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(54) RAILWAY AXLE WITH AUTOMATIC CHANGE TO MULTIPLE TRACK WIDTHS

(57) The railway axle comprises railway wheels (1) mounted on an axle (2) by means of sliding adjustment, by virtue of the interposition of adjusted bushings (3) that are lubricated by means of grease on the inside (4) of the wheel (1), allowing the transition from one width to another without the need to release the wheel load. The wheels (1) are immobilised on the axle (2) in terms of the axle movement thereof by means of the sleeve (5) of claws (5') secured in rotation to the axle (2), the claws (5') being housed in annular, trapezoidal grooves (6') provided in rings (6) mounted on the hub (7) of the wheel (1), locking and unlocking involving a clamping sleeve (10) and pretensioned springs (11), the force of which may be overcome by a disc-like pusher (12), the railway axle furthermore including articulated compasses (13) connected by one end to a supporting sleeve (14) of the actual articulated compasses (13) and by the other end to a base ring (9) that is hooped and secured to the axle.

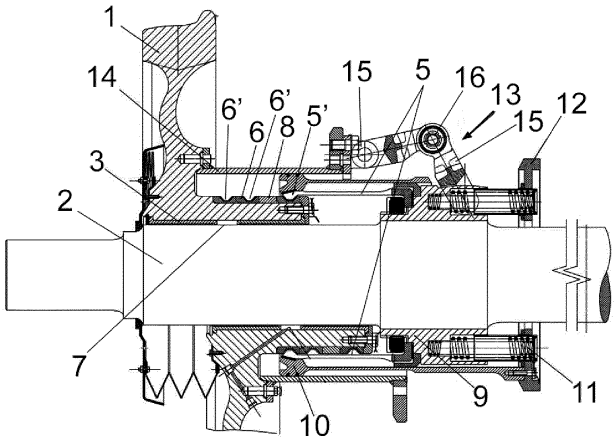

FIG. 1

EP 3 020 610 A1

Description

OBJECT OF THE INVENTION

[0001] The present invention relates to a railway axle with automatic change to multiple track widths, making it possible to solve the problem of the difference in track widths adopted in different railway networks around the world and which represent a barrier to railway traffic, requiring the transfer of the goods or manual width change.

[0002] Specifically, the railway axle of the invention is envisaged to change the width between wheels in railway vehicles to continuously switch from one track width to another, making them circulate along a transition track section with rail and check rail which, by continuously varying its width, connects the two tracks of different width.

[0003] The object of the invention is to remove the physical barrier currently represented by the change in width both in freight and passenger traffic, in order to execute said transition smoothly, without the need for stopping and without releasing the wheel load during the width change process.

[0004] The invention falls within the field of railways and, specifically, that of wheel tandems corresponding to railway vehicles or convoys.

BACKGROUND OF THE INVENTION

[0005] The problem of width difference between railway networks is a problem which has historically been addressed by means of solutions oriented mainly towards passenger traffic, namely the CAF Talgo or Brava Universal Shifting Rolling System, inter alia, which currently functions satisfactorily.

[0006] However, in the field of railway freight transport, there are different known solutions based on axles with automatic change to variable widths, each with its own peculiarities, but none of which has been capable of addressing the challenge posed by freight transport due to the stringent heavy-haul requirements imposed.

[0007] Thus, the Talgo system titled "Railway axle assembly equipped with automatic track width change and adaptable to conventional freight bogies" is known. However, it is not a typical continuous mounted axle and the width change process is performed by releasing the wheel load. It requires internal bearings which have a problem with the detection of internal hot boxes, in addition to the possibility that the locks may perform poorly in the event of extremely low temperatures. Said locks are disposed in an upright position and have a hollow bridge that joins the vertical unblocking rods on receiving the head of an appropriate profile of an unlocking guide of the width changing installation, which requires precise action on the axle.

[0008] Typical assembled axle systems valid for freight include, namely, the Polish SUW2000 system and the German Rafil Type V system.

