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(54) **Damping arrangements for Y25 bogies**

Schwingungsdämpfende Einrichtungen für Y25 Drehgestelle

Dispositifs amortisseurs pour bogies Y25

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**EP-A- 1 186 504 EP-A- 1 186 505  
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## Description

**[0001]** This invention relates to the Y25 bogie and variants thereto, and in particular to improvements to this type of bogie to improve the track friendliness thereof.

**[0002]** Within Europe a bogie known as the Y25 bogie is in widespread use, particularly on freight wagons. A typical Y25 bogie comprises a pair of pedestals, each being supported by a pair of axle boxes through respective pairs of spring sets. Friction damping arrangements are provided to damp, primarily, vertical and lateral movement between the axle boxes and pedestals. Each damping arrangement typically comprises a piston slidably mounted upon one of the pedestals and having an end face which can be brought into contact with a surface of an associated one of the axle boxes, the piston being moveable by a drive member in the form of a spring holder located between one of the spring sets and the pedestal. A link arrangement known as a Lenoir link is connected between the pedestal and the drive member. The Lenoir link is inclined to the vertical such that the weight of the pedestal and the wagon and load carried thereby applies a lateral force to the drive member and piston. The magnitude of the force applied to the piston is thus dependent upon the load. As the magnitude of the force applied to the piston varies, it will be appreciated that the frictional load between the axle box and the pedestal also varies, thus the degree of damping between these components is load dependent.

**[0003]** The mounting of the piston is such that there is contact between the piston and the pedestal and, in use, between the end face of the piston and the axle box. As the piston, pedestal and axle box are of metallic, typically steel, construction, such contact is thought to be undesirable due to stiction and the metal-metal interfaces.

**[0004]** US 3 882 794 describes such a bogie arrangement. EP 1186504 in contrast describes a different type of bogie arrangement utilising friction wedges as opposed to such a piston arrangement.

**[0005]** According to the invention there is provided a bogie comprising a pedestal supported through spring sets by an axle box, and a damping arrangement for damping relative vertical movement between the axle box and the pedestal, the damping arrangement comprising a piston guided for movement relative to the pedestal and having a surface cooperable with a surface of the axle box, a drive arrangement being provided to move the piston, and wherein the said surface of the piston comprises a composite material such that in use there is no metal to metal sliding interface between the axle box and piston.

**[0006]** Such an arrangement is advantageous in that the metal-to-metal interface and stiction at the interface between the piston and the axle box can be avoided or reduced.

**[0007]** The drive arrangement for the piston conveniently includes an inclined Lenoir link or similar arrangement.

**[0008]** The composite material surface of the piston may comprise a surface of a composite material element secured to the piston. The composite material element may be mechanically secured to the piston, and could be removable therefrom. Alternatively, it may be hot-bonded to the piston.

**[0009]** Alternatively, the piston may be constructed from the composite material, a suitable reinforcing structure being provided within the piston to give the piston the required rigidity to operate correctly.

**[0010]** The piston may be guided for sliding movement relative to the pedestal.

**[0011]** Alternatively, a resilient mounting arrangement may be provided between the piston and the pedestal so as to allow the piston to move relative to the pedestal, the resilient mounting arrangement undergoing resilient deformation, whilst avoiding sliding contact between the pedestal and the piston. Clearly, such an arrangement is advantageous in that further metal-to-metal contact is avoided. In such an arrangement, the resilient mounting arrangement conveniently comprises a resilient material sleeve secured both to the piston and to the pedestal.

**[0012]** In any of the above arrangements, a second piston may also be guided for movement relative to the pedestal, the second piston also having a surface cooperable with a surface of the axle box, a second drive arrangement being provided to move the second piston. The second drive arrangement preferably includes a Lenoir link. The said surface of the second piston may comprise a composite material. As before, the second piston may be guided for sliding movement relative to the pedestal, or alternatively, a resilient mounting arrangement may be provided between the second piston and the pedestal so as to allow the second piston to move relative to the pedestal, the resilient mounting arrangement undergoing resilient deformation, whilst avoiding sliding contact between the pedestal and the second piston.

**[0013]** The spring set of a typical Y25 type bogie has a rate falling within the range of approximately 980N/mm tare and 2600N/mm laden, and a compressed length falling within the range of approximately 240mm to 200mm. It is thought that the track friendliness of the bogie may be enhanced by modifying the bogie to use a softer, longer spring set. Preferably, therefore, the spring sets of the bogie have a compressed length falling within the range of approximately 300mm to 190mm and a rate falling within the range of 390N/mm tare to 1750N/mm laden. In order to accommodate a longer spring set within a bogie of the Y25 type whilst complying with the usual design constraints placed upon a bogie of this type, the axle box is conveniently modified compared to a standard axle box so that, in use, the lower end of the spring set is located at a height falling within the range of 220mm to 250mm above the track, with 920mm diameter wheels.

