(57) Abstract: This invention relates to a child safety seat comprising a seat body with a base portion, a back portion, a headrest, and an impact energy absorbing element positioned at or about the level of the headrest, wherein the height of at least the impact energy absorbing element above the base is adjustable, and the impact energy absorbing element is adapted to absorb and/or redirect blows incident to or about at least the headrest of the seat.
1

CHILD SEAT WITH IMPACT PROTECTION

FIELD OF THE INVENTION

The present invention relates to child safety seats or restraints for child passengers in vehicles.

PRIORITY

This patent application claims priority from:

- Australian Provisional Patent Application 2009905464, titled "CHILD SEAT WITH IMPACT PROTECTION", and filed on 9 November 2009; and
- Australian Provisional Patent Application 2010900686, titled "CHILD SEAT WITH IMPACT PROTECTION", and filed on 18 February 2010;

The entire content of these applications is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

As young children cannot be safely restrained in a vehicle by a standard seat belt, specialised safety seats or child restraints have been developed to protect a child ranging in age from that of a newborn to that of a toddler, in the event of an accident. A number of child restraints or safety seats have been developed which are designed to accommodate this wide range of ages in a single unit. Typically these seats can be configured in either the prone configuration suitable for a rearward facing installation or the forward facing upright configuration. In this manner, a single safety seat can be used for both a baby (prone configuration) and a large toddler (forward facing configuration) thereby saving on unnecessary expense.

However, the heads of very young children are particularly fragile and therefore vulnerable in the event of motor vehicle accidents (particularly vehicle side impacts) where:

1. vehicle body work (such as a door) is forced to encroach on the space occupied by the seat;
2. the seat may be thrown against the side of the vehicle during the impact, including the encroaching portions; and
3. unrestrained vehicle contents and other miscellaneous debris created in the accident are flung about inside of the vehicle.

It is an object of the present invention therefore to provide a child safety seat or child restraint capable of accommodating occupants of varying age and size, whilst providing at least some degree of protection for
the head of the child from the above identified hazards, or which at the least, is a useful alternative to known child safety seats.

Other objects and advantages of the present invention will become apparent from the following description, taken in connection with the accompanying drawings, wherein, by way of illustration and example, an embodiment of the present invention is disclosed.

SUMMARY OF THE INVENTION

In a first aspect the present invention accordingly provides a child safety seat comprising a seat body with a base portion, a back portion, a headrest, and an impact energy absorbing element positioned at or about the level of the headrest, wherein the height of at least the impact energy absorbing element above the base is adjustable, and the impact energy absorbing element is adapted to absorb and/or redirect blows incident to or about at least the headrest of the seat.

In a further aspect, the invention maybe said to reside a child safety seat comprising a seat body with a base portion, a back portion, and an impact energy absorbing element adapted to guard a head of a seat occupant, where the height of the impact energy absorbing element above the base is adjustable.

In one form, the impact absorbing element depends from the headrest.

In one form, the position of the headrest can be adjusted relative to the back portion.

In one form, the headrest extends above the back portion of the seat. In an alternative, the headrest travels along the back portion of the seat. In yet a further alternative, the headrest and at least a portion of the back portion are fixed relative to each other, and adjustable up and down together.

In one form, the seat comprises its own harness for restraining the occupant. In an alternative, it is a seat without its own harness, such as a booster seat.

In one form, in an alternative, the impact absorbing element depends form the back portion of the seat, but is adjustably mounted thereto so that the position of this can follow the headrest or head of the child (where there is no headrest).

In one form, the headrest comprises a pair of side edges and a top edge, where an impact absorbing element forms a head guard on or along any one or more or all of these edges.

In one form, the or each impact absorbing element is directed away or outwardly from the head of a seat occupant.
In one form, in conjunction with the outwardly directed impact energy absorbing element, a cushioning element is directed toward the head of a seat occupant. That is, the cushioning element is located between the head of the occupant and the headrest (or seat portion).

In one form, the headrest comprises a back portion adapted to extend behind an occupant’s head, and a side wing extending forwardly from said back portion on at least one side thereof, where an impact absorbing element is secured to an outer side of one or each of the wings. In one form, a cushioning element is secured to the inside of each of the wings.