[0009] SUW2000 has the complication of transmitting torsional torque between wheelsets by means of threaded male-female joining elements, which entail severe deterioration in contact zones, giving rise to clearances that end up being supported by the wheel locking system and consequently destroying it, thereby adding to the complexity of the maintenance tasks.

[0010] Other variable-width systems are known that resolve this problem by means of fixation compasses, but do not have an articulated connection and are disposed on the outer part of the axle, which increases fatigue and, therefore, breakage of the part. In addition, they require specially designed grease boxes, which significantly raise the cost of the solution. Other variable-width systems are also known wherein the forces required to perform the change in width are applied by means of the guiding of additional wheel treads of the railway wheels, which adds excess weight. In other axles, the width-changing process is carried out by means of the participation of pendulums that interact with the width-changing platform, said pendulums being elements which add excess weight to the system, in addition to further complicating maintenance.

[0011] Furthermore, both Rafil Type V and SUW2000 have the characteristic of being exclusively compatible with two different track widths, restricting its use to a single railway border, limiting any traffic to other networks with multiple widths, as becoming required in Europe-Asia freight traffic.

[0012] In addition, there is a problem generally associated with current variable-width railway axles, as they require the use of specific rolling material from the manufacturer, which represents a handicap for their use in freight transport, since the car and bogie fleet cannot be reused for the existing fixed width, raising total operating costs.

[0013] In summary, there is currently no railway axle with automatic track width change that solves the problem of international rail freight traffic between infrastructures with different track widths, capable of changing to more than two widths without releasing the wheel load, smoothly and with low maintenance requirements, without need for bearings on the inner sides of the wheel, and being compatible with the twin-axle cars and freight bogies customarily used by operators.

DESCRIPTION OF THE INVENTION

[0014] The railway axle with automatic change to multiple track widths, which does not need to release wheel load, is based on the design of a new axle which, installed on a train, allows it to freely circulate between railway networks of different widths. The change of width is performed on passing through a system installed on the track which is in charge of performing the corresponding manoeuvres that enable the unlocking and subsequent locking of an internal mechanism envisaged for this purpose.

[0015] Specifically, the railway axle of the invention is

composed of an actual axle and two wheels which are coupled to said axle by means of adjusted bushings, allowing the axial movement of the wheels on the axle under load conditions, without suffering excessive wear or breakage, even under heavy-haul conditions due to freight traffic. This is possible as a result of the lubrication by means of grease achieved in the inner zone by means of greasers disposed for this purpose. The axle has a system of claws shaped in the manner of a sliding sleeve for each wheel, such that the locking which makes it possible to maintain a constant track width is achieved when the claws of said sleeve enter annular, trapezoidal grooves envisaged in rings mounted on the wheel hub.

[0016] The axle may be configured to achieve more than two widths by modifying the length of the sliding sleeves, as well as the length of the axle, and mounting more rings with annular, trapezoidal grooves, combined with spacer rings envisaged to separate the rings with annular grooves, and whose separation will establish the appropriate distance until achieving the desired track widths.

[0017] Each sleeve of claws will rotate secured in rotation to the axle, as it is fixed by means of a base ring that is hooped and secured to the axle, said fixation and hooping being carried out by a single bolt that is screwed onto a threaded section of the hooped base ring. In order to enable the exact adjustment of track width dimensions, a calibration washer will be installed between the sleeve of claws and the base ring that is hooped and secured to the axle. In order to prevent the end of the sleeve of claws, which maintains the locking, from slipping out of the annular ring grooves, a clamping sleeve associated with one or more pretensioned springs will be used.

[0018] The change in width, and therefore the unlocking or unblocking of the wheels, will occur when a force is applied that can overcome the resistance offered by installed pretensioned springs and move the sleeve of claws. This force will be applied throughout the width change process due to the interaction of the axle with a width-changing device or platform installed on the track. The force will be applied to a disc-like pusher secured to the sleeve of claws that will compress the springs installed in the axle, in order to release the claws from the annular grooves, facilitating the movement of the wheels in an axial direction until the claws of the end of the sleeve are housed in the annular groove corresponding to the new track width on which the railway vehicle will circulate.

