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(54) BOGIE FOR RAILWAY VEHICLE

(57) Bogie for railway vehicle consisting of bogie frame (1) and at least four wheels (2a) arranged as in pairs of independently rotating wheels (2a) or arranged in wheelsets, where these wheels (2a) or wheelsets (2) are connected with swing arms (4) by means of bearings (3), where swing arms (4) are jointed to the bogie frame (1) by means of joints (5), where the suspension springs (6) are arranged between swing arms (4) and bogie frame (1) and the springs (6) belonged to swing arms (4) on one bogie side are supported each other or suspension springs (6) are supported by means of floating brace (9) on this said bogie side where motion of floating brace (9) is limited by bogie frame (1), or there is arranged only one suspension spring (6) between swing arms (4) on this said bogie side, and the suspension springs (6) belonged to swing arms (4) on the opposite bogie side are supported by means of brackets (8) fixed to the bogie frame (1).

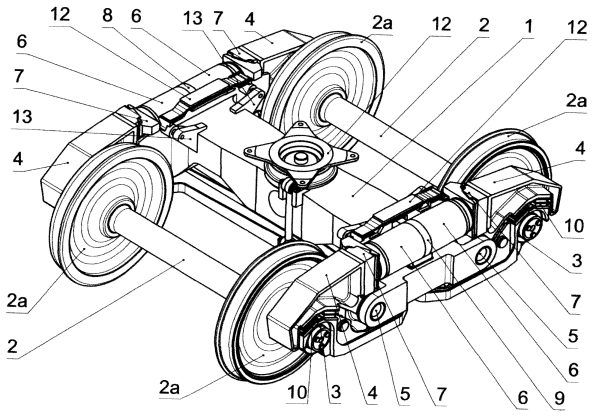

Fig. 1

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Description

The Technical Field

[0001] The invention relates on a railway bogie, particularly for freight cars.

The Prior Art

[0002] Railway vehicles, particularly freight cars, are generally equipped with a two axle running gear or with bogies. Freight bogies are claimed with strict demands. There is a significant difference between the weight of an empty and a fully loaded coach. This difference is based on possible payload whereas the vehicle at all of possible load states must meet safety requirements, particularly derailment safety, values of guidance forces between the wheel and the rail, and stable run.

[0003] Two axle bogies are the most widespread type of freight bogies. These bogies are obviously equipped with a single stage suspension that is located between the wheelset and the bogie frame or between the bogie frame and the cross beam which is connected to the car body. Wheelset guidance is generally done via axle guide with slide plates located on the bogie frame. Connection of the bogie and the car body is generally done via standardized components, i.e. spherical joint with side sliders or central bowl with side bearing pads. Bogie frame serves as a structural framework.

[0004] Appropriate torsional stiffness between two wheelsets of the bogie is necessary to meet the requirements of derailment safety on a twisted rail. This torsional stiffness may be achieved with a flexible bogie frame or with soft bogie suspension. Large payloads of freight cars that are currently required do not allow designing of soft suspension in the whole work range, However the suspension is designed as a single staged, the bogies without flexible bogie frames have to use a load dependent suspension stiffness. This means that stiffness of the empty coach and fully loaded coach is significantly different. Empty coach uses soft suspension; fully loaded coach uses stiff suspension If the flexibility betwenn wheelsets in a bogie using load dependent suspension is not sufficient, the bogie has to be equipped with a second stage suspension. This increases complexity and weight of the design.

[0005] This leads to two basic bogie designs. The first one uses bogie frames that can adjust to rail twist - the bogie frame is designed as a joint frame. This means that the bogie frame contains flexible connections allowing its torsional deformation. The only one stage of the suspension is then located between sideframes and a bolster. This principle uses a bogie labelled as a "Three - piece bogie" type (also labelled as a "Diamond bogie"). This bogie runs under freight cars that are operated in Northern and Southern Americas, Asia, Africa and in eastern Europe part of the railway net that is using wide gauge. This bogie is generally composed from two sideframes that are placed on wheelsets bearings via adapters and one bolster, which is flexible connected with both sideframes.