In one form, there is a side wing side wing extending forwardly from said back portion on both sides thereof, where each of these wings has at least one impact absorbing element secured to an outer side thereof. In this way the headrest bounds and protects the occupants head on both sides.

In one form each impact absorbing element is adapted to absorb impact by means of any one or more of plastically or elastically deforming, cushioning, crushing, rupturing, deflating or bursting.

In one form each impact absorbing element comprises any one or more of a hollow and/or gas, liquid, gel or other energy absorbing material filled shell of deformable or cellular material.

In one form, the shell has thin wall of plastic material.

In one form, in an alternative, each impact energy absorbing element comprises padding material covered with a pliable covering material. In one form, the pliable covering material encapsulates the padding material.

In one form, the pliable covering material is a pliable plastic sheet material, and the padding material is a sponge like element.

In one form, there is at least one aperture in the pliable covering material, where this aperture permits at least the release of air from the impact energy absorbing element. In one form, there are a plurality of these holes in the pliable covering material.

In one form, the pliable covering material is a PVC bag, and the padding material is either of an open cell or closed foam material. In one form, the or each impact energy absorbing element is secured to the seat with an adhesive or adhesive material.

In a further aspect, the invention maybe said to reside in a child safety seat comprising a seat body with a base portion, a back portion, and an impact energy absorbing element adapted to absorb and/or redirect blows incident to or about at least a head supporting portion of the seat, where the height of the impact energy absorbing element above the base is adjustable.
In order to fully understand the invention, an exemplary embodiment will now be described. However, it will be realised that the scope of the invention is not to be limited to precise details of this embodiment and that variations apparent to a skilled person are to be deemed included within the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of this disclosure it will now be described with respect to an exemplary embodiment which shall be described herein with the assistance of drawings wherein:

Figure 1 is a perspective view of a child safety seat having a headrest with impact absorbing elements depending therefrom;

Figure 2 is a perspective view of the headrest from the child safety seat in Figure 1, in isolation;

Figures 3 through 12 are cross-sectional views through various, alternative embodiments of impact absorbing elements;

Figures 13 through 15 illustrate a seat according to a further embodiment, where the headrest extends above the back portion of the seat, and is adjustable relative to the back portion;

Figures 16 through 18 illustrate a seat according to yet a further embodiment, where the headrest and at least a portion of the back portion are fixed relative to each other, and adjustable up and down together; and

Figure 19 is a cross-sectional view through a further, alternative embodiment of an impact absorbing element.

In the following description, like reference characters designate like or corresponding parts throughout the several views of the drawings.

DETAILED DESCRIPTION OF AN EMBODIMENT OF THE INVENTION

Referring now to Figure 1, where there is illustrated a child safety seat 1 for use with a seatbelt equipped vehicle seat by being positioned thereon and retained thereto using the vehicle's seat belts and a tether strap extending from the child safety seat 1 to a vehicle mounting point.

The child safety seat 1 comprises a seat body 2 with a base portion 4 and a back portion 6. and, in this embodiment, an adjustable headrest 8, the position of which can be adjusted relative to the back portion 6.
The position of the headrest 8 is adjusted by grasping the upper edge of this, tilting it forward relative to the back portion 6 of the body 2, and then sliding the headrest 8 up or down as required (usually up as the child grows) between upper and lower travel limits thereof.

As can be seen in Figure 2, in the embodiment illustrated, the headrest 8 comprises a back portion 20, and a pair of side wings 22 extending outwardly and forward therefrom so as to extend on each side of a seat occupant's head.

Depending from each of these side wings 22 is an outwardly directed impact energy absorbing element 30, which is adapted to absorb and/or redirect blows incident to the wings 22 of the headrest 8 and thereby guard the head of the child occupying the seat 1. In this exemplary embodiment, the impact absorbing element 30 is a hollow, plastic blow moulded item that is secured to the headrest 8 via plastic clips.

As can be seen in Figure 1, each of the base 4, back 6 and headrest 8 portions of the seat 1, and the impact absorbing elements 30, are covered with a padded covering material to improve comfort of the seat 1 for both its occupant, and any vehicle occupants sitting adjacent to the seat 1. Potentially, the impact absorbing elements 30 could even be sewn (or otherwise incorporated) into the headrest covering itself.