[0019] The railway axle also has parts called compasses that serve as a coupling between the wheel and the axle in the direction of rotation, each compass being formed by a pair of semi-compasses or arms, articulated therebetween, with the participation of a ball-and-socket joint which allows for pitching, such that the use of this ball-and-socket joint allows for the absorption of small non-axial movements of the wheel on the axle during rolling thereof, preventing the rod that connects them from breaking. The coupling between the wheel and the axle occurs upon connecting a semi-compass to the inside of the wheel by means of a supporting sleeve and the other semi-compass to the base ring that is hooped and secured to the axle. The compass supports additionally serve to protect the rings having annular, trapezoidal grooves when the axle is operating on greater track-width configurations.

[0020] In addition, the railway axle is complemented with a bellows-type extendable membrane having one or more folds and that will serve as protection for smaller track-width positions, such that said membrane is joined to the axle and to the wheel on the outer part thereof by means of a plate housed in a concave projection of the axle joined to an outer protection part, and joined to the wheel by means of a ring whereto the extendable membrane will be joined.

[0021] The structural elements that constitute the railway axle object of the invention include, namely, the following:

- The axle is designed to support heavy-haul rail freight transport.
- The inclusion of the articulated compass system guarantees the absorption of non-axial movements of the wheel on the axle during normal operation, without causing fatigue of the connecting rod that joins the two semi-compasses.
- The use of non-ferrous material in the contact zone between the sleeve claws and the trapezoidal grooves of the rings, and in the contact or outer zone between the sleeve of claws and the clamping sleeve extends the useful life of the contact elements.
- All the elements are designed to be quickly replaced without auxiliary means.

[0022] The advantages of the railway axle described are as follows:

- It solves the problem of ice that appears in various width-changing systems.
- It achieves reduced maintenance, limited to the usual wear.
- The railway axle is compatible with any twin-axle car and bogie available to railway operators.
- The railway axle is valid for changing to more than two widths simultaneously.
- The railway axle constitutes a highly robust assembly.
- The railway axle has sufficient structural resistance to house brake discs in its middle area.

DESCRIPTION OF THE DRAWINGS

[0023] As a complement to the description made below, and for the purpose of helping to make the characteristics of the invention more readily understandable, this specification is accompanied by a set of drawings that form an integral part thereof and whose figures, by way of illustration and not limitation, represent the follow-

ing:

Figure 1 shows a cross-sectional view of the variable-width railway axle assembly with the different components that integrate it in two positions, one of maximum width and the other of minimum width.

Figure 2 shows a cross-sectional view of the compasses that participate in the railway axle of the invention, showing the ball-and-socket joint incorporated between the two compasses.

Figure 3 shows a cross-sectional view corresponding to a detail that shows the fixation of the hooped ring and the sleeve of claws with respect to the axle.

Figure 4 shows, lastly, a cross-sectional view corresponding to a detail of the extendable membrane constituted by an external protection bellows of the variable-width axle.

PREFERRED EMBODIMENT OF THE INVENTION

[0024] As can be observed in the aforementioned figures, the variable-width axle object of the invention is envisaged to be able to change from one width to another in a fully satisfactory manner, such that, in accordance with figure 1, the railway axle as a whole comprises the wheels (1) mounted on the corresponding axle (2) with sliding adjustment, i.e. with axial sliding capacity of the wheel (1) over the axle (2). This sliding adjustment occurs due to the use of adjusted bushings (3) lubricated by means of grease on the inside (4) of the wheel (1), allowing the transition from one width to another without the need to release the wheel load, even under heavy-haul conditions, such as freight traffic. The wheels (1) will be immobilised with respect to the axle (2) by means of a sleeve (5) of claws (5') that will prevent the axial movement thereof when the claws (5') are housed in trapezoidal grooves (6') provided in rings (6) mounted on the hub (7) of the wheel (1) itself, such that the layout of the trapezoidal grooves (6') will establish annular grooves that will enable the configuration of two or more track widths, by modifying the length of the hub (7) of the wheel (1), the length of the axle (1) and the use of spacer rings (8) disposed between the rings (6) of the groove (6').

