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(54) **FRICTION DAMPER SUPPORTED BY A JOINT**

(57) Friction damper supported by a joint in the suspension of a wheelset of a railway car, comprising an axle (1), together with wheels (12), bearings (13), and axle boxes (2), there are helical springs (3) fitted to the ends of the axle (1) at least on both sides of the axle box (2) of the axle (1), in order to carry the railway car or to attach the bogie of the railway car to the frame of the bogie (4). At the side of the upper end of each helical spring (3) there is a slider (6) arranged to be moveably attached to the axle box (2) of the axle (1), in which there is at least one curved guide surface (7), which guide surface (7) has at least one radius of curvature parallel to the axle of the wheel pair around the axle. At the upper end of the helical springs (3), a friction damper is fitted, which comprises a counter surface (8) supported on the curved guide surface (7) of the axle box's (2) slider (6), the shape of which corresponds to the shape of the curved guide surface (7), a spring plate (9), which contains a head cap (17) for supporting the upper end of the helical spring (3), and at least one planar slanting friction surface (10) to be supported on a planar slanting counter surface (11) in the frame (4) of the bogie/car, which is correspondingly arranged to correspond to the slanting friction surface (10) of the friction damper.

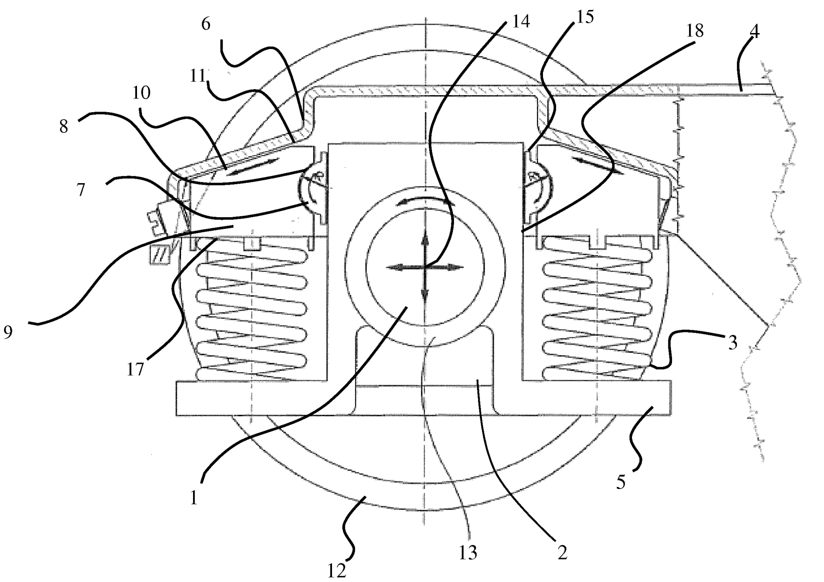

FIG 1.

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Description

Field of the invention

[0001] The present invention relates to a friction damper supported by a joint, in the bogies and wheelsets of railway cars and other railway rolling stock.

Background

[0002] Railway-car bogie and wheelset solutions are intended to attach the wheelsets flexibly and permit the axles to rotate and be steered according to the rails of the track. For the steering to be controlled, the flexes and movements of the structure must be suitably controlled and damped, so that uncontrolled movements will not take place within the operating speed range of the cars. In particular, the movements must be in all conditions as similar as possible, while there can be no deviations or variations in the kinetic forces. Detrimental variation can be caused, for example, by the formation of ice or rime on the guide or damper surfaces, in which case the forces and coefficients of friction affecting their movements will change uncontrollably.

[0003] Many different kinds of bogie and wheelset solutions are known. One solution for guiding sets of wheels is disclosed in United States patent application US2009/0031918. In it, at least some of the bogie's springs are supported at their upper end on a convex head-cup surface. The solution described is stated to improve transverse and longitudinal stiffness and friction properties. In this way hunting and wheel wear are reduced. Attempts have also been made to improve controllability by means of various elastomeric dampers and supports.

