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(54) **Title:** PRIMARY PAN-VEHICULAR SAFETY SYSTEMS

(57) **Abstract:** To reduce injuries resulting from a collision, a vehicle is provided with motile seats. The seats are capable of, for example, movement in first and second directions, the first direction being substantially parallel to a line from the front to the back of the vehicle and the second direction is substantially perpendicular to the first direction. In response to a force generated from a collision, the seats move to reduce the impact force on an occupant of the seat, thereby reducing injuries.

PRIMARY PAN-VEHICULAR SAFETY SYSTEM

FIELD OF INVENTION

The invention relates to improved safety of vehicles. More particularly, the invention relates to protecting occupants in a vehicle during a collision.

BACKGROUND OF INVENTION

During a vehicle collision, the occupants of the vehicle often suffer injuries from the impact force. Various vehicle structures have been designed to absorb the impact energy, in order to protect the vehicle occupants from injuries. In conventional vehicle body structures, a crushable zone is formed at the front of the vehicle body, the vehicle components within the crushable zone capable of being deformed to absorb a portion of the impact energy. Other forms of impact energy absorbing systems include inflatable air bags that are deployed upon impact, foam padding, or aluminum honeycomb structures.

However, a substantial portion of the impact force is transmitted to the interior components of the vehicle. Conventionally, the interior components are fixed to the

However, a substantial portion of the impact force is transmitted to the interior components of the vehicle. Conventionally, the interior components are fixed to the vehicle body and are unable to adequately absorb the impact energy of the collision. For example, the seats of the vehicle are fixed to the vehicle body and moves with the vehicle body as a single body during the impact. The force is subsequently imparted on the vehicle occupant, who may be restrained to the seat using restraint devices such as seat belts. The occupant is subjected to substantial acceleration (or deceleration) from the impact force and moves forward (or backward) relative to the vehicle body. The sharp increase in acceleration (or deceleration) can result in serious and possibly fatal injuries.

As evidenced from the foregoing discussion, it is desirable to provide a vehicle which can reduce the impact force imparted to the vehicle occupants during a collision, hence protecting the occupants from severe injuries.

SUMMARY OF THE INVENTION

The invention relates to reducing injuries to an occupant of a vehicle in the event of a collision. In one embodiment, a vehicle is provided with a motile seat. The motile seat is capable of moving in first and second directions. The first direction is substantially parallel to a line from the back to the front of the vehicle and the

second direction is substantially perpendicular to the first direction. In one embodiment, the seat is motile in response to a force generated from a collision. By providing a vehicle with motile seat, the movement of the seat absorbs at least some of the force from the collision, thereby reducing injuries to the occupant of the seat.

In another embodiment, the seat is capable of reclining in response to the force generated from a collision to further reduce injuries to occupant. The movements of the seat should be such that it does not cause injuries to the occupant.

In yet another embodiment, the vehicle is provided with an engine which is designed to absorb some of the force generated from a collision. Preferably, the engine is designed with heavier components adjacent to the end to which the engine is located closest. For example, the heavier components are located near the front of the vehicle for front engine mounted vehicles. Alternatively, the engine can be designed to be motile in response to the force generated. Preferably, the parts of the engine adjacent the end to which it is located closest are more motile than the parts at the opposite end. More preferably, the motile engine is designed with heavier components adjacent the end to which it is located closest. In another embodiment, the vehicle is provided with both motile seat and engine designed to absorb some of the force generated from a collision.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a simplified view of a vehicle in accordance with one embodiment of the invention;

Fig. 2 shows another embodiment of the invention;

Fig. 3 shows a vehicle seat in accordance with one embodiment of the invention; and

Fig. 4 shows a seat in accordance with one embodiment of the invention during a collision.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The invention relates generally to reducing injuries to occupants of vehicles during, for example, a collision. In one embodiment of the invention, the injuries to vehicle occupants can be reduced by designing a vehicle which absorbs some of the impact force from a collision, thereby reducing the impact force on the occupants. Preferably, the vehicle is designed to absorb as much of the impact force as possible.

