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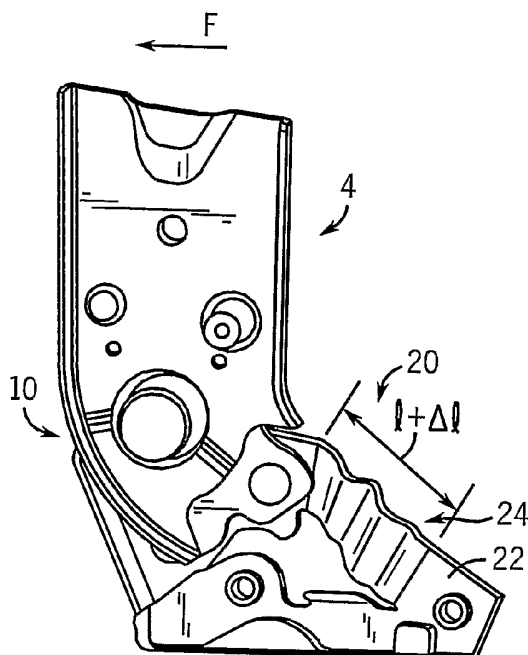
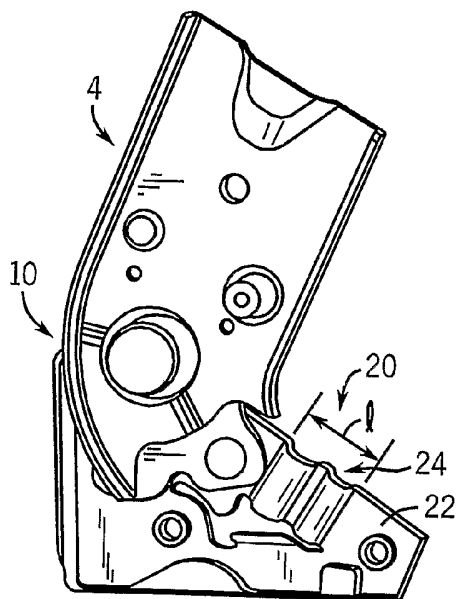
- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

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[Continued on next page]

(54) Title: ENERGY ABSORPTION APPARATUS



(57) Abstract: A method and an energy absorption apparatus for use with a vehicle seat having a seat recline mechanism. The energy absorption apparatus includes a bracket coupled to the seat recline mechanism. A member is coupled to the bracket, with the member configured to elongate in response to a force on the vehicle seat. The kinetic energy of the force is absorbed by the member as strain energy when the member elongates.



For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

ENERGY ABSORPTION APPARATUS

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims benefit of U.S. Provisional Application No. 60/656,988 filed February 28, 2005, entitled Energy Absorption Apparatus and incorporated herein by this reference.

FIELD

[0002] The present invention relates generally to the art of vehicle seating and more particularly to an energy absorption apparatus for a seat recline mechanism.

BACKGROUND OF THE INVENTION

[0003] If a vehicle experiences a very rapid acceleration or deceleration as a result of a collision, forces are imparted to all of its components. One of the components of the vehicle that experiences the forces during a collision is the vehicle seat. It is known in the art that a tilt-back recliner seat for a vehicle can be utilized in a first, second or even third row seat of a vehicle such as a Sport Utility Vehicle or a van. It is also known in the art of vehicle seats to provide the formable features that are selected to provide necessary strength requirements for normal operating conditions but also to provide a way of managing the forces exerted on a seat during collision. Known energy management arrangements include devices that collapse or buckle under load. Other devices utilize a compression spring or a gas cylinder to manage energy in a vehicle seat. Such arrangements, typically, function in a limited energy range, or in the case of collapsing devices, are unstable after operation.

[0004] Thus, there is a need for a vehicle seat that includes an energy absorption apparatus to supplement the strength of the vehicle seat. There is a further need for the energy absorption apparatus to be operative only if an abnormal operating condition exists such as exceeding a predetermined force exerted on the vehicle seat and is stable after operating.