[0006] The other design uses relatively stiff bogie frame, manufactured as one part, with single staged suspension with load dependent stiffness.

[0007] Example of those bogies: a) bogies equipped with leaf springs that are standardized and mainly used in western southern, northern and central Europe. The bogie is specific for its solid bogie frame whose length significantly exceeds the wheelbase and leaf springs between axleboxes and the bogie frame. Wheelset guidance is flexible. The suspension is done via leaf springs whose stiffness is load dependent. Leaf springs operate in two modes. The first one uses not all leafs in the spring (empty car), the second one uses whole spring leaf (leads to higher stiffness) - the suspension has a linear two stage characteristics. There is also older design that uses leaf springs, where all leafs are used during the operation. This design does not meet today's requirements for payloads and derailment safety.

[0008] Another example of bogies with rigid frame is: b) bogies labelled as an Y25 family. These bogies are standardized and operated particularly in western, southern, northern and central Europe. The bogies have a rigid bogie frame, the wheelset guidance is done via axle guide with sliders and the only one suspension stage is done via helical springs placed between axleboxes and the bogie frame. The stiffness of the suspension is load dependent, which is done via duplex spring configuration, where empty coach uses only outer springs - the inner are inactive.

[0009] Above mentioned bogie design have its disadvantages.

[0010] Bogies with flexible bogie frames that allow reducing the wheel forces change on twisted rail perform warping motion of sideframes during the operation (this is a situation when the bogie is not square). This warping leads to instable run of the vehicle and higher wear of the wheels. This design also suffers with a high value on unsprung masses. Another problem is a need of additional components that provide joint connection among sideframes and bolster. These components suffer by a wear and increase total weight of the bogie and operating costs.

[0011] Bogies with rigid bogie frames and with leaf springs do not suffer on warp motions and have lesser weight of unsprung masses, because the suspension is located between the wheelset and the bogie frame. Soft wheelset guidance in longitudinal direction allows radial steering. The bogie frame length must significantly exceed the wheelbase due to brackets for leaf springs. This leads to a high weight and size of the bogie. Another problem is a fact that the manufacturing of the leaf spring with load dependent stiffness (amount of active leafs depends on the load of the car) is relatively expensive. Although the stiffness is load dependent, the bogie is unable to achieve such a torsional flexibility which is typical

to flexible bogie frames without using of additional mechanisms.

[0012] Bogies with rigid frame of type Y25 do not show adverse effect of warping motions and have less weight of unsprung masses, because the suspension is located between the wheelset and the bogie frame. These bogies contain higher number of components that provide load dependent suspension stiffness and the length of bogie frame must exceed wheelbase of the bogie. This increases total weight of the bogie. Another disadvantage are inactive (unloaded) springs in the empty coach that may be source of noise during the operation Although the stiffness is load dependent, the bogie is unable to achieve such a torsional flexibility which is typical for flexible bogie frames. Operation of empty or partially loaded coach is adverse according to running behaviour. Inner springs with higher stiffness may become active in short term due to dynamics of the running vehicle. Another disadvantage is a fact that wheelset guidance (done via side plates) suffers to wear of components. Wheelset guidance in Y25 bogie is rigid, which is adverse for radial steering of the wheelset when passing the curve. A small number of those bogies have been modified to more flexible guidance of the wheelset. Disadvantage of the modification is a need of additional components that suffer to wear and increase complexity of the design.

[0013] There are solutions allowing minimizing the length of the bogie. The sideframes do not exceed significantly the wheelbase, whereas the suspension is located between the wheelset and the bogie frame. These solutions allow reducing the weight of the bogie and its length. This is convenient for design of the car body.

[0014] Following design serves as an example.

[0015] Patent application no. WO 93/09989 describes bogie for low floor vehicles. This bogie contains freely rotating wheels that are fitted in swing arms. Every single swing arm is connected to the bogie frame via joint connection. Primary suspension is made via springs that support the swing arm on one side and on the bogie frame on the other side. Connection point on the bogie frame is located on console on top side of the bogie frame. This design has other structural modifications of connection with car body. This allows increasing the area of low floor.