Fig. 1 shows a simplified view of a vehicle 101 in accordance with one embodiment of the invention. The vehicle comprises aft and fore sections 104 and 105. As shown, the vehicle comprises a chassis 110 extending in the fore and aft direction. The chassis serves as the main frame of the vehicle and includes, for example, the wheels and suspension. The chassis serves to support a body 120 of the vehicle and an engine. The engine can be mounted to the vehicle in the

aft, fore, or mid section of the chassis. A drive train couples the engine to at least one set of wheels. For example, for a rear wheel drive type of vehicle, the drive train couples the engine to the rear wheels. Alternatively, a front wheel or all wheel drive type vehicle is also useful.

The body of the vehicle includes a passenger compartment 160. In one embodiment, the vehicle is provided with aft and/or fore compartments 170 and 180. One of the compartments provides access to the engine while the other compartment serves as a storage compartment. For example, for a front engine mounted vehicle, the fore compartment provides access to the engine while the aft compartment serves as a storage compartment. Providing a vehicle with either the aft or fore compartment is also useful. Other vehicle configurations are also useful.

The passenger compartment includes at least one seat for the driver. As shown, the passenger compartment is provided with two seats. Providing a passenger compartment with two or more seats is also useful. Doors can be provided to provide access to the passenger compartment. Various types of passenger compartments can be used, depending on the type of vehicle. For example, the passenger compartment can be designed for a sports car, a sedan, a convertible, a passenger van, or a sports utility vehicle. Other types of vehicles are also useful.

In accordance with one embodiment of the invention, at least one of the seats of the vehicle is designed to be motile upon occurrence of a collision. Preferably, at least some of the seats of the vehicle are designed to be motile upon occurrence of a collision. More preferably, all the seats of the vehicle are designed to be motile upon occurrence of a collision. In one embodiment, the motility of the seat is in a direction parallel to a line between the aft and fore of the vehicle, as indicated by arrow 109. Preferably, the motility of the seat is in directions parallel and perpendicular to a line between the aft and fore of the vehicle. More preferably, the seat comprises an omni-directionally motile seat.

During a collision, the seat moves in response to the impact force. Preferably, the seat absorbs some of the impact force by moving away from the point of impact. For example, if a vehicle were hit from behind, the force from the collision would cause the seat to move forward toward the front of the vehicle. Likewise, if the vehicle were hit from the front, the seats move toward the rear of the vehicle. The seat serves to support the body of the occupant during the impact and reduce the acceleration (or deceleration) that the occupant is subjected to. This reduces or avoids injuries to the seat's occupant.

Each motile seat is designed to be motile within a defined area. For seats, such as the front seats, whose

position can be adjusted, the defined area can be extended beyond the adjustable area. Preferably, the defined area is designed to enable the seat to move sufficiently to absorb some of the impact force from a collision, thereby reducing injury to the occupant. Typically, the defined area is about 12 - 24 inches. Providing a defined area with other dimensions is also useful.

The defined area should also be designed such that movement of a seat during a collision does not cause additional injuries to the occupant of the seat. For example, the movement of the seat should not contact another passenger or cause the occupant of the seat to contact a part of the vehicle or another passenger. Additionally, the parts of the vehicle in which the motile seats or passengers may come into contact can be provided with force absorbing material to reduce injuries. Various types of force absorbing materials, such as foam or rubber, can be used. Other types of force absorbing materials are also useful. The use of air bags at such parts of the vehicle is also useful. Providing a seat which wholly or partially inflatable is also useful.

For vehicles having seats additional to the front seats of a vehicle, air bags can be provided for such seats. The air bags, for example can be located on the backside of the front seats to protect passengers behind the seats. Additionally or in lieu, air bags can be located on the sides

of the vehicles to protect passengers occupying the seats other than the front seats. Also, air bags can be provided on the sides of the seat to prevent the seats from contacting each other or other parts of the vehicle. During a collision, the air bags are activated for passengers in seats other than the front seats.

