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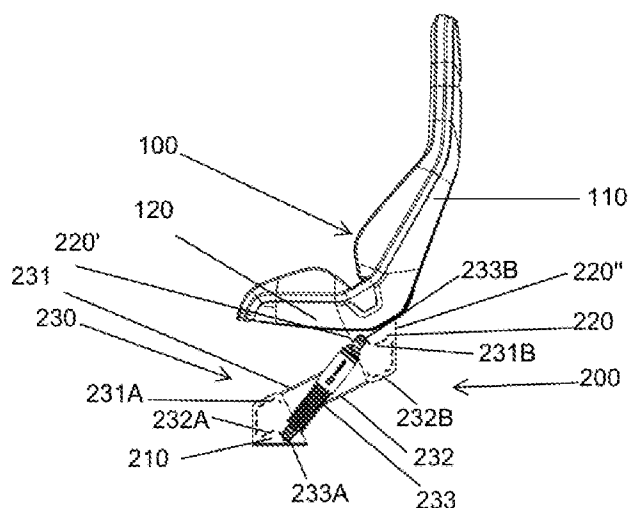
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(54)	Title	Seat frame with damper
(57)	Abstract	

A sprung seat frame (200) for providing damping to a seat (100) of a vehicle, the sprung seat frame (200) comprising: a base element (210) configured for attaching the frame (200) to the floor of a vehicle; a top element (220) configured for attaching the frame (200) to a seat (100); and a spring arrangement (230) comprising at least a first leaf spring (231) and a first damper (233); wherein the first leaf spring (231) comprises a first end (231A) non-rotatably connected to the base element (210) and a second end (231B) non-rotatably connected to the top element (220), and the damper (233) comprises a first end (233A) connected to the base element (210) at a first connection and a second end (233B) connected to the top element (220) at a second connection; wherein the first connection and/or the second connection is a rotatable connection; and wherein the first leaf spring (231) and damper (233) are obliquely inclined between the base element (210) and the top element (220).



Description and claims

SEAT FRAME WITH DAMPER

FIELD

The present invention relates to a damping system for a seat. More particularly, a
5 damping system for a seat for a land or water vehicle which travels over rugged terrain or waves. The invention finds particular utility in high-speed watercraft, such as in speed-boats for example.

BACKGROUND

Many different types of boats are designed to travel over rough water at high
10 speeds. Performance leisure craft as well as rescue craft are just some examples of such boats. The boats may be in the form of, for example, yachts, cabin cruisers or rigid inflatable boats also known as RIBs. When such a boat travels over waves, the entire boat experiences the powerful forces of the waves. To ensure that the driver and passengers of the boat are not injured, removed from their seats, or uncomfortably shaken, the seats of
15 such boats are often installed on a support frame which comprises some form of damping.

US Patent 5,505,521 discloses a sprung seat frame comprising a base element, a top element and a spring arrangement between the base and top elements. The spring arrangement has at least two leaf springs which are arranged one above the other at a spacing from each other and at least approximately parallel to each other. One end portion of each leaf spring is connected to the base element and the second end portion of
20 each leaf spring is connected to the top element. The leaf springs are disposed obliquely inclined between the base and top elements. At least one corrector leaf spring which is oriented at least approximately parallel to the leaf springs and which is shorter than the same is additionally operatively disposed between the base and top elements. This arrangement allows for optimisation of the springing characteristic of the seat frame.
25

However, since the corrector leaf spring is shorter than the at least two leaf springs, the footprint required to install the sprung seat frame is large. Typically on high speed watercraft, available space is limited and so there is a strive towards a reduction of the footprint of equipment on the watercraft. Additionally, the corrector leaf spring being shorter provides a potential trip hazard, which is highly undesirable particularly on watercraft which may already be experiencing motions or travelling at high speeds.

US 2,641,307 provides a sprung seat frame comprising two leaf springs which are connected by a plurality of coil springs. This design is rather complicated and has a considerable number of components which make the assembly and maintenance of the seat frame time consuming and complicated. Additionally, the seat frame only has a single defined springing characteristic, which cannot be adjusted in any way by the user. This means that if the seat frame is to be provided on a boat for travelling at particularly high speeds and/or rough sea states for example, the seat frame springing characteristic may not be adjusted to provide the greater damping required at such speeds and/or in such environments.