With reference now to Figure 3, where it can be seen that in one form, the impact absorbing elements 30 comprise a thin walled plastic shell 32 secured to the wings 22 of the headrest by way of clips or fasteners 33, or tabs 34 (as shown in Figure 4). The thin shell 32 of the impact absorbing elements 30 may be any one of hollow, partially or fully gas, liquid or gel filled, or contain or be filled with an energy absorbing material such as a foamed plastic or cellular material or the like. Further still, a combination of fillings may be employed.

Referring now to Figure 5, where it can be seen that in one form, the shell 32 of the impact absorbing elements 30 may be shaped so as to incorporate features that aid in impact absorption or redirection. In this case, shell 32 incorporates side walls 35 having the general shape of a sinusoidal wave form, whereupon at least some of the energy imparted by the collision of an incident object will cause the side walls 35 to be compressed with a 'concertina' affect. Moreover, there are aligned apertures 37 and 39 in both the shell 32 and wings 22 respectively, so that some of any air in the shell can be released in a controlled fashion as the elements 30 are compressed by the incident impact.

Referring now to Figure 6, where it can be seen that in one form, the impact absorbing elements 30 comprise a thin shell 32 filled with a material 38 having an energy absorbing honeycomb structure. The honeycomb structure may comprise extruded polypropylene or similar three-dimensional collapsible structure.
Referring now to Figure 7, where it can be seen that in one form, the shell 32 of the impact absorbing elements 30 may be formed from multiple (in this case 2) parts 50 and 52 which are adapted to move relative to one another and thereby absorb impact energy. Similar to the embodiment of Figure 5, there are aligned apertures in both one part 52 of the shell 32 and the wings 22 of the headrest 8, so that some of any air in the shell 32 can be released in a controlled fashion as the elements 30 are compressed by the incident impact. A seal comprising an o-ring 56 is retained between shell 30 parts 50 and 52 to restrict the escape of air at the point at which the portions 50 and 52 overlap.

With reference to Figure 8, where it is illustrated how it is that a valve 60 may be used to fill the aperture 37 in the shell 32. Such a valve may be used to seal the shell 32 or otherwise precisely control the release of fluid (particularly gas) or otherwise sacrificially rupture when the element 30 is compressed by impact.

Referring now to Figures 9 and 11, where it can be seen that in one form, the impact absorbing elements 30 may comprise multiple (in this case 2) energy absorbing cushion elements 70 and 72 mounted one atop of the other (alternatively, they may be side by side). In this way, the properties of the two cushion elements 70 and 72 may be varied as required, so that either of these is more or less impact energy absorbing than the other for instance.

Referring now to Figure 10, where it can be seen that in one form, the impact absorbing elements 30 comprise a shell 32 that extends over a cushion element 70. In this way, the shell 32 may protect the cushion element 70 from damage, and the cushion element 70 may provide the majority of the impact energy absorption. Similarly in figure 11, the cushion element 70 may be adhered to the outer surface of the impact absorbing element 30, which may have a suitably shaped depression within which to locate the cushion element 70.

Referring now to Figure 12, where it can be seen that in one form, the impact absorbing elements 30 are integrally formed energy absorbing structures 80, defining, in this embodiment, a cross-section that is comprised of a plurality of triangular apertures 82. In use, the structure 80 would have a pre-determined length and is adapted to be crushed and thereby absorb incident impact energy.

By incorporating impact energy absorbing elements 30 in an adjustable headrest 8 of a child safety seat 1, there is provided a child safety seat 1 or child restraint capable of accommodating occupants of varying age and size while providing a guard for the occupant's head that is optimally positioned for them as they grow. Significantly, these impact energy absorbing elements 30 will reduce the amount of energy imparted to the headrest 8 of the seat 1 (and the occupants head in turn) by any one or more of:

1. vehicle body work forced to encroach on the space occupied by the seat (particularly in a side collision) or intrusion of other vehicles or intrusion of objects such as trees, poles or the like in side impacts;
2. the seat being thrown against the side of the vehicle, including any encroaching portions (particularly in a side collision); and

3. unrestrained vehicle contents and other miscellaneous debris created in the accident and flung about inside of the vehicle.

Referring now to Figures 13 through 15, where there is a child safety seat 100 comprising a seat body 102 with a base portion 104, a back portion 106, and an adjustable headrest 108, that extends above the back portion 106, and which can be adjusted relative to the back portion 106.