In one embodiment, some or all the seats can be motile as a unit. Although the seats can be arranged to be motile as a unit during a collision, each or some can be adjustable individually or as a subset for normal use. Preferably, the seats of the passenger compartment are motile as a unit. This advantageously ensures that the movement of the seats does not cause additional injury by creating contact with other passengers during a collision.

In another embodiment, the steering wheel can be designed to move as a unit with at least the vehicle operator's seat of the passenger compartment. More preferably, the pedals which are used to control operation of the vehicle, such as brake, accelerator, and/or clutch, can also be designed to move as a unit with at least the vehicle operator's seat of the passenger compartment. This is particularly useful to prevent injuries to the operator of the vehicle when the seat is moved forward as a result of force due to a collision. Additionally or in lieu of, the dashboard of the vehicle can also be designed to be motile to absorb energy from a collision.

The seats, in one embodiment, are motile when a collision exceeding a threshold force occurs. During normal operation (e.g., acceleration and deceleration in the course of driving the vehicle), the seats remain in a fixed position. Preferably, the threshold force is a force above which injuries to an occupant are likely to occur. The threshold force, for example, is about 3 - 10 miles per hour (mph) and preferably about 4 - 6 mph. Other threshold force values are also useful. In another embodiment, the seats are motile upon occurrence of a collision.

In accordance with one embodiment of the invention, an elongated member 168 is provided in the passenger compartment. The elongated support member comprises, for example, a circular cross-section. Other cross-sectional shapes are also useful. The elongated member is along the direction from the aft to fore of the vehicle and serves to support a seat of the vehicle. In one embodiment, the elongated member is fixed to the body of the vehicle. Preferably, the member is fixed to the chassis of the vehicle.

The seat of the vehicle is provided with a mount for mounting the seat the member. In one embodiment, the mount enables the seat to be motile in a direction along the direction of the elongated member when a collision occurs. Preferably, the mount enables the seat to move in a direction along and perpendicular to the elongated member. The mount

should keep the seat stationary during normal operation. The mount, in one embodiment, allows a seat to be adjusted into a desired position and remains fixed during normal operation. This is particularly useful for front seats of a vehicle. Providing mounts enabling seats other than the front seat to be adjustable is also useful.

In one embodiment, one member can be associated with each motile seat. For seats which move as a unit or subunit, they can be associated with the same member. Providing a motile seat or motile seat subunit with more than one support member is also useful. Other configurations or support members and motile seats are also useful.

In another embodiment of the invention, at least a portion of the passenger compartment is lined with protective padding to absorb some of the force form a collision, protecting occupants of the vehicle. In one embodiment, the sides and/or doors of the passenger compartment are lined with protective padding 141. Other portions of the passenger compartment can be lined in addition or in lieu of the sides with protective padding. For example, protective padding (143 and 145) can also be provided to line the front and back of the passenger compartment. The protective padding absorbs the impact energy as the seat and/or occupant moves against the sides and rear portions of the vehicle compartment. In one embodiment, the protective padding comprises foam padding

such as expanded polypropylene foams. Other types of padding or force absorbing material can also be used.

Fig. 2 shows a vehicle seat in accordance with one embodiment of the invention. As shown, the seat includes base and back portions 262 and 282. The back portion can pivot about a mounting point 268 to the base portion, enabling adjustment to a desired position. In one embodiment, the back portion retracts or reclines at least partially in the event of a collision. The retraction is in response to impact force from, for example, the rear of the vehicle. Preferable, the seat retracts in response to a collision which exceeds a threshold force. Techniques for retracting the seat, such as those described in US Patent Application Publication US 2003/001415A1, which is herein incorporated by reference for all purposes, can be employed. Other techniques for retracting the seats are also useful. The retraction of the seat should be dampened so as to prevent injuries to an occupant stemming from the movement itself.