**[0014]** In a typical Y25 bogie, the maximum permitted travel of the piston is of the order of 4mm. It is thought that the bogie would benefit from increasing the maximum travel of the piston. Preferably, therefore, the bogie

is designed to allow the piston to move through a distance of at least about 7mm, and preferably around 9mm or more. In a typical bogie of this type, the piston is slidable within a metallic sleeve mounted upon the pedestal, the sleeve having a lip protruding from the pedestal. One way in which the travel of the piston can be increased, therefore, is to omit this lip. Alternatively, or additionally, the dimensions of the pedestal may be modified to allow an increase in the maximum permitted travel of the piston.

**[0015]** Although it may be advantageous to use a number of the modifications mentioned hereinbefore in combination with one another, some benefits may still be seen by using, say, just a few of the modifications.

**[0016]** The invention will further be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a sectional view of part of a bogie in accordance with one embodiment of the invention;  
 Figure 2 is a side view of part of the bogie of Figure 1;  
 Figure 3 is an enlargement of part of Figure 1;  
 Figures 4 and 5 are views similar to Figures 1 and 2 illustrating an alternative embodiment; and  
 Figures 6 and 7 are views similar to Figures 1 and 3 illustrating another embodiment.

**[0017]** Referring first to Figures 1 to 3 there is shown part of a bogie which is, generally of the Y25 type, the bogie comprising a pair of pedestals 10 (only part of one of which is shown) arranged parallel to one another and secured to one another, each pedestal 10 being supported by a pair of axle boxes 12. A pair of spring sets 14, 16 are provided between each axle box 12 and the associated pedestal. Each spring set 14, 16 comprises a first, outer spring 18 and an inner spring 20, the length of the inner spring 20 being chosen such that the inner spring 20 only becomes an effective part of the primary suspension once a predetermined load is carried by the bogie. An axle and wheel set (not shown) extends between each axle box 12 associated with one of the pedestals and a respective axle box 12 associated with the other of the pedestals 10.

**[0018]** A drive member 22 in the form of a spring holder is carried by the outer spring 18 of one of the spring sets 12 and is connected to the pedestal 10 through an inclined link member known as a Lenoir link 24, as shown in Figure 2. The inclination of the Lenoir link 24 is arranged such that a lateral load is applied to the drive member 22, the magnitude of which is dependent upon the load carried by the bogie.

**[0019]** The drive member 22 abuts a piston 26 which is guided for sliding movement relative to a part of the pedestal 10. As shown, a metallic sleeve 28 is provided in the pedestal 10 within which the piston 26 slides. In a conventional Y25 type bogie, the end of the piston remote from the drive member is arranged to bear against a surface 12a of the axle box, the engagement between the piston and the axle box being a metal-to-metal engage-

ment which is undesirable. In the embodiment of the invention illustrated in Figure 1, rather than arrange for the metallic piston to bear directly upon the surface 12a of the axle box, the piston 26 includes a composite material component 29 located such that the surface of the piston 26 which engages the axle box is not metallic but rather is of the composite material. The composite material component 29 comprises a plate 30 mounted upon the piston 26 and having mechanically secured or hot bonded thereto an element 32 of composite material. If desired, the composite material component 29 may be removably attached to the piston, but this need not be the case.

**[0020]** Although, in order to avoid the provision of a metal to metal contact between the piston and the axle box, only the end surface of the piston need be of non-metallic form, the piston could be entirely or largely of a non-metallic material, if desired. For example, the piston could comprise a suitably reinforced composite material component.

**[0021]** In the arrangement of Figure 1, only one piston 26 is associated with each axle box 12 of the bogie. This need not be the case, and Figures 4 and 5 illustrate a modification in which two pistons 26a, 26b are provided, each of the pistons being driven by an associated drive member 22a, 22b using an associated Lenoir link 24a, 24b (see Figure 5). The arrangement of Figures 4 and 5 does not make use of the provision of a composite material surface on the piston, but is still advantageous in that the symmetry of the bogie is improved. Although the arrangement of Figures 4 and 5 does not make use of the composite material surface, one or both of the pistons 26a, 26b may be provided with a composite material surface, for example using any of the techniques or arrangements described hereinbefore.

**[0022]** The improved symmetry achieved by providing two pistons on opposite sides of the axle box in this manner allows constant friction damping and axle steering to occur, the pistons moving to accommodate movement of the axle box relative to the pedestal in the fore-aft direction.

**[0023]** It is thought that the track friendliness of the bogie may be enhanced by designing the bogie in such a manner as to allow the travel of the piston or pistons to be increased from the 4mm maximum travel permitted by a typical Y25 bogie to a maximum travel of at least 7mm, and preferably around 9mm. In the arrangements described and illustrated hereinbefore, such an increase in the travel of the piston or pistons may be achieved by modifying the sleeve 28 in which the piston 26 is slidable to omit the lip 28a (see Figure 3) thereof. Alternatively, or additionally, a minor alteration of the design of the pedestal 10 may be made to increase the maximum permitted travel of the piston. In order to accommodate the increase in the maximum travel of the piston, it is also important to ensure that the design of the drive member 22 and the pedestal 10 is such as to allow the drive member 22 to move relative to the pedestal 10 through the

increased travel without fouling.

