(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 741 249 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
13.05.2026 Bulletin 2026/20

(21) Application number: **25213603.1**

(22) Date of filing: **05.11.2025**

(51) International Patent Classification (IPC):
B61G 9/06 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
B61G 9/06

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
GE KH LA MA MD TN

(30) Priority: **11.11.2024 IN 202411086637**

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(54) COUPLING DAMPER FOR A TRAIN COUPLING OF A RAIL VEHICLE

(57) The invention relates to a coupling damper for a tow coupling of a rail vehicle, with a reversible damping device comprising a plurality of elastomer elements, pressure plates and a tie rod, with an irreversible damping device comprising a deformation pipe and a deformation element acting on the deformation pipe to deform it, wherein the reversible damping device and the irreversible damping device extend along a longitudinal axis of the coupling damper, and the reversible damping device is at least partially positioned within the irreversible damping device.

Said coupling damper is characterized in that the reversible damping device has a central pressure plate, which can be moved in the direction of the longitudinal axis and which is arranged between the elastomer elements for damping tensile and impact forces in the direction of the longitudinal axis, and the central pressure plate forms the deformation element or acts on it for deforming the deformation pipe.

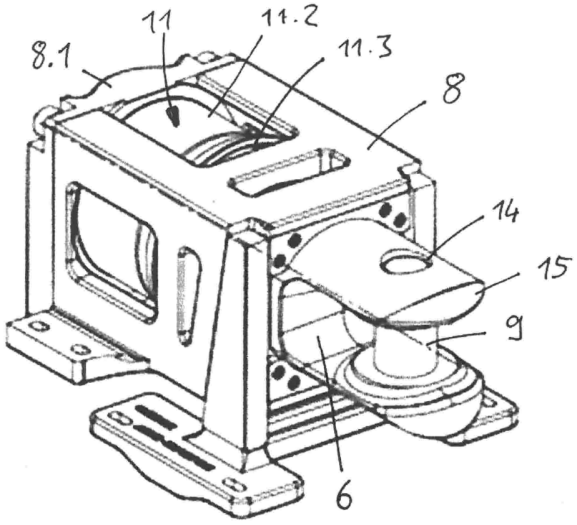

Figure : 1

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Description

[0001] The present invention relates to a coupling damper for a tow coupling of a rail vehicle according to the generic term of claim 1.

[0002] Tow couplings of rail vehicles comprise a coupling rod, which is mounted on the rail vehicle, i.e. its car body, in particular in the frame of the car body, so that it can be pivoted about a vertical axis of rotation and, if necessary, can be moved in vertical direction. Such coupling dampers conventionally comprise a reversible damping device, which is able to reversibly, i.e. non-destructively, transfer forces transmitted via the coupling rod during operation of the tow coupling, as well as an irreversible damping device, which is designed to absorb energy in the event of an accident and can accordingly absorb much greater compressive forces than what are transmitted with the reversible damping device and can convert them as far as possible into deformation energy, in order to avoid deformation of a critical area of the car body.

[0003] An embodiment of such a coupling damper with a reversible as well as an irreversible damping device is disclosed in WO 2017/178213 A1. The reversible damping device and the irreversible damping device are arranged in series with one another, wherein the reversible damping device and/or a housing thereof can be located at least partially within a deformation pipe of the irreversible damping device in the direction of the longitudinal axis. This saves axial installation space.

[0004] WO 2023/121537 A1 discloses a coupling damper with a reversible damping device, which comprises a plurality of elastomer elements and two end pressure plates, wherein a piston damper is additionally arranged in radial direction within the elastomer elements between the pressure plates.

[0005] EP 2 640 620 B1 discloses a further coupling damper for a tow coupling with a frame-shaped structure that encloses the damping devices on both sides.