Fig. 3 shows a vehicle seat 362 in accordance with one embodiment of the invention. As shown, the seat comprises base portion 352 supported by a base frame 351 and back portion 382 supported by a back frame 381. Additionally, a head or neck support 365 can be provided for the seat. The back frame is secured to the base frame by mount 368. The

back portion pivots around the mount to adjust the seat into a desired position.

In accordance with one embodiment of the invention, wheels are mounted onto the base frame. As shown, each side of the base frame is provided with two wheels. Providing the seat with other number of wheels is also useful. The elongated member, as previously described, can be used to serve as a guide, preventing the seats from tilting over. The wheels contact the floor of the passenger compartment. In one embodiment, the wheels are tension loaded with a desired resistance. Upon application of a force which exceeds a threshold of the resistance, the wheels can be rotated, enabling the seats to move. Due to the tension loading, the movement is dampened. In one embodiment, the resistance is selected such that the seat would not move unless a collision occurs. Preferably, the resistance is selected such that the seats would not move unless a force exceeding the threshold force is created from a collision.

In another embodiment, the back portion can recline, as previously described in accordance with Fig. 2. Optionally, to enhance the absorption of force by the seat, the seats can be filled with force absorbing materials, such as foam. Other types of force absorbing materials are also useful.

Fig. 4 shows a seat 462 during a collision in accordance with one embodiment of the invention. For purposes of discussion, the seat is depicted as the driver's seat. Other

seats are also useful. The seat is in a first position 464a during normal operation. The seat can be adjusted to the desired position.

In one embodiment, a seat belt is provided. The seat belt is designed to restrain an occupant 415 to the seat to reduce injuries to the occupant during, for example, a collision. Preferably, the seat belt allows the occupant and the seat to move as a single unit. In one embodiment, the seat belt comprises three anchor points. A first end of the seat belt is attached to a first anchor point 423a located in the upper portion of the side of the back of the seat. Preferably, the first anchor point is located as high as possible while maintaining adequate stability to serve as an anchor point. The second or intermediate anchor point 423b is located on a first side of the seat toward the back of the base of the seat while the third anchor point 423c is located at a similar position as the intermediate anchor point but on the other side of the back of the base seat. The third anchor point serves as the point to which the second end of the seat belt is latched. The first end of the seat belt includes a retractor which allows the seat belt to extend or retract. However, during sudden acceleration, deceleration, or a collision, the retractor is locked, causing the seat belt to be a fixed length.

Upon impact from the rear, the force generated from the impact causes the seat to move forward to a second position

464b. The amount of distance and direction the seat moves, in one embodiment, depends on the magnitude of the impact force generated, with the limits defined by the defined area of movement. The movement of the seat reduces the magnitude of the impact force on the occupant of the seat, thereby reducing injury. Additionally, the force of the impact causes an air bag 478 disposed in, for example, the steering wheel 479 to deploy. This further reduces injury to the occupant of the seat.

In yet another embodiment of the invention, the engine can be designed to enable it to absorb energy of force during a collision. The engine, to the extent possible, is arranged such that the heavier components are located toward the end of the vehicle. For example, the heavier parts of the engine are located toward the front of the vehicle for front mounted engine vehicles or toward the back of the vehicle for rear or mid mounted engine vehicles. More preferably, the heavier components of the engine are also located toward the sides of the vehicle.

The engine, in another embodiment, is designed to be motile upon the occurrence of a collision. Preferably, the engine is designed to be motile when a force of the collision exceeds a threshold force. In one embodiment, the engine is motile along a line from the aft to fore of the vehicle. Preferably, the engine is motile along and perpendicular to a line from the aft to the fore of the vehicle. More

preferably, the engine is motile in all directions. The motility of the engine should be limited to prevent the engine from intruding into the passenger compartment. By designing the vehicle with a motile engine, force generated from the impact can be absorbed by the engine. Since typically, the engine is relatively heavy, a relatively substantial amount force can be absorbed by the motility of the engine. The motile engine can be combined with designing an engine having heavier components strategically located to absorb impact force.