SUMMARY OF THE INVENTION

[0005] There is provided an energy absorption apparatus for use with a vehicle seat having a seat recline mechanism. The energy absorption apparatus includes a bracket

coupled to the seat recline mechanism. A member is coupled to the bracket, with the member configured to elongate in response to a force on the vehicle seat. The kinetic energy of the force is absorbed by the member as strain energy when the member elongates. Another embodiment of the energy absorption apparatus provides the bracket and member integrally formed as a single piece. Additional members may be configured to elongate in response to the force on the vehicle seat.

[0006] There is also provided a method for absorbing energy exerted on a vehicle seat by a force. The vehicle seat includes a seat recline mechanism. The method includes the steps of coupling a bracket to the seat recline mechanism, coupling a member to the bracket with the member configured to elongate in response to the force. The kinetic energy of the force is absorbed by the member as strain energy as the member elongates. Another embodiment of the method includes forming the bracket and member as a single integral piece.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] Fig. 1 is a partial side view of a vehicle seat with a recline mechanism including an exemplary embodiment of an energy absorption apparatus, before operation, having a relative length of " ℓ ".

[0008] Fig. 2 is a partial side view of the energy absorption apparatus illustrated in Fig. 1 after operating, having a relative extended length of " ℓ plus $\Delta\ell$ ".

[0009] Fig. 3 is a partial side view of the vehicle seat including an exemplary embodiment of an energy absorption apparatus, before operation, having a relative length of " ℓ ", and including additional members.

[0010] Fig. 4 is a partial side view of the energy absorption apparatus illustrated in Fig. 3, after operating, having a relative extended length of " ℓ plus $\Delta\ell$ ".

[0011] Fig. 5 is a partial side view of the vehicle seat including an exemplary embodiment of an energy absorption apparatus, before operation, having a relative length of " ℓ ".

[0012] Fig. 5a is a partial top plan view of the energy absorption apparatus illustrated in Fig. 5 along the line 5a-5a.

[0013] Fig. 6 is a partial side view of the energy absorption apparatus illustrated in Fig. 5 after operating, having a relative extended length of " ℓ plus $\Delta\ell$ ".

[0014] Fig. 6a is a partial top plan view of the energy absorption apparatus illustrated in Fig. 6 along the line 6a-6a.

[0015] Fig. 7 is a partial side view of the vehicle seat including an exemplary embodiment of an energy absorption apparatus, before operation, having a relative length of " ℓ " and including an additional member.

[0016] Fig. 8 is a partial side view of the energy absorption apparatus illustrated in Fig. 7, after operation, having a relative extended length of " ℓ plus $\Delta\ell$ ".

DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

[0017] Before beginning the description of the exemplary embodiments of the present invention, several general comments can be made about the applicability and scope thereof.

[0018] First, while automotive seating may be referred to in the following portions of the specification, the invention is useful in all types of vehicle seating including, but not limited to, automobiles, sport utility vehicles, vans, trucks, buses, and the like, where it is desirable to prevent one seating component from being significantly displaced with respect to another under an impact or impulse force.

[0019] Second, the following discussion and illustrations generally are directed to an energy absorption apparatus for a recline mechanism of a vehicle seat. However, depending on the construction of the seat and the recline mechanism, other parts can be mechanically locked according to the scope and teaching of the specification. Furthermore, the components can be orientated other than as illustrated but still providing the operation of the energy absorption apparatus for a recline mechanism as described herein.

[0020] Third, with regard to the materials for the construction of the energy absorption apparatus for a recline mechanism components, materials currently in use, such as steel or aluminum, are entirely appropriate as well as other selected by those skilled in the specification and materials for use in vehicle seating. Strength, welding capabilities, fabrication and adaptability would be factors considered by one skilled in the art seeking to adapt to the teachings of the present invention to a particular energy absorption apparatus design.