[0016] Patent application no. CZ 305 621 describes bogie for railway vehicle. The bogie comprises bogie frame, two wheelsets, swing arms and suspension. The bogie frame is made from two sideframes connected with at least one crossbeam into the H shape. The length of the bogie frame is smaller than the wheelbase. The wheelsets are equipped with inner bearings and placed into swing arms. Swing arms are connected to the bogie frame via joint connection. Suspension of the bogie is done via springs that are placed between the swing arms and stiff brackets on the bogie frame, whereas the spring axes are oriented in horizontal direction.

[0017] Advantage of these solutions is smaller size and weight of the bogie frame. This also allows placing sideframes closer to the top of the rail along the entire length.

[0018] Disadvantage is a fact that these bogies do not solve increasing of derailment safety already in the stage of suspension - between the swing arm and the bogie frame. This arrangement with rigid bogie frame does not allow decreasing of the bogie torisonal stiffness when running on twisted rail. Increasing of the derailment safety must be done via additive components in the suspension - one stage of suspension more in this case. This increases the weight and number of components.

[0019] There are also solutions allowing increasing the torsional flexibility of the bogie. Patent application no. EP 2 386 454 A1 is an example of this solution. Structural framework of this bogie is composed from flexible bogie frame containing two sideframes and crossbeam that are flexible connected. This solution minimizes changes of wheel forces on twisted rail. Bogie torsional flexibility is performed via flexible connection between crossbeam and sideframes. Disadvantage of this solution is a suspension that is located between the sideframes and the crossbeam which increases unsprung masses weight and does not allow compensating the warp motion of the bogie. Joint elements (connecting parts of the bogie frame) increase number of components and suffer to wear.

The Nature of Invention

[0020] The main purpose is to create a concept of a bogie that eliminate previously mentioned disadvantages and that is simple, robust, has low weight of unsprung masses and has a minimal number of components. And the bogie at this is via special spring arrangement achieved such a level of torsional flexibility, which is typical for flexible bogie frames, but the bogie frame remains simple rigid and without bogie frame joints.

[0021] The principle of the presented bogie for a railway vehicle which is composed from: bogie frame; at least four wheels that may be arranged as a standard wheelset or independently rotating wheels; swing arms that are connected with the wheelset via bearing and said swing arms are jointed with the bogie frame via joint connections, base on the springs arrangement, where the springs are on one bogie side placed only between swing arms, where also only single spring may be used connecting both swing arms; or the springs may be equipped with floating brace which motion is limited by bogie frame; the springs may be equipped with floating brace that has no contact with the bogie frame, and where on the opposite bogie side are the springs supported by a brackets fixed to the bogie frame. This special spring arrangement lends to the bogie with rigid frame flexibility on twisted track which is similar to the flexibility of bogie with flexible frame, but without using any joints in the bogie frame. This leads to reduction of number of parts and weight of the bogie. The bogie also does not warp during the operation so it behaves as a bogie with rigid frame. This improves running stability of the bogie and decreases wear of the wheels. Mentioned improvements may be

reached with a small number of components of the suspension. The suspension is also placed between the wheelset and the bogie frame, which reduces weight of unsprung masses. All the suspension elements are permanently loaded, which removes one of possible sources of the noise.

[0022] Introduced design of the bogie allows placing of flexible elements between bearings and swing arms. In case when the wheelset or the axle bridge with independent wheels is used, flexibility of these elements allows a radial steering. This reduces wear of the wheels. This suspension arrangement allows connection of wheels, wheelset or the axle bridge via mechanical linkage that improves radial steering. These flexible elements also reduce transmission of vibrations to the car body and noise emissions.

[0023] Described design allows a simple use of friction dumping or dumping based on another physical principle. The dumping should be on one side connected to the swing arm and supported by the bogie frame on the other side. This device dumps directly the swing arm motion relatively to the bogie frame.