**[0024]** Figures 6 and 7 illustrate another bogie based closely upon the standard Y25 bogie but modified in order to improve its track friendliness. The bogie of Figures 6 and 7 differs from a typical Y25 type bogie in four main respects. Firstly, as with the arrangement of Figure 1, the pistons 26 are provided with composite material surfaces, thereby avoiding metal-to-metal contact between the pistons and the axle box. Secondly, as with the arrangement shown in Figures 4 and 5, two pistons 26 are provided, each being driven by an associated drive arrangement using an associated Lenoir link.

**[0025]** The third important difference between the arrangement of Figures 6 and 7 and a typical Y25 bogie resides in the design of the pistons. As shown in Figure 6, the pistons 26 are located within resilient material sleeves 34 which, in turn, are mounted upon the pedestal 10. The mounting of the pistons 26 in this manner allows the pistons 26 to move in their longitudinal direction towards and away from the associated surfaces of the axle box 12 without any sliding contact occurring between the pistons 26 and the pedestal 10 or members affixed thereto. As a result, metal-to-metal frictional forces serving to impede movement of the pistons are reduced.

**[0026]** A further advantage of this mounting of the pistons 26 is that the pistons 26 are permitted to move through a small distance horizontally (generally perpendicularly to the axis of the piston), vertically, and to tilt slightly, relative to the pedestal 10, thereby providing additional degrees of freedom in the movement of the pistons 26, permitting braking inertial forces to be accommodated and axle box movement relative to the pedestal in the horizontal (fore-aft direction) and vertical direction to be accommodated. As a result, constant load dependent friction damping and axle steering can be achieved.

**[0027]** The fourth important distinction between the arrangement of Figures 5 and 6 and the typical Y25 bogie resides in the spring sets 14, 16. The spring sets 14, 16 used in the arrangement of Figures 6 and 7 are significantly longer and softer than the spring sets typically used in a Y25 bogie. The arrangements illustrated in Figures 1 to 5 use the typical spring sets, and the increase in length is apparent by comparing, say, Figure 1 with Figure 6. By way of example, a typical spring set used in a Y25 type bogie at tare weight has a length of approximately 240mm and a rate of about 980N/mm. In comparison, the arrangement of Figures 6 and 7 has a length of about 300mm and a rate of about 390N/mm.

**[0028]** In order to accommodate the revised spring sets into the bogie whilst still meeting the usual design criteria of a Y25 bogie, the axle box 12 has been modified as shown in Figure 6 to lower the height of the lower end of each spring set above the ground/rails, in use. The change in the design of the axle box 12 is such as to position the lower end of the spring sets at a height of approximately 220mm from the rails.

**[0029]** As mentioned hereinbefore, any combination of the various modifications to the conventional Y25 bo-

gie described herein may be used to provide a bogie of improved track friendliness.

**[0030]** It will be appreciated that a number of modifications may be made to the embodiments described hereinbefore without departing from the scope of the invention as defined herein.

## Claims

1. A bogie comprising a pedestal (10) supported through spring sets (14,16) by an axle box (12), and a damping arrangement for damping relative vertical movement between the axle box (12) and the pedestal (10), the damping arrangement comprising a piston (26) guided for movement relative to the pedestal (10) and having a surface co-operable with a surface (12a) of the axle box (12), a drive arrangement (22,24) being provided to move the piston (26); **characterized in that** the said surface of the piston (26) comprises a composite material (29) such that in use there is no metal-to-metal sliding interface between the axle box (12) at piston (26).
2. A bogie according to Claim 1, wherein the drive arrangement for the piston (26) includes an inclined Lenoir link (24).
3. A bogie according to Claim 1 or Claim 2, wherein the composite material (29) surface of the piston (26) comprises a surface of a composite material element (32) secured to the piston (26).
4. A bogie according to Claim 3, wherein the composite material element (32) is mechanically secured to the piston (26).
5. A bogie according to Claim 3, wherein the composite material element (32) is hot-bonded to the piston (26).
6. A bogie according to Claim 1 or Claim 2, wherein the piston (26) is constructed from the composite material, a suitable reinforcing structure being provided within the piston (26) give the piston (26) the required rigidity to operate correctly.
7. A bogie according to any one of the preceding claims, wherein the piston (26) is guided for sliding movement relative to the pedestal (10).
8. A bogie according to any of Claims 1 to 6, wherein a resilient mounting arrangement (34) is provided between the piston (26) and the pedestal (10) so as to allow the piston (26) to move relative to the pedestal (10), the resilient mounting arrangement (34) undergoing resilient deformation, whilst avoiding sliding contact between the pedestal (10) and the

piston (26).

