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(54) ENERGY ABSORBING DEVICE FOR A COUPLER FOR A RAILWAY VEHICLE

(57) The present invention relates to an energy absorbing device (10, 10') for a coupler comprising
- a housing (11) comprising a first chamber (A) delimited by a rear plate (22) and a front plate (21), a second chamber (B) delimited by a rear plate (32) and a front plate (31),
- elastically deformable elements (A1, B1) held in the first chamber (A) and second chamber (B),
wherein the first and second chambers (A, B) are arranged in series in a front position and a rear position in the housing (11) such that the front plate of one of the chambers (A, B) is connected to the rear plate of the other, and such that the rear plate of the chamber in the rear position is prevented from moving in the rear direction by a rear stop (12)
and comprising
- a traction force transmitting member (40) connected to the rear plate of the first chamber, and
- a buff force transmitting member (50) connected to the front plate of the chamber in the front position,
such that a traction force compresses the first chamber (A) and a buff force compresses both chambers (A, B).

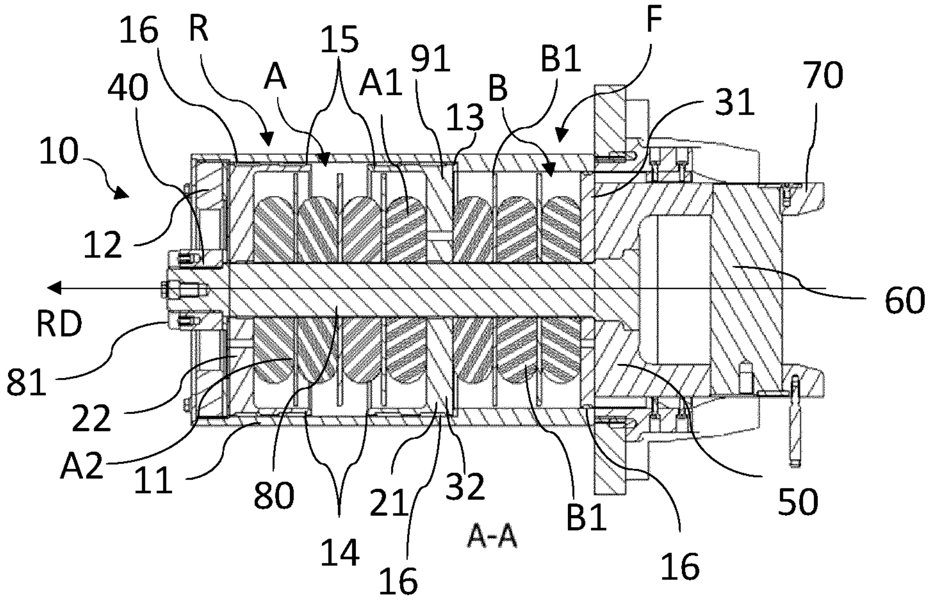

Fig. 2b

EP 4 342 763 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to an energy absorbing device for a coupler, the energy absorbing device having elastically deformable elements for absorbing a traction force and a buff force.

BACKGROUND

[0002] Within the field of railway vehicles, energy absorbing devices such as draft gears are used to absorb smaller forces that appear during operation of the railway vehicle. Such forces are traction forces pulling the railway vehicle in the direction of travel and buff forces in the opposite direction, and typically elastomeric elements are provided for absorbing each of these forces. The most common type of elastomeric elements used are stacks of elastic rings or discs held on a central rod.

[0003] There is generally a need for developing existing draft gears to render them more space efficient and also to modify the maximum force that can be absorbed by the energy absorbing device when subjected to traction or buff forces. When desiring to absorb larger forces, the draft gear is rendered more expensive due to the need for additional elastomeric elements and also bulkier due to the larger space required to house them.

[0004] There is therefore a need for further improvements within this area.

SUMMARY

[0005] The object of the present invention is to eliminate or at least to minimize the problems discussed above. This is achieved by an energy absorbing device and a coupler with such an energy absorbing device according to the appended independent claims.

[0006] The energy absorbing device according to the present invention comprises a housing having a front end and a rear end, the housing comprising a first chamber, a second chamber and a rear stop. It also comprises at least one first elastically deformable element held in the first chamber and at least one second elastically deformable element held in the second chamber. The first chamber is further delimited by a rear plate and a front plate, said rear plate being slidable in a forward direction towards the front end of the housing and said front plate being slidable in a rear direction towards the rear end of the housing, but said front plate being prevented from moving in a forward direction beyond a front stop. Also, the second chamber is delimited by a rear plate and a front plate, said front plate being slidable in the rear direction. Furthermore, the first and second chambers are arranged in series in a front position and a rear position in the housing such that the front plate of one of the chambers is connected to the rear plate of the other, and such that the rear plate of the chamber in the rear position is prevented from moving in the rear direction by the rear stop of the housing.

[0007] The energy absorbing device also comprises a traction force transmitting member connected to the rear plate of the first chamber, and a buff force transmitting member connected to the front plate of the chamber in the front position such that a traction force on the traction force transmitting member pulls the rear plate of the first chamber towards the front plate of the first chamber, thereby compressing the at least one first elastically deformable element while not compressing the at least one second elastically deformable element, and such that a buff force on the buff force transmitting member pushes the front plate of the chamber in the front position in the rear direction, thereby causing the front plate of the chamber in the rear position to move in the rear direction and compressing both the at least one first elastically deformable element and the at least one second elastically deformable element.

[0008] The present invention is particularly advantageous since the elastically deformable element in the first chamber is configured to absorb both traction forces and buff forces, whereas the elastically deformable element in the second chamber is configured to absorb only buff forces. Due to the dual function of the elastically deformable element in the first chamber, the energy absorbing device is rendered significantly more space efficient than prior art solutions, and the maximum buff force that can be absorbed is significantly larger than in prior art solutions where one set of elastomeric elements is used for traction forces, and another is used for buff forces. Another advantage is that the stroke length for the buff force differs from the stroke length of the draft force, giving the energy absorbing device different characteristics for each type of stroke. It also increases stability of the energy absorbing device to provide both elastically deformable elements for compression in one direction and only the first elastically deformable element in the other direction, since this decreases or even eliminates vibrations in the energy absorbing device after the energy absorbing device returns to a neutral position after compression.

[0009] Suitably, the front plate of the chamber in the rear position is connected to the rear plate of the chamber in the front position by being integrated with or identical to said rear plate. Thereby, the two chambers are realised with only one plate between them, so that the rear plate of one chamber is also the front plate of the other. This is advantageous in providing a more compact and reliable energy absorbing device.

[0010] The front plate of the chamber in the front position may be fixed to or integrated with the buff force transmitting member. This also renders the energy absorbing device more space efficient and further ensures that the buff force is applied to compress the chambers by acting directly on the front plate.

[0011] The energy absorbing device suitably comprises a central rod extending through the first chamber and the second chamber, the central rod passing from the front plate of the chamber in the front position to the rear plate of the chamber in the rear position and passing through central openings in the plate or plates therebetween, wherein the first and second elastically deformable element are elastomers arranged on the central rod. This is convenient in aligning the elastically deformable elements in a suitable way so the buff force and traction force are applied symmetrically to achieve an advantageous compression and absorption of the force.

[0012] In some embodiments, the central rod is the traction force transmitting member. Thereby, the traction force is applied to the rear plate of the first chamber in a convenient and compact manner, rendering the energy absorbing device particularly robust and reliable.

[0013] In other embodiments, the energy absorbing device may also comprise an inner housing that is slidable in relation to the housing, wherein the inner housing is the traction force transmitting member. Thereby, the inner housing applies the traction force to the rear plate of the first chamber in a stable and reliable manner and ensures that the rear plate is able to slide symmetrically in relation to the housing.

[0014] In all embodiments, the energy absorbing device may comprise at least one friction reducing element that can be arranged between the inner housing and the housing, or alternatively or additionally between at least one of the front plate and rear plate of any of the chambers and the housing. This is advantageous in ensuring a convenient sliding of the parts of the energy absorbing device inside the housing to lower friction and ensure a longer lifetime of the device.