[0024] The bogie is equipped with interface that allows connection with car body. This interface may be made in standardized design or in special design.

[0025] The bogie is equipped with brake interface. This brake may be done as a block brake, a disc brake or another special brake design.

[0026] The invention relates bogie with high derailment safety and stable run.

Outline of the Figures in Drawings

[0027] The invention is further explained on attached drawings. There is a view from above in the fig. 1, there is a bottom view in the fig. 2, there is a side view showing float brace that supports the spring in the fig. 3 and there is the other side view showing rigid bracket that supports the spring in the fig. 4.

Example Version of the Invention

[0028] The example of the invention is the bogie shown in figures comprising bogie frame 1 and two wheelsets 2 with wheels 2a. Wheelsets 2 are guided via swing arms 4, whose connection with wheelsets is done via bearings 3. Swing arms 4 and the bogie frame 1 are connected via joints 5 Joints 5 may be manufactured from rubber. The suspension springs 6 are arranged between swing arms 4 and bogie frame 1. Suspension 6 may be made from steel springs, rubber springs or with air springs. Two springs 6 are on one bogie side supported by swing arms 4 on one spring end and rigidly supported on the second spring end via fix brackets 8 on the bogie frame 1. On the opposite bogie side are two springs 6 supported by swing arms 4 on one spring end and via floating brace 9 on the second spring end. Floating brace 9 is movable and it's motion is limited by bogie frame 1 or floating brace 9 is done in free version without connection to the bogie frame 1. On this bogie side is also possible a design version, where both springs 6 are connected together or are replaced with one spring 6 between swing arms 4. Others flexible suspension elements 10 are placed between bearings 3, which belong to the wheelset 2, and swing arms 4. These elements allow radial steering of the wheelset 2 when passing the curve. Both wheelsets 2 are connected via kinematic linkage 11 that improves efficiency of radial steering The flexible elements 10 also reduce transmission of vibrations to the structure of the bogie car body and reduce noise emissions. In the bogie suspension are arranged dumpers 7. Dumpers 7 may be friction dumpers or hydraulic dumper. The bogie is equipped with interface for use of the brake 13. The brake may be done as a block brake, a disc brake or another design. The bogie is equipped with interface 12 that allows connection with car body. There is shown the central-European interface in the figure.

Industrial Applicability

[0029] The bogie described in the invention may find its applicability especially in the design of freight cars or in applications where the space for bogie is very limited, this means for vehicles with low floor and The bogie is also appropriate for the applications where a good adaptability to the twisted track is required.

Claims

1. A bogie for railway vehicle comprised of bogie frame (1) and at least four wheels (2a) arranged as in pairs of independently rotating wheels or arranged in wheelsets, where said wheels (2a) or said wheelsets (2) are connected with swing arms (4) by means of bearings (3), where said swing arms (4) are jointed to the said bogie frame (1) by means of joints (5) **characterized in that,** the suspension springs (6) belonged to swing arms (4) on one bogie side are supported each other and contactless to said bogie frame (1), or said suspension springs (6) are movably supported on the bogie frame (1) by a movable brace (9) which is movably coupled to the chassis frame (1) or said suspension springs (6) are supported by means of floating brace (9) where motion of said floating brace (9) is not limited by said bogie frame (1), or there is arranged only one suspension spring (6) between said swing arms (4) on this said bogie side, and the suspension springs (6) belonged to swing arms (4) on the opposite bogie side are supported by means of brackets (8) fixed to the said bogie frame (1).

2. The bogie according to claim 1, **characterized in that** the joints (5) are made of rubber and metal.

3. The bogie according to claims 1 or 2, **characterized in that** between bearings (3) and swing arms (4) are arranged flexible parts (10).

4. The bogie according to any one of the preceding claims 1 - 3, **characterized in that** the wheelsets (2) are coupled each other by means of mechanical link (11).