[0006] EP 2 072 370 B1 discloses a coupling damper for a tow coupling of a rail vehicle according to the generic term of claim 1. The coupling damper comprises a reversible damping device with a plurality of elastomer elements, pressure plates and a tie rod. Further, an irreversible damping device is envisaged, comprising a deformation pipe and a deformation element acting on the deformation pipe to deform it. The reversible damping device and the irreversible damping device both extend along a longitudinal axis of the coupling damper, and the reversible damping device is at least partially located within the irreversible damping device. This allows the overall length and the necessary installation space for the coupling damper to be significantly reduced.

[0007] In some known rail vehicles, a limited space is foreseen within the frame of the car body for the reversible damping device of a conventional coupling damper. For example, such a holding space has a length of 510 mm. However, in such setups, irreversible damping devices are arranged outside the space, for example inside the coupling rod. Even the previously mentioned coupling damping devices with reduced axial length are still too long to fit into such a space in the frame of the car body.

[0008] The present invention is, therefore, based on the object of specifying a coupling damper for a tow coupling of a rail vehicle, which comprises a reversible damping device and an irreversible damping device, which can be arranged together in a holding space that is greatly reduced in the direction of the longitudinal axis, for example in the aforementioned holding space with a maximum length of 510 mm.

[0009] Said object is achieved by a coupling damper with the features of claim 1. The dependent claims describe the preferred and particularly expedient embodiments of the invention.

[0010] Said coupling damper for a tow coupling of a rail vehicle can, in particular, be arranged completely outside the coupling rod, in particular in a holding space in the frame of a car body of the rail vehicle.

[0011] The coupling damper according to the invention has a reversible damping device. The reversible damping device comprises a plurality of elastomer elements, pressure plates and a tie rod. For example, the elastomer elements are elastically prestressed in the direction of the longitudinal axis of the coupling damper by means of the pressure plates and the tie rod.

[0012] The coupling damper also has an irreversible damping device. The irreversible damping device comprises a deformation pipe and a deformation element that acts on the deformation pipe to deform it. The reversible damping device and the irreversible damping device extend along the longitudinal axis of the coupling damper, and the reversible damping device is at least partially positioned within the irreversible damping device so as to reduce the axial length.

[0013] According to the invention, the reversible damping device comprises a central pressure plate, which can be moved along the longitudinal axis and is arranged between the elastomer elements to dampen tensile and impact forces in the direction of the longitudinal axis. According to the invention, the central pressure plate forms the deformation element of the irreversible damping device or acts on it to deform the deformation pipe.

[0014] The invention allows the axial length of the coupling damper to be significantly reduced again and at the same time, a reversible damping device is provided, which reversibly dampens both tensile forces and compressive forces. According to one embodiment, the compressive forces can be absorbed by a first elastomer element or a first group of elastomer elements, and the tensile forces can be absorbed by a second elastomer element or a group of second elastomer elements. The first elastomer element or the first group of elastomer elements is preferably arranged on one axial side of the middle pressure plate, and the second elastomer element or the second group of elastomer elements is preferably arranged on the other axial side of the middle

pressure plate. This allows the desired damping properties in the tensile direction and the compressive direction to be optimally adjusted independent of one another.

[0015] The middle pressure plate preferably forms the deformation element in one piece or carries it. In the first case, the middle pressure plate thus lies directly on the deformation pipe with a preferred outer region in radial direction that tapers conically in particular in the direction of the deformation pipe. According to the second alternative, an intermediate element is mounted on the middle pressure plate, in particular connected to the middle pressure plate in a form-fitting and/or material-locking manner, which lies directly on the deformation pipe. This intermediate element can also be conically tapered in the direction of the deformation pipe, for example.

[0016] The middle pressure plate is preferably positioned, at least partially in radial direction within the deformation pipe, in particular at least for the most part, preferably essentially completely, in relation to its extension in the direction of the longitudinal axis.

[0017] The deformation element is, for example, a conical ring that is closed around the circumference and acts in a radial direction from the inside on the deformation pipe. This allows the forces that deform the deformation pipe to be transmitted particularly symmetrically.