The invention has for its object to remedy or to reduce at least one of the drawbacks of the prior art, or at least provide a useful alternative to prior art.

The object is achieved through features, which are specified in the description below and in the claims that follow.

SUMMARY

The invention is defined by the independent patent claims. The dependent claims define advantageous embodiments of the invention.

According to a first aspect of the invention, there is provided a sprung seat frame for providing damping to a seat of a vehicle, the sprung seat frame comprising: a base element configured for attaching the frame to the floor of a vehicle; a top element configured for attaching the frame to a seat; and a spring arrangement comprising at least a first leaf spring and a first damper; wherein the first leaf spring comprises a first end non-rotatably connected to the base element and a second end non-rotatably connected to the top element, and the damper comprises a first end connected to the base element at a first connection and a second end connected to the top element at a second connection; wherein the first connection and/or the second connection is a rotatable connection; and wherein the first leaf spring and damper are obliquely inclined between the base element and the top element.

The spring arrangement may be configured to allow the top element to move relative to the base element in a pivotal movement in use.

The spring arrangement may be configured to allow the top element to move relative to the base element in a sprung fashion, thereby providing smooth and comfortable
5 motion of a seat attached to the top element in use.

The spring arrangement may further comprise a second leaf spring comprising a first end non-rotatably connected to the base element and a second end non-rotatably connected to the top element such that the second leaf spring is obliquely inclined between the base element and the top element; and wherein the first leaf spring and the
10 second leaf spring are arranged in a spaced and superposed configuration relative to each other.

The first leaf spring and the second leaf spring may be arranged substantially parallel to each other.

The spring arrangement may further comprise a second damper comprising a first
15 end connected to the base element at a third connection and a second end connected to the top element at a fourth connection such that the second damper is obliquely inclined between the base element and the top element; wherein the third connection and/or the fourth connection is a rotatable connection.

The first and second dampers may be arranged substantially parallel to each
20 other.

The first damper may be a mechanical shock absorber or a hydraulic shock absorber.

The second damper may be a mechanical shock absorber or a hydraulic shock absorber.

The second connection may be located higher on the top element than where the
25 second end of the first leaf spring is non-rotatably connected to the top element. The fourth connection may be located higher on the top element than where the second end of the second leaf spring is non-rotatably connected to the top element.

The first and/or second leaf springs may be configured at an angle of between 10 degrees and 80 degrees, more preferably between 10 degrees and 50 degrees, more preferably between 21.5 degrees and 31.5 degrees, more preferably at or around 26.5 degrees, to the horizontal in use when in a non-loaded configuration. The first and/or second dampers may be configured at an angle of between 10 degrees and 80 degrees, more preferably between 20 degrees and 70 degrees, more preferably between 47.3 degrees and 57.3 degrees, more preferably at or around 52.3 degrees to the horizontal in use when in a non-loaded configuration.

The second connection may be at a forward end of the top element or closer to a forward end of the top element than a rearward end of the top element. The fourth connection may be at a forward end of the top element or closer to a forward end of the top element than a rearward end of the top element.

According to a second aspect of the invention, there is provided a seat for a vehicle, comprising: a sprung seat frame according to the first aspect of the invention a back portion configured for receiving a back of a user in use; and a seat squab attached to the back portion and configured to be sat on by a user in use; wherein the top element of the sprung seat frame is attached to the seat squab by an attachment means, such that in use the sprung seat frame provides damping to the seat squab and back portion of the seat.

According to a third aspect of the invention, there is provided a method of damping a motion of a vehicle seat, comprising the steps of: providing a seat for a vehicle according to the second aspect of the invention; attaching the base element to the floor of the vehicle; providing an impulse to the vehicle; pivoting the top element relative to the bottom element using the spring arrangement; and damping the impulse to the top element using the spring arrangement.

BRIEF DESCRIPTION OF THE DRAWINGS

An embodiment of the invention will now be described, by way of example only, with reference to the following drawings, in which:

Figure 1 shows a sprung seat frame in side view;

Figure 2 shows the sprung seat frame of Figure 1 in front view; and

Figure 3 shows the sprung seat frame of Figure 1 in isometric view.