In another embodiment, the parts of the engine toward the end of the vehicle, to the extent possible, are more motile than the parts of the engine toward the passenger compartment. During a collision, the more motile parts of the engine toward the end absorb greater amount of force than the engine parts toward the passenger compartment. Preferably, the heavier parts of the engine are located toward the end of the vehicle. The seat or seats of the vehicle and the engine can be motile as a result of the force generated from a collision. Preferably, seat or seats of the vehicle and the engine can be designed to be motile as a unit to reduce the impact force of a collision on the passenger.

One, some, or all various motile components can be implemented in a vehicle. The motile components can be integrated individually or some or all can be integrated as a motile system for vehicle safety. In addition, the vehicle

can be implemented with energy absorbing materials as described herein and/or conventional safety features, such as air bags to reduce injuries to occupants of the vehicle.

While the invention has been particularly shown and described with reference to various embodiments, it will be recognized by those skilled in the art that modifications and changes may be made to the present invention without departing from the spirit and scope thereof. The scope of the invention should therefore be determined not with reference to the above description but with reference to the appended claims along with their full scope of equivalents.

What is claimed is:

1. A vehicle comprising:

a chassis substantially along a first direction substantially parallel to a line from a back to a front of the vehicle; and

a passenger compartment mounted onto the chassis, wherein the passenger compartment comprises a seat which is motile in first and second directions in response to a force generated from a collision to reduce injuries to an occupant of the seat, wherein the second direction is substantially perpendicular to the second direction

2. The vehicle of claim 1 further comprises additional motile seats, wherein the motile seats either are motile individually or at least some of the motile seats are motile as a unit in response to the force generated while maintained stationary during normal operation.

3. The vehicle of claim 1 wherein the seat is motile in substantially omni directions in response to the force generated.

4. The vehicle of claim 3 further comprises additional motile seats, wherein the motile seats either are motile individually or at least some of the motile seats are motile

as a unit in response to the force generated while maintained stationary during normal operation.

5. The vehicle of claim 1 wherein the seat further is capable of reclining in response to the force to reduce injuries to the occupant.

6. The vehicle of claim 5 further comprises additional motile seats, wherein the motile seats either are motile individually or at least some of the motile seats are motile as a unit in response to the force generated while maintained stationary during normal operation.

7. The vehicle of claim 5 wherein the seat is motile in substantially omni directions in response to the force generated.

8. The vehicle of claim 7 further comprises additional motile seats, wherein the motile seats either are motile individually or at least some of the motile seats are motile as a unit in response to the force generated while maintained stationary during normal operation.

9. The vehicle of claim 1 wherein the seats are motile in response the force generated which exceeds a threshold force.

10. The vehicle of claim 9 further comprises additional motile seats, wherein the motile seats either are motile individually or at least some of the motile seats are motile as a unit in response to the force generated while maintained stationary during normal operation.

11. The vehicle of claim 9 wherein the seat is motile in substantially omni directions in response to the force generated which exceeds the threshold force.

12. The vehicle of claim 9 wherein the seat further is capable of reclining in response to either the force generated or to the force generated which exceeds the threshold force to reduce injuries to the occupant.

13. The vehicle of claim 1 further comprises an engine compartment for housing an engine of the vehicle, the engine compartment adjacent to a first end of the passenger compartment, the engine is designed to absorb some of the force generated.