[0015] In some embodiments, the first chamber is in the rear position and the energy absorbing device comprises the front stop connected to the housing, said front stop being configured to prevent movement in the forward direction of the front plate of the first chamber. Thereby, the first chamber can be compressed without affecting the second chamber. In such embodiments, the traction force transmitting member may be a central rod or an inner housing that are connected to or integrated with the rear plate of the first chamber.

[0016] In other embodiments, the first chamber is instead in the front position and the rear plate of the first chamber is slidable in both forward and rear direction. Thereby, the first chamber is compressed by traction forces in a convenient way and both the front plate and rear plate of the first chamber are slidable when subjected to buff forces so that the second chamber is compressed. In such embodiments, the traction force transmitting member is suitably an inner housing that is connected to or integrated with the rear plate of the front chamber.

[0017] In embodiments where the first chamber is in the front position, the rear plate of the second chamber may be fixedly connected to or integrated with the housing. Thereby the rear plate forms the stop for compression of the first chamber and the second chamber, to ensure stable and secure operation of the energy absorbing device.

[0018] In all embodiments, the at least one first elastically deformable element and the at least one second elastically deformable element may be stacks of elastomers. This is one particularly convenient form of elastic elements that are robust and reliable.

[0019] Suitably, the energy absorbing device may comprise a buff stroke limiter configured to limit compression of the first chamber and the second chamber to a desired buff stroke length. Thereby, the risk of damage to the elastically deformable elements is minimized.

[0020] Also, the energy absorbing device may comprise a traction stroke limiter configured to limit compression of the first chamber to a desired traction stroke. Thereby, the risk of damage to the elastically deformable element when subjected to traction forces is minimized.

[0021] Suitably, the at least one first elastically deformable element and the at least one second elastically deformable element are configured to absorb a maximum buff force, and the at least one first elastically deformable element are selected to be configured to absorb a maximum traction force, said maximum traction force being selected to be smaller than the maximum buff force. Thereby, the maximum traction force can be selected by choosing the at least one first elastically deformable element so that a desired traction force can be absorbed while still maintaining absorption of a maximum buff force. This is particularly advantageous since it allows the energy absorbing device to be designed for absorption of any desired maximum traction force smaller than the maximum buff force without requiring additional space for additional elastically deformable elements. Instead, the proportions of the first chamber and the second chamber can be modified or the elastically deformable elements chosen to fit the desired force to absorb.

[0022] Many additional benefits and advantages of the present invention will be readily understood by the skilled person in view of the detailed description below.

DRAWINGS

[0023] The invention will now be described in more detail with reference to the appended drawings, wherein

Fig. 1 discloses a perspective view of a first embodiment of the energy absorbing device according to the invention;

Fig. 2a discloses a planar view of the first embodiment in a direction along a longitudinal axis of the energy absorbing device of Fig. 1;

Fig. 2b discloses a cross-sectional view of the first embodiment in a neutral state taken along the line A-A of Fig. 2a;

Fig. 3 discloses a cross-sectional view from the side of the first embodiment in a draft state;

Fig. 4 discloses a cross-sectional view from the side of the first embodiment in a buff state;

Fig. 5a discloses a perspective view of a coupler according to the invention with an energy absorbing device according to a second embodiment of the invention;

Fig. 5b discloses a planar view from the side of the coupler of Fig. 5a;

Fig. 6a discloses a cross-sectional view from the side of an energy absorbing device according to the second embodiment of the invention in a neutral state;

Fig. 6b discloses a perspective view of the energy absorbing device of Fig. 6a;

Fig. 7a discloses a cross-sectional view from the side of an energy absorbing device according to a second embodiment of the invention in a draft state;

Fig. 7b discloses a perspective view of the energy absorbing device of Fig. 7a;

Fig. 8a discloses a cross-sectional view from the side of an energy absorbing device according to a second embodiment of the invention in a buff state;

Fig. 8b discloses a perspective view of the energy absorbing device of Fig. 8a;

Fig. 9a discloses a perspective view of the energy absorbing device according to the second embodiment showing a clearance at the pivot pin;

Fig. 9b discloses a perspective view of a cross-section of the energy absorbing device of Fig. 9a taken along a longitudinal axis;

Fig. 10a discloses a planar view from the side of a holder for the energy absorbing device in an expanded position; and

Fig. 10b discloses a cross-sectional view from the side of the holder of Fig. 10a.

[0024] All the figures are schematic, not necessarily to scale, and generally only show parts which are necessary in order to elucidate the respective embodiments, whereas other parts may be omitted or merely suggested. Any reference number appearing in multiple drawings refers to the same object or feature throughout the drawings, unless otherwise indicated.

DETAILED DESCRIPTION

[0025] The invention will now be described in detail with reference to a first main embodiment and a second main embodiment. In its most general form, the present invention comprises an energy absorbing device 10, 10' for a coupler 100 for a railway vehicle that comprises a first chamber A housing at least one first elastically deformable element A1 and a second chamber B housing at least one second elastically deformable element B1. The energy absorbing device 10, 10' is configured such that the first chamber A is compressed when a traction force is applied and such that both the first chamber A and the second chamber B are compressed when a buff force or thrust is applied. The main difference between the first embodiment and the second embodiment is the order in which the chambers are arranged in the energy absorbing device 10, 10', so that the first chamber A is arranged in a rear position R and the second chamber B in a front position F in the first embodiment, whereas the first chamber A is instead in the front position F and the second chamber B is in the rear position R in the second embodiment. Other than that, the first embodiment and second embodiment are similar and it is in particular to be noted that any feature from one of the embodiments can freely be implemented in the other embodiment, unless such a combination is expressly stated as undesirable or unsuitable.

[0026] Each of the chambers A, B has a front plate and a rear plate, and suitably the rear plate of the chamber in the front position F is connected to, integrated with or identical to the front plate of the chamber in the rear position R.

[0027] The first and second elastically deformable elements A1, B1 may be one or more elastomers, suitably elastomer stacks, that are held in the chambers A, B. Alternatively, they may be objects made from rubber or any other material that is able to elastically deform in a controlled manner, or alternatively they may be metal springs.

[0028] When the term "connected" or "operatively connected" is used herein, this is to be understood as two parts being arranged such that a transfer of a force or a movement from one part to another is enabled. Such a connection can be from one part to the other directly or via at least one intermediate part.

[0029] When the term "traction force" or "draft force" is used herein, this is to be understood as a force resulting from a part connected to the energy absorbing device 10, 10' being pulled away from the energy absorbing device 10. Also, the term "buff force" or "thrust force" is to be understood as a force resulting from a part connected to the energy absorbing device 10, 10' being pushed towards the energy absorbing device 10, 10'.

[0030] A buff stroke length of the energy absorbing device 10 is defined as a length that the front plate of the chamber in the front position F is able to move in the rear direction RD. Similarly, a traction stroke length is a length that the rear plate 22 of the first chamber A is able to move in the forward direction FD.

[0031] The energy absorbing device 10, 10' of the invention is suitable for use in a coupler for a railway vehicle, and this coupler may form a part of a railcar or a locomotive without requiring any significant modifications of the energy absorbing device 10, 10'.

