 Hz), the system 10 activates, via the stems 8, 9, a periodic force having the typical frequency of oscillation of the bogies 90° out of phase with respect to the excitation and with an amplitude such as to offset, or in any case reduce, the critical motion of oscillation.

[0029] If the transducers (accelerometers) positioned on the bogie 1 do not signal any situation of instability, the system 10 keeps the stems 8, 9 inactive. For example, at medium-to-low speeds the system remains inactive, thus enabling, in contrast to conventional hydraulic anti-hunting devices, reduction in transmission of vibrations from the bogie to the body, and also improvement of entry onto bends thanks to the absence of resisting torque.

[0030] In the case where the rail vehicle is going round a bend, the control system 10 activates the stems 8, 9 in such a way as to generate a steering torque, between the bogie and the body, having an appropriate amplitude, according to the lateral acceleration, as well as to the radius of curvature of the bend, and to the position of the bogie with respect to advance of the vehicle.

[0031] The steering torque makes it possible both to reduce considerably the skidding forces, i.e., the horizontal forces transmitted between the wheels and the rails, which enables an improvement in the running safety and a reduction in the wear of the wheels and rails, as well as achieving lower skidding ratios (ratios between the horizontal wheel-rail forces and the vertical forces).

[0032] As is evident from the foregoing description, the anti-hunting device according to the present invention makes possible an appreciable improvement both in the lateral stability of the bogie during rectilinear movement of the vehicle and during entry of the bogie onto bends. These advantages are all the more appreciable in the case of application to high-speed rail vehicles and/or rail vehicles that enter bends with high lateral acceleration which is not offset.

[0033] Of course, the details of construction and the embodiments may vary widely with respect to what is described and illustrated herein, without thereby departing from the scope of the present invention as defined in the ensuing claims.

Claims

1. An anti-hunting device for railway vehicles having a body (C) and a pair of bogies (1), each of which is connected to the body (C) so that the bogie is free to turn about a vertical axis (A), said device including a pair of elongated elements (8, 9) which longitudinally connect the opposite sides of each bogie (1) with the body (C), and the length of which is variable when there is a relative rotation between the bogie (1) and the body (C) about said vertical axis

(A) in one direction or in the opposite direction, in such a way that with the extension of one of said elongated elements (8, 9) there is a corresponding contraction of the other elongated element (9, 8), **characterized in that** the extension and contraction of said elongated elements (8, 9) are positively controlled.

2. A device according to Claim 1, **characterized in that** each of said elongated elements (8, 9) includes an external thread (8a, 9a) - internal thread (8b - 9b) stem (8, 9) driven by an electric motor (8c, 9c), and control means (10) controlling said electric motor (8c, 9c) according to the running conditions of the railway vehicle.
3. A device according to Claim 2, in which the railway vehicle is equipped with accelerometric, gyroscopic and tachymetric transducers, **characterized in that** said control means (10) use said transducers.
4. A device according to Claim 3, **characterized in that** said control means (10) are arranged to apply, by means of said elongated elements (8, 9):
 - during rectilinear movement of said rail vehicle, in conditions of the bogie approaching instability as regards oscillatory motions in the horizontal plane, periodic forces with a frequency typical of the oscillation of the bogie itself and 90° out of phase with respect to the excitation and with an amplitude such as to offset the oscillatory motion;
 - when the said vehicle is going round a bend, a steering torque between the bogie and the body.
5. A device according to Claim 4, **characterized in that** said control means are moreover arranged for generating said periodic force and/or said steering torque according to the running conditions of the vehicle detected by said transducers.