14. The vehicle of claim 13 wherein the engine is motile in response to the force generated.

15. The vehicle of claim 14 wherein the engine and seat is motile as a unit.

16. The vehicle of claim 1 wherein the motile seat is motile within a defined area.

17. The vehicle of claim 16 wherein the defined area is about 12 - 24 inches.

18. The vehicle of claim 16 wherein movement of the motile seat itself does not cause injuries to the occupant.

19. The vehicle of claim 16 wherein the passenger compartment comprises an elongated member in the first direction, the seat is mounted to the elongated member, wherein the mount enables the seat to be motile in response to the force.

20. The vehicle of claim 19 wherein the defined area is about 12 - 24 inches and the movement of the motile seat itself does not cause injuries to the occupant.

21. The vehicle of claim 16 wherein the seat comprises wheels to facilitate motility in response to the force generated.

22. The vehicle of claim 21 wherein the defined area is about 12 - 24 inches and the movement of the motile seat itself does not cause injuries to the occupant.

23. The vehicle of claim 21 wherein the passenger compartment comprises an elongated member in the first direction, the seat is mounted to the elongated member, wherein the mount serves as a guild for the motile seat.

24. The vehicle of claim 23 wherein the defined area is about 12 - 24 inches and the movement of the motile seat itself does not cause injuries to the occupant.

25. A vehicle comprising:

a chassis substantially along a first direction substantially parallel to a line from a back to a front of the vehicle; and

a passenger compartment mounted onto the chassis, wherein the passenger compartment comprises a seat which is motile in substantially the first directions in response to a force generated from a collision to reduce injuries to an occupant of the seat, the seat comprises wheels mounted thereon to facilitate motility of the seat.

26. A method for reducing injuries of an occupant of a vehicle comprising:

providing a vehicle with a passenger compartment having a motile seat substantially in first and second directions, the first direction along a line from the front to back of

the vehicle and the second direction substantially perpendicular to the first direction; and

moving the motile seat in response to a force generated from a collision.

