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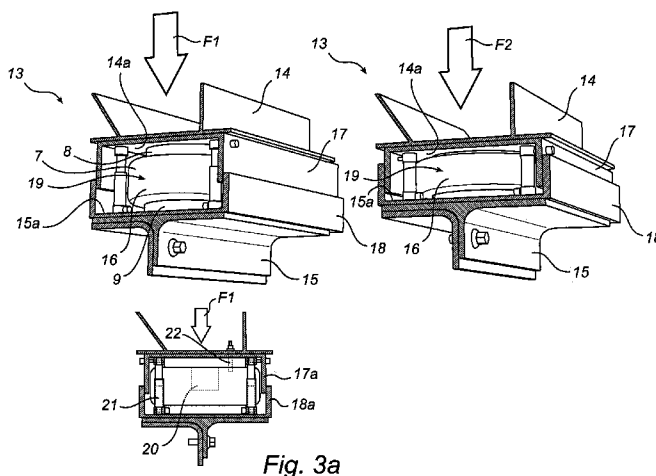


Fig. 3a

(57) Abstract: A supporting device (13) for a superstructure mounted on a vehicle frame, comprising a first fitting (14) for attaching the device to the superstructure, a second fitting (15) for attaching the device to the vehicle frame, and a resilient support element sandwiched between a first surface (14a) of the first fitting and a second surface (15a) of the second fitting, wherein the resilient support element is a pneumatic cushion (16). A resilient pneumatic cushion has better material characteristics and is more durable than rubber cushions. The present invention therefore provides a supporting device for a superstructure on a vehicle frame which is more durable and requires less maintenance than today's rubber cushions solutions.

SUPERSTRUCTURE SUPPORTING DEVICE, VEHICLE PROVIDED WITH
SUCH A DEVICE, AND A PNEUMATIC SYSTEM FOR A VEHICLE

Technical field

The present invention relates to a device for supporting a superstructure mounted on a vehicle frame, comprising: a first fitting for attaching the device to the superstructure, a second fitting for attaching the device to the vehicle frame, and a resilient support element sandwiched between a first surface of the first fitting and a second surface of the second fitting. The invention also relates to a vehicle provided with such a device, and a pneumatic system for a vehicle.

10 Technical background

Heavy vehicles are often provided with a superstructure or body building, such as a tank or load platform, mounted on the vehicle frame. In order to allow for movement of the frame, e.g. caused by unevenness in the road, the body is suspended by rubber cushions, in turn mounted on the frame. This is especially important for torsion stiff superstructures, such as tanker bodies, dry bulk bodies, waste compactors and slurry tanker bodies.

An example of a conventional rubber cushion is illustrated in figure 1, and comprises a frame fitting 1, a body fitting 2, and two rubber members 3, 4 of different stiffness arranged between the two fittings. The fittings are typically provided with guiding rims 5, to secure the rubber members in place.

Such rubber cushions are subject to extensive wear, due to high and varying stress, as well as extreme climate conditions. As a result, the rubber members become exhausted, and require expensive maintenance and replacement.

25

Summary of the invention

It is therefore an object of the invention to provide an improved apparatus for supporting a superstructure mounted on a vehicle frame.

A first aspect of the invention relates to a device for supporting a superstructure mounted on a vehicle frame, comprising a first fitting for

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attaching the device to the superstructure, a second fitting for attaching the device to the vehicle frame, and a resilient support element sandwiched between a first surface of the first fitting and a second surface of the second fitting, wherein the resilient support element is a pneumatic cushion.

5 By "pneumatic cushion" is intended any element where a gas such as air is arranged to provide a damping spring action.

A resilient pneumatic cushion has better material characteristics and is more durable than solid rubber cushions. The present invention therefore provides a device for supporting a superstructure on a vehicle frame which is
10 more durable and requires less maintenance than today's rubber cushions solutions.

A pneumatic cushion may also provide greater adjustability, and thus handle larger variations in distance between the superstructure and the frame. This is advantageous when the superstructure is torsion stiff and the
15 vehicle is exposed to large level differences, e.g. is operated over a curb. Under such circumstances, the vehicle frame may twist as much as 10-15 degrees, requiring a large compensation by the supporting devices.

Also, pneumatic cushions have better damping characteristics than rubber cushions and this may contribute to better performance for the truck as
20 whole. A shock absorber may also be arranged between the surfaces in order to further improve shock handling.

The first surface and second surfaces are preferably horizontal, in order to avoid causing stress on the pneumatic cushion.

The supporting device may include an abutment arranged between the
25 opposing surfaces and adapted to ensure a minimum distance between the surfaces. Such an abutment serves for limitation of the cushion compression and ensures emergency operating characteristics. It also prevents the air cushion from being damaged.

The device may further comprise a first rim extending from said first
30 surface towards the pneumatic cushion and a second rim extending from the second surface towards said pneumatic cushion, wherein the rims are adapted to guide horizontal movement of the pneumatic cushion. Such rims will ensure a more reliable function of the cushion.

The rims may further be telescopically arranged relative each other so as to form a compartment, in which the cushion is enclosed. Such an arrangement will serve to protect the pneumatic cushion from outside forces and dirt.

5 Furthermore, the pneumatic cushion can comprise an inlet connectable to a pressurized channel for allowing adjustment of a gas pressure in said pneumatic cushion.

Such an inlet can advantageously be connected to a pneumatic system of the vehicle and this gives several advantages, since it is possible to
10 increase or decrease the air pressure of the air cushion and hence easily regulate the vertical elevation of the superstructure of the vehicle.

For example, an operator may manually increase or decrease the pressure in one or several supporting devices, thereby lowering, raising, or tilting the superstructure. By lowering the superstructure when the vehicle is
15 driving at a smooth way, and less clearance between the superstructure and frame is required, the fuel consumption of the vehicle can be reduced due to decreasing of the air resistance.

A controller of the pneumatic system may also be connected to various sensors, thereby enabling automatic adjustments of the pressure in the
20 supporting devices.

Such sensors may include a level sensor connected to the fittings and adapted to detect the vertical distance between the opposing surfaces and a pressure sensor arranged to detect a pressure inside the pneumatic cushion.

25 Brief description of the drawings

The present invention will now be described in more detail with reference to the accompanying schematic drawings which show preferred embodiments of the invention.

Fig. 1 shows a supporting device according to prior art.

30 Fig. 2 shows a heavy vehicle having a torsion stiff superstructure mounted thereon, supported by a plurality of supporting devices according to an embodiment of the present invention.

Fig. 3a show a perspective view of a supporting device according to a first embodiment of the present invention in a first, unloaded, position.

Fig. 3b shows the supporting device in figure 3a in a second, loaded and compressed, position.

5 Fig. 4a-b show a perspective cross section of a supporting device according to a second embodiment of the present invention.

Fig. 5a-b show a cross section of a supporting device according to a third embodiment of the present invention.

Fig. 6 shows a schematic diagram of a pneumatic/electrical control
10 system for controlling supporting devices according to an embodiment of the present invention.

Fig. 7 shows a schematic diagram of a pneumatic/manual control system for controlling supporting devices according to an embodiment of the present invention.

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Detailed description of preferred embodiments

Figure 2 shows a heavy vehicle with a superstructure construction 11, mounted on the vehicle frame 12. By superstructure is intended any separate construction mounted on a vehicle frame, but not light weight bodywork such
20 as a driver cab, fenders or wheel housing. Examples of superstructures are tanks and cargo carrying structures. The superstructure 11 is supported by a number of supporting devices 13 according to an embodiment of the present invention. The number of supporting devices will depend on the superstructure construction and expected load, and is typically four or six.

25 The embodiments of supporting devices described hereinafter are suitable for any vehicle superstructure, but are particularly advantageous for supporting torsion stiff superstructures, i.e. superstructures that will not adapt, or only partially adapt, to torsion motion of the frame. Such torsion motion may result e.g. when passing a curb or simply because the road or ground is
30 uneven. Examples of a torsion stiff superstructure are a tanker body, a dry bulk body, a waste compactor or a slurry tanker body.

If the superstructure construction 11 is torsion stiff, it is important that the supporting devices 13 are resilient, and can adjust the distance between

the superstructure and the frame in a situation where the frame turns or bends.

A first embodiment of the supporting device in figure 2 is shown in figure 3a and 3b. According to this embodiment, the device 13 comprises in one end a fitting 14 for the superstructure, typically adapted to be bolted to a supporting structure of the superstructure. In the other end, the air cushion comprises a fitting 15 for the vehicle frame, typically adapted to be bolted to a beam of the frame. In between these two attachments 14, 15 a resilient support element in the form of at least one pneumatic cushion 16 is arranged, so as to be sandwiched by opposing surfaces 14a, 15a of the fittings 14, 15. The opposing surfaces are here horizontal, but in principle they may be inclined, as long as the pneumatic cushion 16 can act as a pneumatic spring when pressure is applied to force the two opposing surfaces towards each other.

In the following description, the pneumatic cushion 16 is referred to as an "air cushion". However, it should be noted that the present invention is not limited to air as the gas of the pneumatic cushion.

In figure 3a, the device 13 is in its normal state, where a force F_1 applied to the superstructure fitting is adapted to the pressure in the air cushion, so that the air cushion 16 is not substantially compressed. In figure 3b, the device 13 is in its active state, where a force F_2 acting on the superstructure fitting has compressed the air cushion 16 and reduced the distance d between the opposing surfaces 14a, 15a.

The air cushion 16 may be of a commercially available type. Such an air spring is able to handle high and varying stress and extreme climate conditions, without the risk of being exhausted.

