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(54) Bogie for railway freight wagons with radial self-steerable wheel-sets

(57) Self steerable bogie for a railway freight wagon, comprising two or more axles (1) provided with wheels (20). Each axle is fitted in a wheel set or axle guiding system (3), vertically suspendedly movable due to vertical load and vertical irregularities emanating from a track while the bogie is in motion, and horisontally to a smaller extent, within the limits of a longitudinal play(e), both in relation to a bogie frame (4). Between said frame (4) and said guiding system (3) is a primary suspension, having two springs or sets of springs (5) arranged vertically at each side of and at each wheel (20) of said guiding system (3). Both springs or sets of springs (5) is connected to a friction dampening arrangement (6, 7, 8, 9) providing a dampening friction force to the suspension movement of the wheel-set guiding system (3). This is achieved by eliminating said longitudinal play (e) between the guiding system (3) and the bogie frame (4) whereby an elastic steerability of the axles which is proportional to vertical load on the bogie is reached by allowing a load dependent elastic movement in the direction of the tangent to the travelling direction of the freight wagon of each wheel-set, amounting to a maximum of (+/- e).

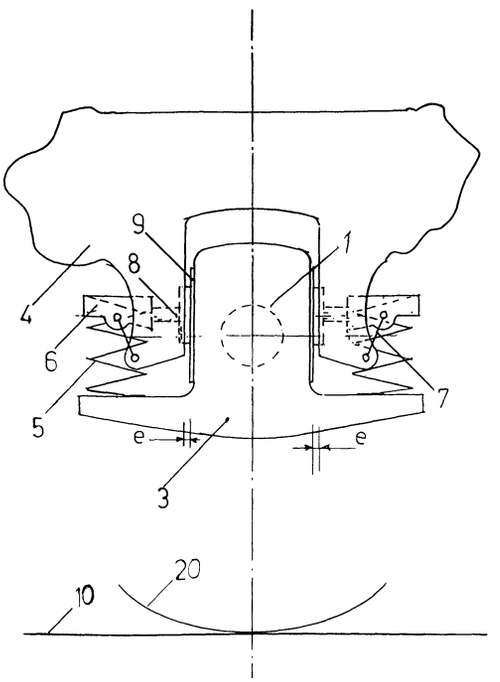

Fig 1

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Description

Technical field

[0001] The present invention relates to a self steerable bogie for a railway freight wagon, comprising two or more axles provided with wheels, wherein each axle is fitted in a wheel set or axle guiding system, vertically suspendedly movable due to vertical load and vertical irregularities emanating from a track while the bogie is in motion, and to a smaller extent movable also horizontally in relation to a bogie frame, between which frame and said guiding system is a primary suspension, having two springs or sets of springs arranged longitudinally at each side of and at each wheel of said guiding system, one of which springs being connected to a friction dampening arrangement providing a dampening friction force onto the suspension movement of the wheel-set guiding system by eliminating a longitudinal play between the guiding system and the bogie frame.

Technical background

[0002] Railway companies and administrations all over the world are looking for new freight transport strategies in the freight transport to minimise the costs, by measures as to increase maximum axle load, to increase the maximum speed, or to decrease the energy consumption and combinations of these measures. A conventional freight-wagon bogie of today, such as Y25 (manufactured by Kockums Industries in Malmö, Sweden), which has been a very popular design, in fact the most used bogie type in for instance Europe.

[0003] The bogie has a rigid frame with primary suspension, two wheel-sets that have little longitudinal clearance between its bogie frame and a wheel-set guiding system. Such a bogie does not perform satisfactory on curves. The bogie can take up a "forced" diagonal position, in which for instance the leading wheel-set is skewed in relation to the rails, and is forced to slip laterally as it turns. The trailing wheel-set is forced towards the inner rail, and therefore revolves on an unsuitable contact diameter. Consequently, the outer wheel slips and the inner wheel slides, thereby creating a turning momentum on the bogie, which increase the flange pressure on the leading outer wheel of the bogie and produce lateral force for the trailing inner wheel.

[0004] The consequence is a high rolling resistance in curve tracking, which is reflected in the fuel consumption of the freight train.