Summary of the invention

[0004] Though bogies and wheelsets could be made of operate well in some operating conditions, changes in the weather, such as changes in temperature and moisture, cause difficulties. Moisture can collect in structures and components, and in turn cause the formation of ice or rime. This can lead particularly to sliding surfaces jamming or their friction properties changing, as a result of which the travel of the bogie or wheelset changes. For the aforementioned reasons, it would be advantageous to create a structure, the operation of which is improved especially in changing weather conditions.

[0005] One special feature of the invention is intended to create a friction damper, the damping response of which can be better forecast than previously, irrespective of the running situation and conditions.

[0006] According to one embodiment of the invention, the intention is to create a friction damper, in which the damping friction surfaces are planar and parallel.

[0007] The invention is based on helical springs being used in the support of at least one wheelset, and a slider, in which there is at least one curved guide surface which has at least one radius of curvature relative to the axis parallel to the longitudinal axis of the wheelset, being fitted to the side of the upper end of each helical spring, and set to be supported on the axle box of the axle. At the upper end of the helical spring, a friction damper is arranged, the shape of which corresponds to the shape of the guide surface for supporting the spring plate of the upper end of the spring, and at least one planar slanting friction surface, which is arranged to correspond to a similar counter surface in the frame of the bogie/car.

[0008] According to one embodiment of the invention, the guide surface is supported on the axle box in such a way that it can move parallel to a vertical line running through the centre point of the axle box of the axle and prevent lateral sliding of the guide surface.

[0009] According to one embodiment, the guide surface is cylindrical.

[0010] According to one embodiment, the guide surface is spherical.

[0011] According to one embodiment, the guide surface, the counter-surface supported on the guide surface, the spring plate, and the slider are formed into a unified piece.

[0012] Several advantages are gained with the aid of the invention.

[0013] One of the greatest advantages of the invention is that the formation of rime or ice between the friction surfaces is prevented or essentially reduced. The friction damper will then operate as designed in all weather conditions and the variation of friction forces caused by rime formation will not occur. Thanks to this, particularly short cars can be permitted to run at higher speeds due to the more stable travel. In addition, the friction damping can be adjusted by means of different friction surfaces and by altering the attitude of the friction surfaces. The friction damper controls the attitude of the spring plate of the helical spring, so that its operation is better controlled. Due to the wide friction and movement surfaces and their controlled movements, the surface pressures of the surfaces are even. By altering the angles of the movement surfaces, the damping can be altered relative to the changing load.

Description of the drawings

[0014]

Figure 1 shows a partial cross-section of one embodiment of the invention.

Figure 2 shows a partial cross-section of a second alternative embodiment of the friction damper and slider of the invention.

Description of the embodiments

[0015] The present invention is intended primarily for use in the bogies and wheelsets of railway cars. It can also be adapted to similar applications in other railway rolling stock.

[0016] Figure 1 shows the support of a wheel set of a railway car, seen from the end of the axle 1. On the axle is a centre point 14 marked by an arrow and the longitudinal axis of the wheelset runs through this point. The axle 1 and the wheel 12 (2 items) form an axle set. The axle set and the axle boxes 2 (2 items) with their bearings 13 form a wheelset. The wheel pair and the opposite sides of the suspension are symmetrical. In the friction damper supported by a joint, in order to form support for a wheelset of a railway car there is at least one axle 1 with wheels 12, bearings 13, and axle boxes 2, as well as helical springs 3 fitted to the axle box at both sides of the axle 1 on at least both ends of the axle 1, in order to carry the railway car. The helical springs 3 can be supported either on support points in the car, i.e. on the frame 4 of the car, or on the frame 4 of the bogie, which in turn supports the railway car. In the axle box 2, there are head-cup plates 5, on which the helical springs 3 fitted between the axle box 2 and the bogie's/car's frame 4 are received.