[0021] Fourth, it may be desirable to weld the bracket to the vehicle seat, however, it should be understood that other means of fastening such as bolting or riveting or an appropriate adhesive (epoxy) can be utilized. However, any means of coupling the bracket

to a vehicle seat should be done to also minimize or eliminate BSR issues, as well as the need to precisely hold the relative position of the components for subsequent operations such as trim out and installation.

[0022] Fifth, for purposes of this disclosure, the term “coupled” means the joining of two components (electrical or mechanical) directly or indirectly to one another. Such joining may be stationary in nature or movable in nature. Such joining may be achieved with the two components (electrical or mechanical) and any additional intermediate members being integrally formed as a single unitary body with one another or with the two components or the two components and any additional member being attached to one another. Such joining may be permanent in nature or alternatively may be removable or releasable in nature.

[0023] It should be understood that when referring to a direction such as forward or rearward, reference is being made to the general direction of vehicle movement in relation to the driver. Also reference to a row of seats typically is the first row being the row in which the driver sits with subsequent rows identified consecutively.

[0024] An energy absorption apparatus 20 for a seat recline mechanism 10 of a vehicle seat 4 is typically provided on each side of the vehicle seat 4. In the illustrated figures, only one side of the seat is depicted. The vehicle seat 4 typically includes a seat back and a cushion structure. The seat back is typically coupled to a seat cushion by pivoting mechanism that may include a recline mechanism 10. As is well known, recliners generally include a first component coupled to a seat back and a second component coupled to a seat cushion structure with the seat supported in a floor system of the vehicle. The seat is typically configured to be moved manually or by powered movement relative to the vehicle floor as well as moving the seat back relative to the seat cushion. For purposes of explaining the exemplary embodiment of the vehicle seat recliner system, the illustrated mechanism is a circular disk but it should be understood that the particular component shown is for descriptive purposes only and that the design of the recliner component coupled to the seat back frame element and the recline mechanism can varied widely.

[0025] The energy absorption apparatus 20 can be formed as part of the recline mechanism 10 or it can be coupled to the recline mechanism 10 as a separate component. The energy absorption apparatus 20 includes a bracket coupled to the seat recline mechanism 10. A member 24 is coupled to the bracket 22 with the member 24 configured to elongate in response to a force on the vehicle seat 4. The kinetic energy of the force F is

absorbed by the member 24 as strain energy as the member 24 elongates. In the figures, Figs. 1, 3 5 and 7 illustrate exemplary embodiments of an energy absorption apparatus 20 in a position before it operates. During normal operation of the vehicle seat, the energy absorption apparatus 20 would be maintained substantially in the configuration illustrated in the odd numbered figures.

[0026] Upon the vehicle experiencing a load force F such as during a collision either from the front or rear of the vehicle, the force will cause the vehicle seat to move and the energy absorption apparatus 20 will elongate by a distance of $\Delta\ell$. Figs. 2, 4, 6, and 8 illustrate exemplary embodiments of the energy absorption apparatuses 20 depicted in the odd numbered figures after operating, and being in elongated conditions. As the member 24 elongates under load, the kinetic energy of the force F is converted to strain energy within the member. Such elongation and conversion of energy reduces the peak loading to an occupant sitting in the vehicle seat 4. The elongation of the member 24 increases as the member 24 elongates the $\Delta\ell$ distance creating energy absorption over a wider range of loading. It is this wider range of loading that is more advantageous than the collapsing or gas cylinder type of apparatus currently utilized in the prior art.

[0027] It is also contemplated that additional members 26 can be utilized wherein each member 24, 26 can be tuned to a different load elongation range for anticipated load forces.

[0028] It should be noted that the members 24 illustrated in Figs. 1 and 2 are curved, however, other configurations, such as square, triangular, rectangular, and trapezoidal shapes can also be utilized. In Figs. 5 and 7, an accordion type or fan type arrangement of member 24 and bracket 22 is illustrated. Figs. 7 and 8 illustrate a compression link type additional member 26 which can be utilized to supplement forward loading conditions. However, when a force is exerted on the vehicle seat 4 that exceeds the predetermined force, the additional member 26, can be configured to slip or shear to allow the member 24 to elongate the $\Delta\ell$ length.