[0005] According to US-A 4 674 412 a device for solving this problem is disclosed wherein use is made of elastomeric devices fixed to a side frame of a bogie beam, by which the problem of running in curves and hunting is said to be reduced. This solution do however not permit transport speeds in the range of up to 120 km/h as is the case with the present solution. Neither is it applicable or exchangeable with conventional bogies, which is one of the main incentives with the present invention.

Objects of the invention

[0006] The main primary object of the present invention is to provide a freight wagon bogie, which has already a primary suspension, with radial self-steerable wheel-sets.

[0007] Another primary object, and one of the most important performance requirements for an ideal freight wagon bogie, is to have wheel-sets with good tracking on curves to minimise lateral forces and which do not sustain hunting on tangent track at speeds up to at least 120 km/h.

[0008] Other important objects and compatibility requirements for such a bogie solution are:

- The inventive bogie solution must be mechanically inter-changeable with existing bogies;
- The inventive bogie solution must be adaptable to standard wheel-sets and wheel profiles;
- Standard suspension components should be able to be used on inventive bogie;
- Standard brake-gear should be able to be used
- Components standard able to survive in railway environment

[0009] According to the invention, these objects are fulfilled with a bogie that is characterised in that the other springs or set of springs of each primary suspension at each side of the guiding system, is also provided with a friction dampening arrangement of the above mentioned kind, whereby an elastic steerability of the axles proportional to vertical load on the bogie is achieved by allowing a load dependent elastic movement in the direction of the tangent to the travelling direction of the freight wagon of each wheel-set, amounting to a maximum of +/- e.

[0010] In a further developed embodiment of the invention the primary suspension thereof is achieved by letting spring load from the suspension springs or spring sets being indirectly loaded from connection links in its starting position inclined by an angle to the vertical (equalling the dead weight of the wagon). By using indirect suspension connections between the bogie frame and each wheel-sets using said angle deviating from the vertical, a load dependent centring force is gained. After tracking through a curve, this centring force will together with a differing angle of the links of each wheel-set and a longitudinal deviation at each wheel-set, positively urge each shaft back to its centred position.

[0011] The general advantages of using radial steered wheel-sets are the following:

- Much better wheel-set tracking on curved track resulting in low lateral wheel-on-rail forces;
- Instability on tangent track, known as "hunting" will

be moved out of the normal operating speed.

- Decreased rolling resistance and consequent decrease energy consumption in train operation.
- Decreased wear on wheel-sets, bogies components and rails.

[0012] Below the invention will be described with reference to drawings schematically showing a preferred embodiment of the invention, in which:

Fig 1 schematically shows the main components of the gear in connection with one wheel-set on an axle of a bogie according to the invention,
Fig 2 in a view mainly the same as that of Fig 1 shows the mechanical variables in action in a wheel-set of a bogie according to the invention.

Detailed description of the invention

[0013] According to Fig 1 a schematically view of a wheel 20 and its wheel-set together with its guiding system 3, show the relations thereof with reference to a rail 10 and a bogie frame 4 of a railway freight wagon.

[0014] Fig 1 shows the existence of a longitudinal clearance $\pm e$ between the wheel-set guiding system 3 of an axle 1 of said bogie and the bogie frame 4, carrying a system of at least two such axles 1. The clearance mentioned makes it possible for a wheel-set 20 to obtain a correct radial position during tracking through a curve.

[0015] Two horizontal longitudinal push rods 8 tries to maintain the wheel-set in neutral position or centred in a starting or neutral position every time when a leading clearance e_{before} and the trailing clearance e_{after} differs (discussed more in detail with reference to Fig 2).

[0016] Springs of the bogie primary suspension 5 is not directly linked, as is usual, between the wheel-set 3 and the bogie frame 4, but indirectly via a spring cup 6, a suspension link 7, and finally the bogie frame 4.