[0032] Turning now to the first main embodiment, Fig. 1 discloses the energy absorbing device 10 with a housing 11. The energy absorbing device 10 is connected to a holder 70 in which a pivot pin 60 of a coupler (see Fig. 5) is held. In this way, a traction force on the pivot pin 60 or a buff force or thrust force on a shank end arranged around the pivot pin 60 is coupled to the energy absorbing device 10. Fig. 2a shows the energy absorbing device 10 from a front side, where both the pivot pin 60 and the holder 70 are to be seen, and also showing a buff force transmitting member 50 that will be explained in more detail further below. The buff force transmitting member 50 is suitably connected to a forward part of the coupler (see Fig. 5) arranged on the pivot pin 60 such that a buff force on the buff force transmitting member 50 is generated when a distance decreases between the forward part of the coupler and a rear part of the coupler where the energy absorbing device is arranged, signifying that the railway vehicle is braking. In other embodiments, the buff force may instead arise from any other part of the coupler pressing on the buff force transmitting member 50. The housing 11 serves to enclose the components of the energy absorbing device 10 and facilitates mounting in a coupler. Many prior art solution require the components to be arranged in a pocket and be biased to remain in place and act as intended. The energy absorbing device 10 of the present invention, however, is already arranged inside the housing 11 with a suitable bias, so mounting in the pocket of a coupler is time efficient and convenient and requires the housing to be placed into the pocket and attached. This is particularly advantageous when mounting the energy absorbing device 10 in a locomotive but is also a benefit when using the energy absorbing device 10 in a coupler of a railcar.

[0033] Fig. 2b discloses the energy absorbing device 10 in detail in a neutral position with the first chamber A in the rear position R inside the housing 11 and with the second chamber B in the front position F in the housing 11. The housing 11 is further connected to a rear stop 12 that serves as a counter surface when the first chamber A is compressed by a buff force acting in a rear direction RD (see Fig. 4).

[0034] The first chamber A is delimited by a rear plate 22 and a front plate 21, and in the first embodiment the rear plate 22 is slidable from the neutral position in a front direction FD opposite the rear direction RD, whereas the front plate 21 is slidable from the neutral position in the rear direction RD. The front plate 21 is prevented from sliding in the forward direction FD by a front stop 13 that is connected to the housing 11, whereas the rear plate 22 is prevented from sliding in the rear direction RD by the rear stop 12.

[0035] The second chamber B is also delimited by a rear plate 32 and a front plate 31, and the front plate 31 is slidable in the rear direction RD. In the first embodiment as shown in Fig. 2b, the rear plate 32 of the second chamber B and the front plate 21 of the first chamber A are integrated or identical so that they are provided in the form of one single plate 32, 21 that may be referred to as a combined plate 91. In other embodiments, they may instead be in the form of two plates that are connected to each other at least when subjected to a buff force in the rear direction RD.

[0036] The first chamber A and second chamber B are arranged in series in the housing 11, and this is to be understood as them being aligned with each other with one in the front position F and the other in the rear position R so that a buff force on the chamber in the front position F is transferred to the chamber in the rear position R.

[0037] Also provided in the energy absorbing device 10 is a traction force transmitting member 40 that is connected to the rear plate 22 of the first chamber A. In this embodiment, the traction force transmitting member 40 is shown as a connection 81 at the end of a central rod 80 that extends through the first and second chambers A, B, but in other embodiments it could instead be in the form of the central rod 80 being embedded into the rear plate 22 in such a way that a traction force can be transmitted to the rear plate 22 when the rod 80 is pulled in the forward direction FD. In some embodiments, the rear plate may comprise an indentation in its rear side for housing the connection 81. The traction force transmitting member 40 could alternatively be in the form of any other component attached or connected to the rod 80, or optionally it could be in the form of an inner housing as will be disclosed below with reference to the second embodiment (see Fig. 6a onwards). Any other designs would also be possible as long as the traction force transmitting member 40 can be simultaneously connected to the rear plate 22 of the first chamber A and to a component connectable to the front part of the coupler, e.g. the pivot pin 60, that provides the traction force.

[0038] The central rod 80 passes through the front plate 21 of the first chamber A and the rear plate 32 of the second chamber B, and may also pass through the front plate 31 of the second chamber B and the rear plate 22 of the first chamber A. In some embodiments, the central rod 80 may be fixed to the front plate 31 of the second chamber B but in other embodiments it may instead be slidably arranged. Where the first and second elastically deformable elements are elastomers, these are suitably elastomer rings arranged on the central rod 80 and aligned in this way. In some embodiments, there may also be separation plates A2, B2 between the elastomer rings to ensure their alignment as they are compressed and expanded.

[0039] The energy absorbing device also comprises a buff force transmitting member 50 that is connected to the front plate of the chamber in the front position F, i.e.

in the first embodiment to the front plate 21 of the second chamber B. In use, the buff force transmitting member 50 is pushed by a shank end of the coupler in the rear direction RD as will be explained below with reference to Fig. 5. In this embodiment, the buff force transmitting member 50 is fixed to the front plate 21 of the first chamber A, but in other embodiments it may instead be either integrated with the front plate 21 or separate from the front plate 21, as long as the buff force transmitting member 50 and the front plate 21 are arranged such that a buff force from the buff force transmitting member 50 can be transferred to the front plate 21 and result in a compression of the first chamber A.

[0040] Furthermore, the energy absorbing device 10 comprises a buff stroke limiter 14 to ensure that the first chamber A is not compressed beyond what is suitable for the at least one elastically deformable element A1. The buff stroke limiter 14 is in the form of a sleeve 14 protruding from each of the front plate 21 and the rear plate 22 towards each other so that a compression of the first chamber A causes the sleeves 14 to meet and contact each other when a desired buff stroke is achieved. In the first embodiment, the sleeves also act as a traction stroke limiter 15 that limits compression of the first chamber A when a traction force is applied to a desired traction stroke. In other embodiments, the traction stroke limiter 15 and the buff stroke limiter 14 may be designed in other ways and may also be two separate limiters. The buff stroke limiter 14 and traction stroke limiter 15 may in some embodiments be provided on more than one side of the energy absorbing device 10, e.g. at either end of the rear plate 22, to ensure a symmetrical buff force or traction force on the limiters 14, 15. In other embodiments, the buff stroke limiter 14 and traction stroke limiter 15 may be provided in only one place. The buff stroke limiter 14 and traction stroke limiter 15 are highly advantageous in protecting the first and second elastically deformable elements A1, B1 and ensure that they are not at risk of compression that would damage them or affect their future performance in the energy absorbing device 10.

[0041] The energy absorbing device 10 suitably also comprises at least one friction reducing element 16 for reducing friction between the plates 21, 22, 31, 32 and the housing 11. Such friction reducing elements 16 may be a layer of polymer or metal or a combination layer of metal and polymer, and it may be applied as a coating on the plates 21, 22, 31, 32 or on the housing 11. In embodiments where metal springs are used as the elastically deformable elements, a lubricant such as oil is also suitable.

[0042] Fig. 3 discloses the energy absorbing device 10 in draft mode where a traction force is transmitted from the traction force transmitting member 40 to the rear plate 22 of the first chamber A so that the rear plate 22 is pulled towards the front plate 21, sliding in the forward direction FD, and the first elastically deformable elements A1 are compressed. Due to the front stop 13, the front plate 21 cannot move in the forward direction FD and this prevents compression of the second chamber B so that only the first elastically deformable elements A1 are compressed. The traction stroke limiter 15 engages in the draft mode when the maximum desired compression of the first elastically deformable elements A1 is reached so that larger forces are not applied to the first elastically deformable elements A1 but instead may be transferred to act on other damping devices provided in the coupler where the energy absorbing device 10 is mounted. Such other damping devices are well known in the art and will not be described further herein.

[0043] As is clearly seen in Fig. 3, the second chamber B is unaffected by the traction force from the traction force transmitting member 40, ensuring that the force absorbed by the at least one first elastically deformable element is a maximum traction force and that no force is absorbed by the second elastically deformable element.

[0044] Fig. 4 discloses the energy absorbing device 10 in buff mode where a buff force is transmitted from the buff force transmitting member 50 to the front plate 31 of the second chamber B. This causes the at least one second elastically deformable element B1 to be compressed and to transfer the force to the rear plate 32 that is in this embodiment identical with the front plate 21 of the first chamber A to form the combined plate 91. This combined plate 91 is then also pushed in the rear direction RD so that also the at least one first elastically deformable element A1 is compressed against the rear plate 22 of the first chamber A. Due to the rear stop 12, the rear plate 22 of the first chamber A is unable to slide beyond its neutral position, thereby acting as a stop. In the buff mode, both the first chamber A and second chamber B are compressed and the buff stroke limiter 14 engage when the desired compression of the first chamber A has been reached. Thus, the maximum buff force that can be absorbed by the energy absorbing device 10 is a combination of the buff force that can be absorbed by the first elastically deformable element(s) A1 and the second elastically deformable element(s) B1.