[0029] Thus there is provided an energy absorption apparatus for a recline mechanism of a vehicle seat that will operate when a predetermined magnitude of force is exerted on the vehicle seat. However, it should be understood that the scope is not limited thereby. For example, while the illustrated and described embodiments refer to the energy absorption apparatus being coupled to a seat recliner mechanism, the energy absorption apparatus could also be coupled to a seat adjuster mechanism of the vehicle seat. Various

modifications of components thereof are possible and will be readily identified by persons skilled in the art. The details of the disclosed energy absorption apparatus, specified above, are only intended to illustrate and not to limit the present invention.

WHAT IS CLAIMED IS:

1 1. An energy absorption apparatus (20) for use with a vehicle seat (4) having a
2 seat recline mechanism (10), the energy absorption apparatus (20) comprising:
3 a bracket (22) coupled to the seat recline mechanism (10); and
4 a member (24) coupled to the bracket (22), with the member (24) configured
5 to elongate in response to a force on the vehicle seat (4), wherein the kinetic energy of the
6 force is absorbed by the member (24) as strain energy.

1 2. The energy absorption apparatus (20) of claim 1, wherein the bracket (22)
2 and member (24) integrally form a single piece.

1 3. The energy absorption apparatus (20) of claim 1, including at least one
2 additional member (26) configured to elongate in response to the force on the vehicle seat
3 (4).

1 4. The energy absorption apparatus (20) of claim 3, wherein each member (24)
2 is configured to respond to a predetermined force.

1 5. The energy absorption apparatus (20) of claim 1, wherein the force is the
2 result of a rear impact exerted on the vehicle seat (4).

1 6. A method for absorbing energy exerted on a vehicle seat (4) by a force, the
2 vehicle seat (4) including a seat recline mechanism (10), the method comprising the steps
3 of:

4 coupling a bracket (22) to the seat recline mechanism (10); and
5 coupling a member (24) to the bracket (22), the member (24) configured to
6 elongate in response to the force, and
7 wherein the kinetic energy of the force is absorbed by the member (24) as
8 strain energy as the member elongates.

9 7. The method of claim 6, including the step of forming the bracket (22) and
10 member (24) as a single integral piece.

1 8. The method of claim 6, including the steps of providing at least one
2 additional member (26) configured to elongate in response to the force.

1 9. The method of claim 8, including the step of configuring each member (24)
2 to respond to a predetermined force.

1 10. The method of claim 6, wherein the force is the result of a rear impact
2 exerted on the vehicle seat (4).

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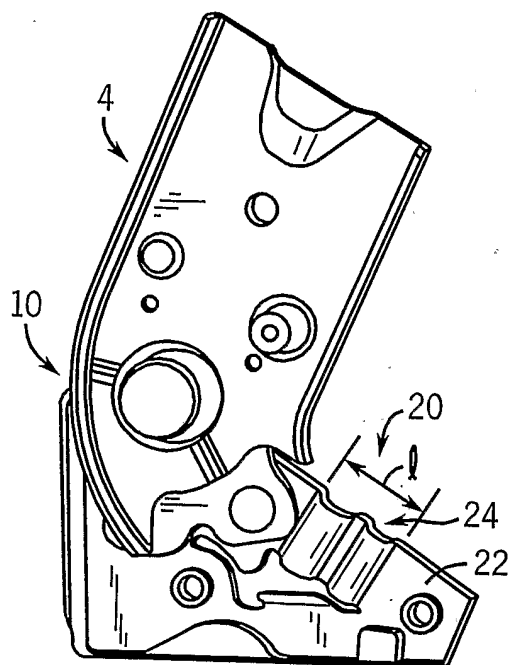