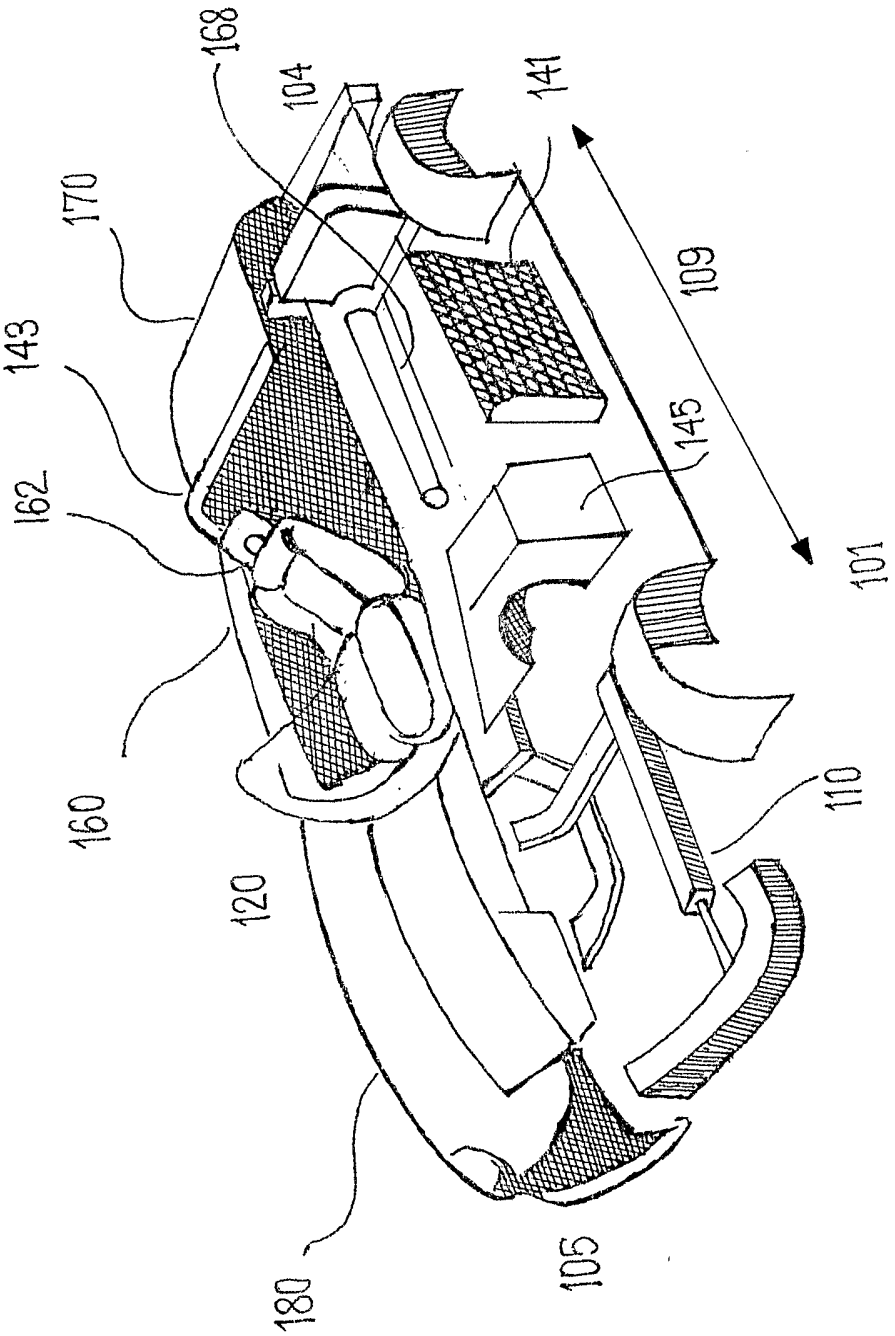

Fig.1

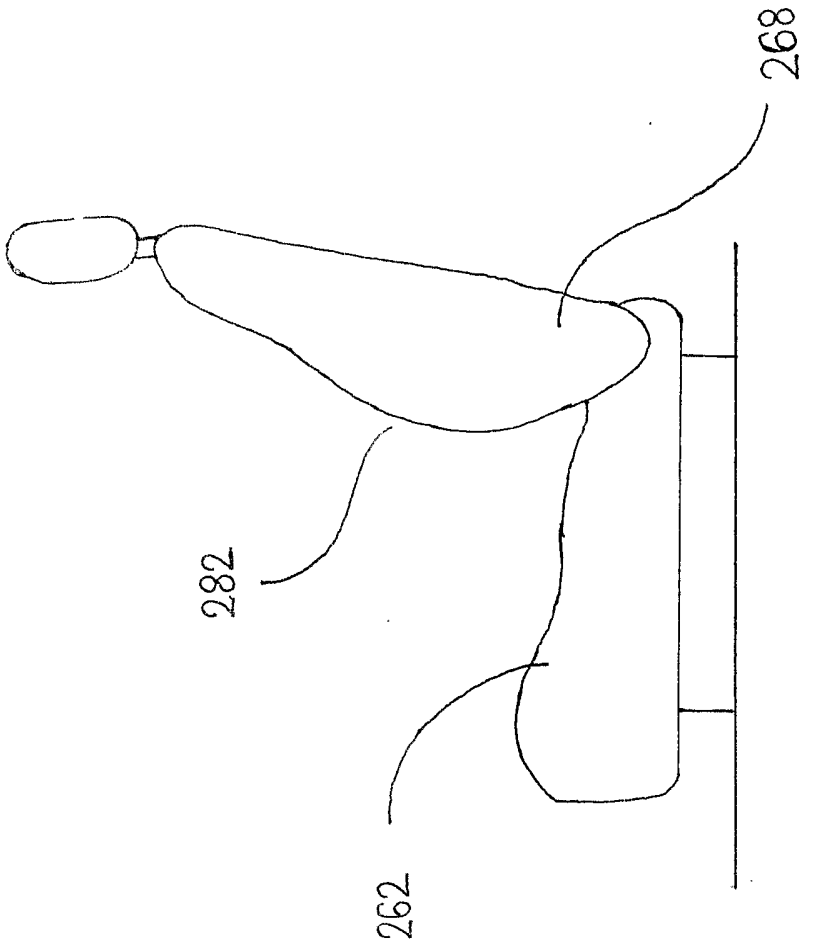

Fig. 2