[0045] For the energy absorbing device 10, the maximum traction force must be smaller than the maximum buff force due to the fact that only some of the elastically deformable elements are active to absorb traction forces. However, by selecting the first elastically deformable element(s) A1 and the second elastically deformable element(s) B1, the maximum traction force can be chosen as desired. This is advantageous in rendering the energy absorbing device 10 versatile by easily adapting it to an intended application where a given traction force needs to be absorbed.

[0046] Fig. 5a-5b disclose the energy absorbing device 10 in a coupler 100 having a front part 101 and a rear part 102 of which the energy absorbing device 10' forms a part. The front part 101 and the rear part 102 are pivotably joined by a shank end 103 arranged on the pivot pin 60. When a traction force is applied to the front part 101, the shank end 103 is pulled to the right-hand side of Fig. 5b and this causes the pivot pin 60 to be pulled along and the traction force to be transmitted to the traction force transmitting member 40 as described herein. When a buff force is instead applied to the front part, the shank end 103 is pushed to the left-hand side and contacts the buff force transmitting member 50 so that the energy absorbing device 10' is compressed as also described herein. To avoid the buff force being applied to the holder 70, a clearance is provided in a connection between the shank end 103 and the pivot pin 60, and/or a connection between the pivot pin 60 and the holder 70.

[0047] Fig. 5a-5b show the energy absorbing device 10' according to the second embodiment, but it is to be noted that any of the embodiments of the present invention can be arranged in the coupler of Fig. 5a-5b without requiring substantive modifications. What is said about the energy absorbing device 10, 10' in relation to its placement and function in the coupler 100 is therefore to be understood as relating to any embodiments disclosed herein.

[0048] Also shown in Fig. 5a-5b is an expandable mounting device 104 that will be explained in more detail further below.

[0049] The second main embodiment of the energy absorbing device 10' will now be described in detail with reference to Fig. 6a onwards. Most features of the second embodiment are similar or identical to the first embodiment and the text below will focus on those features that differ. It is in particular to be noted that any feature or function not specifically described as differing is the same in the first and second embodiments.

[0050] The second embodiment is shown in Fig. 6a in the neutral position, i.e. where neither buff forces nor traction forces are applied. The first chamber A is provided in the front position F with the front plate 21 and the rear plate 22 and at least one first elastically deformable element A1. The central rod 80 is provided to align the elastically deformable elements but does not serve to transfer force to either of the plates 21, 22. The front plate 21 is connected to the buff force transmitting member 50 and suitably also to a forward end 82 of the central rod 80. The buff force transmitting member 50 may be a plate or similar on which the buff force from the forward part 101 of the coupler 100 can act, suitably by a component such as the shank end 103 arranged on the pivot pin 60 pressing on the buff force transmitting member 50 when a distance between the forward part 101 and the rear part 102 decreases as explained above. The front stop 13 is provided as a stop surface adjacent to the front plate 21.

[0051] In the second embodiment, the traction force transmitting member 40 is an inner housing 17 that is slidably arranged in the housing 11 and that is connected to the pivot pin 60 such that a traction force on the pivot pin 60 is coupled to the inner housing 17. The rear plate 22 of the first chamber A is connected to the inner housing 17 such that movement of the inner housing 17 causes a corresponding movement of the rear plate 22.

[0052] The second chamber B is in the rear position R and comprises the front plate 31 and the rear plate 32. Similar to the first embodiment, the front plate 31 is integrated with or identical to the rear plate 22 of the first chamber A to form the combined plate 91 but this may also be varied as mentioned above. The rear plate 22 is fixed to the housing 11 to form the rear stop 12, but in other embodiments of the second main embodiment the rear plate 12 may instead be provided as in the first main embodiment above.

[0053] Fig. 6b shows the energy absorbing device 10' in a perspective view that also discloses the buff stroke limiter 14 that is provided in two parts: as a part of the front plate 21 of the first chamber A and as a stop surface on the inner housing 17. Also, the traction stroke limiter 15 is similarly provided in two parts: as a part of the front plate 21 of the first chamber A and as a stop surface on the housing 11. In this embodiment, the stroke limiters 14, 15 are provided on both the first chamber A and the second chamber B by the inner housing 17 being prevented from moving further in the rear direction RD when the front plate 21 contacts the housing 11. Thus, the buff stroke limiter 14 in this embodiment is provided also for the second chamber B to limit compression of the second elastically deformable element(s). It is to be noted, however, that in some embodiments stroke limiters 14, 15 may be provided for only one of the chambers A, B.

[0054] In some embodiments, the stroke limiters 14, 15 may be provided by a portion of the inner housing 17 that in the draft mode is pulled towards the front plate 21 and contacts the front plate 21 to provide the traction stroke limiter 14. In the buff mode, the front plate 21 pushes on the first elastically deformable element A that in turn causes the rear plate 22 connected to the inner housing 17 to move in the rear direction such that the portion of the inner housing 17 acting as stroke limiter is pushed against a stop surface on the housing 11.

[0055] Fig. 7a and 7b show the draft mode where the traction force is applied to the rear plate 22 of the first chamber A by the inner housing 17, resulting in the rear plate 22 sliding in the forward direction FD to compress the first elastically deformable element(s) A1 in the first chamber A. As with the first embodiment, the second chamber B is not compressed by the traction force and the front plate 21 is not moved from the neutral position even though the inner housing 17 has moved in the forward direction FD.

[0056] Fig. 8a and 8b show the buff mode where the buff force is applied to the front plate 21 of the first chamber A by the buff force transmitting member 50. This causes the front plate 21 to slide in the rear direction RD, pushing against the first elastically deformable element(s) A1 that in turn pushes on the combined plate 91 and causes it to slide towards the rear plate 32 of the second chamber B. The inner housing 17 is slidable in the rear direction RD to allow the combined plate 91 to move in this way. Both the first chamber A and the second chamber B are compressed so that both the first and second elastically deformable element(s) act to absorb the buff force.

[0057] Fig. 9a discloses an alternative second embodiment that is similar or identical to the second embodiment as described herein and shown in Fig. 6a-8b, but that also comprises a clearance C or play between the pivot pin 60 and the holder 70 such that the pivot pin 60 is able to move in the rear direction RD without this movement being transferred to the holder 70. This clearance C is shown most clearly in Fig. 9b. The advantage of providing the clearance C is that the shank end 103 (see Fig. 5) is able to push against the buff force transmitting member 50 without the movement in the rear direction RD being transferred to the inner housing 17 or the housing 11. This increases the possible stroke length of the energy absorbing device. Suitably, the clearance C is equal to a maximum buff stroke or larger, so that the compression of the first chamber A and second chamber B in buff mode can take place in a convenient and reliable way. Where the clearance is equal to the maximum buff stroke, the clearance C may in some embodiments also act as a buff stroke limiter. One particular advantage of the holder 70 that is connected to the housing 11 is that a stable design of the energy absorbing device 10' is achieved so that very large traction forces are handled in a stable and reliable manner. This in turn allows for use of the energy absorbing device 10' in train sets with many cars or with very heavy cars.

[0058] As shown in Fig. 9b, the pivot pin 60 is adjacent to the buff force transmitting member 50 or even close enough to contact it in the neutral position where no buff force or traction force is applied. This is advantageous in increasing stability of the energy absorbing device 10' since the buff force from the pivot pin 60 acts on the buff force transmitting member 50 immediately when the pivot pin 60 starts to move towards the buff force transmitting member 50. Thereby, a swift response of the energy absorbing device 10' to a buff force is given and any delay in response is minimized or even eliminated.