[0018] The middle pressure plate is preferably mounted on the tie rod so that it can be moved in the direction of the longitudinal axis. This gives it safe guidance in radial direction on the inside.

[0019] The reversible damping device preferably comprises a first pressure plate at the end and a second pressure plate at the end, which can be moved in the direction of the longitudinal axis and enclose the middle pressure plate in the direction of the longitudinal axis with at least one elastomer element between them. For example, the first pressure plate together with the middle pressure plate encloses the first elastomer element or the first group of elastomer elements, in particular consisting of two or three elastomer elements, between them, and the second pressure plate together with the middle pressure plate encloses the said second elastomer element or the said second group of elastomer elements, in particular a single second elastomer element, between them.

[0020] The elastomer elements are in particular disc-shaped with an inner through-bore and in axial section with a round, in particular part-circular or semicircular outer circumference.

[0021] The second pressure plate is preferably arranged in radial direction inside the deformation pipe and engages the deformation pipe in radial direction inside to guide it during displacement in the direction of the longitudinal axis. This prevents the second pressure plate from being tilted. At the same time, the deformation pipe is supported in radial direction from the inside during its deformation, so that the desired uniform expansion occurs along the circumference without having to tilt the deformation pipe.

[0022] The middle pressure plate preferably comprises an axial projection, with which it engages the deformation pipe and/or the second pressure plate to guide it during movement in the direction of the longitudinal axis. This prevents the middle pressure plate being tilted.

[0023] The reversible damping device preferably comprises a housing, which encloses the tie rod, the middle pressure plate and in particular also the first pressure plate and the second pressure plate, and the deformation pipe is positioned at least for the most part within the housing. The deformation pipe is particularly preferably positioned essentially completely, i.e. for example more than 90% of its axial extent in the direction of the longitudinal axis within the housing.

[0024] It is preferred if the housing has an end plate, in which the deformation pipe is mounted with one axial end.

[0025] According to a further embodiment of the invention, the second pressure plate, in particular with an axial extension, is guided in radial direction inside the deformation pipe. In this case, for example, the axial end of the deformation pipe can be enclosed, in radial direction, between the axial extension of the second pressure plate and the end plate of the housing.

[0026] If the tie rod is slidably mounted in the middle pressure plate and the second pressure plate, the supports of the middle pressure plate and the second pressure plate in radial direction inside the deformation pipe, in particular with the axial projection and the axial extension, prevent the tie rod from tilting when the deformation pipe is deformed.

[0027] According to a preferred embodiment of the invention, the deformation pipe in a non-deformed state, i.e. in its initial state, comprises a cylindrical section and a widened section, and the middle pressure plate is located in the widened section. The cylindrical section can then, for example, form the axial end of the deformation pipe, with which the deformation pipe is mounted in the end plate of the housing.

[0028] It is preferred if the housing forms an axial stop for the middle pressure plate facing away from the deformation pipe in the direction of the longitudinal axis. This means that the middle pressure plate cannot be shifted in the housing under tensile load, but can move under compressive load.

[0029] The tie rod preferably comprises a pivot pin for the articulated connection of a coupling rod of the tow coupling, in particular at its axially front end. For example, the tie rod has a fork, in which the pivot pin is mounted. The coupling rod is thus axially connected to the said coupling damper and can itself be free of damping elements, in particular of the type mentioned here.

[0030] The invention will be described below using an exemplary embodiment and the figures as an example.

[0031] They show:

Fig. 1: a three-dimensional view of the said coupling damper;

Fig. 2: a vertical axial section through the coupling damper from Fig. 1;

Fig. 3: a horizontal axial section through the coupling damper from Fig. 1.

[0032] Fig. 1 shows a three-dimensional plan view of an embodiment of the said coupling damper. Fig. 2 shows an associated vertical axial section and Fig. 3 shows an associated horizontal axial section.