[0017] The friction damper comprises a slider 6, in which there is a first guide surface 7 and a second guide surface 15 supported on the axle box 2 (in the second embodiment 19, Figure 2), fitted moveably to the axle box 2 of the axle 1 on the side of the upper end of every helical spring 3. In this embodiment, the guide surface 7 is a spherical guide surface 7 pointing away from the axle box. The sliding surface of the other guide surface 15 is planar, as is the head-cup surface 18 of its axle box 2, a second alternative embodiment of the second guide surface being shown in Figure 2. The first guide surface 7 is formed of at least one curved surface, which forms the guide surface 7 and which guide surface 7 has at least one radius of curvature around the axis parallel to the longitudinal axle of the wheelset. This guide surface can preferably be cylindrical or spherical. A spherical guide surface permits a free rotation in all directions around the spherical surface, whereas a cylindrical guide surface supports the spring plate 9 against lateral torsion.

[0018] A spring plate 9, with the aid of which the actual friction damper is formed, is fitted to the upper end of the helical springs 3. The friction damper comprises a counter surface 8 supporting the guide surface 7 of the slider 6 of the axle box 2, the shape of which corresponds to the shape of the guide surface 7 and the head-cup surface 17 of the spring plate 9, in order to support the upper end of the spring 3. At the upper end of the friction damper, there is, on the opposite side of the head-cup surface 17 of the spring plate 9, at least one planar slanting friction surface 10, which is arranged to correspond to the similar counter surface 11 in the frame of the bogie/car 4. The slant of these surfaces relative to the horizontal can vary, and the surfaces or at least one of them can be surfaced, hardened, or otherwise treated in order to created suitable friction properties. The surfaces can preferably be changed in order to facilitate servicing and maintenance. By means of changeable friction surfaces it is also possible, if desired, to alter the coefficient of friction and thus affect the damping and the travel of the car. The slanting friction surface of the spring plate 9 can be supported directly on the structure of the car's frame. A bogie can also be formed as a totality to create a changeable unit, or be otherwise built on its own frame, in which case the counter surfaces will be in the bogie frame, which in turn is attached to the car frame.

[0019] In the friction damper according to the invention, the slider 6 is supported against the side of the axle box 2, but does not prevent the axle box 2 from moving vertically. The movements of the wheelset seek to rotate the axle box 2 around its vertical axis relative to the frame of the bogie/car 4, and the movements of the axle box 2 and the spring 3 correspondingly tend to move the slider 6 and the friction damper's spring plate 9 arranged against it, but if the movement surface (7 and 8) between the slider 6 and the friction damper's spring plate 9 is given a spherical shape, a change in the attitude of the slider 6 will not cause a rotational force in the spring plate 9. The helical spring 3 conforms well to lateral movement, and thus the helical spring 3 continues to press the slanting friction surface 10 of the friction damper evenly on the slanting counter surface 11 of the frame of the bogie/car 4, irrespective of the movements of the axle box, and the friction surface 10 and the counter-surface 11 remain precisely against each other, and a gap cannot form between them. The spring plate 9 remains horizontal despite the movements, whereas the head-cup plates 5 of the springs of the axle box 2 can move according to the movements of the axle box 2 caused by the steering of the wheels 12. Due to this, the slanting surfaces are continuously in a planar contact with each other. The friction force between the surfaces remains constant and rime, ice, or dirt cannot collect between the surfaces, which could hinder the movement of the friction surfaces and thus the travel of the bogie/car. Correspondingly, the surface pressure in the movement surface 15 between the axle box 2 and the slider 6 remains even and the surfaces remain in parallel. This is made possible by the spherical or cylindrical curved surface acting as a pivot or bearing. In addition, it is advantageous to arrange the longitudinal axis of the helical spring 3 at, or close to the centre point of the friction surface, when the surface pressure will be as even as possible over the whole surface.