[0059] In some embodiments, the maximum buff stroke may be 110 mm whereas a maximum traction stroke may be 55 mm. Also, the maximum buff force may be 2000 kN and the maximum traction force may be 1000 kN. In some embodiments, the maximum traction force may be larger, suitably 1500 kN.

[0060] Similar to other embodiments herein, at least one friction reducing element 16 may be provided to reduce friction as components of the energy absorbing device 10' slides. Suitably, such friction reducing elements 16 are placed between the inner housing 17 and the housing 11 and/or between the front plate 21 of the first chamber A and the inner housing 17.

[0061] Fig. 10a and 10b disclose an expandable mounting device 104 that may be included in a coupler 100 having an energy absorbing device 10, 10' according to any embodiment of the invention. When mounting the energy absorbing device 10, 10', it is placed in a mounting compartment 105 in the coupler 100 and the expandable mounting device 104 is also inserted to fill any empty space between the energy absorbing device 10, 10' and walls of the mounting compartment 105. The expanding mounting device 104 may suitably be in the form of at least one wedge and may comprise an expansion mechanism 106 that can be operated to extend at least one part of the expanding mounting device 104 from at least one other part. Thereby, the expandable mounting device 104 is able to push against walls of the mounting compartment 105 and/or the energy absorbing device 10, 10' to fix the energy absorbing device 10, 10' in place.

[0062] Fig. 8b shows the expandable mounting device 104 provided between the energy absorbing device 10' and an end of the mounting compartment 105 on the rear part 102 where it is seen how the wedge shapes ensures that the energy absorbing device 10' is held firmly in place.

[0063] It is to be noted that features from the various embodiments described herein may freely be combined, unless it is explicitly stated that such a combination would be unsuitable.

Claims

1. Energy absorbing device (10, 10') for a coupler for a railway vehicle, the energy absorbing device comprising

- a housing (11) having a front end and a rear end, the housing comprising a first chamber (A), a second chamber (B) and a rear stop (12) connected to the housing (11),
- at least one first elastically deformable element (A1) held in the first chamber (A),
- at least one second elastically deformable element (B1) held in the second chamber (B),

wherein the first chamber (A) is delimited by a rear plate (22) and a front plate (21), said rear plate (22) being slidable in a forward direction (FD) towards the front end of the housing (11) and said front plate (21) being slidable in a rear direction (RD) towards the rear end of the housing (11) but said front plate (21) being prevented from moving in a forward direction (FD) beyond a front stop (13),
and wherein the second chamber (B) is delimited by a rear plate (32) and a front plate (31), said front plate (31) being slidable in the rear direction (RD),
wherein the first chamber (A) and second chamber (B) are arranged in series in a front position (F) and a rear position (R) in the housing (11) such that the front plate (21; 31) of one of the chambers (A; B) is connected to the rear plate (32; 22) of the other

chamber (B; A), and such that the rear plate (22; 32) of the chamber (A; B) in the rear position (R) is prevented from moving in the rear direction (RD) by the rear stop (12) of the housing (11),
and the energy absorbing device (10, 10') further comprising

- a traction force transmitting member (40) connected to the rear plate (22) of the first chamber (A), and
- a buff force transmitting member (50) connected to the front plate of the chamber in the front position (F),

such that a traction force on the traction force transmitting member (40) pulls the rear plate (22) of the first chamber (A) towards the front plate (21) of the first chamber (A), thereby compressing the at least one first elastically deformable element (A1), and such that a buff force on the buff force transmitting member (50) pushes the front plate (21; 31) of the chamber (A; B) in the front position (F) in the rear direction (RD), thereby causing the front plate (31; 21) of the chamber (B; A) in the rear position (R) to move in the rear direction (RD) and compressing both the at least one first elastically deformable element (A1) and the at least one second elastically deformable element (B1).

2. Energy absorbing device according to claim 1, wherein the front plate (21; 31) of the chamber (A; B) in the rear position (R) is connected to the rear plate (32; 22) of the chamber (B; A) in the front position (F) by being integrated with said rear plate (32; 22) to form a combined plate (91).

3. Energy absorbing device according to claim 1 or 2, wherein the front plate (21; 31) of the chamber (A; B) in the front position (F) is fixed to or integrated with the buff force transmitting member (50).

4. Energy absorbing device according to any of claims 1-3, further comprising a central rod (80) extending through the first chamber (A) and the second chamber (B), the central rod (80) passing from the front plate (21; 31) of the chamber (A; B) in the front position (F) to the rear plate (32; 22) of the chamber (B; A) in the rear position (R) and passing through central openings in the plate or plates therebetween, wherein the first and second elastically deformable elements (A1, B1) are elastomers arranged on the central rod (80).

5. Energy absorbing device according to claim 4, wherein the central rod (80) is the traction force transmitting member (40).

6. Energy absorbing device according to any of claims 1-4, further comprising an inner housing (17) that is slidable in relation to the housing (11), and wherein the inner housing (17) is the traction force transmitting member (40).

7. Energy absorbing device according to claim 6, further comprising at least one friction reducing element (16) arranged between the inner housing (17) and the housing (11).

8. Energy absorbing device according to any previous claim, wherein the first chamber (A) is in the rear position (R) and the energy absorbing device (10) comprises a front stop (13) connected to the housing (11), said front stop (13) being configured to prevent movement in the forward direction (FD) of the front plate (21) of the first chamber (A).

9. Energy absorbing device according to any of claims 1-7, wherein the first chamber (A) is in the front position (F) and wherein the rear plate (22) of the first chamber (A) is slidable in both forward and rear direction (FD, RD).

10. Energy absorbing device according to claim 9, wherein the rear plate (32) of the second chamber (B) is fixedly connected to or integrated with the housing (11).

11. Energy absorbing device according to any previous claim, wherein the at least one first elastically deformable element (A1) and the at least one second elastically deformable element (B1) are stacks of elastomers.

12. Energy absorbing device according to any previous claim, further comprising a buff stroke limiter (14) configured to limit compression of at least one of the first chamber (A) and the second chamber (B) to a desired buff stroke.

13. Energy absorbing device according to any previous claim, further comprising a traction stroke limiter (15) configured to limit compression of the first chamber (A) to a desired traction stroke.

14. Energy absorbing device according to any previous claim,
wherein the at least one first elastically deformable element (A1) and the at least one second elastically deformable element (B1) are configured to absorb a maximum buff force, and wherein the at least one first elastically deformable element (A1) is selected to be configured to absorb a maximum traction force, said maximum traction force being selected to be smaller than the maximum buff force.

15. Energy absorbing device according to any previous claim, further comprising at least one friction reducing element (16) arranged between the housing (11) and at least one of the rear plate (22) of the first chamber (A), the front plate (21) of the first chamber (A), the rear plate (32) of the second chamber (B) and the front plate (31) of the second chamber (B).

16. Energy absorbing device according to any previous claim, further comprising a holder (70) connected to the housing (11) and a pivot pin (60) arranged in the holder (70), and also comprising a clearance (C) such that the pivot pin (60) is moveable in the rear direction (RD) in relation to the holder (70), and wherein preferably the clearance (C) is equal to or larger than a buff stroke length of the energy absorbing device (10, 10').

17. Coupler for a railway vehicle, the coupler comprising at least one energy absorbing device (10, 10') according to any of claims 1-16.

18. Coupler according to claim 17, further comprising an expandable mounting device (104) for mounting the energy absorbing device (10) in a mounting compartment (105) of the coupler (100), wherein the energy absorbing device (10, 10') and the expandable mounting device (104) are configured to be placed in the mounting compartment (105) and wherein the expandable mounting device (104) is configured to be expanded for preventing movement of the energy absorbing device (10, 10') in relation to the mounting compartment (105).