- The suspension link 7 is in the unloaded condition of the wagon inclined with an angle α (see Fig. 2), which makes it possible to develop longitudinal force components H to centre each wheel-set in a neutral position when clearances $e_{before} \neq e_{after}$.
- The horizontal force components H is proportional to a vertical load on each wheel-set:
  $H = F \text{ tg } \alpha$ (see Fig. 2; F = vertical load)
  (Valid for a constant angle α), Thus H increase with both an increasing α and an increasing vertical load F

[0017] When the wheel-set 20 in a curve is moved from the centred position, the two suspension links 7 at each wheel-set 20 will make different angles, α_{max} and α_{min}, whereby the wheel-set 20 will positively strive to become centred back by a force H_{strive},

$$H_{strive} = F (\text{tg } \alpha_{max} - \text{tg } \alpha_{min})$$

[0018] Also another centering force emanating from the primary suspension of each wheel exist, which is proportional to the vertical load on each wheel-set 20 and to the longitudinal deviation Δx of the same, where

$$\Delta x = e_{max} - e_{min}$$

following the equation

$$H_s = k_x |\Delta x|$$

(where k_x equals the stiffness of the primary suspension in the coordinate-direction x at each wheel-set).

[0019] Due to the dead weight of the bogie as a whole together with a chassis and a superstructure mounted thereon (neither of which are shown), there is always a normal force between the push rod 8 and a wear plate 9. This force acertain an effective damping of the vertical and transversal relative motions between the guiding system of each wheel-set 3 and the bogie frame 4, by the friction force between the two surfaces.

[0020] The friction forces aswell are proportional to the vertical axle load, and to the deviation Δx, which acertain that the relative movements between each wheel-set 3 and the bogie frame 4 will be dampened more effectivly than ever before.

[0021] The preload centering force will of course always amount to $(H_{strive} + H_s)$

Claims

1. Self steerable bogie for a railway freight wagon, comprising two or more axles (1) provided with wheels (20), wherein each axle is fitted in a wheel set or axle guiding system (3), vertically suspendedly movable due to vertical load and vertical irregularities emanating from a track while the bogie is in motion, and horisontally to a smaller extent, within the limits of a longitudinal play(e), both in relation to a bogie frame (4), between which frame (4) and said guiding system (3) is a primary suspension, having two springs or sets of springs (5) arranged vertically at each side of and at each wheel (20) of said guiding system (3), one of which springs (5) being connected to a friction dampening arrangement (6, 7, 8, 9) providing a dampening friction force onto the suspension movement of the wheel-set guiding system (3) by eliminating said longitudinal play (e) between the guiding system (3) and the bogie frame (4), **characterised in that**, the other springs or set of springs (5) of each primary suspension at each side of the guiding system (3), is

also provided with a friction dampening arrangement (6, 7, 8, 9) of the abovementioned kind, whereby an elastic steerability of the axles proportional to vertical load on the bogie is achieved by allowing a load dependent elastic movement in the direction of the tangent to the travelling direction of the freight wagon of each wheel-set, amounting to a maximum of (+/- e).

2. Bogie according to claim 1, **characterised in that** the primary suspension thereof is achieved by letting spring load from the suspension springs or spring sets (5) being indirectly loaded from connection links (7) in its starting position inclined by an angle α to the vertical (equalling the dead weight of the wagon).

3. Bogie according to claim 1 or 2, **characterised in that**, the horizontal force from each friction dampening arrangement (6, 7, 8, 9) amounts to $H = F \text{ tg } \alpha$, where F is the vertical force from the bogie-frame (4) at each spring or springset (5).

4. Bogie according to anyone of claims 2 to 4, **characterised in that**, after tracking through a curve the total returning force on each friction dampening arrangement (6, 7, 8, 9) amounts to $H_{total} = 2 (H_s + H_{strive})$,where $H_s = k_x|\Delta X|$; $\Delta x = e_{max} - e_{min}$ and $H_{strive} = F (\text{tg } \alpha_{max} - \text{tg } \alpha_{min})$ in which relation α_{max} and α_{min} are the different angles of each suspension link (7) of each wheel-set.