[0020] The operation of the friction damper can be influenced by dimensioning. For example, the radius R of the sphere or cylinder surface 7 and its head-cup surface 8, the distance between the starting point of the radius R and the sliding surface of the axle box, and the eccentricity of the starting point of the radius R and the support force acting on the spherical surface, as well as well as changes relative to the angle β relative to the vertical of the axle box 2 and the slider's movement surface 15, and the angle α of the slanting friction surface 10 and the slanting counter surface 11, can affect the surface pressures and damping. By means of the dimensioning of the radius R, the surface pressure between the spherical or cylindrical curved surfaces 7 and 8 are adjusted and, with the aid of the distance between the starting point of the radius R and the sliding surface of the axle box and the eccentricity of the starting point of radius R and the support force acting on the spherical surface, the surface pressure between the curved surfaces 7 and 8 and the planar surfaces 10 and 11 can be adjusted. By means of changes of the angle β relative to the vertical of the axle box 2 and the movement surface of the slider and of the angle α relative to the horizontal of the slanting friction surface 10 and the slanting counter surface 11, the changing of the damping relative to the load can be influenced. In this embodiment, damping is created on the basis of the kinetic friction between the friction surface 10 and its counter surface 11 and partly of the kinetic friction between the slider 6 and the axle box 2, examples of the values of the coefficient of friction being 0.4 - 0.5.

[0021] Figure 2 shows a second alternative embodiment of the structure of the friction damper and the slider. In this structure, a grooved sliding surface 18 is formed on the outer surface of the axle box 2, against which a slider 6 is arranged, to which a grooved sliding shoe 19 is attached. These grooved surfaces guide the movement of the slider and prevent it from sliding laterally or twisting. The head-cup surface 8 of the spring plate 9 corresponding to the guide surface 7 of the slider 6 is, in this case, implemented by means of a separate head-cup component 29, which is attached by screws 20 and can thus be changed.

[0022] The slider 6 can be made as a changeable separate item as can the slanting friction surfaces. The slider can be made as differently-sized pieces, or spacer pieces of different thicknesses can be combined, in order to adjust the distances between and attitudes of the slider 6, the axle box 9, and the friction damper's spring plate.

[0023] The friction surfaces of the damper according to the invention can be made, for example, of tempered steel, with the counter surface being of fibre-reinforced plastic, such as nylon, reinforced rubber, or cast iron. However, it is obvious that the friction-surface pairs or guide-surface pairs can be made from other materials too, which have sufficient strength in the desired surface pressure and suitable friction properties. Their friction properties should, however, remained as unchanged as possible in use. The angle of the slanting friction surfaces must be arranged to operate according to the material pair in such a way that the desired damping is achieved with a suitable angle and pair of materials. There can be a changeable friction surface in the spherical or cylindrical surface of the joint of the friction damper. As its materials, it is possible to use cast iron, a reinforced polyamide, or other similar materials referred to in this description. The centre point of the radius R of curvature should preferably be close to the surface permitting movement of the axle box and slider. The rotational moment will then remain as small as possible. Wear of the components affects this distance, so that wear should naturally be taken into account when servicing the apparatus. The travel of the car is also affected by the play in the axle box and wear and shape, as well as small differences due to the manufacturing tolerances of the springs. These affect the car's travel and cause vibration and wear. These effects are sought to be reduced with the aid of the embodiments of the solution according to the invention, and these effects can be taken into account during maintenance by changing components and thus adjusting the structure.

[0024] A construction is depicted in the example of Figure 1, in which there is one spring on each side of the axle box. In addition to these, there can be several springs in the construction, if required by the load-bearing capacity.

[0025] Figure 2 also shows that the spring plate's 9 slanting friction surface 10 against the frame 4 of the bogie/car and the corresponding slanting counter surface 11 against the spring plate 9 of the frame 4 of the bogie/car can also be constructed from replaceable components, the slanting friction surface 10 from a corresponding friction component 30 the slanting counter surface 11 from a corresponding friction component 31, and these components can be attached, for example, by gluing or screws.