5. The bogie according to any one of the preceding claims, 1 - 4, **characterized in that** there is arranged a damper (7) in the bogie, where said damper (7) damps directly the movement of swing arms (4) relatively to bogie frame (1).

6. The bogie according to any one of the preceding claims 1 - 5, **characterized in that** the bogie is equipped with bogie - carbody interfaces (12).

7. The bogie according to any one of the preceding claims 1 - 6, **characterized i n that** there are arranged interfaces (13) for the brakes in the bogie.

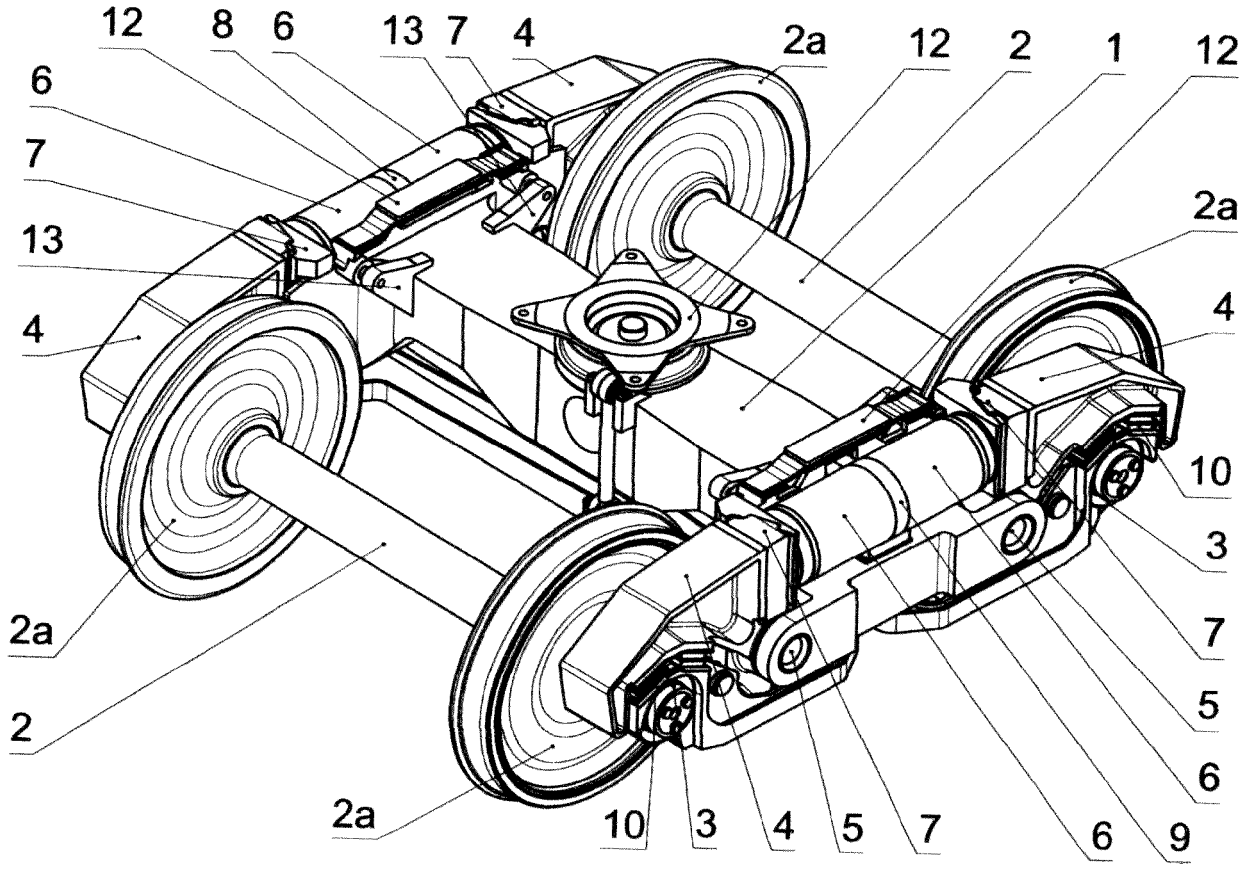

Fig. 1

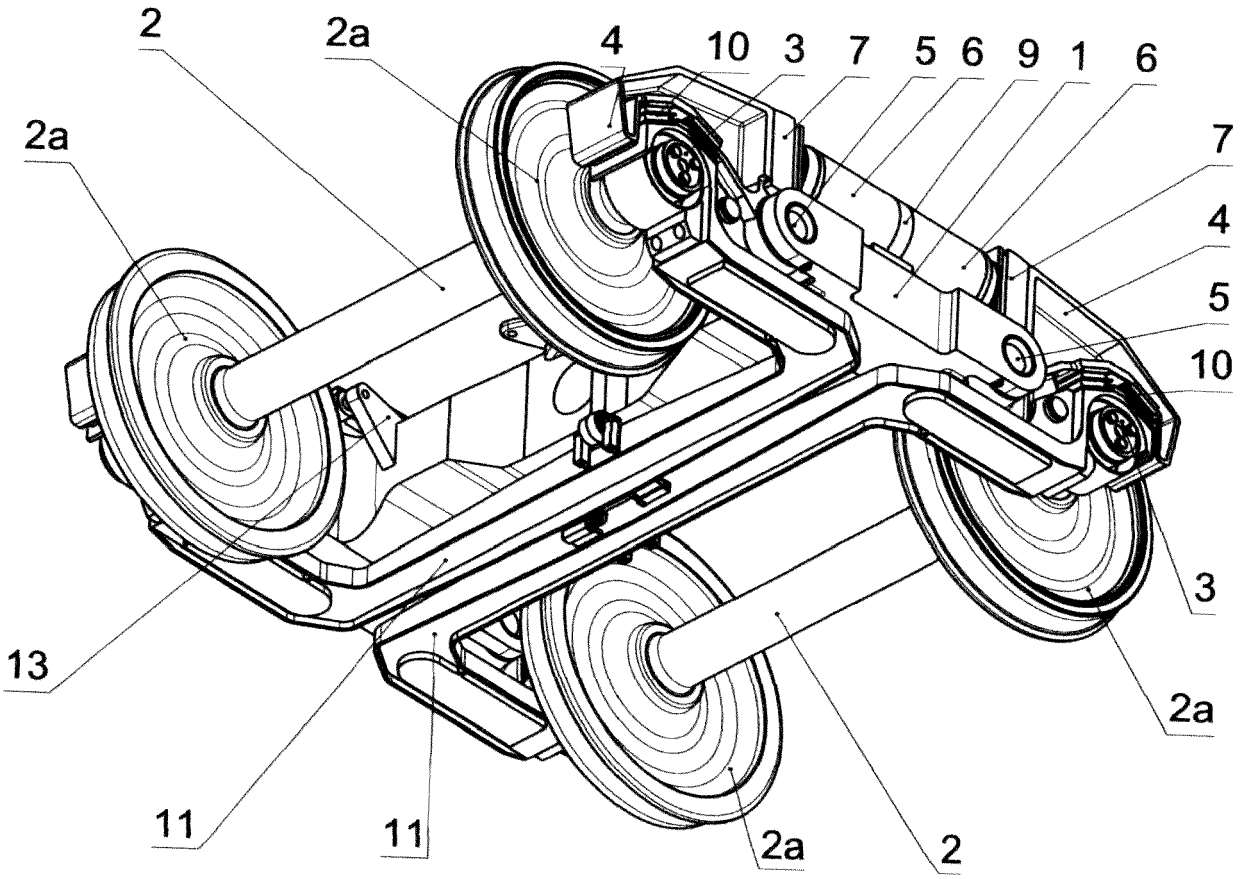

Fig. 2