[0033] The coupling damper has a reversible damping device 1, into which an irreversible damping device 10 is integrated. The irreversible damping device 10 comprises a deformation pipe 11 and a deformation element 12, with which the deformation pipe 11 is expanded in the radial direction when a compressive force is exerted on the coupling damper via a coupling rod. The coupling rod 13 is only shown schematically in Fig. 2.

[0034] The reversible damping device 1 has a housing 8, which at least substantially completely encloses the reversible damping device 1 and the irreversible damping device 10. The outer edge of a widened section 11.3 of the deformation pipe 11 protrudes from the irreversible damping device 10, in which the deformation element 12 is located. The widened section 11.3 is adjoined on the side facing away from the deformation element 12 by a cylindrical section 11.2, which is mounted with an axial end 11.1 in an end plate 8.1 of the housing 8. Further, the housing 8 comprises an axial stop 8.2, which stands in the way of the widened section 11.3 of the deformation pipe 11 in the direction of the longitudinal axis X of the coupling damper and on which a central pressure plate 3 of the reversible damping device 1 is supported on one side in the direction of the longitudinal axis X.

[0035] The middle pressure plate 3 forms the deformation element 12 positioned in the widened section 11.3 of the deformation pipe 11 and has an axial projection 7 that extends into the cylindrical section 11.2 in order to guide the middle pressure plate 3.

[0036] The middle pressure plate 3 is enclosed in the direction of the longitudinal axis X between elastomer elements 2 of the reversible damping device 1. The elastomer elements 2 are seated on a tie rod 6 of the reversible damping device 1, which forms a receptacle 14 for a pivot pin 9 at its free axial end 15. The coupling rod 13 is mounted on the pivot pin 9 so that it can be rotate within a horizontal plane.

[0037] The tie rod 6 forms a first pressure plate 4 next to the free axial end 15, in particular integrally, and a second pressure plate 5 is accommodated on the tie rod 6 at the opposite axial end in the region of the end plate 8.1 of the housing 8 and enclosed between an elastomer element 2 and a nut 6 screwed onto the tie rod 6. By means of the nut 16, which is screwed onto the tie rod 6 next to the second pressure plate 5, the elastomer elements 2 are elastically clamped between the first pressure plate 4 and the middle pressure plate 3 and the second pressure plate 5 and the middle pressure plate 3.

[0038] Except for the lower connection flanges provided here for screwing-together the housing 8, for example, on a support of the frame of the car body of the rail vehicle, the housing 8 has an axial length L, within which the entire reversible damping device 1, with the exception of its free axial end 15 with the pivot pin 9, and the entire irreversible damping device 10 are arranged. This length L is, for example, a maximum of 510 mm. The housing 8 is, for example, essentially cuboid-shaped.

[0039] If a tensile force is exerted on the free axial end 15 of the tie rod 6 with the coupling rod 13, this tensile force is transferred as a compressive force from the nut 16 to the second pressure plate 5 and the elastomer element 2 arranged between the second pressure plate 5 and the middle pressure plate 3 to the middle pressure plate 3 and from there via the axial stop 8.2 to the housing 8. If a compressive force is exerted on the coupling rod 13, this compressive force pushes the tie rod 6 with the first pressure plate 4 against the two elastomer elements 2 positioned between the first pressure plate 4 and the middle pressure plate 3 and thus pressurizes the middle pressure plate 3, which transfers this compressive force to the widened section 11.3 of the deformation pipe 11. As long as the compressive force does not exceed a certain limit, the deformation pipe 11 absorbs this compressive force without deforming. On the other hand, if the pressure force exceeds the predetermined limit, the deformation pipe 11 gets deformed because the middle pressure plate 3 expands the expanded section 11.3 and the cylindrical section 11.2 in radial direction outward.

[0040] In the embodiment shown, the second pressure plate 5 has an axial extension 5.1, with which it slides in radial direction inside the deformation pipe 11. The axial extension 5.1 encloses the cylindrical section 11.2 of the deformation pipe 11 together with the housing 8, in particular the end plate 8.1, in the radial direction. The second pressure plate 5 also forms a radial gap with the cylindrical section 11.2 of the deformation pipe 11, into which the axial projection 7 of the middle pressure plate 3 is immersed.