The headrest 108 comprises a back portion 120, and a pair of side wings 122 extending outwardly and forward therefrom so as to extend on each side of a seat occupant's head.

Depending from each of these side wings 122 is an outwardly directed impact absorbing element 130 adapted to absorb and/or redirect blows incident to the wings 122 of the headrest 108 and thereby guard the head of the child occupying the seat 100. In this exemplary embodiment, each impact absorbing element 130 is a hollow, plastic blow moulded item that is secured to the headrest 108 via plastic clips.

Referring now to Figures 16 through 18, where there is a child safety seat 200 comprising a seat body 202 with a base portion 204, a lower back portion 206, an upper back portion 207 and an headrest 208 that is fixed relative to upper back portion 207, and which extends above the back portion 207, where the position of the combined upper back portion 207 and headrest 208 together is adjustable relative to the lower back portion 206.

The headrest 208 comprises a back portion 220, and a pair of side wings 222 extending outwardly and forward therefrom so as to extend on each side of a seat occupant's head.

Depending from each of these side wings 222 is an outwardly directed impact absorbing element 230 adapted to absorb and/or redirect blows incident to the wings 222 of the headrest 208 and thereby guard the head of the child occupying the seat 200. In this exemplary embodiment, each impact absorbing element 230 is a hollow, plastic blow moulded item that is secured to the headrest 208 via plastic clips.

Referring now to Figure 19, where there is illustrated an impact absorbing element 30 comprised of two sheets of soft, pliable plastic material 300 secured together (such as by welding or use of adhesives) around matching perimeters 302 thereof so as to create a casing for a piece of expanded polystyrene foam 304 (or any suitable material having similar properties). The casing is then secured to an externally directed portion of a child safety seat such as any of 1, 100 or 200 using an adhesive or adhesive strip 307 or the like.
An advantage of open cell foam is that it gives the impact absorbing element 30 some shape and volume, and the open cell structure contains gas that can be expelled when impacted upon, so as to slow down the rate of compression of the impact absorbing element 30. This gas (air) may be released from the casing through one or more apertures 306 formed in sheets 300, or alternatively, by bursting a casing deficient of such release apertures 306.

In an alternative, a closed cell foam may be used to vary the energy absorbing properties of the impact absorbing element 30, as aside form its inherent properties, a closed cell foam may not contain as much gas for release when impacted upon.

In a further alternative, the foam element may be surrounded with additional air (i.e. the casing may be slightly pressurised), so as to provide a composite method for absorbing impact energy.

It will be understood that the term "comprise" and any of its derivatives (e.g. comprises, comprising) as used in this specification is to be taken to be inclusive of features to which it refers, and is not meant to exclude the presence of any additional features unless otherwise stated or implied.

The reference to any prior art in this specification is not, and should not be taken as, an acknowledgement of any form of suggestion that such prior art forms part of the common general knowledge.

Although an illustrative embodiment of the present invention has been described in the foregoing detailed description, it will be understood that the invention is not limited to the embodiment disclosed, but is capable of numerous rearrangements, modifications and substitutions without departing from the scope of the invention as set forth and defined by the following claims.
THE CLAIMS:

1. A child safety seat comprising a seat body with a base portion, a back portion, a headrest, and an impact energy absorbing element positioned at or about the level of the headrest, wherein the height of at least the impact energy absorbing element above the base is adjustable, and the impact energy absorbing element is adapted to absorb and/or redirect blows incident to or about at least the headrest of the seat.

2. The child safety seat of claim 1, wherein the impact absorbing element depends from the headrest.

3. The child safety seat of claim 1, wherein the impact absorbing element depends from the back portion.

4. The child safety seat as in any one of the preceding claims, wherein the position of the headrest can be adjusted relative to the back portion.

5. The child safety seat as in any one of the preceding claims, wherein the headrest extends above the back portion of the seat.

6. The child safety seat as in either of claims 4 or 5, wherein the headrest travels along the back portion of the seat.

7. The child safety seat as in any one of the preceding claims, wherein the headrest is carried by a first back portion, and the first back portion is adjustable up and down relative to a second back portion.