In brief, such an air spring comprises an annular bellow 7 of a flexible and air tight material, such as rubber, and two end plates 8, 9 are arranged on either side of the bellow. The plates are provided with rims adapted to engage the upper and lower edges of the bellow, so as to provide a compartment that is air tight when put under pressure. The working principle is similar to that of a wheel tire. The upper and lower end plates may be

provided with means for mechanically mounting the air spring, typically threaded holes for receiving bolts.

The fittings 14, 15 can be provided with lateral guiding edges or rims 17a, 18a, arranged to secure the air cushion in the horizontal plane. In the illustrated example, each guiding rim 17a, 18a is part of a cup-shaped cover 17, 18 that is mounted to the upper and lower attachments 14, 15, respectively. The covers 17, 18 are arranged to engage each other telescopically so as to form a box-like compartment 19 in which the air cushion 16 is arranged. The rims 17a, 18a serve to secure the air cushion 16 in the horizontal plane. In the illustrated example, the rims 17, 18 have a rectangular cross section in the horizontal plane. Alternatively, this cross section can be circular, square, or any other suitable shape, typically corresponding to the shape of the air cushion 16.

The device may further comprise bump stops 20, preferably integrated in the air cushion, but alternatively arranged on one or both of the fittings 14, 15. Such a bump stop 20 is arranged to be brought into contact with an opposing bump stop or an opposing surface when the air cushion is subject to such an excessive load that the air cushion 16 is fully compressed. This prevents the air cushion 16 from being damaged by an excessive pressure.

The device 13 may further comprise a shock absorber 21, connected between the two attachments to reduce any shock. The shock absorber may e.g. be a commercially available shock absorber in the form of a hydraulic cylinder.

The air cushion 16 may be a closed system, i.e. a sealed air bellow with a constant amount of gas inside. As mentioned above, the gas is not restricted to air, even though this is a functional choice of gas.

However, according to a preferred embodiment, the air cushion 16 has an inlet/outlet 22, arranged to be connected to a pneumatic system of suitable type. The mentioned air spring has such an inlet/outlet.

Obviously, the device may comprise more than one air cushion 16, for example in order to withstand larger pressure, i.e. larger loads.

Figures 4a and 4b shows a further embodiment of a supporting device 25 according to the invention, wherein elements similar to those described in

relation to figure 3 have been given identical reference numerals. The device 25 here comprises two air bellows 26a, 26b arranged above each other in two compartments 27a, 27b formed by two interacting box-like members 28, 29. The members 28, 29 are interleaved in each other, and the lower side 28a of
5 the upper member 28 divides the inner space of the lower box 29 into the two compartments 29a, 29b.

When a pressing force F_1 is applied on the superstructure fitting 14 (fig 4a), the entire upper member 28 is pressed downwards, against the action of the air cushion 26a in the lower compartment 27a. The air cushion 26a is
10 compressed between the lower side 28a of the upper member 28 and the lower side 29a of the lower member 29. When, on the other hand, a dragging force F_2 is applied on the superstructure fitting 14 (fig 4b), the entire upper member 28 is pulled upwards, against the action of the air cushion 26b in the upper compartment 27b. The air cushion 26b is compressed between the
15 lower side 28a of the upper member 28 and the upper side 29b of the lower member 29.

The working principle of the device in figure 4 is similar to that of the prior art device in figure 1, but with all the advantages of the present invention. In the prior art device in figure 1 the rubber dampers may be of
20 different characteristics, i.e. have different softness, in order to provide the desired characteristics. In a similar fashion, the air cushions 26a, 26b in figure 4 may have different gas pressure, thereby having different characteristics. As an example, the lower air cushion 26a, arranged to absorb the comparably large downwards forces, may have a higher internal gas pressure than the
25 upper air cushion 26b, arranged to absorb the comparably smaller upwards forces.

It should be noted that the air cushion 26a equally well could be arranged in the compartment 27c formed between the upper side 28b of the upper member 28, and the upper side 29b of the lower member 29.

30 Figure 5 shows a further embodiment, similar to that in figure 4, but with three air cushions 30a, 30b, 30c. Here, the centre air cushion 30b corresponds to the upper air cushion 26b in figure 4, while the other two air cushions 30a, 30c correspond to the lower air cushion 26a in figure 4.

According to an embodiment of the invention, several air cushions may be connected to a pneumatic system of the vehicle. This is illustrated schematically in figure 6 and 7, illustrating two embodiments of the present invention. In both embodiments, the inlet 22 of each of a set of supporting
5 devices 13 is connected to a pressurized air channel 31 connected to a pneumatic system 32 of the vehicle, e.g. by connection to a manifold adapted for connection of auxiliary equipment.

The system in figure 6 is electronic and at least partly automatic. The pressurized channel 31 of the air cushion 13 is here connected to the
10 pneumatic system 32 of the vehicle via an electronically controllable valve, e.g. a solenoid valve 33. The solenoid valve 33 is controlled by a control unit 34, which is provided with various input data, including for example a manual control signal from a manual switch 35, a detected pressure in the channel 31 from a pressure sensor 36, a detected level from a level sensor 37 and
15 control data from the central vehicle computer 38. The control unit 34 is programmed to control the valve 33, and thus the pressure in the air cushion 13, in response to the data supplied to it.