[0041] The tie rod 6 is guided laterally in the area of its free axial end 15 over flat guide surfaces in the housing 8, as well as above and below over curved guide surfaces. However, this is not mandatory. The flat guide surfaces do offer the advantage that the tie rod 6 is secured against rotation in the housing 8.

List of reference numerals

[0042]

1	reversible damping device
2	elastomer element

3	middle pressure plate
4	first pressure plate
5	second pressure plate
5.1	axial extension
6	tie rod
7	axial projection
8	housing
8.1	end plate
8.2	axial stop
9	pivot pin
10	irreversible damping device
11	deformation pipe
11.1	axial end
11.2	cylindrical section
11.3	flared section
12	deformation element
13	coupling rod
14	support
15	free axial end
16	nut
X	longitudinal axis
L	length

Claims

1. Coupling damper for a tow coupling of a rail vehicle; with a reversible damping device (1) comprising a plurality of elastomer elements (2), pressure plates (3, 4, 5) and a tie rod (6), with an irreversible damping device (10) comprising a deformation pipe (11) and a deformation element (12) acting on the deformation pipe (11) to deform it, wherein the reversible damping device (1) and the irreversible damping device (10) extend along a longitudinal axis (X) of the coupling damper, and the reversible damping device (1) is at least partially located within the irreversible damping device (10); **characterized in that** the reversible damping device (1) has a central pressure plate (3), which can be moved in the direction of the longitudinal axis (X) and which is arranged between the elastomer elements (2) for damping tensile and impact forces in the direction of the longitudinal axis (X), and the central pressure plate (3) forms the deformation element (12) or acts on it for deforming the deformation pipe (11).

2. Coupling damper as claimed in claim 1, **characterized in that** the middle pressure plate (3) forms the deformation element (12) in one piece or carries it.

3. Coupling damper according to one of the claims 1 or 2, **characterized in that** the middle pressure plate (3) is positioned at least partially in radial direction inside the deformation pipe (11).

4. Coupling damper according to one of the claims 1 to 3, **characterized in that** the deformation element (12) is a conical ring that engages the deformation pipe (11) in radial direction from inside.

5. Coupling damper according to one of the claims 1 to 4, **characterized in that** the middle pressure plate (3) is mounted on the tie rod (6) so that it can be moved in the direction of the longitudinal axis (X).

6. Coupling damper according to one of the claims 1 to 5, **characterized in that** the reversible damping device (1) has a first pressure plate (4) at the end and a second pressure plate (5) at the end, which can be moved in the direction of the longitudinal axis (X), and enclose the middle pressure plate (3) in the direction of the longitudinal axis (X) with at least one elastomer element (2) interposed between them.

7. Coupling damper as claimed in claim 6, **characterized in that** the second pressure plate (5) is arranged in radial direction inside the deformation pipe (11) and acts in radial direction on the inside of the deformation pipe (11) to guide it during displacement in the direction of the longitudinal axis (X).

8. Coupling damper according to one of the claims 6 or 7, **characterized in that** the middle pressure plate (3) comprises an axial projection (7), with which it engages the deformation pipe (11) and/or the second pressure plate (5) for guiding during movement in the direction of the longitudinal axis (X).

9. Coupling damper according to one of the claims 1 to 8, **characterized in that** the reversible damping device (1) has a housing (8), which encloses the tie rod (6), the middle pressure plate (3) and in particular, the first and second pressure plates (4, 5), and the deformation pipe (11) is at least largely, in

particular substantially completely, positioned within the housing (8).

10. Coupling damper as claimed in claim 9, **characterized in that** the housing (8) has an end plate (8.1), in which the deformation pipe (11) is mounted with an axial end (11.1).

11. Coupling damper as claimed in claim 10, **characterized in that** the second pressure plate (5), in particular with an axial extension (5.1), is guided in radial direction inside the deformation pipe (11).