9. A bogie according to Claim 8, wherein the resilient mounting arrangement comprises a resilient material sleeve (34) secured both to the piston (26) and to the pedestal (10).
10. A bogie according to any one of the preceding claims, further comprising a second piston (26b) guided for movement relative to the pedestal (10), the second piston (26b) also having a surface co-operable with a surface (12a) of the axle box (12), a second drive arrangement (22b,24b) being provided to move the second piston (26b).
11. A bogie according to Claim 10, wherein the second drive arrangement includes a Lenoir link (24b).
12. A bogie according to Claim 10 or Claim 11, wherein the said surface of the second piston (26b) comprises a composite material.
13. A bogie according to any of Claims 10 to 12, wherein the second piston (26b) is guided for sliding movement relative to the pedestal (10).
14. A bogie according to any of Claims 10 to 13, wherein a resilient mounting arrangement (34) is provided between the second piston (26b) and the pedestal (10) so as to allow the second piston (26b) to move relative to the pedestal (10), the resilient mounting arrangement (34) undergoing resilient deformation, whilst avoiding sliding contact between the pedestal (10) and the second piston (26b).
15. A bogie according to any of the preceding claims, wherein the spring sets of the bogie have a compressed length falling within the range of approximately 300mm to 190mm.
16. A bogie according to any of the preceding claims, wherein the spring sets (14,16) have a spring rate falling within the range of 390N/mm tare to 1750N/mm laden.
17. A bogie according to Claim 15 or 16, wherein, in use, the lower end of the spring set (14,16) is located at a height falling within the range of 220mm to 250mm above the track, in a bogie with 920mm diameter wheels.
18. A bogie according to any of the preceding claims, wherein the piston (26) is allowed to move through a distance of at least about 7mm.
19. A bogie according to Claim 18, wherein the piston (26) is allowed to move through a distance of 9mm or more.

## Patentansprüche

1. Drehgestell, enthaltend einen Lagerbock (10), der durch Federsätze (14, 16) mittels eines Achsgehäuses (12) gelagert ist, und eine Dämpfungsvorrichtung, die eine vertikale Relativbewegung zwischen dem Achsgehäuse (12) und dem Lagerbock (10) dämpft, wobei die Dämpfungsvorrichtung einen Kolben (26) enthält, der für eine Bewegung relativ zum Lagerbock (10) geführt ist und eine Oberfläche aufweist, die mit einer Oberfläche (12a) des Achsgehäuses (12) zusammenwirken kann, wobei eine Antriebsvorrichtung (22, 24) vorgesehen ist, um den Kolben (26) zu bewegen;  
**dadurch gekennzeichnet, dass** die Oberfläche des Kolbens (26) ein Kompositmaterial (29) enthält, so dass es in der Verwendung keine Gleitberührung von Metall und Metall zwischen dem Achsgehäuse (12) und dem Kolben (26) gibt.
2. Drehgestell nach Anspruch 1, bei dem die Antriebsvorrichtung für den Kolben (26) eine geneigte Lenoir-Schake (24) enthält.
3. Drehgestell nach Anspruch 1 oder 2, bei dem die Oberfläche aus Kompositmaterial (29) des Kolbens (26) eine Oberfläche aus einem Kompositmaterial-Element (32) enthält, das am Kolben (26) befestigt ist.
4. Drehgestell nach Anspruch 3, bei dem das Kompositmaterial-Element (32) am Kolben (26) mechanisch befestigt ist.
5. Drehgestell nach Anspruch 3, bei dem das Kompositmaterial-Element (32) mit dem Kolben (26) heißgebonded ist.
6. Drehgestell nach Anspruch 1 oder 2, bei dem der Kolben (26) aus dem Kompositmaterial aufgebaut ist, wobei eine geeignete Verstärkungsstruktur innerhalb des Kolbens (26) vorgesehen ist, um dem Kolben (26) die erforderliche Steifigkeit für eine korrekte Funktionstätigkeit zu verleihen.
7. Drehgestell nach einem der vorhergehenden Ansprüche, bei dem der Kolben (26) für eine Gleitbewegung relativ zum Lagerbock (10) geführt ist.
8. Drehgestell nach einem der Ansprüche 1 bis 6, bei dem eine elastische Anbringungsanordnung (34) zwischen dem Kolben (26) und dem Lagerbock (10) vorgesehen ist, um es dem Kolben (26) zu gestatten, sich relativ zum Lagerbock (10) zu bewegen, wobei die elastische Anbringungsanordnung (34) einer elastischen Verformung ausgesetzt ist, während ein Gleitkontakt zwischen dem Lagerbock (10) und dem Kolben (26) verhindert wird.