As a simple example, the control unit may be programmed to control the pressure of the individual air cushions so as to maintain a desired
20 inclination of the superstructure, based on detected levels from each air cushion 13. Most typically, the control unit 34 is programmed to keep the superstructure in a horizontal position. Such a programming will thus automatically adjust for any uneven load distribution, by increasing the pressure in an air cushion 13 that is compressed more than others.

25 As another example, the control unit 34 may decrease the pressure in all air cushions 13 in response to the vehicle being operated under highway conditions. Such reduced pressure will serve to lower the height of the superstructure, thus reducing air resistance. Highway conditions may be indicated by few and small fluctuations in level and pressure signaled from
30 the level sensor 37 and pressure sensor 36, or may be signaled from the main vehicle computer 38, based e.g. on vehicle speed variations.

Similarly, the vehicle computer 38 may instruct the control unit 34 to increase pressure in the air cushions 13 if the vehicle is operated under rough

and bumpy conditions. Such increased pressure will serve to increase the clearance between frame and superstructure. Rough and bumpy conditions may be indicated by large and frequent fluctuations in level and pressure signaled from the level sensor 37 and pressure sensor 36, or may be signaled
5 from the main vehicle computer 38, based e.g. on vehicle speed variations.

The manual switch may be used to manually adjust the pressure of one or several air cushions 13, for example for temporarily adjusting the inclination of the superstructure, or to temporarily increase the clearance between the vehicle frame and superstructure. Such temporary increase in
10 clearance may be advantageous for example to prevent heat from the hot engine to warm the cargo in the superstructure.

The signals from the sensors 36 and 37 may also be communicated to the main vehicle computer 38 via the control unit 34 and be used for various diagnostic and evaluation purposes. For example, a detected increase in
15 pressure detected by sensor 36 indicates an increased load. By using a simple relationship between applied weight on the air cushion 13 and the resulting pressure increase, the detected pressure can therefore be used to weigh the cargo loaded into the superstructure 12. The vehicle computer can be adapted to provide this information to an operator. In a similar way, the
20 computer 38 can be arranged to detect and indicate any displacement of the load, and uneven load distribution, etc.

The system in figure 7 is mechanical and manual. Here, the channel 31 is again connected to the vehicle pneumatic system 32, this time via a pneumatical level valve 41 and a manual valve 42.

25 The pneumatical level valve 41 is fixedly arranged in relation to the vehicle frame 12, and is provided with a mechanical lever 43 arranged to rest against the superstructure 11. The lever 43 will thus be influenced by any relative movement between the superstructure 11 and frame 12, and will influence the valve 41 accordingly, to adjust the pressure in the air cushion
30 13. The lever thus acts as a mechanical feedback, and the valve 41 can be adapted to maintain a predefined distance between the superstructure 12 and frame 11.

10

The manual valve 42 is arranged to allow a user to manually adjust the pressure in the air cushion 13, and thus has a similar function as the manual switch 35 in the electronic system in figure 6.

5 Of course, also in a system with manual/ pneumatical valves 41, 42 as shown in figure 7, sensors 36, 37 may be provided to detect the pressure in the channel 31 and the level of the air cushion 13. Signals from these sensors may be connected to a main vehicle computer 38, and be used to provide the same advantages as described above with reference to the electronic system.

10 The person skilled in the art realizes that the present invention by no means is limited to the preferred embodiments described above. On the contrary, many modifications and variations are possible within the scope of the appended claims. For example, the shape and form of the pneumatic cushion 16, as well as any enclosing covers 17, 18 may be different. Also, the number of cushions in each individual supporting device may vary, depending
15 on the application.

The block diagrams of the illustrated pneumatic systems are merely schematic, and not intended to limit the invention. Other components may be included in such systems, and the number of supporting devices will be determined by the implementation.

20

CLAIMS

1. A supporting device (13) for a superstructure (11) mounted on a vehicle frame (12), comprising:

- 5 a first fitting (14) for attaching the device to the superstructure,
 a second fitting (15) for attaching the device to the vehicle frame, and
 a resilient support element sandwiched between a first surface (14a) of
said first fitting and a second surface (15a) of said second fitting,
c h a r a c t e r i z e d i n t h a t
10 said resilient support element is a pneumatic cushion (16).

2. The device according to claim 1, wherein
the first surface of said first fitting and the second surface of said
second fitting are horizontal.

15

3. The device according to claims 1 or 2, wherein said pneumatic
cushion (16) is an air spring comprising
a annular wall (7) of flexible material, and
an end plate (8, 9) arranged at each end of the wall so as to form an air
20 tight compartment.

4. The device according to one of claims 1-2, further comprising an
abutment (20) arranged between said surfaces (14a, 15a) and adapted to
ensure a minimum distance between said surfaces (14a, 15a).