FIG. 1

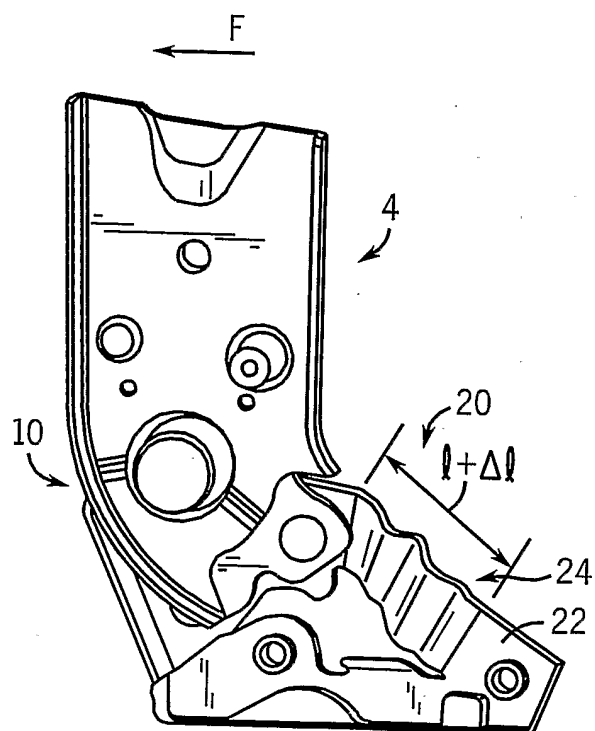


FIG. 2

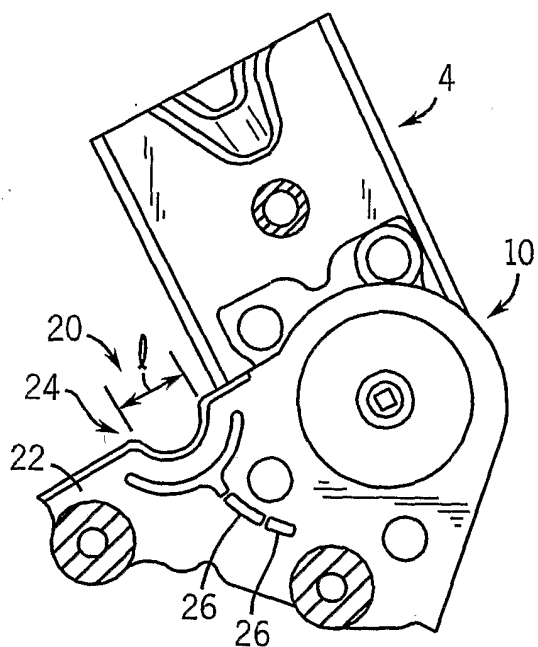


FIG. 3

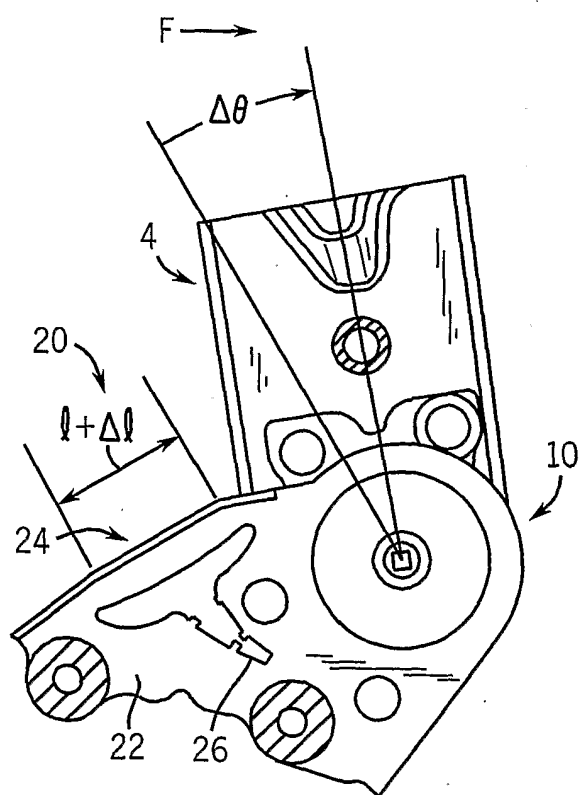