9. Drehgestell nach Anspruch 8, bei dem die elastische Anbringungsanordnung eine Buchse (34) aus einem elastischen Material enthält, die sowohl am Kolben (26) als auch am Lagerbock (10) befestigt ist.
10. Drehgestell nach einem der vorhergehenden Ansprüche, weiterhin enthaltend einen zweiten Kolben (26b), der für eine Bewegung relativ zum Lagerbock (10) geführt ist, wobei der zweite Kolben (26b) ebenfalls eine Oberfläche hat, die mit einer Oberfläche (12a) des Achsgehäuses (12) zusammenwirken kann, wobei eine zweite Antriebsvorrichtung (22b, 24b) vorgesehen ist, die den Kolben (26b) bewegt.
11. Drehgestell nach Anspruch 10, bei dem die zweite Antriebsanordnung eine Lenoir-Schake (24b) enthält.
12. Drehgestell nach Anspruch 10 oder 11, bei dem die Oberfläche des zweiten Kolbens (26b) ein Kompositmaterial enthält.
13. Drehgestell nach einem der Ansprüche 10 bis 12, bei dem der zweite Kolben (26b) für eine Gleitbewegung relativ zum Lagerbock (10) geführt ist.
14. Drehgestell nach einem der Ansprüche 10 bis 13, bei dem eine elastische Anbringungsanordnung (34) zwischen dem zweiten Kolben (26b) und dem Lagerbock (10) vorgesehen ist, um es dem zweiten Kolben (26b) zu gestatten, sich relativ zum Lagerbock (10) zu bewegen, wobei die elastische Anbringungsanordnung (34) einer elastischen Verformung ausgesetzt ist, während ein Gleitkontakt zwischen dem Lagerbock (10) und dem zweiten Kolben (26b) vermieden wird.
15. Drehgestell nach einem der vorhergehenden Ansprüche, bei dem die Federsätze des Drehgestells eine komprimierte Länge im Bereich von etwa 300 mm bis 190 mm haben.
16. Drehgestell nach einem der vorhergehenden Ansprüche, bei dem die Federsätze (14, 16) eine Federkonstante im Bereich von 390 N/mm bei Leergewicht bis 1.750 N/mm bei Last haben.
17. Drehgestell nach Anspruch 15 oder 16, bei dem sich in Verwendung das untere Ende des Federsatzes (14, 16) in einer Höhe befindet, die im Bereich von 220 mm bis 250 mm über der Schiene bei einem Drehgestell mit Rädern eines Durchmessers von 920 mm liegt.
18. Drehgestell nach einem der vorhergehenden Ansprüche, bei dem sich der Kolben (26) über eine Distanz von wenigstens etwa 7 mm bewegen kann.

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19. Drehgestell nach Anspruch 18, bei dem sich der Kolben (26) über eine Distanz von wenigstens etwa 9 mm bewegen kann.

## Revendications

1. Bogie comprenant une plaque de garde (10) supportée par l'intermédiaire d'ensembles de ressort (14, 16) par une boîte d'essieu (12) et un ensemble d'amortissement pour l'amortissement d'un mouvement vertical relatif entre la boîte d'essieu (12) et la plaque de garde (10), l'ensemble d'amortissement comprenant un piston (26) guidé pour le mouvement par rapport à la plaque de garde (10) et présentant une surface pouvant coopérer avec une surface (12a) de la boîte d'essieu (12), un ensemble d'entraînement (22, 24) étant prévu pour déplacer le piston (26), **caractérisé en ce que** ladite surface du piston (26) comprend un matériau composite (29) tel qu'en utilisation, il n'y ait aucune interface de glissement métal à métal entre la boîte d'essieu (12) et le piston (26).
2. Bogie selon la revendication 1, dans lequel l'ensemble d'entraînement pour le piston (26) comporte une coulisse Lenoir (24) inclinée.
3. Bogie selon la revendication 1 ou la revendication 2, dans lequel la surface du matériau composite (29) du piston (26) comprend une surface d'un élément de matériau composite (32) fixé au piston (26).
4. Bogie selon la revendication 3, dans lequel l'élément de matériau composite (32) est fixé mécaniquement au piston (26).
5. Bogie selon la revendication 3, dans lequel l'élément de matériau composite (32) est collé à chaud au piston (26).
6. Bogie selon la revendication 1 ou la revendication 2, dans lequel le piston (26) est construit en matériau composite, une structure de renforcement adaptée étant prévue dans le piston (26) pour lui donner la rigidité requise pour fonctionner correctement.
7. Bogie selon l'une quelconque des revendications précédentes, dans lequel le piston (26) est guidé pour le mouvement de glissement par rapport à la plaque de garde (10).
8. Bogie selon l'une quelconque des revendications 1 à 6, dans lequel un ensemble de montage résilient (34) est prévu entre le piston (26) et la plaque de garde (10) de sorte à permettre au piston (26) de se déplacer par rapport à la plaque de garde (10), l'ensemble de montage résilient (34) subissant une dé-