25

5. The device according to claim 1-4, wherein
said device further comprises:

- a first rim (17a) extending from said first surface (14a) towards said
pneumatic cushion (16) and a second rim (18a) extending from said second
30 surface (15a) towards said pneumatic cushion (16),
 wherein said rims are adapted to guide horizontal movement of said
pneumatic cushion (16).

6. The device according to claim 4, wherein
the first rim and second rim (17a, 18a) are telescopically arranged
relative each other forming a compartment (19), wherein said pneumatic
5 cushion (16) is enclosed in the compartment.

7. The device according to one of the preceding claims, comprising a
first box-like frame member (28) mounted to the first fitting (14), and a second
box-like frame member (29) mounted to the second fitting (15), said members
10 (28, 29) being interleaved in each other so as to form two compartments (27a,
27b), each compartment housing a pneumatic cushion (26a, 26b), so that a
compression of said fittings (14, 15) will cause compression of one of said
pneumatic cushions (26a) and a separation of said fittings (14, 15) will cause
a compression of another pneumatic cushion (26b).

15

8. The device according to one of the preceding claims, wherein said
device further comprises a level sensor (37) connected to said fittings,
adapted to detect the vertical distance between said opposing surfaces (14a,
15a).

20

9. The device according to one of the preceding claims, wherein said
device further comprises a shock absorber (21) arranged between said
fittings (14, 15) to reduce shocks.

25

10. The device according to one of the preceding claims, wherein said
device further comprises a pressure sensor (36) arranged to detect a
pressure inside said pneumatic cushion.

11. The device according to one of the preceding claims, wherein said
30 device comprises an inlet (22) connectable to a pressurized channel (31) for
allowing adjustment of a gas pressure in said pneumatic cushion.

13

12. A pneumatic system for a vehicle, comprising a supply (32) of pressurized gas, and a set of supporting devices (13) according to claim 11 connected to said supply (32).

5 13. The pneumatic system according to claim 12, further comprising a valve (33, 41, 42) for controlling the pressure of each pneumatic cushion (16).

14. The pneumatic system according to claim 13, further comprising a control unit (34) for controlling the valve (33).

10

15. The pneumatic system according to claim 14, wherein said control unit is connected to a pressure sensor (36) providing an indication of a pressure in said pneumatic cushion (16).

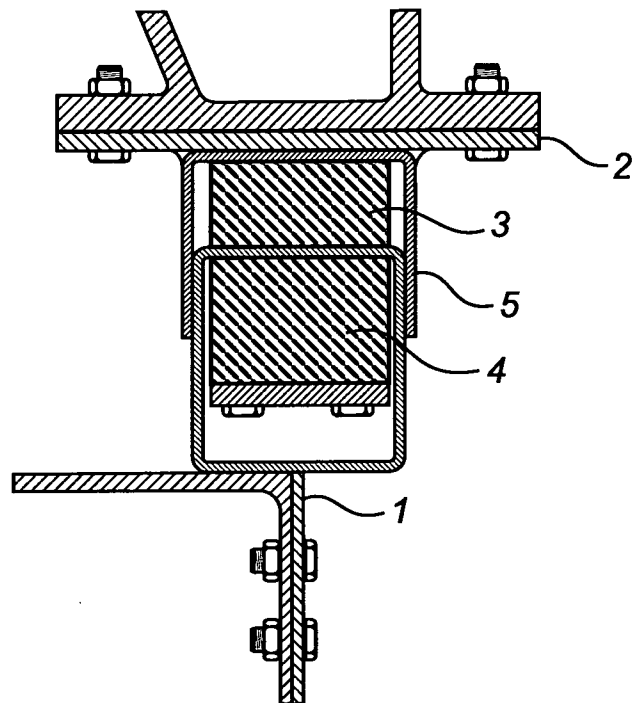
15 16. The pneumatic system according to claim 14 or 15, wherein said control unit is connected to a level sensor (36) providing an indication of a level of said pneumatic cushion (16).

17. A vehicle comprising a frame (12), a superstructure (11), and a set
20 of pneumatic supporting devices (13) according to any one of claims 1-11.

18. The vehicle according to claim 13, further comprising a pneumatic system according to one of claims 12 - 16.

25 19. The vehicle according to claim 17 or 18, wherein said superstructure is torsion stiff.

1/4



(Prior art) *Fig. 1*

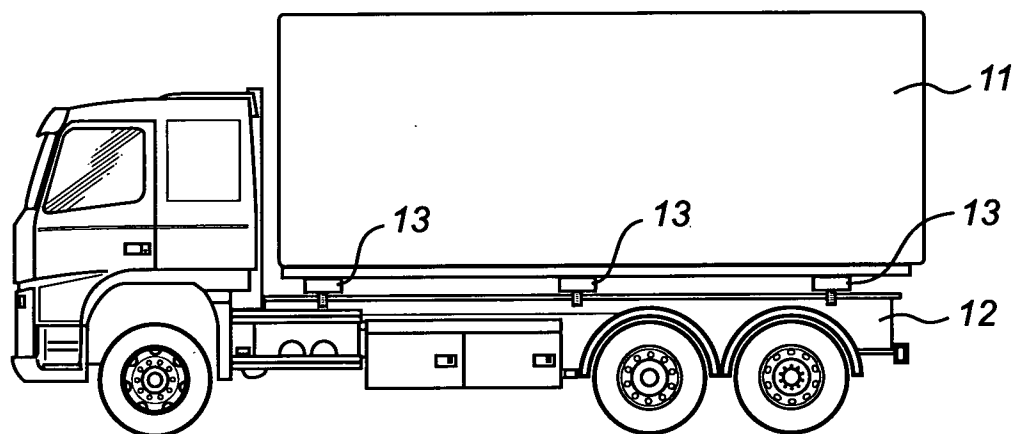


Fig. 2

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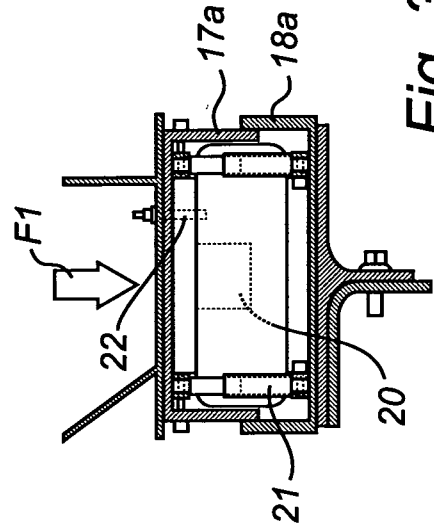
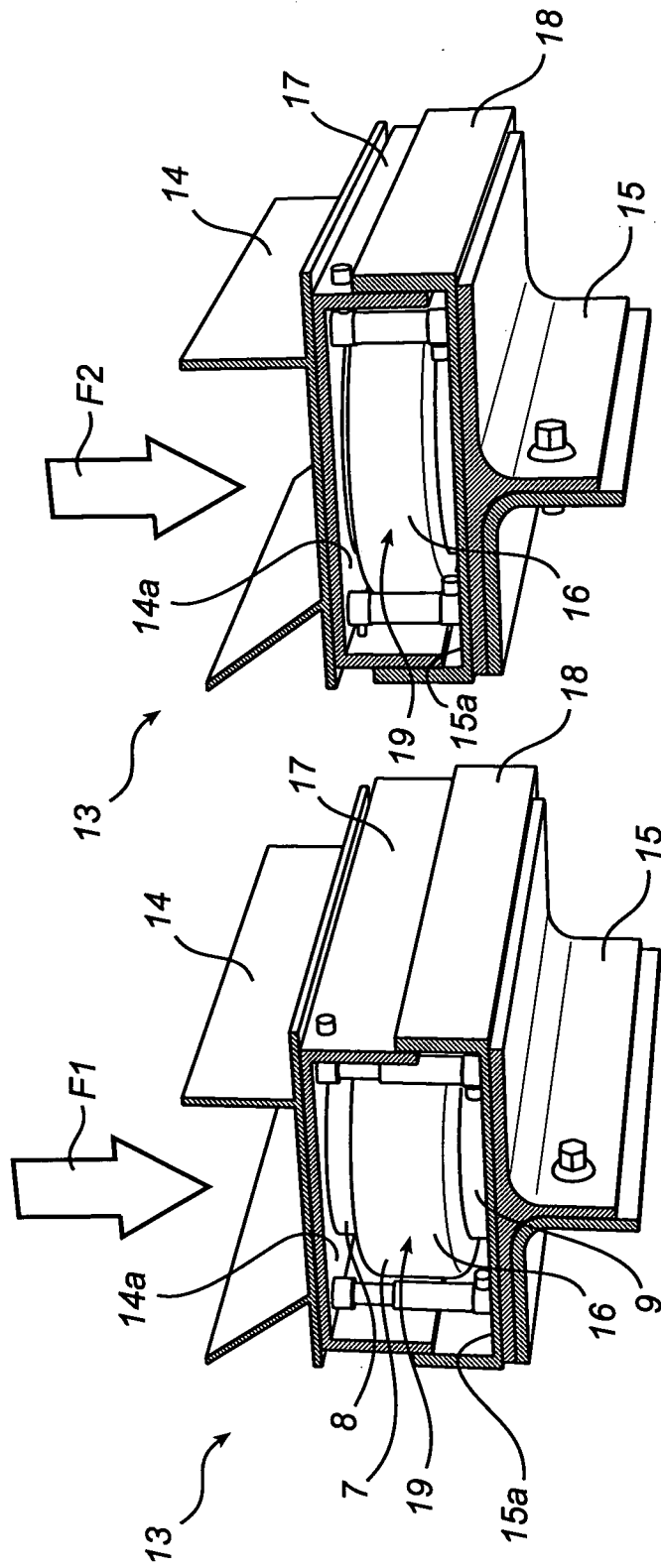


Fig. 3a

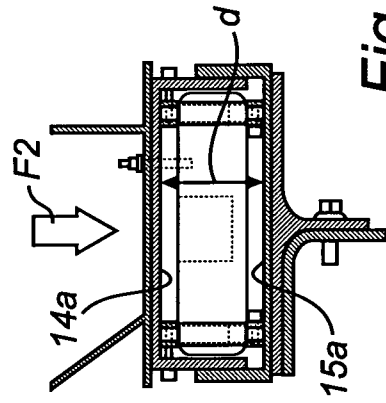
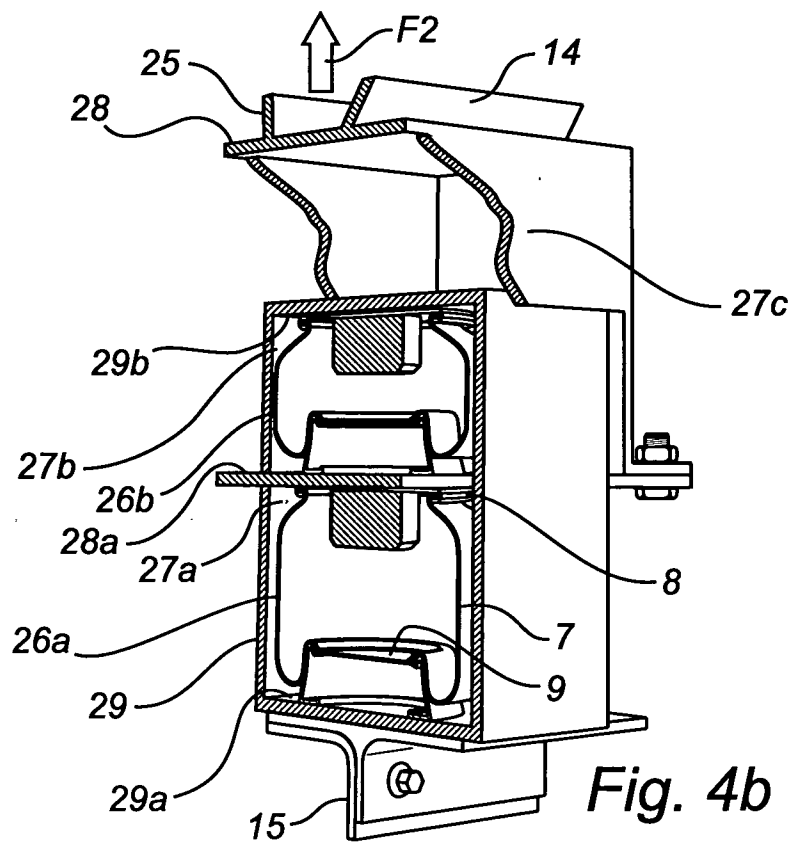
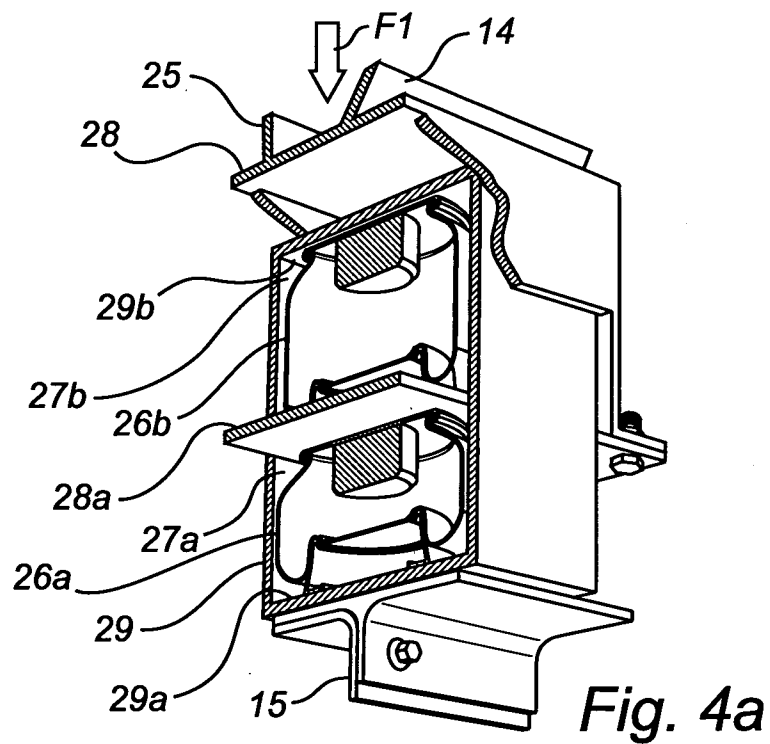


Fig. 3b

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4/4

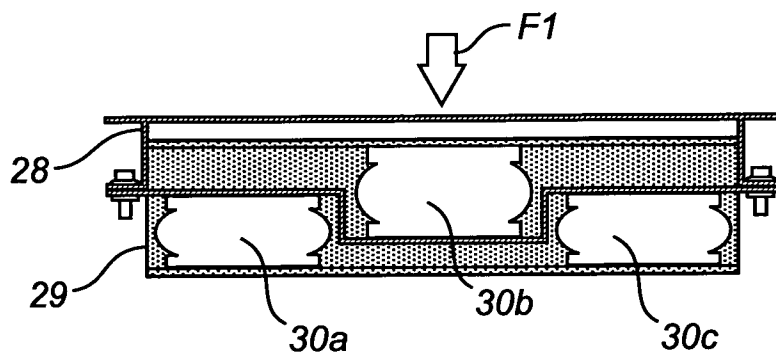


Fig. 5a

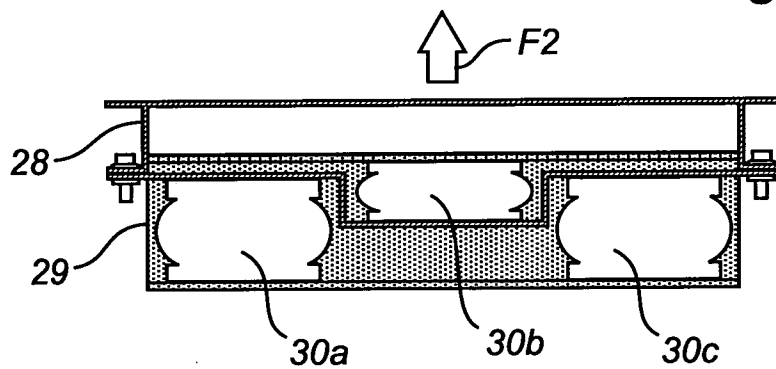


Fig. 5b

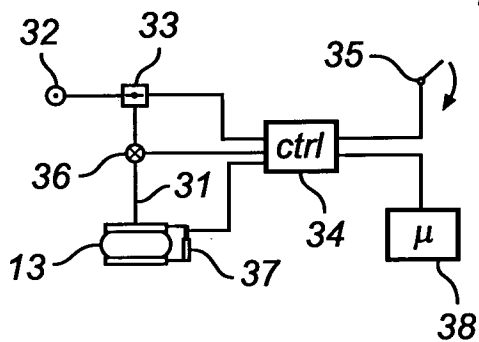


Fig. 6

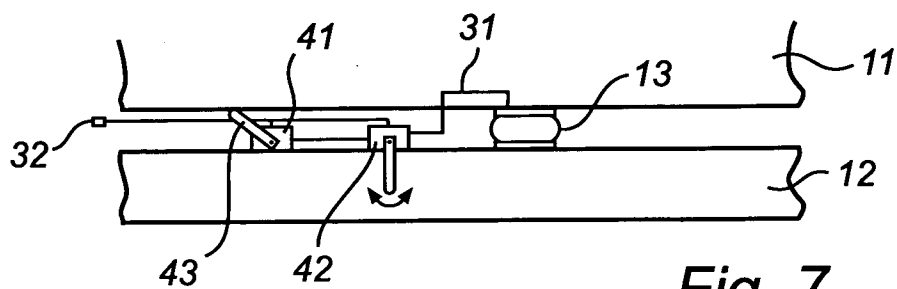


Fig. 7

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE2007/001137

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: B62D

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

SE,DK,FI,NO classes as above

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

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3361444 A (H.C. HARBERS), 2 January 1968 (02.01.1968), column 2, line 29 - column 3, line 26, figures 1-3 --	1-19
X	FR 857541 A (M. PAULCHAUVIN), 17 Sept 1940 (17.09.1940), figures 1-3 --	1
X	DE 427440 C (CHARLES EDWARD HOLDEN), 8 April 1926 (08.04.1926), figures 1-4 --	1
X	GB 229543 A (HENRY BEVAN SWIFT), 26 February 1925 (26.02.1925), figures 1,2 --	1

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search

22 August 2008

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE2007/001137

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 1329683 A (F.J. TROLL), 3 February 1920 (03.02.1920), figures 1-3 --	1
X	WO 2006114945 A1 (MUGEN CORPORATION), 2 November 2006 (02.11.2006), figures 1-9 -- -----	1

International patent classification (IPC)**B62D 33/10** (2006.01)**B62D 24/02** (2006.01)**Download your patent documents at www.prv.se**

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Use the application number as username.

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Paper copies can be ordered at a cost of 50 SEK per copy from PRV InterPat (telephone number 08-782 28 85).

Cited literature, if any, will be enclosed in paper form.

INTERNATIONAL SEARCH REPORT

Information on patent family members

28/06/2008

International application No.

PCT/SE2007/001137

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