For clarity reasons, some elements may in some of the figures be without reference numerals. A person skilled in the art will understand that the figures are just principal drawings. The relative proportions of individual elements may also be distorted.

DETAILED DESCRIPTION OF THE DRAWINGS

5 Figure 1 shows a side view of a seat 100 for a vehicle attached to a sprung seat frame 200. Figures 2 and 3 show front and isometric views of the seat 100 and sprung seat frame 200. The seat 100 comprises a back rest portion 110 and a seat squab 120 configured to be sat on by a driver or passenger of the vehicle (not shown), referred to hereafter as the user.

10 Referring firstly to Figure 1, the sprung seat frame 200 comprises a base element 210 which is configured to be attached in use to a vehicle floor (not shown), such as the floor of a boat, a tractor, a lorry, or any other vehicle which may experience violent forces from the surface upon which it travels such as water, soil, mud or sand, for example. In this regard, the term vehicle is used herein to refer to any thing used for transporting people or goods across land or water, or through air. Since vehicle may also refer to a plane,
15 the plane may experience violent forces from extreme weather conditions such as wind, rather than from a surface upon which the plane travels. The sprung seat frame 200 further comprises a top element 220 which is configured to be the attachment point in use between the seat 100 and the sprung seat frame 200.

20 It will be understood that in the presently described example, the base element 210 and top element 220 are each small footprint fixing points, which are configured to provide attachment to the seat 100 and the floor, respectively. However, it will be understood that in some examples the base element 210 and/or top element 220 may be in the form of plate or frame like structures, thereby enabling a larger footprint for attachment to the seat 100 and the floor, respectively. Alternatively, an intermediate plate or frame (not
25 shown) may be provided between the base element 210 and the floor and/or between the top element 220 and the seat 100, to provide a larger footprint for attachment between the base element 210 and the floor and/or the top element 220 and the seat 100, respectively.

The attachment between the top element 220 and a portion of the seat 100 may be
30 by any known attachment means, such as by welding. Alternatively, in some examples, rivets may be provided to secure the top element 220 to a portion of the seat 100. Alternatively, as in the presently described example, releasable attachment may be made by bolts protruding through correspondingly aligned apertures in a portion of the seat 100

and the top element 220. It will be apparent to a person skilled in the art that the attachment of the seat 100 to the top element 220 may take many forms.

Disposed between the base element 210 and the top element 220 is a spring arrangement 230 configured to allow the top element 220 to move in a generally pivotal movement relative to the base element 210. By generally pivotal it is intended to mean that the top element 220 may move around the base element 210 in an arcuate path (not shown). The arcuate path may be of varying radii throughout the arc.

Additionally, as will be described in more detail later, the spring arrangement 230 allows the top element 220 to move in a sprung fashion as it generally pivots relative to the base element 210. This translates into a smooth and comfortable motion of the seat 100 attached to the top element 220 in use.

The spring arrangement 230 comprises first 231 and second 232 leaf springs which are arranged obliquely in a spaced configuration relative to each other and parallel to each other in a superposed configuration, as can be clearly seen in Figure 1. In the presently described example, the leaf springs 231, 232 are arranged at 26.5 degrees relative to the horizontal in use when in a non-loaded configuration shown in Figure 1. In other examples, the leaf springs 231, 232 may be arranged at another acute angle relative to the horizontal in use when in the non-loaded configuration shown in Figure 1, such as between 10 degrees and 80 degrees, more preferably between 10 degrees and 50 degrees, more preferably between 21.5 degrees and 31.5 degrees. It will be understood that the non-loaded configuration refers to the position of the seat frame 200 when the seat frame 200 is not subject to any loading from the vehicle, i.e. the seat frame 200 is in a resting position.

It will be understood that in alternative examples, the first and second leaf springs 231, 232 may be arranged obliquely in a spaced configuration but not strictly parallel to each other. Such an arrangement may be used to adjust the damping force provided by the leaf springs 231, 232 in use.

Additionally, it will be understood that in the presently described example two leaf springs 231, 232 are provided, however in some examples only one leaf spring may be provided. Alternatively, instead of only two leaf springs 231, 232, three, four, five or more leaf springs may be arranged in a spaced configuration to provide sufficient damping in some applications.