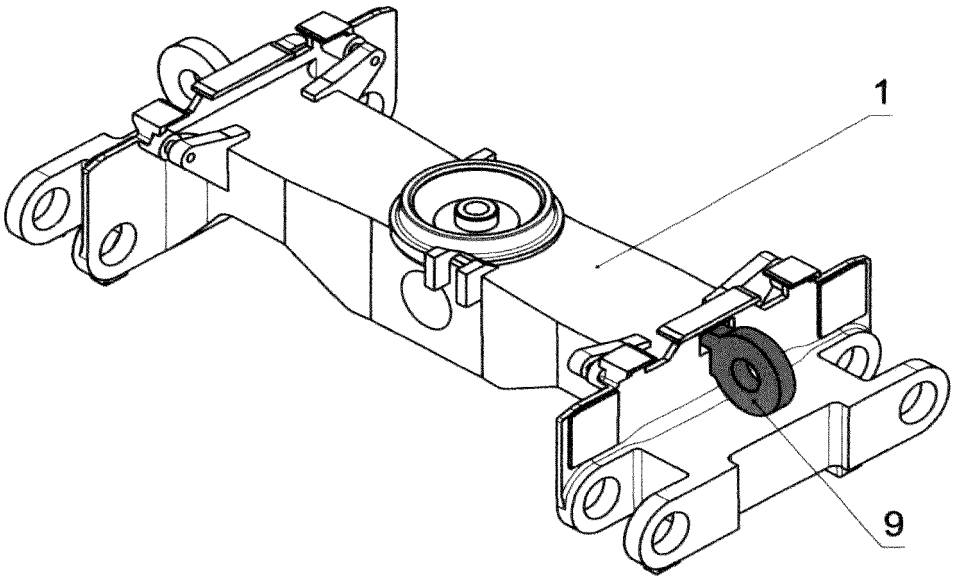

Fig. 3

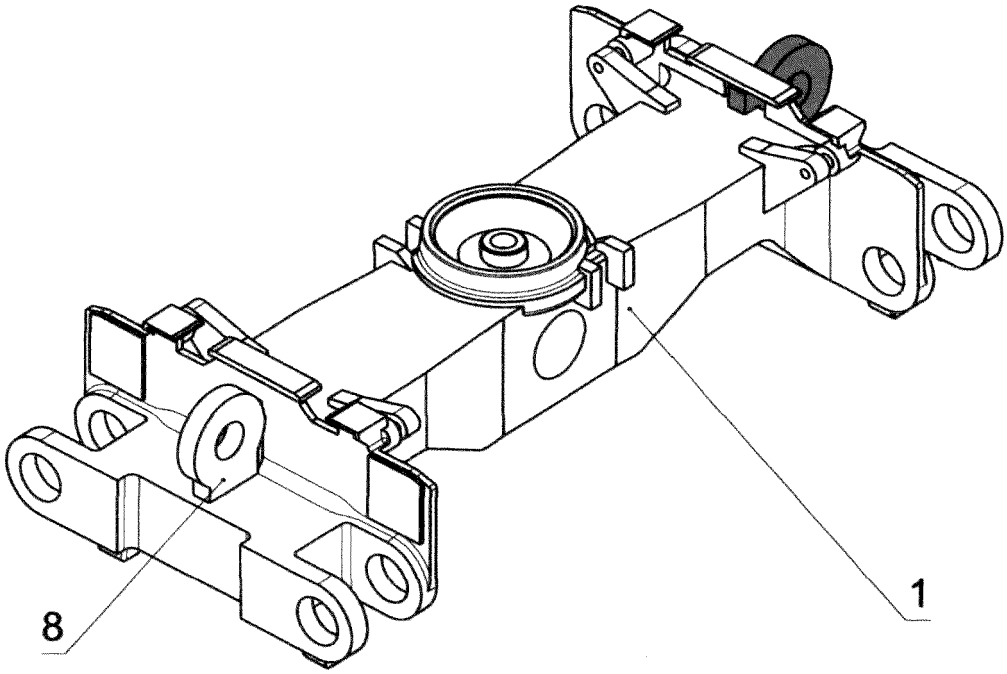

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 17 46 6012

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	8 February 2018	Crama, Yves

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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