- formation résiliente tout en évitant tout contact de glissement entre la plaque de garde (10) et le piston (26).
- 9.** Bogie selon la revendication 8, dans lequel l'ensemble de montage résilient comprend un manchon en matériau résilient (34) fixé à la fois au piston (26) et à la plaque de garde (10). 5
- 10.** Bogie selon l'une quelconque des revendications précédentes, comprenant en outre un second piston (26b) guidé pour le mouvement par rapport à la plaque de garde (10), le second piston (26b) ayant aussi une surface pouvant coopérer avec une surface (12a) de la boîte d'essieu (12), un second ensemble d'entraînement (22b, 24b) étant prévu pour déplacer le second piston (26b). 10  
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- 11.** Bogie selon la revendication 10, dans lequel le second ensemble d'entraînement comprend une coulisse Lenoir (24b). 20
- 12.** Bogie selon la revendication 10 ou la revendication 11, dans lequel ladite surface du second piston (26b) comprend un matériau composite. 25
- 13.** Bogie selon l'une quelconque des revendications 10 à 12, dans lequel le second piston (26b) est guidé pour le mouvement de glissement par rapport à la plaque de garde (10). 30
- 14.** Bogie selon l'une quelconque des revendications 10 à 13, dans lequel un ensemble de montage résilient (34) est prévu entre le second piston (26b) et la plaque de garde (10) de sorte à permettre au second piston (26b) de se déplacer par rapport à la plaque de garde (10), l'ensemble de montage résilient (34) subissant une déformation résiliente tout en évitant tout contact de glissement entre la plaque de garde (10) et le second piston (26b). 35  
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- 15.** Bogie selon l'une quelconque des revendications précédentes, dans lequel les ensembles de ressort du bogie présentent une longueur compressée comprise dans la plage d'approximativement 300 à 190 mm. 45
- 16.** Bogie selon l'une quelconque des revendications précédentes, dans lequel les ensembles de ressort (14, 16) présentent une constante de rappel comprise dans la plage de 390 N/mm à vide à 1 750 N/mm chargé. 50
- 17.** Bogie selon la revendication 15 ou 16, dans lequel, en utilisation, l'extrémité inférieure de l'ensemble de ressort (1A, 16) est située à une hauteur comprise dans la plage de 220 à 250 mm au-dessus de la voie dans un bogie doté de roues de 920 mm de diamètre. 55
- 18.** Bogie selon l'une quelconque des revendications précédentes, dans lequel le piston (26) est autorisé à se déplacer sur une distance d'au moins environ 7 mm.
- 19.** Bogie selon la revendication 18, dans lequel le piston (26) est autorisé à se déplacer sur une distance de 9 mm ou plus.

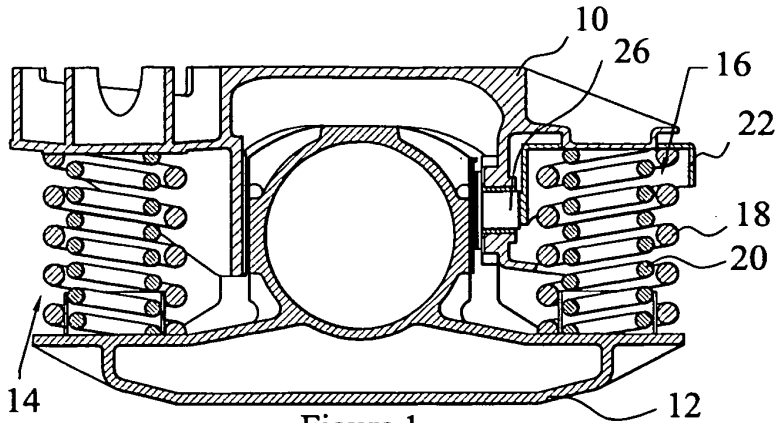


Figure 1

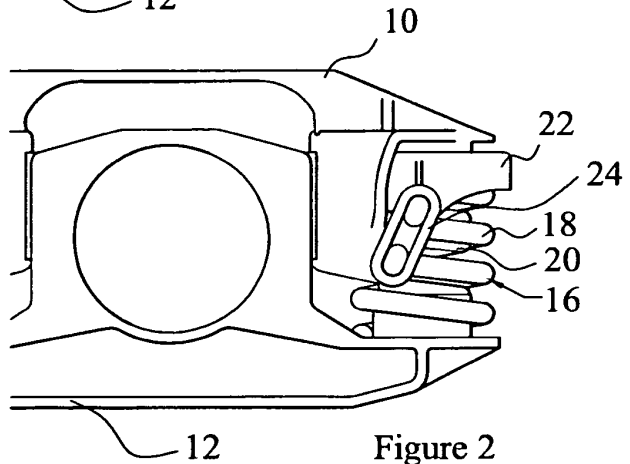


Figure 2

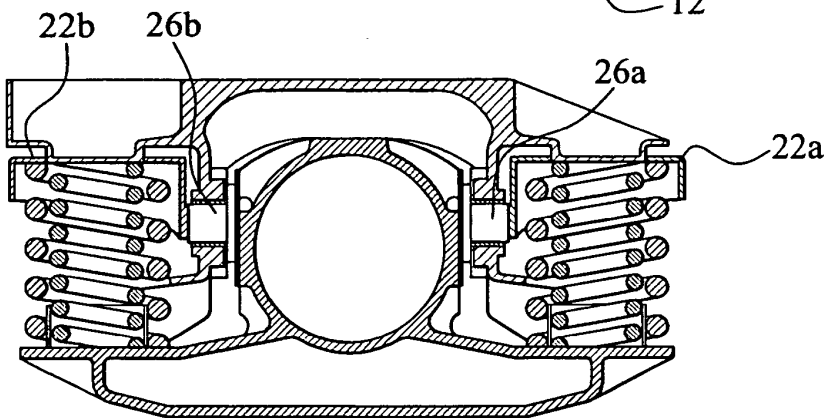
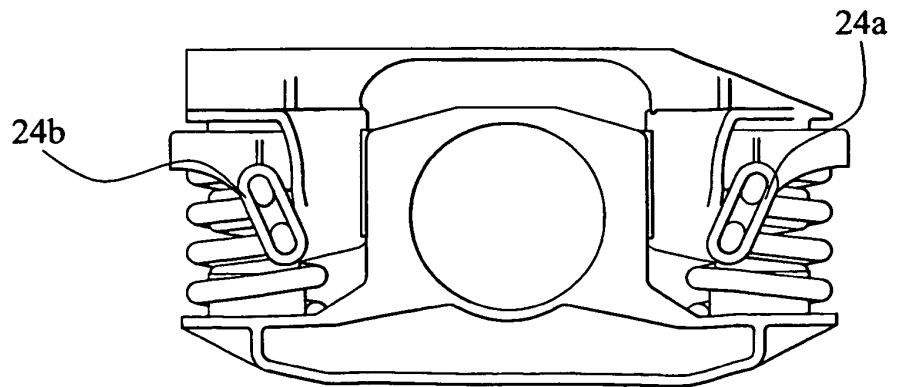