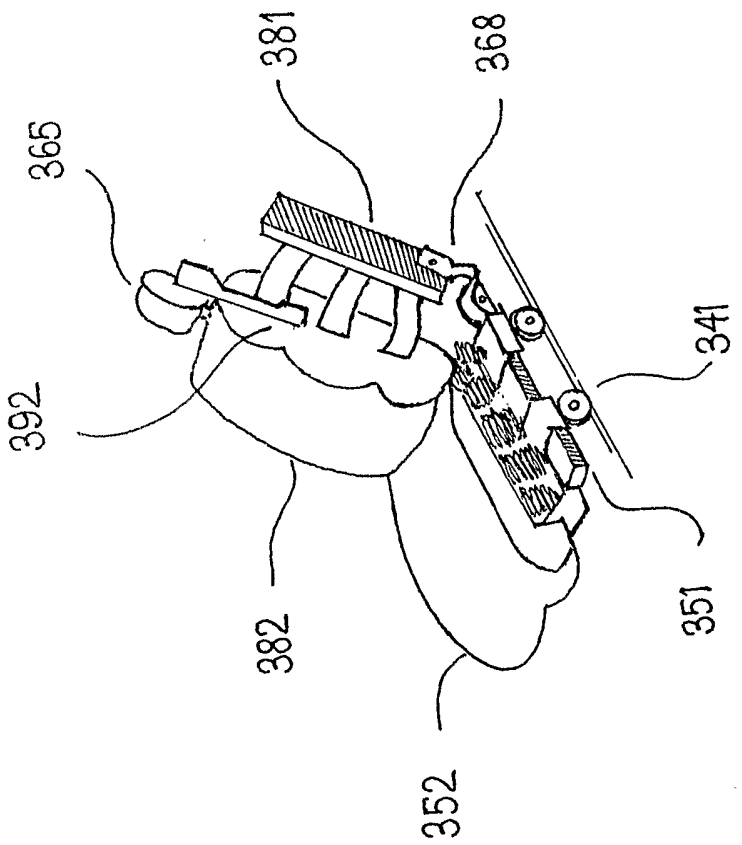

Fig. 3

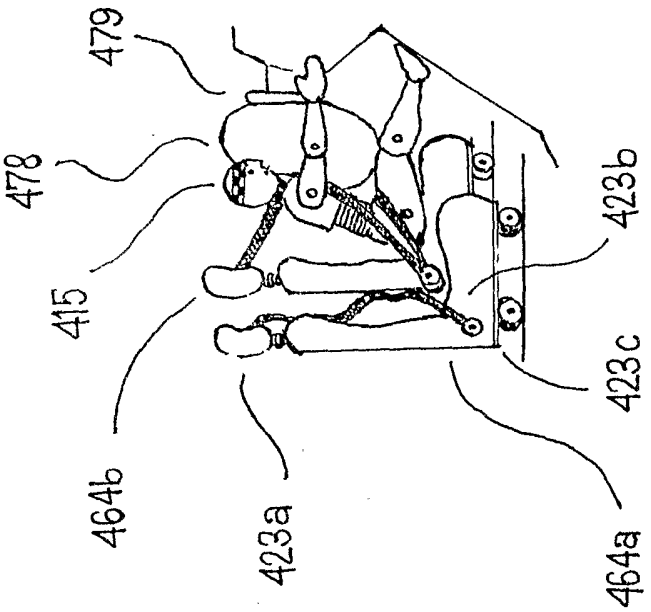

Fig. 4