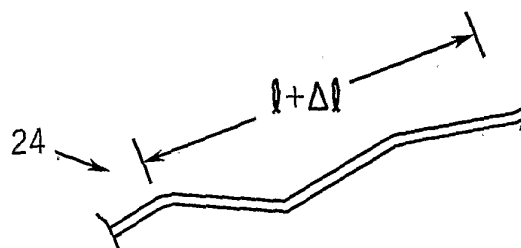
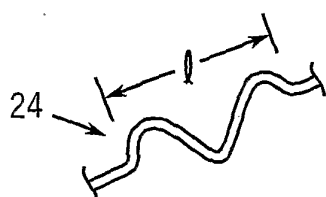
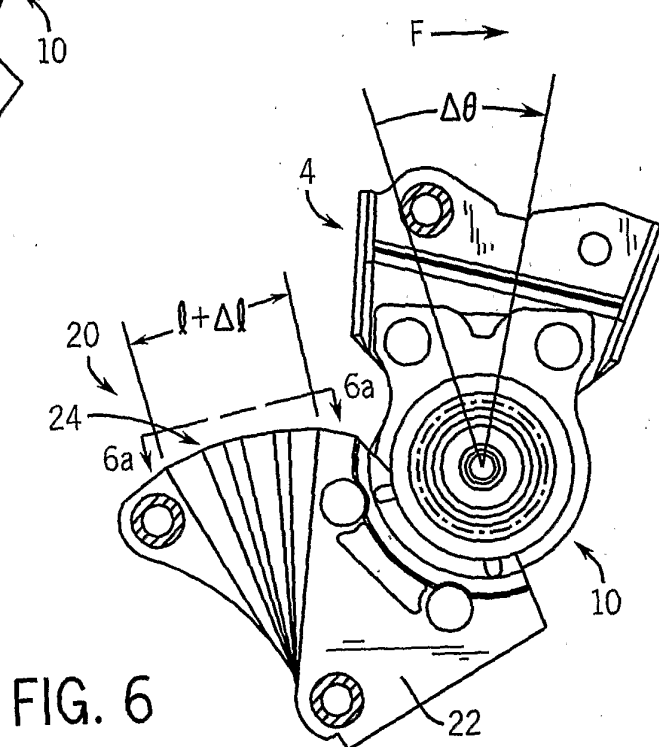
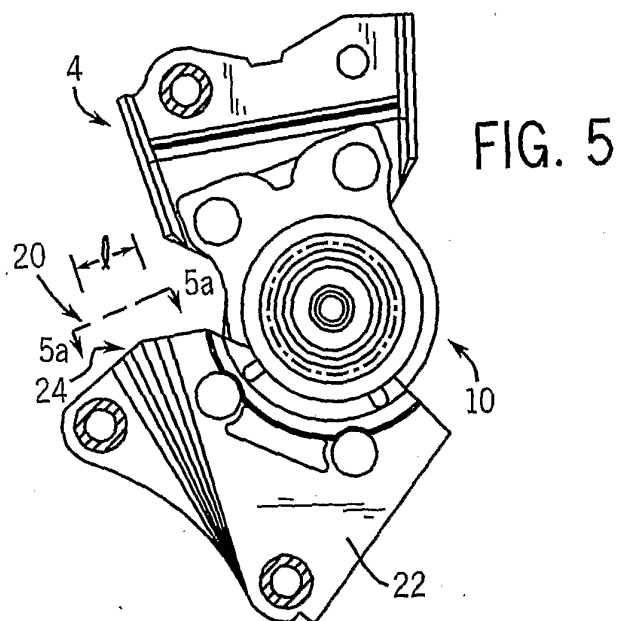