[0025] The claws (5') will be secured in rotation to the axle (2) and are fixed by means of a base ring (9) that is hooped and secured to the axle, housed in the trapezoidal grooves of the rings (6), where they will form annular wedges along the entire perimeter. In order to prevent damage to the claws (5'), non-ferrous materials will be used both in the contact zone thereof with the trapezoidal grooves (6') and on the outer part that is in contact with a clamping sleeve (10), the latter being envisaged to prevent the claws (5') from abandoning the trapezoidal grooves (6') through the action of one or more pretensioned springs (11).

[0026] In order to perform the change in width, said claws (5') must be unblocked with respect to the grooves (6'), which is possible by means of the action of a force to overcome one or more pretensioned springs (11) and move the clamping sleeve (10), a force applied when said axle circulates through the track device or mechanism envisaged to perform the change in width.

[0027] During the transition, a disc-like pusher (12) secured to said clamping sleeve (10), which will compress one or more pretensioned springs (11), will be actuated, releasing the claws (5') from the grooves (6') for the purpose of facilitating movement in an axial direction until the desired claw (5') enters the corresponding groove (6') and establishes the new track width to which the change is made. The coupling between the wheel (1) and the axle (2), in the direction of rotation, is carried out based on articulated compasses (13) connected by one end to the inside of the wheel (1), by means of a supporting sleeve (14) and, by the other end, to the base ring (9) hooped and secured to the axle (2), whereto the sleeve (5) with claws (5') is also connected, thereby enabling the transmission of moment between the two wheels (1), without preventing axial movement. The compass support (14) will in turn serve to protect the rings (6) with trapezoidal grooves (6') when the axle (2) is in the maximum track-width position.

[0028] Figure 2 shows a more detailed view of the articulated compass system (13) formed by two semi-compasses (15) which make rotation possible by means of an articulation shaft (16), as well as shifting by means of a ball-and-socket joint (17) coupled to said shaft (16) and housed in one of the semi-compasses (15). The use of this ball-and-socket joint (17) absorbs the small non-axial movements of the wheel (1) on the axle (2), during normal operation, without causing fatigue of the rod that connects them, thereby preventing it from breaking. The position of the articulated compasses (13), which transmit the rotation movement between the wheels (1), on the inside of the axle (2), and not having to release the wheel (1) load during the transition, makes it possible to use standard running systems and enables the variable-width railway axle to be used in existing vehicles, requiring only small changes to apply it.

[0029] Figure 3 shows a more precise view of the fixation of the sleeve (5) of claws (5') to the axle (2), said fixation being carried out by means of a single bolt (18) that is screwed onto a threaded section of the base ring (9). In order to allow for the exact adjustment of the dimensions, a calibration washer (19) will be inserted between the base ring (9) and the sleeve (5) of claws (5').

[0030] Figure 4 shows the protection system when the axle (2) is in the minimum track-width position, said protection system being based on a bellows-type extendable membrane (20), having one or more folds, which will be joined to the axle (2) by means of a plate (21) disposed on a concave projection (23) of the axle (2) joined to an outer protection part and joined to the external part of the wheel (1) by means of a ring (22) whereto the extendable membrane (20) will be joined.

[0031] Lastly, it should be noted that in relation to the railway braking system, brake discs can optionally be

disposed in the middle area of the axle, secured thereto, or disposed secured to the wheels, requiring in this latter case a simple steering system to accompany the movement of the wheels during the transition from one width to another.