12. Coupling damper as claimed in claims 10 and 11, **characterized in that** the axial end (11.1) of the deformation pipe (11) is embedded in radial direction between the axial extension (5.2) and the end plate (8.1).

13. Coupling damper as claimed in one of the claims 1 to 12, **characterized in that** the deformation pipe (11) in the non-deformed state comprises a cylindrical section (11.2) and a widened section (11.3) and the middle pressure plate (3) is positioned in the widened section (11.3), the cylindrical section (11.2) in particular, forming the axial end (11.1).

14. Coupling damper as claimed in one of the claims 9 to 13, **characterized in that** the housing (8) forms an axial stop (8.2) for the middle pressure plate (3) facing away from the deformation pipe (11) in the direction of the longitudinal axis (X).

15. Coupling damper as claimed in one of the claims 1 to 14, **characterized in that** the tie rod (6) comprises a pivot pin (9) for the articulated connection of a coupling rod (13) of the tow coupling.

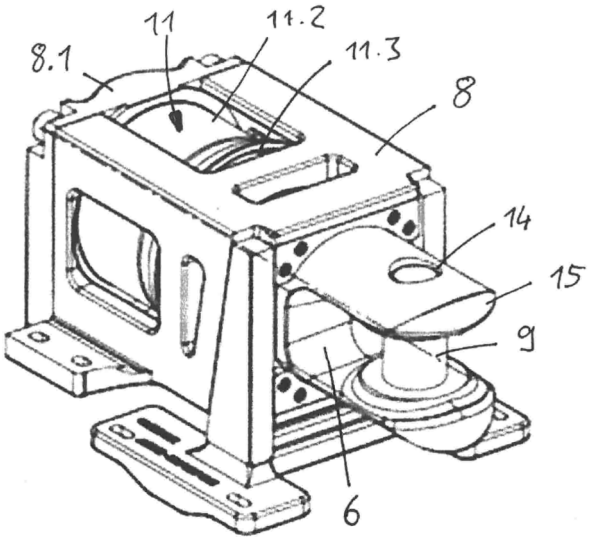

Figure : 1

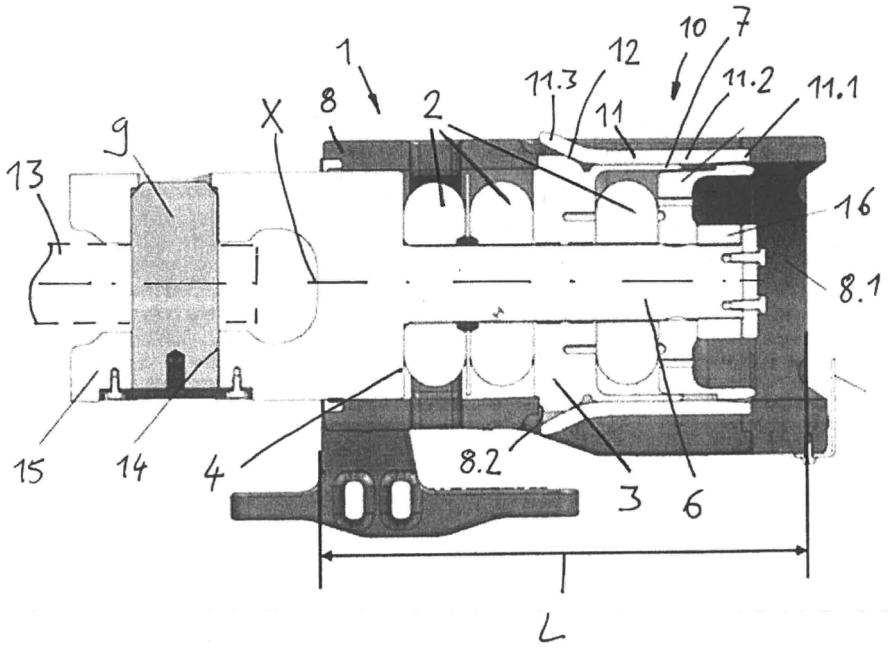

Figure : 2

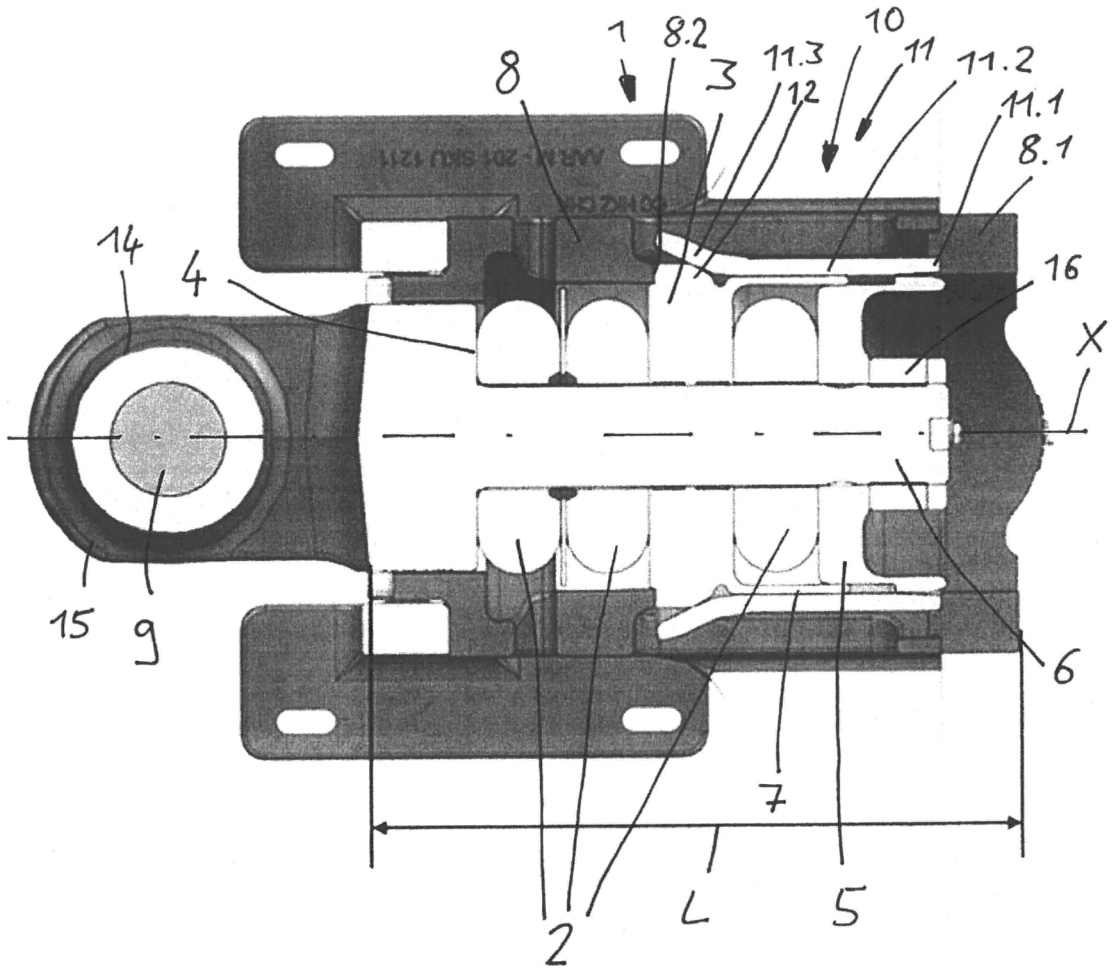

Figure : 3

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EUROPEAN SEARCH REPORT

Application Number
EP 25 21 3603

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TECHNICAL FIELDS SEARCHED (IPC)

B61G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	16 March 2026	Crama, Yves

CATEGORY OF CITED DOCUMENTS

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