Figure 4

Figure 5



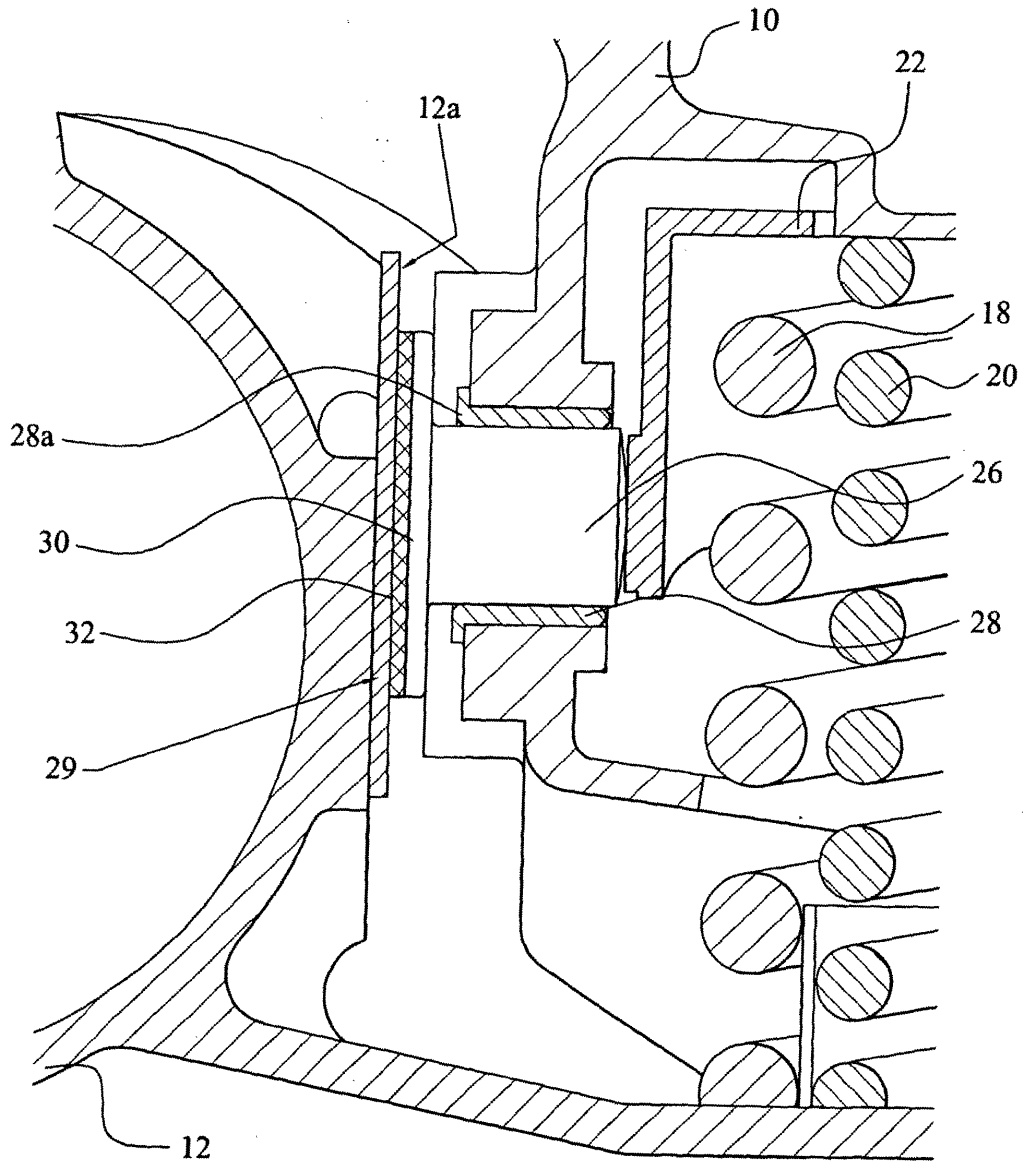
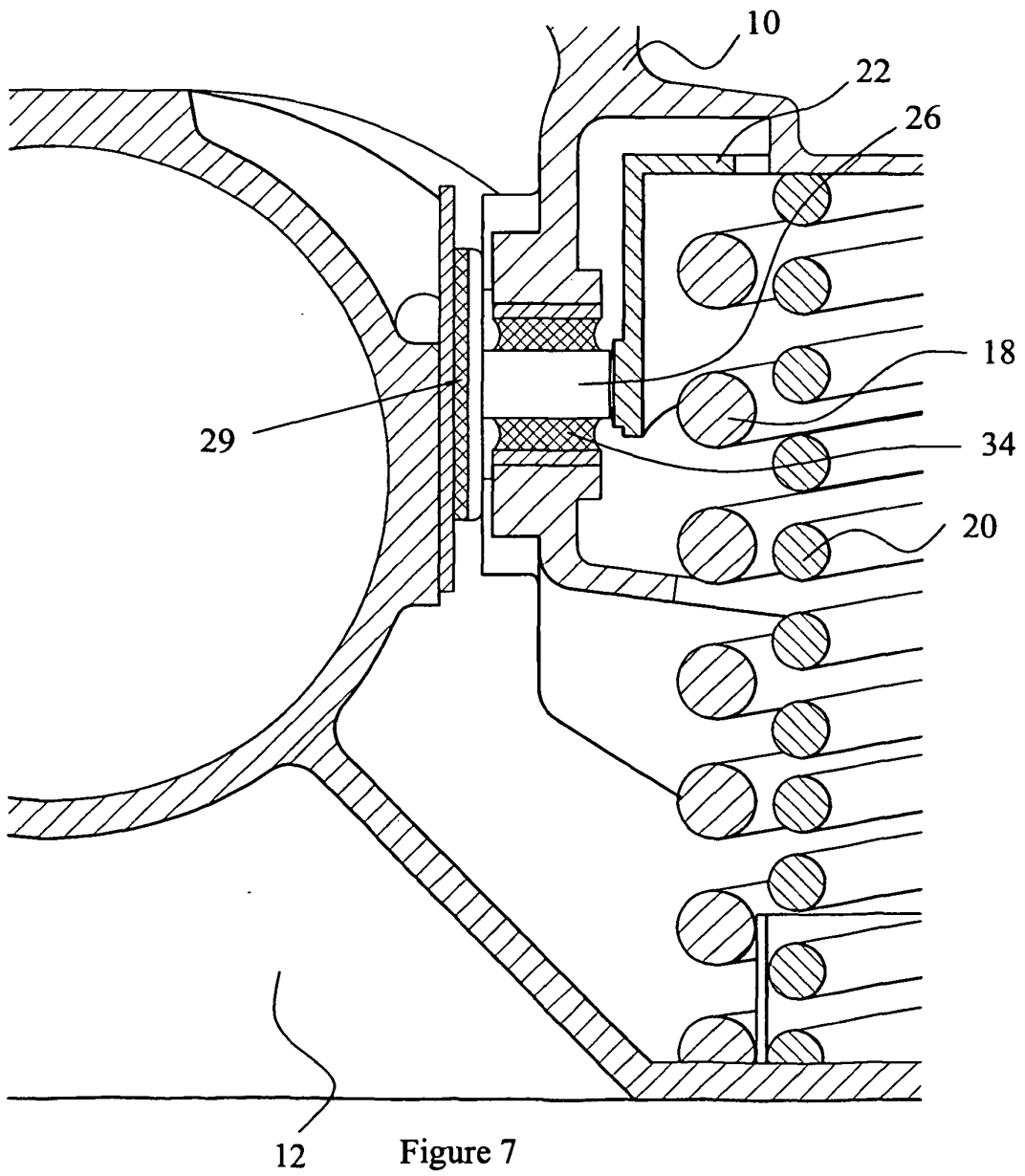
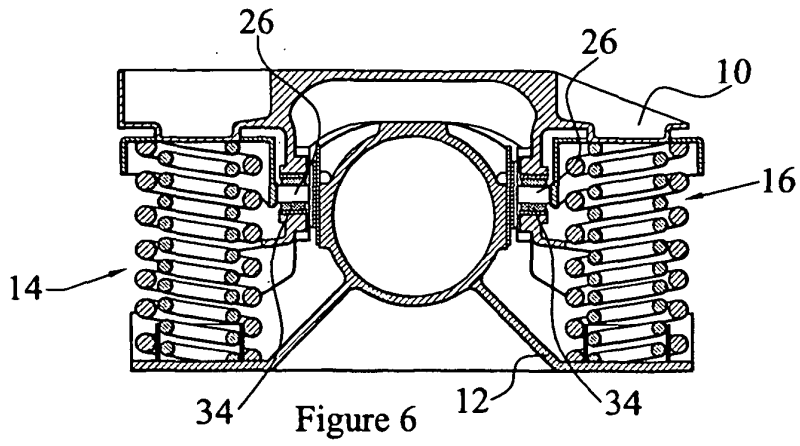


Figure 3



**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

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- EP 1186504 A [0004]