Claims

1. A railway axle with automatic change to multiple track widths, comprising wheels (1) mounted on an axle (2) by means of sliding adjustment, enabling the transition from one width to another without the need to release the wheel load, even in the case of heavy hauling, wherein the wheels (1) are immobilised on the axle (2) in terms of the axle movement thereof by means of a sleeve (5) of claws (5') secured in rotation to the axle (2), the claws (5') envisaged on one of the ends of the sleeve (5) being housed in annular, trapezoidal grooves (6') spaced apart from one another to enable the configuration of the axle operating width, with the participation of a clamping sleeve (10) associated with one or more pretensioned springs (11), with the collaboration of articulated compasses (13) connected in an articulated manner between the axle and the wheel, **characterised in that** the annular, trapezoidal grooves (5') wherein the claws (6') of the sleeve (6) are housed define rings (5) mounted on the hub (7) of the wheel (1), with the interposition of spacer rings (8); it being envisaged that the surface of the contact zone between the claws (6') and the annular, trapezoidal grooves (5'), and between the outer zone of said claws (6') and the clamping sleeve (10) will be made of non-ferrous materials, with the added peculiarity that a ball-and-socket joint (17) mounted on the articulation shaft (16) itself between the semi-compasses (15) participates in the articulation between said semi-compasses (15') that form the articulated compasses (13), in order to absorb the small non-axial movements of the wheel (1) on the axle (2).

2. The railway axle with automatic change to multiple track widths, according to claim 1, **characterised in that** the sliding adjustment between the wheels (1) and the axle (2) is performed by adjusted bushings (3) lubricated by means of grease on the inside (4) of the wheel (1).

3. The railway axle with automatic change to multiple track widths, according to claim 1, **characterised in that** the pretensioned springs (11) that establish the blocking of the claws (5') on the trapezoidal grooves (6') are mounted on a base ring (9) that is hooped and secured to the axle (2), said pretensioned springs (11) being compressed by means of a disc-like pusher (12) secured to the clamping sleeve (10).

4. The railway axle with automatic change to multiple track widths, according to claims 1 and 3, **characterised in that** the fixation of the sleeve (5) of claws (5') to the axle (2) by means of a base ring (9) that is hooped and secured to the axle is executed by means of a bolt (18) threaded on a section of said base ring (9), also incorporating a collaboration washer (19) between the sleeve (5) of claws (5') and the base ring (9), in order to allow the exact adjustment of track width.

5. The railway axle with automatic change to multiple track widths, according to claim 1, **characterised in that** it incorporates a bellows-type extendable membrane (20), having one or more folds, mounted on the axle (2) by means of a plate (21) housed in a concave projection (23) of the axle (2) itself, and joined to an external protection part, and to the outer part of the wheel (1) by means of a ring (22).

6. The railway axle with automatic change to multiple track widths, according to claim 1, **characterised in that** the joint between the articulated compasses (13) and the wheels (1) is executed through a supporting sleeve (14) which acts as a protection element of the rings (6) with trapezoidal grooves (6') when the axle (2) is in the configurations with the greatest width.

7. The railway axle with automatic change to multiple track widths, according to claim 1, **characterised in that** in the middle area of the axle (2) it is possible to mount brake discs secured thereto, or to dispose said brake discs secured to the wheels (1).