Still referring to Figure 1, the first leaf spring 231 comprises a first end portion 231A and a second end portion 231B and the second leaf spring 232 comprises a first end portion 232A and a second end portion 232B. The first end portions 231A, 232A are mounted to the base element 210 and the second end portions 231B, 232B are mounted
 5 to the top element 220.

The seat frame 200 is movable between the non-loaded configuration (shown in Figure 1) and a plurality of loaded configurations (not shown), the exact position of such configurations is dependent on the weight of the user and the forces applied to the top element 220 via the seat 100 from the user, and to the bottom element 210 via the floor
 10 from the vehicle passing over bumps, ditches, potholes etc on land, or waves at sea, for example. Furthermore, forward (or backward) thrust forces of the vehicle will also adjust the exact position of the loaded configuration at any moment in time, therefore a myriad of loaded configurations is possible depending on the use and forces applied in use.

Although not shown in the Figures, it will be understood that as the base element
 15 210 experiences forces from the floor and/or the top element 220 experiences forces from the user, the leaf springs 231, 232 will elastically deform into substantially S-shaped forms with the two first end portions 231A, 232A and two second end portions 231B, 232B remaining mounted in the bottom element 210 and top element 220 respectively.

It will be understood that in some examples the first and second leaf springs 231,
 20 232 may already be in a substantially S-shaped form in the non-loaded configuration. In this regard, the S-shaped form may become more pronounced upon loading of the leaf springs 231, 232.

Referring to Figures 2 and 3 it can be seen that the spring arrangement 230 further comprises a first damper 233 and a second damper 234. In the presently described example,
 25 the first and second dampers 233, 234 are arranged at 52.3 degrees relative to the horizontal in use when in the non-loaded configuration shown in Figures 2 and 3. In other examples, the first and second dampers 233, 234 may be arranged at another acute angle relative to the horizontal in use when in the non-loaded configuration, such as between 10 degrees and 80 degrees, more preferably between 20 degrees and 70 degrees, more
 30 preferably between 47.3 degrees and 57.3 degrees.

Each of the first and second dampers 233, 234 comprise a first end 233A, 234A attached to the base element 210 and a second end 233B, 234B attached to the top element 220. The first and second dampers 233, 234 are arranged obliquely in a spaced

configuration relative to each other with one damper 233, 234 on either side of the leaf springs 231, 232.

As can be seen in Figure 1, the first and second dampers 233, 234 are attached to the top element 220 at a point on the top element 220 which is higher than the point at which the first and second leaf springs 231, 232 are mounted. This ensures that there is enough travel available for the first and second dampers 233, 234. Additionally, by attaching the first and second dampers 233, 234 at a higher point on the top element 220 relative to the mounting point of the first and second leaf springs 231, 232, there is a large enough relative angle between each leaf spring 231, 232 and each damper 233, 234 such that the dampers 233, 234 experience enough travel to dampen the energy of an impact. In the presently described example, the relative angle is 25.8 degrees when in the non-loaded configuration shown in Figures 1-3. It will be understood that in other examples, a relative angle of around 25 degrees when in the non-loaded configuration may be provided. Alternatively, a relative angle of around 20 degrees or around 30 degrees when in the non-loaded configuration may be provided. In some examples, a relative angle of between 15 degrees and 35 degrees when in the non-loaded configuration may be provided.

Still referring to Figure 1, it can be seen that the top element 220 has a forward end 220' and a rearward end 220". In the presently described example the first and second dampers 233, 234 are attached to the top element 220 **closer to the forward end 220' than the rearward end 220"**. In some examples, the first and second dampers 233, 234 may be attached at the forward end 220'. Providing the attachment between the first and second dampers 233, 234 **closer to the forward end 220' than the rearward end 220"** allows the rearward end 220" to be kept clear such that a wider variety of types of seats may be attached to the top element 220 as previously described. The first and second dampers 233, 234 are also parallel to each other. In the presently described example, the first and second dampers 233, 234 are rotatably attached to the base element 210 and top element 220, respectively. This allows the top element 220 to move in a pivotal fashion around the base element 210 during loading and unloading. In some examples, only either the first end 233A, 234A or the second end 233B, 234B of the dampers 233, 234 may be rotatably attached to the bottom element 210 or top element 220 respectively.