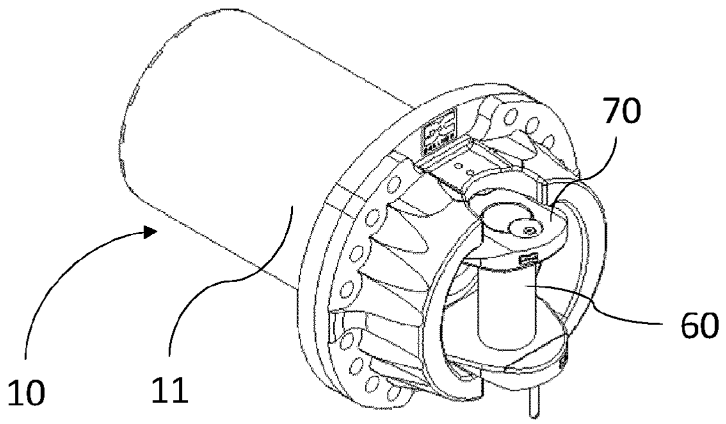

Fig. 1

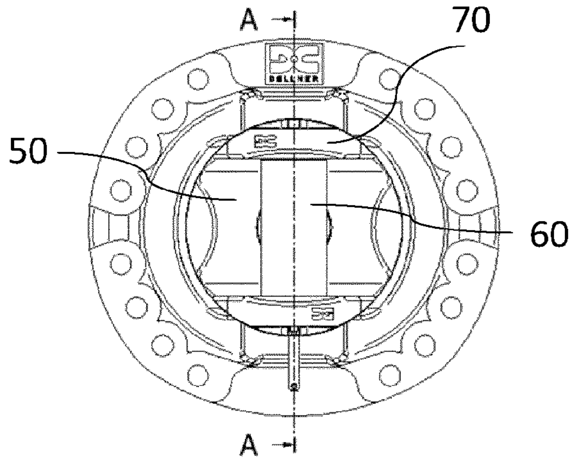

Fig. 2a

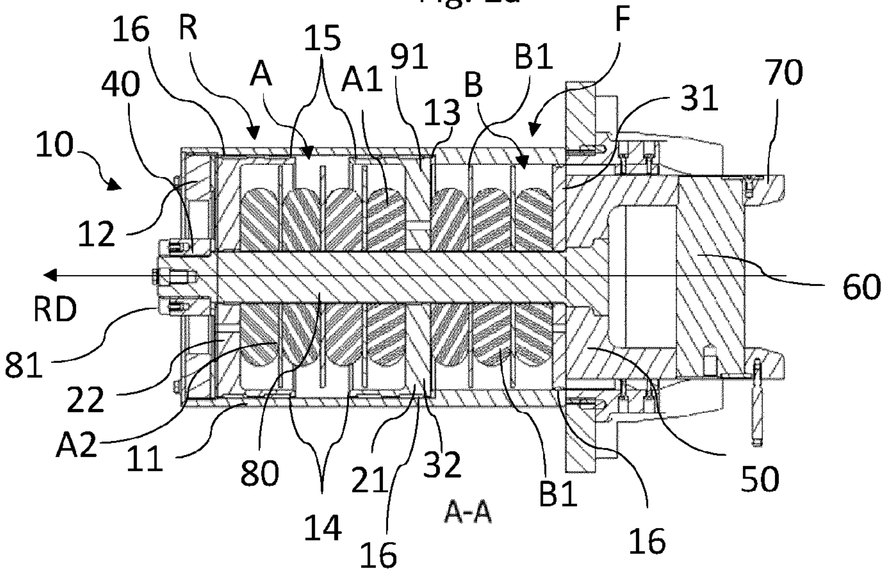

Fig. 2b

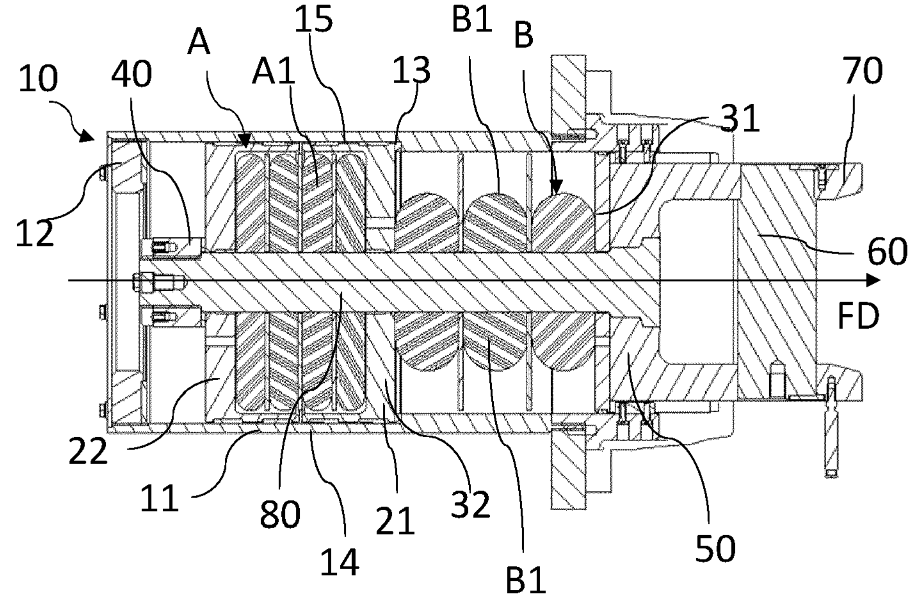
10
40
A
15
A1
13
B1
B
70
31
12
60
FD
22
11
80
21
32
14
B1
50

Fig. 3

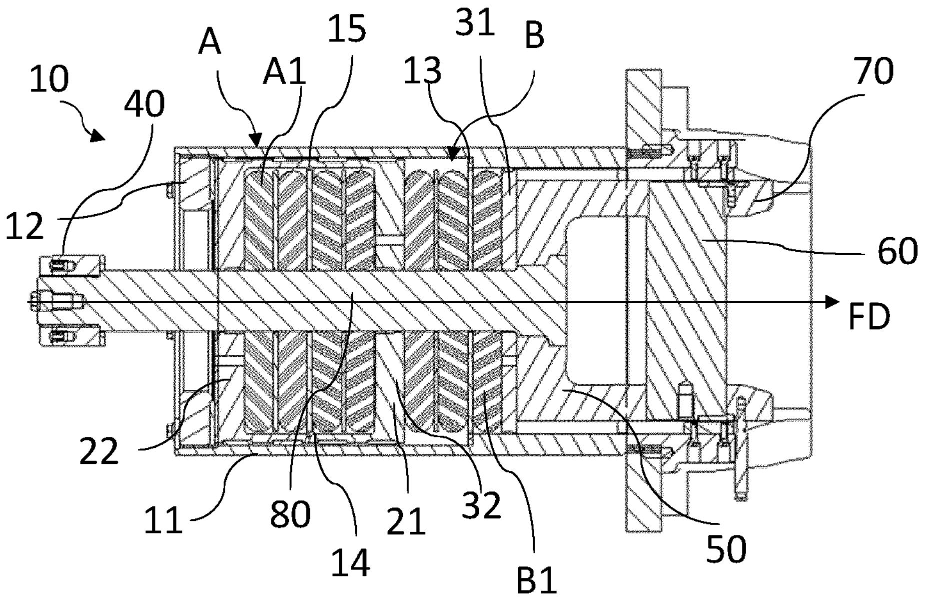
10
40
A
A1
15
13
31
B
70
12
60
FD
22
11
80
14
21
32
B1
50