FIG. 4

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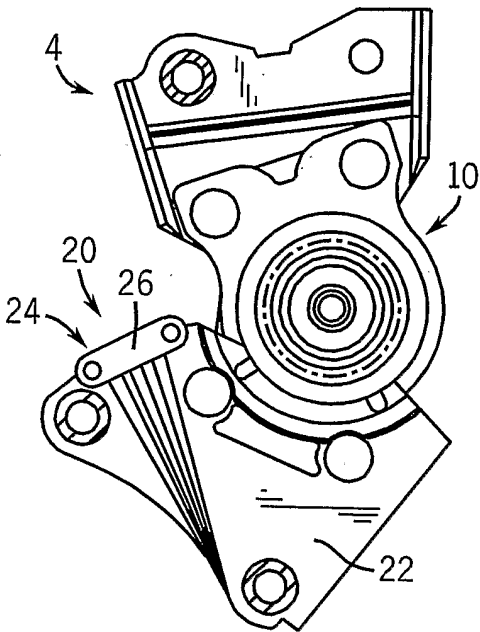


FIG. 7

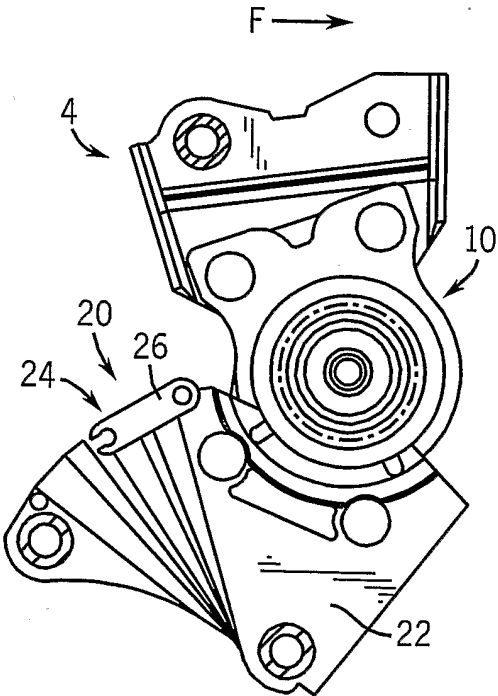


FIG. 8

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2006/004520

A. CLASSIFICATION OF SUBJECT MATTER

INV. B60N2/427

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)
B60N

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

Electronic data base consulted during the international search (name of data base and, where practical, 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 6 176 543 B1 (NAWATA KATSUMI ET AL) 23 January 2001 (2001-01-23) column 10, line 1 - line 25; figures	1,3-6, 8-10
X	US 2004/061364 A1 (HUMER MLADEN ET AL) 1 April 2004 (2004-04-01) page 1, paragraph 13 - page 2, paragraph 25; figures	1,2,5-7, 10
X	US 6 296 306 B1 (SPECHT MARTIN ET AL) 2 October 2001 (2001-10-02) column 3, line 48 - column 6, line 50; figures	1,3-6, 8-10
X	EP 0 709 249 A (ADWEST JOHNSON CONTROLS LTD) 1 May 1996 (1996-05-01) the whole document	1,2,5-7, 10
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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

14 June 2006

Date of mailing of the international search report

21/06/2006

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2006/004520

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 3 501 200 A (SEIZO OHTA) 17 March 1970 (1970-03-17) the whole document -----	1,2,5-7, 10
A	PATENT ABSTRACTS OF JAPAN vol. 1995, no. 08, 29 September 1995 (1995-09-29) -& JP 07 132767 A (MITSUBISHI MOTORS CORP), 23 May 1995 (1995-05-23) abstract -----	1-10
A	US 6 164 720 A (HAGLUND ET AL) 26 December 2000 (2000-12-26) the whole document -----	1,3-6, 8-10

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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