It will be understood that in alternative examples, the first and second dampers 233, 234 may be arranged obliquely in a spaced configuration but not strictly parallel to each other. Additionally, it will be understood that in the presently described example two dampers 233, 234 are provided, however in some examples only one damper may be

provided. Alternatively, instead of only two dampers 233, 234, three, four, five or more dampers may be arranged in a spaced configuration to provide sufficient damping in some applications.

5 In the presently described example, the dampers 233, 234 are mechanical shock absorbers and are each configured to absorb or damp shock impulses applied to the spring arrangement 230. In this connection, the dampers 233, 234 work together with the leaf springs 231, 232 to provide smooth motion of the seat 100 attached to the top element 210 in use, thereby ensuring that the user is not injured, ejected from the seat or simply has an uncomfortable ride. This is provided by the leaf springs 231, 232 providing
10 a springy motion to dampen out smaller vibrations and shocks, while the dampers 233, 234 provide damping of larger shock impulses.

The damping force provided by the dampers 233, 234 may be adjusted by changing spring stiffness of the coil spring in the mechanical shock absorbers. In other examples where hydraulic shock absorbers are used for example, the stiffness of the shock ab-
15 sorbers may be changed by changing the hydraulic pressure in the hydraulic shock absorbers. The dampers 233, 234 may be configured such that the user may be able to adjust the damping force provided by the dampers 233, 234 in use. In this regard, if the boat is expected to experience particularly rough sea states or is going to be used at a relatively high speed, then the user may wish to adjust the dampers 233, 234 before use.

20 The described attachment of the dampers 233, 234 to the base element 210 minimises the footprint required of the sprung seat frame 200. In this regard, the base element 210 can be attached directly to the floor of the vehicle and the total footprint is therefore the area of the underside (not shown) of the base element 210, which makes the sprung seat frame 200 easier to install in space limited areas. Furthermore, a smaller footprint of
25 the sprung seat frame 200 makes the vehicle floor easier to clean and maintain. Furthermore, by providing attachment of the dampers 233, 234 to the base element 210 rather than to a separate feature, the dampers 233, 234 are not protruding from the footprint of the base element 210, therefore a trip hazard is avoided.

CLAIMS

1. A sprung seat frame (200) for providing damping to a seat (100) of a vehicle, the sprung seat frame (200) comprising:
 - a base element (210) configured for attaching the frame (200) to the floor of a vehicle;
 - a top element (220) configured for attaching the frame (200) to a seat (100); and
 - a spring arrangement (230) comprising at least a first leaf spring (231) and a first damper (233);
- wherein the first leaf spring (231) comprises a first end (231A) non-rotatably connected to the base element (210) and a second end (231B) non-rotatably connected to the top element (220), and
- the first damper (233) comprises a first end (233A) connected to the base element (210) at a first connection and a second end (233B) connected to the top element (220) at a second connection; wherein the first connection and/or the second connection is a rotatable connection; and
- wherein the first leaf spring (231) and damper (233) are obliquely inclined between the base element (210) and the top element (220).
2. A sprung seat frame (200) according to claim 1, wherein the spring arrangement (230) is configured to allow the top element (220) to move relative to the base element (210) in a pivotal movement in use.
3. A sprung seat frame (200) according to either claim 1 or 2, wherein the spring arrangement (230) is configured to allow the top element (220) to move relative to the base element (210) in a sprung fashion, thereby providing smooth and comfortable motion of a seat (100) attached to the top element (220) in use.
4. A sprung seat frame (200) according to any preceding claim, wherein the spring arrangement (230) further comprises a second leaf spring (232) comprising a first end (233A) non-rotatably connected to the base element (210) and a second end (233B) non-rotatably connected to the top element (220) such that the second leaf spring (233B) is obliquely inclined between the base element (210) and the top

element (220), wherein the first leaf spring (231) and the second leaf spring (232) are arranged in a spaced and superposed configuration relative to each other.