Fig. 4

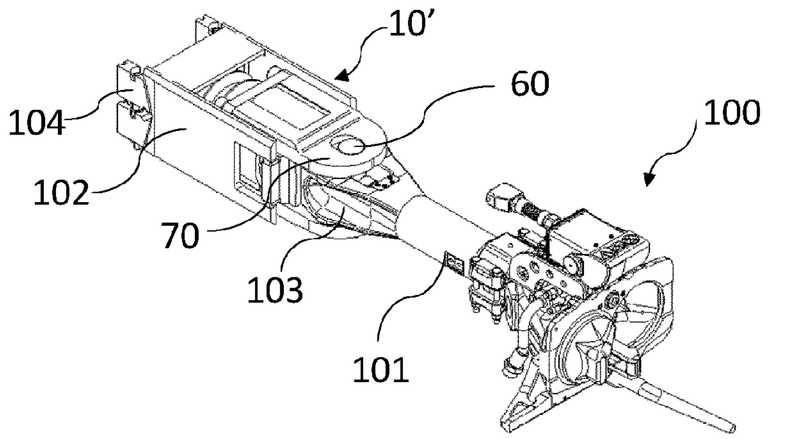

Fig. 5a

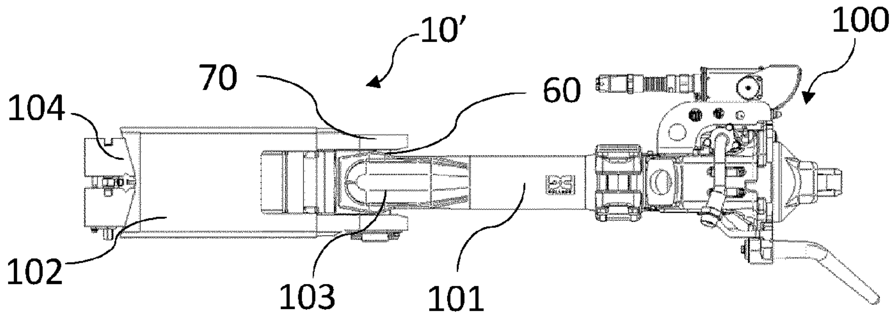

Fig. 5b

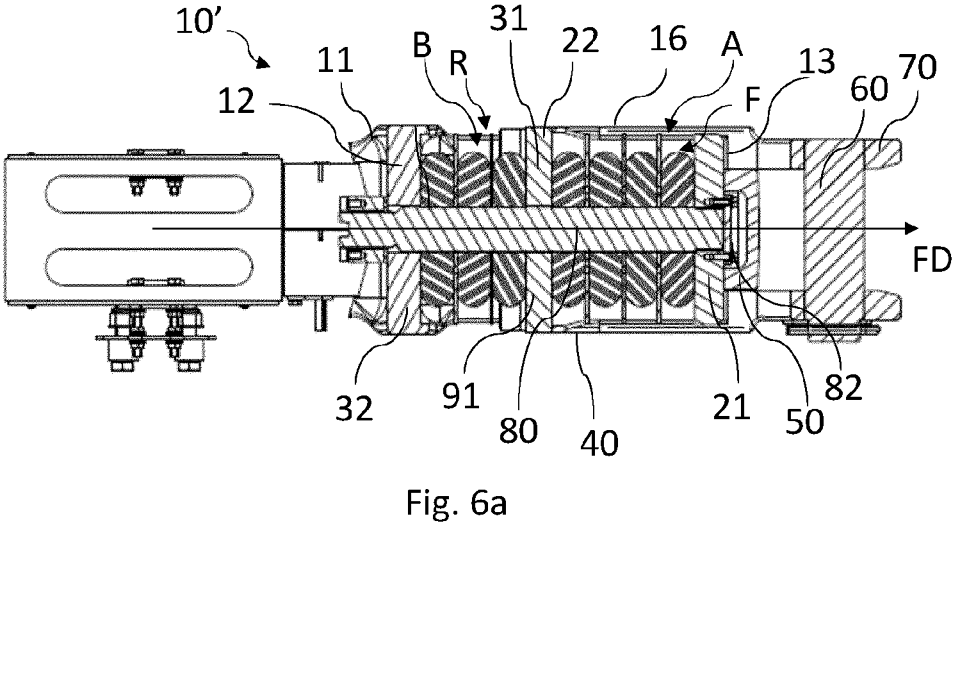

Fig. 6a

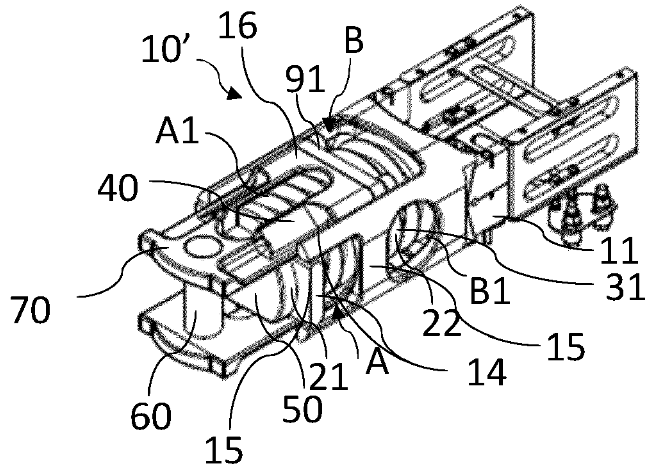

Fig. 6b

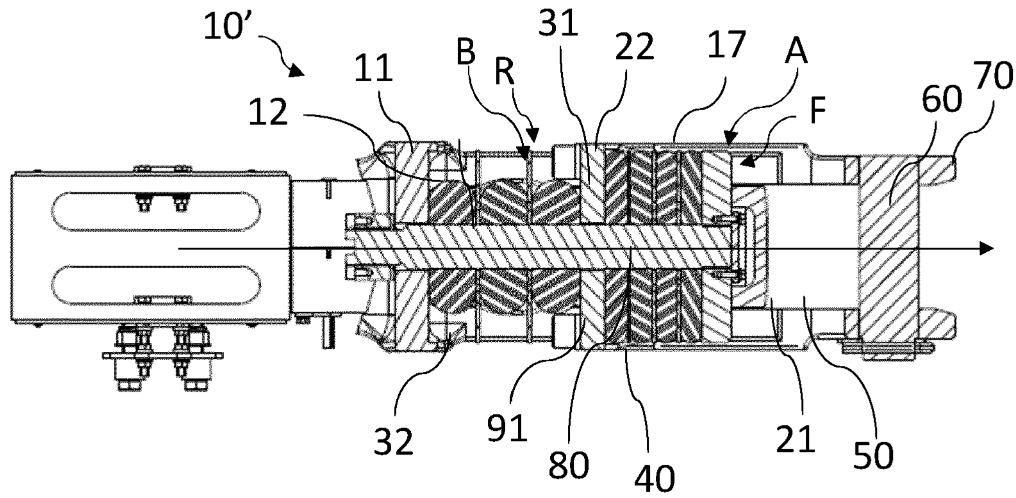

Fig. 7a

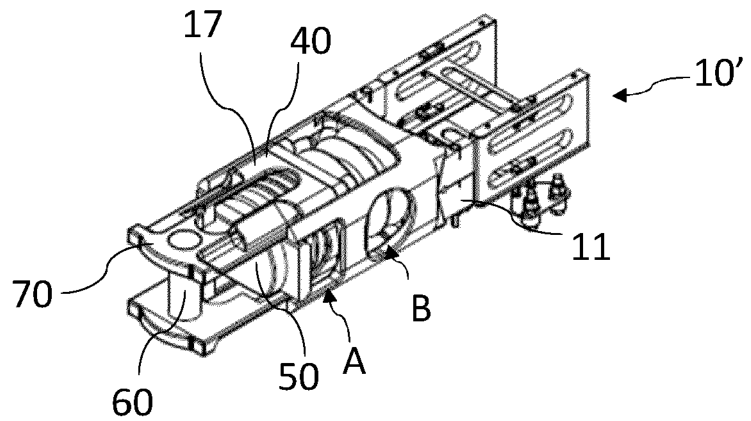

Fig. 7b

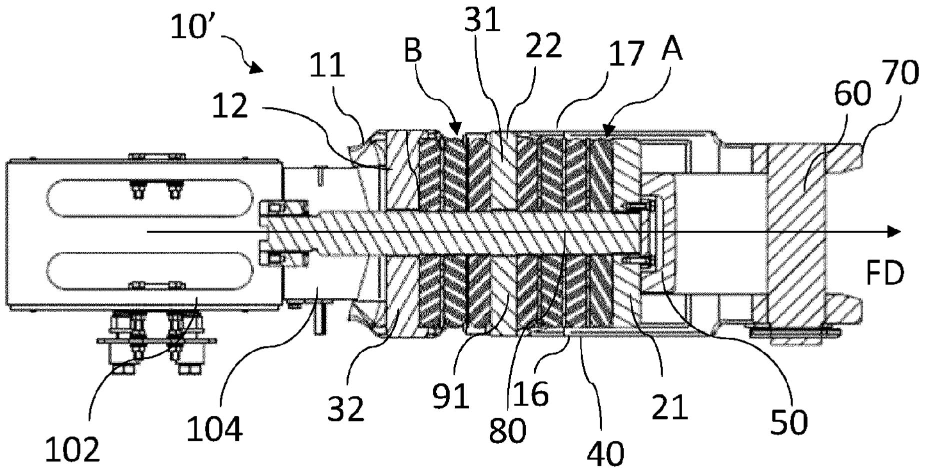

Fig. 8a

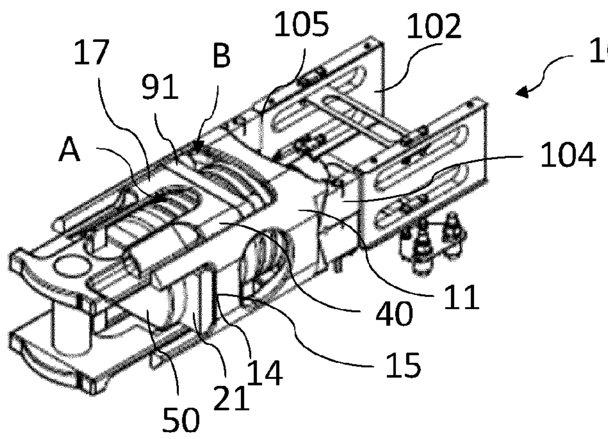

Fig. 8b

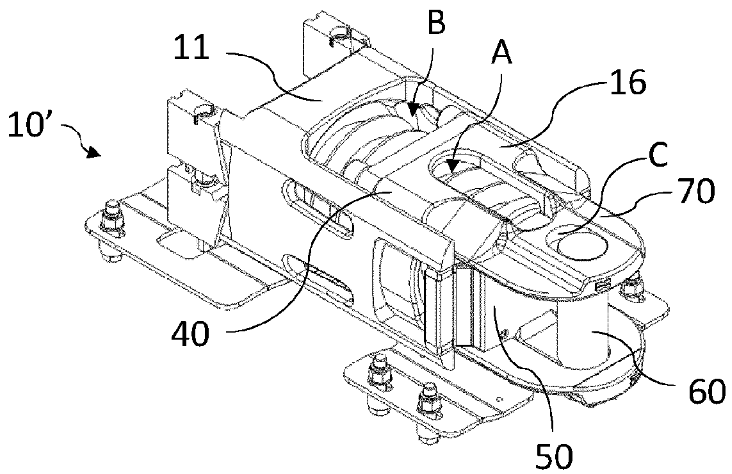

Fig. 9a

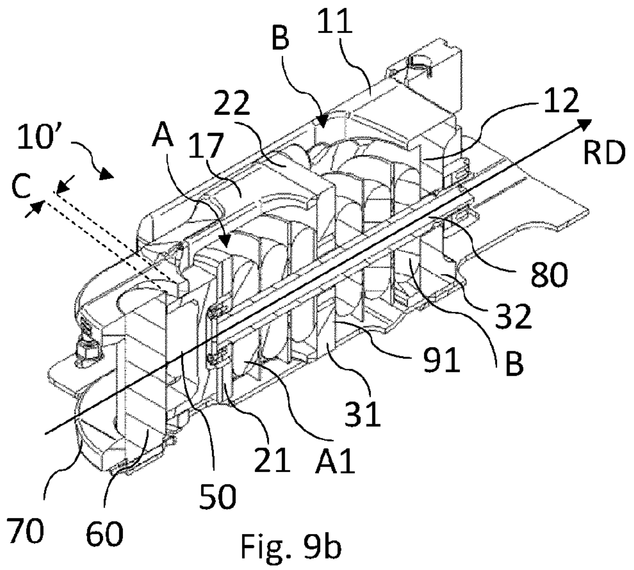

Fig. 9b

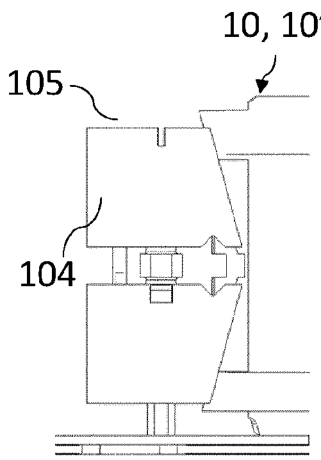

Fig. 10a

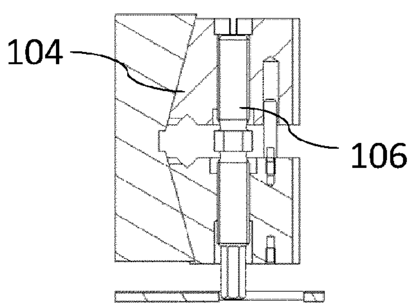

Fig. 10b

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EUROPEAN SEARCH REPORT

Application Number
EP 23 19 8315

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	US 906 643 A (MATHER ALONZO C [US]) 15 December 1908 (1908-12-15) * the whole document * -----	1-5,8,9, 11-18 6,7,10	INV. B61G9/06
A	US 2008/011700 A1 (BROUGH STEVE [US] ET AL) 17 January 2008 (2008-01-17) * the whole document * -----	1-18	
A	US 3 840 126 A (DOMER MICHEL [FR]) 8 October 1974 (1974-10-08) * the whole document * -----	1-18	
A	CH 486 352 A (GOMMA ANTIVIBRANTI APPLIC [IT]) 28 February 1970 (1970-02-28) * the whole document * -----	1-18	
A	US 2002/070189 A1 (BARKER RONALD E [US] ET AL) 13 June 2002 (2002-06-13) * the whole document * -----	1-18	

TECHNICAL FIELDS SEARCHED (IPC)

B61G