[0026] List of reference numbers, Figure 1:

1 axle

2 axle box

3 helical spring

4 frame (frame of bogie/car)

5 head cup (axle box's 2 or saddle's head cup 5 for the helical spring 3)

6 slider

7 first guide surface (surface against the slider's 6 spring plate)

8 counter surface (surface against the spring plate's 9 slider 6)

9 spring plate

10 slanting friction surface (spring plate's 9 surface against the bogie's/car's frame 4)

11 slanting counter surface (surface against the spring plate 9 of the bogie's/car's frame 4)

12 wheel

13 bearing

14 centre point

15 second guide surface (slider's 6 surface against the axle box 2)

17 spring's head-cup (surface of the spring plate 9 against the helical spring 3)

18 axle box's counter surface (surface of the axle box 2 against the slider 6)

R radius of the counter surface

α angle relative to the horizontal plane

β angle relative to the vertical plane

[0027] List of reference numbers, Figure 2, second alternative embodiment of the friction damper and slider:

2 axle box

6 slider

9 spring plate

18 axle box's grooved counter surface (axle box's 2 "sliding surface" against the slider 6)

19 grooved sliding shoe (slider's 6 separate sliding shoe against the axle box 2)

20 screw (attachment screw of the separate counter component 29 formed by the counter surface 8 of the spring plate 9)

29 spring plate's counter component (separate component formed by the spring plate's 9 counter surface 8)

30 slanting friction component (separate component formed by the spring plate's 9 guide surface 10)

31 slanting counter component (separate component formed by the bogie's/car's frame's 4 counter surface 11)

Claims

1. Friction damper supported by a joint in the suspension of a wheelset of a railway car, in at least one wheelset, which comprises at least one axle (1), together with wheels (12), bearings (13), and axle boxes (2), there are helical springs (3) fitted to the ends of the axle (1) on both sides of the axle's (1) axle box (3), in order to support the railway car, or to attach the railway car to the frame (4) of the bogie, **characterized by** a slider (6) on the side of the upper end of each helical spring (3) and arranged to be moveably attached to the axle's (1) axle box (2), and in which there is at least one curved guide surface (7), which guide surface (7) has at least one radius of curvature parallel to the axis of the wheelset around the axle, and by a friction damper fitted to the upper end of the helical springs (3), which comprises a counter surface (8) supported on the curved guide surface (7) of the slider (6) of the axle box (2), the shape of which corresponds to the shape of the curved guide surface (7), a spring plate (9), which contains a head cup (17) for supporting the upper end of the helical spring (3), and at least one planar slanting friction surface (10), which is arranged to be supported on a planar slanting counter surface (11) in the frame of the bogie/car (4), and which is correspondingly arranged to correspond to the slanting friction surface (10) of the friction damper.

2. Damper according to Claim 1, **characterized**

    - **by** a guide surface (7) fitted to the side of the upper end of the helical spring (3) and fitted against the axle box (2) of the axle, and which has at least one curved guide surface and which guide surface (7) has at least one radius of curvature around the longitudinal axis of the wheelset,
    - by a friction damper fitted to the upper end of the helical spring (3), which comprises
    - a counter surface (8) supported on the guide surface (7) of the axle box (2), the shape of which corresponds to the shape of the guide surface (7),
    - a spring plate (9) to be supported on the end of the helical spring (3),
    - at least one planar slanting friction surface (10), which is arranged to correspond to a similar counter surface (11) in the frame of the bogie/car (4).

3. Damper according to Claim 1 or 2, **characterized in that** the guide surface (7) fitted against the axle box (2) is implemented in such a way, that the guide surface (7) can move in parallel with a vertical line running through the centre point of the axle box (2) of the axle (1), and lateral sliding of the guide surface (7) is prevented.

4. Friction damper according to any of Claims 1 - 3, **characterized in that** the guide surface (7) fitted to the axle box (2) is cylindrical.

5. Friction damper according to any of Claims 1 - 3, **characterized in that** the guide surface (7) fitted to the axle box (2) is spherical.