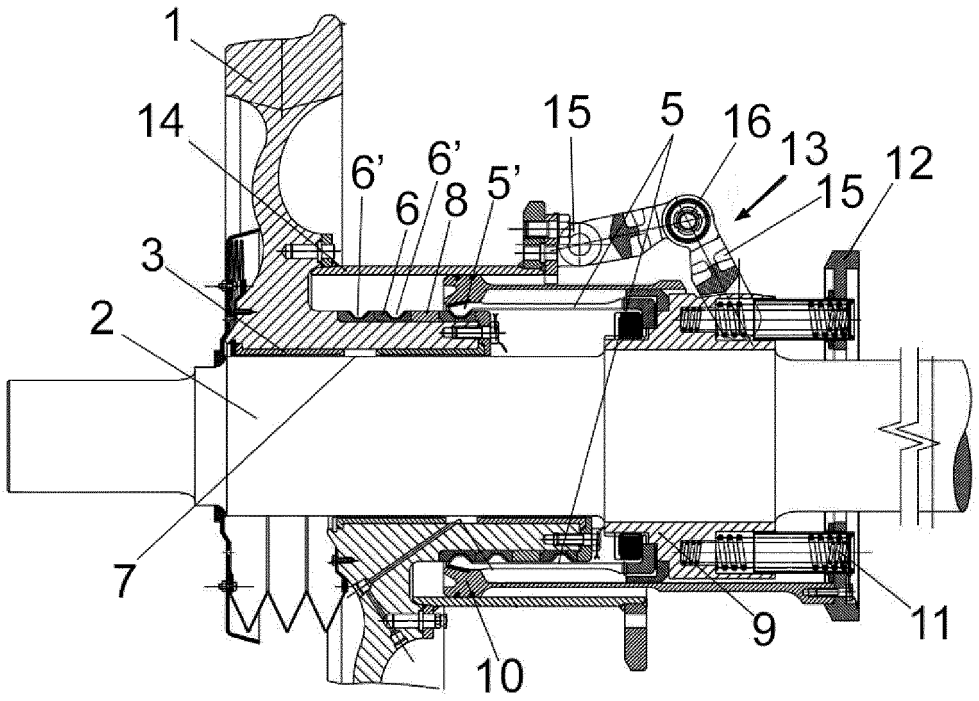

FIG. 1

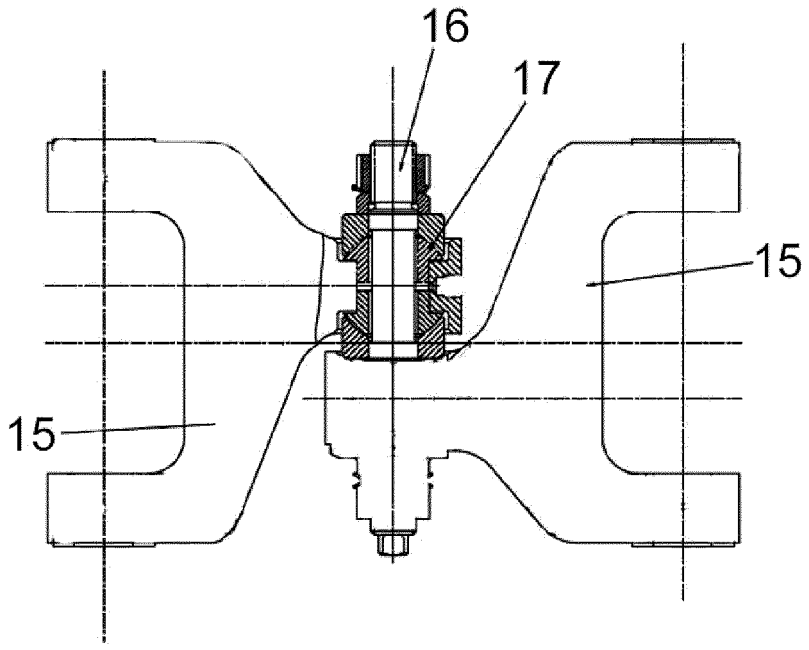

FIG. 2

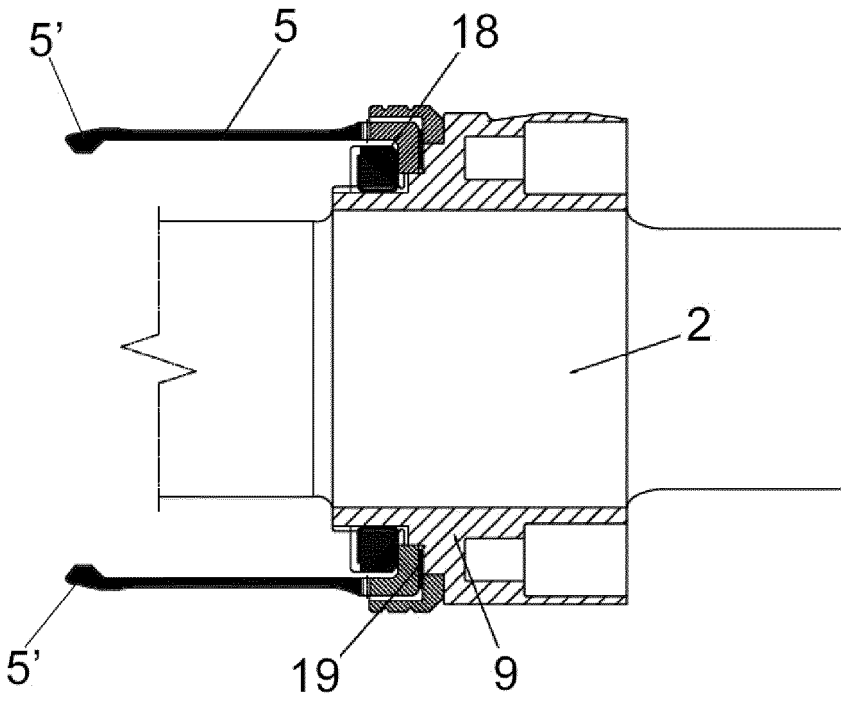

FIG. 3

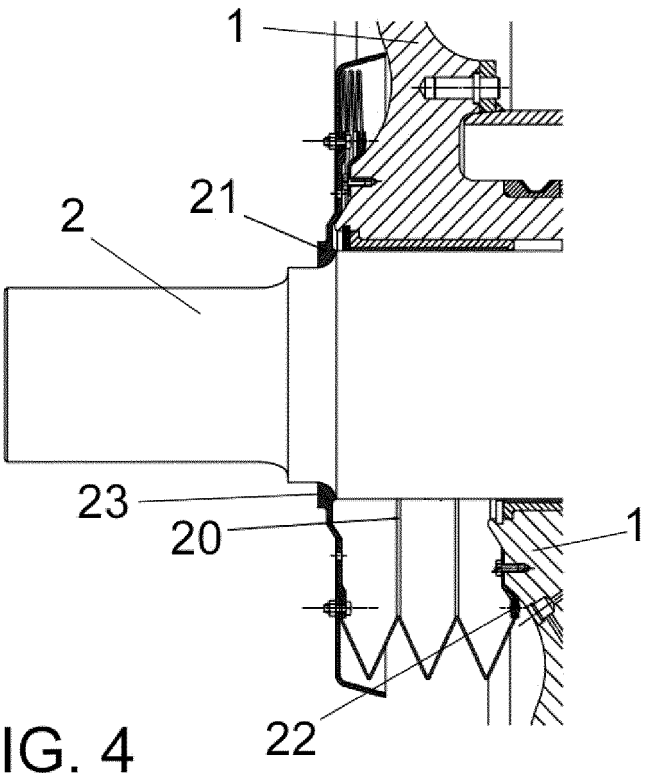

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ES2014/070565

A. CLASSIFICATION OF SUBJECT MATTER

B61F7/00 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B61F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, INVENES

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	ES 338183 A1 (RUBIO LARA BASTIDA CAMACHO ET AL.) 01/04/1968, page 1, line 10 – page 3, line 49; figures.	1-6
A	FR 2702187 A1 (PKP TS B KONSTRUKCYIN ET AL.) 09/09/1994, page 4, line 25 - page 6, line 2; figures.	1-5, 7
A	DE 2004725 A1 (FRIED KRUPP HUETTENWERKE AG) 02/09/1971, pages 4 - 5; figures.	1-5
A	CH 517612 A (VEVEY ATEL CONST MEC) 15/01/1972, column 4, line 19 - column 5, line 80; figures 1 - 3.	1-4

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
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Date of the actual completion of the international search	Date of mailing of the international search report
11/09/2014	**(15/09/2014)**
Name and mailing address of the ISA/ OFICINA ESPAÑOLA DE PATENTES Y MARCAS Paseo de la Castellana, 75 - 28071 Madrid (España) Facsimile No.: 91 349 53 04	Authorized officer V. Población Bolaño Telephone No. 91 3498493

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
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