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	24 January 2024	Awad, Philippe

CATEGORY OF CITED DOCUMENTS

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....
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 23 19 8315

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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24-01-2024

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 906643 A	15-12-1908	NONE	
US 2008011700 A1	17-01-2008	AU 2007202405 A1	31-01-2008
		BR PI0702970 A	04-03-2008
		CA 2589665 A1	17-01-2008
		CN 101117126 A	06-02-2008
		UA 85637 C2	10-02-2009
		US 2008011700 A1	17-01-2008
US 3840126 A	08-10-1974	AR 193575 A1	30-04-1973
		AT 343175 B	10-05-1978
		AU 5195273 A	08-08-1974
		BE 795795 A	22-08-1973
		CA 984344 A	24-02-1976
		CH 572410 A5	13-02-1976
		DD 102117 A5	05-12-1973
		DE 2307943 A1	13-09-1973
		ES 411614 A1	01-01-1976
		FR 2173387 A5	05-10-1973
		GB 1412888 A	05-11-1975
		IT 976546 B	10-09-1974
		JP S4897208 A	11-12-1973
		NL 7302270 A	24-08-1973
		PL 82430 B1	31-10-1975
		SE 381849 B	22-12-1975
		SU 583728 A3	05-12-1977
		US 3840126 A	08-10-1974
		ZA 73823 B	28-11-1973
CH 486352 A	28-02-1970	BE 724561 A	02-05-1969
		CH 486352 A	28-02-1970
		DE 1904840 A1	26-03-1970
		ES 369439 A1	01-07-1971
		FR 1601643 A	07-09-1970
US 2002070189 A1	13-06-2002	CA 2352804 A1	07-03-2002
		US 6446820 B1	10-09-2002
		US 2002070189 A1	13-06-2002

EPO FORM P0459

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