6. Friction damper according to any of Claims 1 - 5, **characterized in that** the friction surface (10) has been treated to create suitable friction properties.

7. Friction damper according to any of Claims 1 - 6, **characterized in that** at least one of the surfaces guide surface (7), counter surface (8), slanting friction surface (10), or slanting counter surface (11) has been treated to create suitable friction properties.

8. Friction damper according to any of Claims 1 - 7, **characterized in that** at least one of the surfaces guide surface (7), counter surface (8), slanting friction surface (10), or slanting counter surface (11) can be changed.

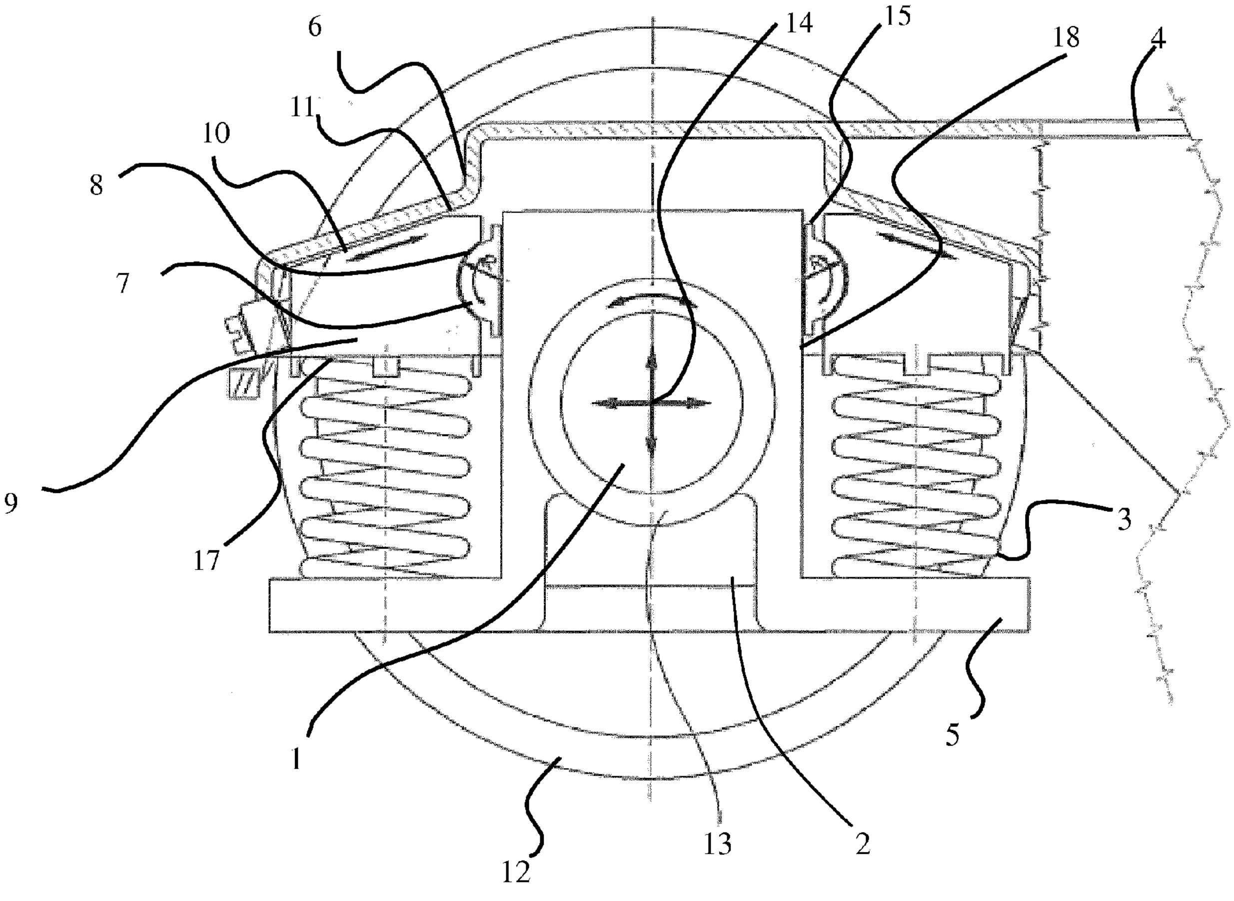

FIG 1.