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FIG. 1

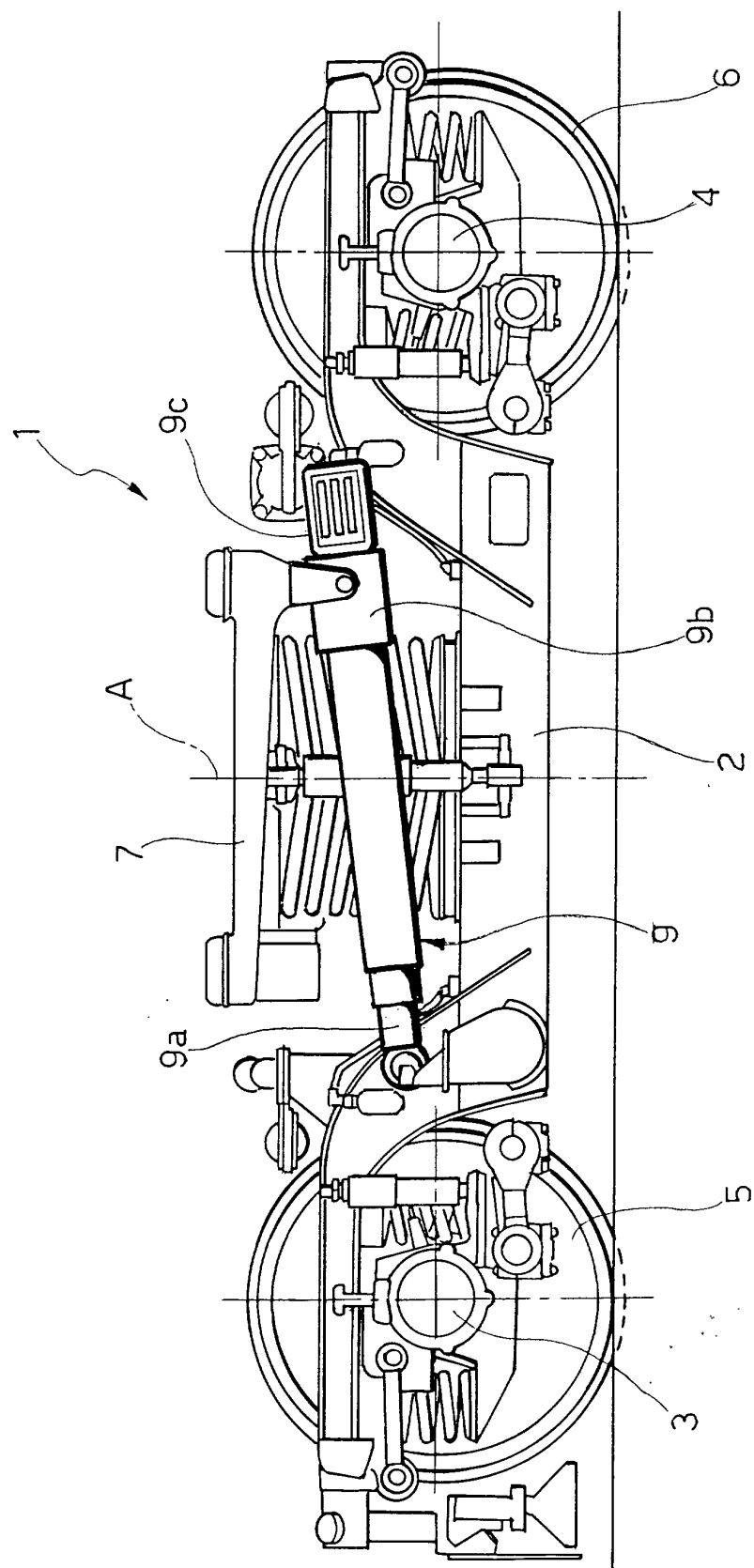
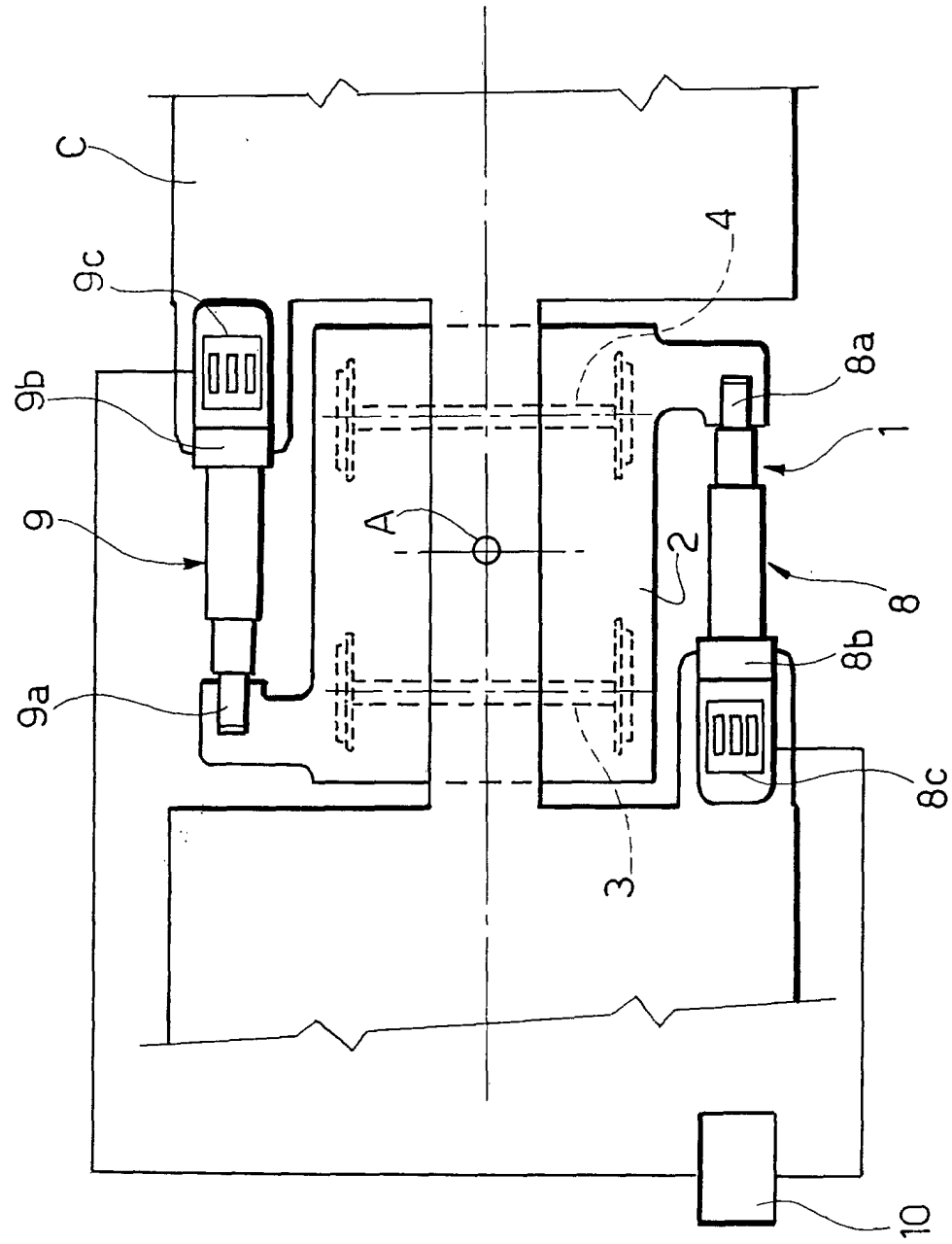


FIG. 2





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EUROPEAN SEARCH REPORT

Application Number
EP 00 83 0469

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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Y	* page 1, line 38 - line 66 *	2	
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Y	EP 0 184 960 A (ANF IND) 18 June 1986 (1986-06-18) * page 8, line 4 - page 9, line 14 * * page 13, line 3 - page 14, line 21 * * page 11, line 29 - page 12, line 8 *	1	
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			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			B61F B60G F16F
The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 26 March 2001	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			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 00 83 0469

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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