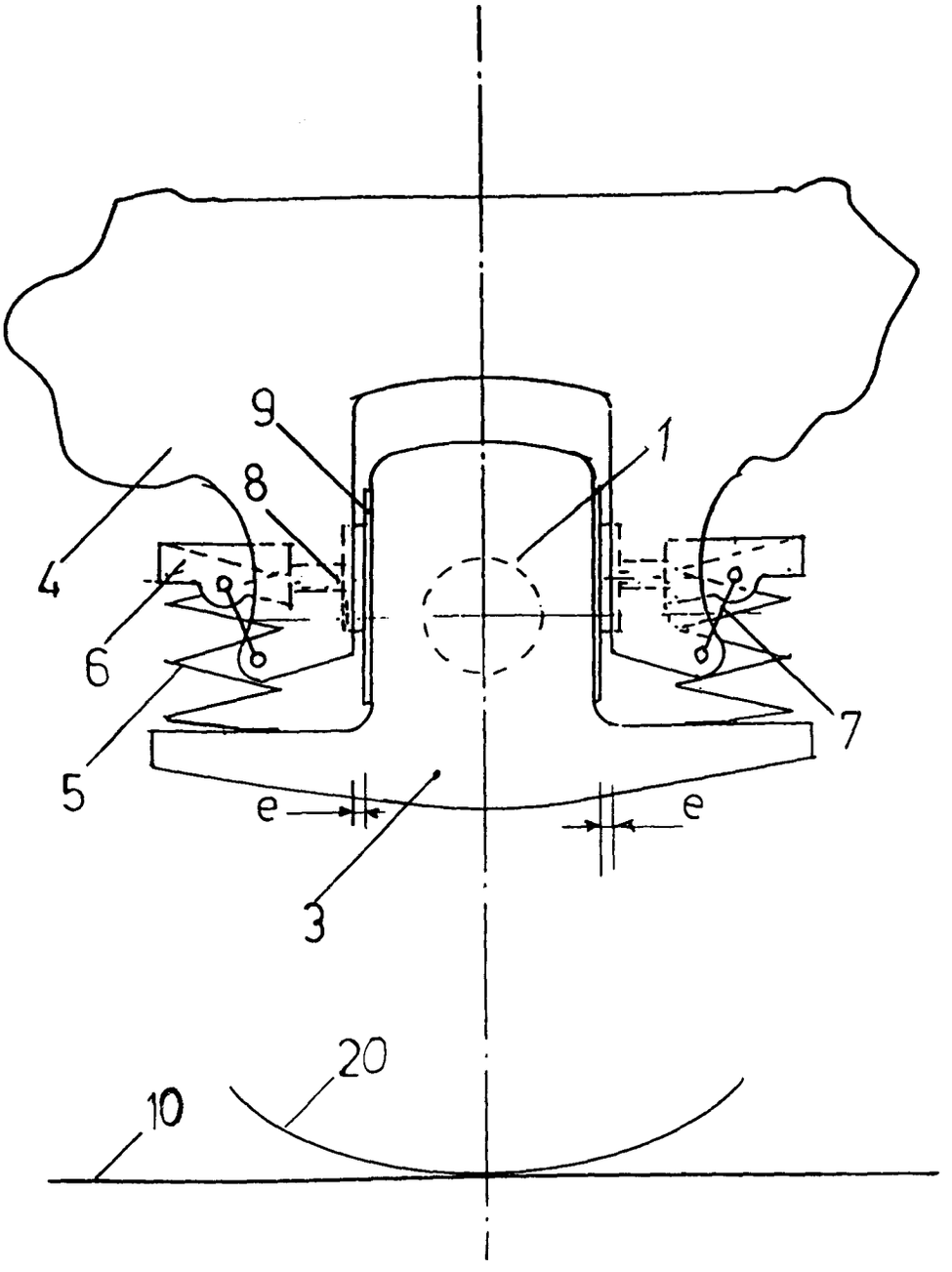

Fig 1

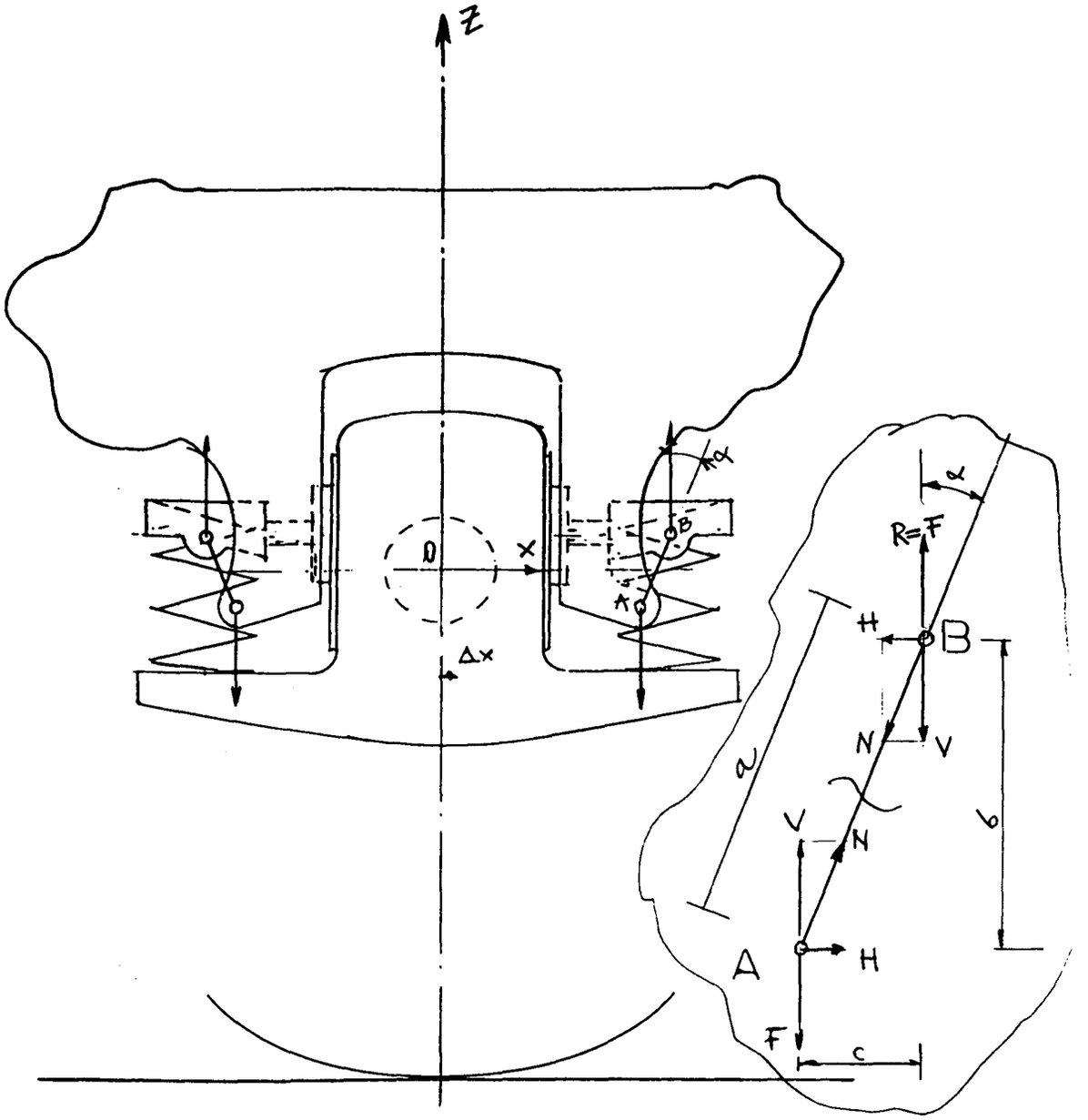

Fig 2

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EUROPEAN SEARCH REPORT

Application Number
EP 99 12 1651

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	WO 90 15744 A (ARBEL FAUVET RAIL SA) 27 December 1990 (1990-12-27) * page 5, line 1 - page 7, line 20; figures 1-3 *	1	B61F5/30
X	EP 0 048 193 A (SNCF) 24 March 1982 (1982-03-24) * page 4, line 3 - page 5, line 7; figure 1 *	1	
X	EP 0 035 443 A (SAMBRE & MEUSE USINES) 9 September 1981 (1981-09-09) * page 4, line 30 - page 7, line 18; figures 1-5 *	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			B61F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	15 March 2000	Chlosta, P

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
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 99 12 1651

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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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82