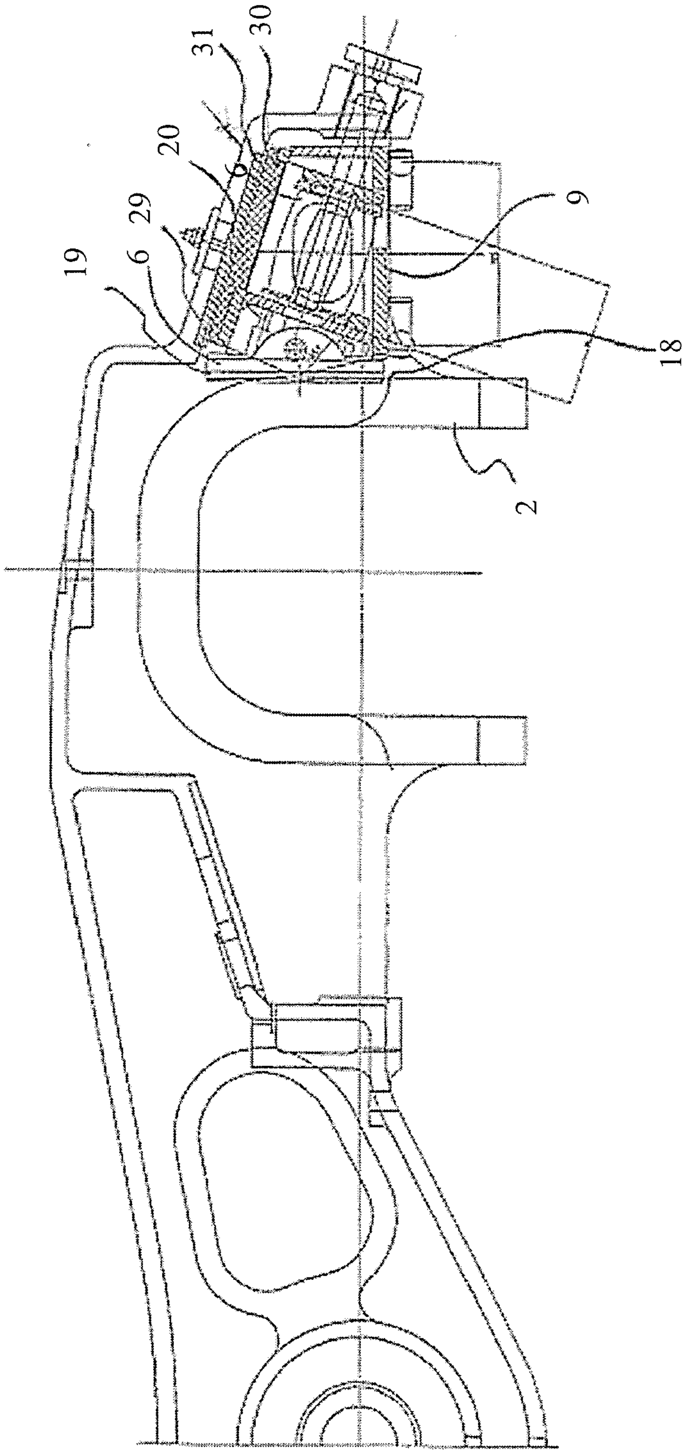

FIG 2.

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EUROPEAN SEARCH REPORT

Application Number
EP 16 15 1893

DOCUMENTS CONSIDERED TO BE RELEVANT

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The present search report has been drawn up for all claims

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Place of search	Date of completion of the search	Examiner
Munich	9 June 2016	Schultze, Yves

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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