- 5 5. A sprung seat frame (200) according to claim 4, wherein the first leaf spring (231) and the second leaf spring (232) are arranged substantially parallel to each other.
6. A sprung seat frame (200) according to any preceding claim, wherein the spring arrangement (230) further comprises a second damper (234) comprising a first end (234A) connected to the base element (210) at a third connection and a second end (234B) connected to the top element (220) at a fourth connection such that the second damper (234) is obliquely inclined between the base element (210) and the top element (220);
- 10 wherein the third connection and/or the fourth connection is a rotatable connection.
- 15 7. A sprung seat frame (200) according to claim 6, wherein the first (233) and second (234) dampers are arranged substantially parallel to each other.
8. A sprung seat frame (200) according to claim 6 or 7, wherein the second damper (234) is a mechanical shock absorber or a hydraulic shock absorber.
- 20 9. A sprung seat frame (200) according to any preceding claim, wherein the first damper (233) is a mechanical shock absorber or a hydraulic shock absorber.
10. A sprung seat frame (200) according to any preceding claim, wherein the second connection is located higher on the top element (220) than where the second end (231B) of the first leaf spring (231) is non-rotatably connected to the top element (220).
- 25 11. A sprung seat frame (200) according to any of claims 6 to 8 or claims 9 or 10 when dependent on claim 6, wherein the fourth connection is located higher on the top element (220) than where the second end (233B) of the second leaf spring (232) is non-rotatably connected to the top element (220).
- 30 12. A sprung seat frame (200) according to any preceding claim, wherein the first leaf spring (231) is configured at an angle of between 10 degrees and 80 degrees,
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more preferably between 10 degrees and 50 degrees, more preferably between 21.5 degrees and 31.5 degrees, more preferably at or around 26.5 degrees, to the horizontal in use when in a non-loaded configuration.

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13. A sprung seat frame (200) according to claim 4 or 5, or any of claims 6 to 12 when dependent on claim 4, wherein the second leaf spring is configured at an angle of between 10 degrees and 80 degrees, more preferably between 10 degrees and 50 degrees, more preferably between 21.5 degrees and 31.5 degrees, more preferably at or around 26.5 degrees, to the horizontal in use when in a non-loaded configuration.

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14. A sprung seat frame (200) according to any preceding claim, wherein the first damper (233) is configured at an angle of between 10 degrees and 80 degrees, more preferably between 20 degrees and 70 degrees, more preferably between 47.3 degrees and 57.3 degrees, more preferably at or around 52.3 degrees to the horizontal in use when in a non-loaded configuration.

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15. A sprung seat frame (200) according to claim 6 to 8 or claims 9 to 14 when dependent on claim 6, wherein the second damper (234) is configured at an angle of between 10 degrees and 80 degrees, more preferably between 20 degrees and 70 degrees, more preferably between 47.3 degrees and 57.3 degrees, more preferably at or around 52.3 degrees to the horizontal in use when in a non-loaded configuration.

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16. A sprung seat frame (200) according to any of claims 1 to 15, wherein the second connection is at a forward end (220') of the top element (220) or closer to a forward end (220') of the top element (220) than a rearward end (220'') of the top element (220).

30

17. A sprung seat frame (200) according to any of claims 6 to 8 or claims 9 to 16 when dependent on claim 6, wherein the fourth connection is at a forward end (220') of the top element (220) or closer to a forward end (220') of the top element (220) than a rearward end (220'') of the top element (220).

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18. A seat (100) for a vehicle, comprising:

a sprung seat frame (200) according to any of claims 1 to 17;
a back portion (110) configured for receiving a back of a user in use; and
a seat squab (120) attached to the back portion (110) and configured to be
sat on by a user in use;

5 wherein the top element (220) of the sprung seat frame (200) is attached to the
seat squab (120) by an attachment means, such that in use the sprung seat frame
(200) provides damping to the seat squab (120) and back portion (110) of the seat
(100).

19. A method of damping a motion of a vehicle seat (100), comprising the steps of:

10 providing a seat (100) for a vehicle according to claim 18;
attaching the base element (210) to the floor of the vehicle;
providing an impulse to the vehicle;
pivoting the top element (220) relative to the bottom element (210) using
the spring arrangement (230); and
15 damping the impulse to the top element (220) using the spring arrangement
(230).