8. The child safety seat as in any one of the preceding claims, wherein the headrest comprises a pair of side edges and a top edge, and an impact absorbing element depends from at least one of these edges.

9. The child safety seat as in any one of the preceding claims, wherein the or each impact absorbing element is directed away or outwardly from the head of a seat occupant.

10. The child safety seat as in claim 9, wherein the or each impact energy absorbing element further comprises a cushioning means directed toward the head of a seat occupant so that the cushioning means is located between the head of the occupant and the impact energy absorbing element.

11. The child safety seat as in any one of the preceding claims, wherein the headrest comprises a back portion adapted to extend behind an occupant's head, and a side wing extending forwardly from said back portion on at least one side thereof, where an impact absorbing element depends from an outer side of one or both of the side wings.

12. The child safety seat as in claim 11, wherein a cushioning means is secured to an inner side of the or each of the side wings.
13. The child safety seat as in any one of the preceding claims, wherein the or each impact absorbing element is adapted to absorb impact by means of any one or more of plastically or elastically deforming, cushioning, crushing, rupturing, deflating or bursting.

14. The child safety seat as in any one of the preceding claims, wherein the or each impact absorbing element comprises any one or more of a hollow and/or gas, liquid, gel or other energy absorbing material filled shell of deformable or cellular material.

15. The child safety seat as in claim 14, wherein the shell has a thin wall of polymeric material.

16. The child safety seat as in any one claims 1 through 13, wherein the or each impact energy absorbing element comprises a padding material covered with a pliable covering material.

17. The child safety seat as in claim 16, wherein the pliable covering material encapsulates the padding material.

18. The child safety seat as in either of claims 16 or 17, wherein the pliable covering material is a pliable plastic sheet material, and the padding material is a sponge like element.

19. The child safety seat as in any one of claims 16 through 18, wherein there is at least one aperture in the pliable covering material, where this aperture permits at least the release of air from the impact energy absorbing element.

20. The child safety seat as in any one of claims 16 through 19, wherein the pliable covering material is a PVC bag, and the padding material is either of an open cell or closed cell foam material.

21. The child safety seat as in any one of the preceding claims, wherein the seat comprises its own harness for restraining the occupant.

22. The child safety seat as in any one of the preceding claims, wherein the seat is not equipped with its own harness, such as in the case of a booster seat.

23. A child safety seat comprising a seat body with a base portion, a back portion, and an impact energy absorbing element adapted to absorb and/or redirect blows incident to or about at least a head supporting portion of the seat, where the height of the impact energy absorbing element above the base is adjustable.

24. A child safety seat as described in the specification with reference to and as illustrated in the accompanying representations.
## INTERNATIONAL SEARCH REPORT

**INTERNATIONAL SEARCH REPORT**

**International application** No.  
PCT/AU2000/00495

### A. CLASSIFICATION OF SUBJECT MATTER

**Int. Cl.**  
B60N 2/26 (2006.01) B60N 2/28 (2006.01)

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)

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 practicable, search terms used)

WPI, EPDOC, IPC, ECLA B60N 2/26, 2/28, 2/42, 2/48 and keywords: adjustable, change, impact, shock, collision, absorb, disperse, dampen and like terms.

### C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C

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<td>document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</td>
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<td>document referring to an oral disclosure, use, exhibition or other means</td>
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<td>document published prior to the international filing date but later than the priority date claimed</td>
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| **T** | document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention |
| **X** | document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone |
| **Y** | document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art |
| **&** | document member of the same patent family |

**Date of the actual completion of the international search**  
03 December 2010

**Authorized officer**  
Naveen De Silva

**Australian Patent Office**  
(ISO 9001 Quality Certified Service)

**Telephone No:** +61 2 6283 2429

Form PCT/ISA/210 (second sheet) (July 2009)
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INTERNATIONAL SEARCH REPORT

Box No. II  Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. [ ] Claims Nos.:
   because they relate to subject matter not required to be searched by this Authority, namely:

2. [X] Claims Nos.: 24
   because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
   The claim does not comply with Rule 6.2(a) because it relies on references to the description and/or drawings.

3. [ ] Claims Nos.:
   because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III  Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. [ ] As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. [X] As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. [X] As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. [ ] No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

[ ] The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

[ ] The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

[ ] No protest accompanied the payment of additional search fees.
This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX