SIDE IMPACT PROTECTION ON CAR SEAT

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Application No. 63/567,967, filed on March 21, 2024, U.S. Application No. 63/568,132, filed on March 21, 2024, U.S. Application No. 63/571,037, filed on March 28, 2024, U.S. Application No. 63/574,681, filed on April 4, 2024, U.S. Application No. 63/632,234, filed on April 10, 2024, U.S. Application No. 63/633,096, filed on April 12, 2024, U.S. Application No. 63/633,321, filed on April 12, 2024, U.S. Application No. 63/633,401, filed on April 12, 2024, U.S. Application No. 63/633,416, filed on April 12, 2024, U.S. Application No. 63/635,674, filed on April 18, 2024, U.S. Application No. 63/637,186, filed on April 22, 2024, U.S. Application No. 63/641,742, filed on May 2, 2024, U.S. Application No. 63/644,886, filed on May 9, 2024, U.S. Application No. 63/649,011, filed on May 17, 2024, U.S. Application No. 63/662,715, filed on June 21, 2024, U.S. Application No. 63/662,717, filed on June 21, 2024, U.S. Application No. 63/663,431, filed on June 24, 2024, U.S. Application No. 63/666,334, filed on July 1, 2024, U.S. Application No. 63/666,909, filed on July 2, 2024, U.S. Application No. 63/672,797, filed on July 18, 2024, U.S. Application No. 63/675,779, filed on July 26, 2024, U.S. Application No. 63/678,269, filed on August 1, 2024, U.S. Application No. 63/687,927, filed August 28, 2024, U.S. Application No. 63/690,014, filed on September 3, 2024, U.S. Application No. 63/696,645, filed on September 19, 2024, U.S. Application No. 63/697,008, filed on September 20, 2024, U.S. Application No. 63/697,012, filed on September 20, 2024, U.S. Application No. 63/697,016, filed on September 20, 2024, U.S. Application No. 63/699,232, filed on September 26, 2024, U.S. Application No. 63/705,287, filed on October 9, 2024, U.S. Application No. 63/705,690, filed on October 10, 2024, U.S. Application No. 63/710,299, filed on October 22, 2024, U.S. Application No. 63/711,185, filed on October 24, 2024, U.S. Application No. 63/714,361, filed on October 31, 2024, U.S. Application No. 63/719,831, filed on November 13, 2024, U.S. Application No. 63/729,088, filed on December 6, 2024, U.S. Application No. 63/729,091, filed on December 6, 2024, U.S. Application No. 63/733,231, filed on December 12, 2024, U.S. Application No. 63/753,107, filed on February 3, 2025, U.S. Application No. 63/760,750, filed on February 20, 2025, U.S. Application No. 63/760,753, filed on February 20, 2025, U.S. Application No. 63/764,102, filed on February 27, 2025, and U.S. Application No. 63/766,086, filed on March 3, 2025, which is incorporated herein by reference in its entirety.

FIELD

[0001] Embodiments of the present disclosure relate to child seats, and more particularly to systems, assemblies, and methods for side impact protection for a child seats in a vehicle.

BACKGROUND

[0002] A child seat is designed to protect a child from injury or death during a collision of a vehicle. Existing child restraint systems commonly include a base portion and a seat portion detachably installed on the base portion. When a child seat is secured on a vehicle by a lower anchor or a vehicle belt, the base portion must be adjusted to a proper reclined angle. In addition, depending on the type of seat that is being used, the seat may be positioned either in a forward-facing or a rearward-facing orientation.

BRIEF DESCRIPTION

[0003] According to an embodiment, a child seat for receiving an occupant includes a seat body having a seat portion, a back portion extending from the seat portion, and a headrest. The back portion defines a cavity for receiving an upper body of the occupant. A side impact protection (SIP) device is affixed to the seat body within the cavity. A position of the SIP device is adjustable relative to the seat body.

[0004] In addition to one or more of the features described above, or as an alternative, in further embodiments, the SIP device is rotatable between a plurality of positions relative to the seat body.

[0005] In addition to one or more of the features described above, or as an alternative, in further embodiments, the plurality of positions includes a first position in which a distal end of the SIP device is arranged adjacent to an inward facing surface of the headrest, and a second position, in which the distal end of the SIP device is arranged adjacent to an outer surface of the headrest.

[0006] In addition to one or more of the features described above, or as an alternative, in further embodiments, the headrest includes a head SIP device.

[0007] In addition to one or more of the features described above, or as an alternative, in further embodiments, the plurality of positions includes a first position in which a distal end of the SIP device is arranged adjacent to the head SIP device, and a second position, in which the distal end of the SIP device is spaced away from the head SIP device.

[0008] In addition to one or more of the features described above, or as an alternative, in further embodiments, the SIP device is mounted to the headrest.

[0009] In addition to one or more of the features described above, or as an alternative, in further embodiments, the SIP device is movable between a plurality of positions relative to the headrest.

[0010] In addition to one or more of the features described above, or as an alternative, in further embodiments, the headrest is movable relative to the back portion of the seat body. The SIP device is movable with the headrest relative to the seat body.

[0011] In addition to one or more of the features described above, or as an alternative, in further embodiments, the SIP device is rotatable about an axis, the axis being oriented generally parallel to a path of movement of the headrest.

[0012] In addition to one or more of the features described above, or as an alternative, in further embodiments, the SIP device is mounted to the back portion of the seat body.

[0013] In addition to one or more of the features described above, or as an alternative, in further embodiments, the back portion includes an upright support surface and at least one upright side member extending from the upright support surface. The SIP device is arranged at the at least one upright side member.

[0014] A child seat for receiving an occupant includes a seat body having a seat portion and a back portion extending from the seat portion. The back portion is separable from the seat portion. A connector member is arranged at the seat body. The connector member is connectable to at least one of the seat portion and the back portion to detachably couple the back portion to the seat portion. The connector member is a side impact protection (SIP) device.

[0015] In addition to one or more of the features described above, or as an alternative, in further embodiments, the connector member fixes a position of the back portion relative to the seat portion.

[0016] In addition to one or more of the features described above, or as an alternative, in further embodiments, the connector member is removably couplable to the back portion.

[0017] In addition to one or more of the features described above, or as an alternative, in further embodiments, the connector member is permanently coupled to the seat portion.

[0018] In addition to one or more of the features described above, or as an alternative, in further embodiments, the connector member is removably couplable to the seat portion.

[0019] In addition to one or more of the features described above, or as an alternative, in further embodiments, the back portion includes an upright side member arranged at a side of the back portion and the seat portion includes a seat side member arranged at a side of the

seat portion. The connector member is connectable to the upright side member and the seat side member.

[0020] In addition to one or more of the features described above, or as an alternative, in further embodiments, a body of the connector member is positioned in overlapping arrangement with a portion of the upright side member and a portion of the seat side member.

[0021] In addition to one or more of the features described above, or as an alternative, in further embodiments, the connector member is arranged at an exterior of the seat body.

[0022] In addition to one or more of the features described above, or as an alternative, in further embodiments, the connector member extends outward from both of the seat back and the seat base to define a maximum width of the child seat.

[0023] In addition to one or more of the features described above, or as an alternative, in further embodiments, the connector member is an external SIP device.

[0024] In addition to one or more of the features described above, or as an alternative, in further embodiments, the connector member is arranged at an interior of the seat body.

[0025] In addition to one or more of the features described above, or as an alternative, in further embodiments, the connector member is a torso SIP device.

[0026] In addition to one or more of the features described above, or as an alternative, in further embodiments, the child seat is a booster seat.

[0027] According to an embodiment, a child seat for receiving an occupant includes a seat body having a seat portion and a back portion extending from the seat portion. The seat body is transformable between a first configuration and a second configuration. A side impact protection (SIP) device is connectable to the seat body.

[0028] In addition to one or more of the features described above, or as an alternative, in further embodiments, the SIP device is connectable to the seat body in both the first configuration and the second configuration.

[0029] In addition to one or more of the features described above, or as an alternative, in further embodiments, the SIP device is connectable to the seat body in only one of the first configuration and the second configuration.

[0030] In addition to one or more of the features described above, or as an alternative, in further embodiments, in the first configuration, the back portion is attached to the seat portion, and in the second configuration, the back portion is separated from the seat portion.

[0031] In addition to one or more of the features described above, or as an alternative, in further embodiments, the SIP device is arranged at the back portion.

[0032] In addition to one or more of the features described above, or as an alternative, in further embodiments, the SIP device is arranged at an exterior surface of the back portion.

[0033] In addition to one or more of the features described above, or as an alternative, in further embodiments, the seat body includes at least one belt path opening associated with a vehicle belt path, and the SIP device is affixed to the seat body proximate the vehicle belt path.

[0034] In addition to one or more of the features described above, or as an alternative, in further embodiments, the SIP device overlaps a portion of the at least one belt path opening.

[0035] In addition to one or more of the features described above, or as an alternative, in further embodiments, the at least one belt path opening is formed at the back portion.

[0036] According to an embodiment, a child seat for installation on a vehicle seat includes a seat body having a seat portion and a back portion extending from the seat portion. The seat body has a vehicle belt path for receiving a belt associated with the vehicle seat. A wall of the seat body proximate the vehicle belt path has a first thickness and the wall of the seat body at a location remote from the vehicle belt path has a second thickness. The first thickness is greater than the second thickness.

[0037] In addition to one or more of the features described above, or as an alternative, in further embodiments, the seat body includes an opening formed in the wall. The opening is associated with the vehicle belt path.

[0038] In addition to one or more of the features described above, or as an alternative, in further embodiments, the wall has the first thickness adjacent to the opening.

[0039] In addition to one or more of the features described above, or as an alternative, in further embodiments, the wall includes a ridge formed about a periphery of the opening. The wall at the ridge has the first thickness.

[0040] In addition to one or more of the features described above, or as an alternative, in further embodiments, a side impact protection (SIP) device is arranged at the back portion of the seat body.

[0041] In addition to one or more of the features described above, or as an alternative, in further embodiments, the SIP device is positioned proximate the opening.

[0042] According to an embodiment, a child seat for receiving an occupant includes a seat body having a seat portion and a back portion extending from the seat portion. The back portion is detachably couplable to the seat portion. A side impact protection (SIP) device is connected to the back portion and is aligned with a hip of the occupant.

[0043] In addition to one or more of the features described above, or as an alternative, in further embodiments, the SIP device is arranged at an interior of the back portion.

[0044] In addition to one or more of the features described above, or as an alternative, in further embodiments, the back portion includes an upright support surface and an upright side member extending from the upright support surface. The SIP device is connectable to the upright side member.

[0045] In addition to one or more of the features described above, or as an alternative, in further embodiments, the back portion includes an upright support surface and an upright side member extending from the upright support surface. The SIP device is connectable to the upright support surface.

[0046] In addition to one or more of the features described above, or as an alternative, in further embodiments, the SIP device is permanently connected to the back portion.

[0047] In addition to one or more of the features described above, or as an alternative, in further embodiments, the SIP device is removably connected to the back portion.

[0048] In addition to one or more of the features described above, or as an alternative, in further embodiments, the SIP device is arranged proximate an interface between the seat portion and the back portion.

[0049] In addition to one or more of the features described above, or as an alternative, in further embodiments, the SIP device is removably connectable to the seat portion.

[0050] In addition to one or more of the features described above, or as an alternative, in further embodiments, the SIP device is operable to affix the back portion in position relative to the seat portion.

[0051] In addition to one or more of the features described above, or as an alternative, in further embodiments, the seat portion includes a seat support surface and a seat side member extending from the seat support surface. The SIP device is connected to the seat side member.

[0052] In addition to one or more of the features described above, or as an alternative, in further embodiments, the seat portion includes a seat support surface and a seat side member extending from the seat support surface. The SIP device is connected to the seat support surface.

[0053] According to an embodiment, a child seat for receiving an occupant includes a seat body having a seat portion and a back portion extending from the seat portion. A side impact protection (SIP) device is arranged at an exterior of the back portion. The SIP device is permanently affixable to the seat body.

[0054] In addition to one or more of the features described above, or as an alternative, in further embodiments, the seat body includes at least one slot and the SIP device includes at

least one mounting member, the at least one mounting member being receivable within the at least one slot.

[0055] In addition to one or more of the features described above, or as an alternative, in further embodiments, the at least one slot includes a plurality of slots and the at least one mounting member includes a plurality of mounting members. Each of the plurality of mounting members is receivable within one of the plurality of slots.

[0056] In addition to one or more of the features described above, or as an alternative, in further embodiments, when the at least one mounting member is installed at the at least one slot, movement of the at least one mounting member in a direction away from the at least one slot if restricted.

[0057] In addition to one or more of the features described above, or as an alternative, in further embodiments, the at least one mounting member includes a locking element and the locking element is permanently engageable with the at least one slot.

[0058] In addition to one or more of the features described above, or as an alternative, in further embodiments, a diameter of the locking element varies over an axial length of the locking element.

[0059] In addition to one or more of the features described above, or as an alternative, in further embodiments, the at least one slot includes a directional control member, the directional control member being movable in only a first direction.

[0060] In addition to one or more of the features described above, or as an alternative, in further embodiments, the directional control member includes at least one resilient tooth operable to flex in the first direction.

[0061] In addition to one or more of the features described above, or as an alternative, in further embodiments, the directional control member defines an opening, the opening having a diameter equal to a minimum diameter of the locking element.

[0062] In addition to one or more of the features described above, or as an alternative, in further embodiments, the locking element has a head and a neck, and a diameter of the head is greater than a diameter of the neck. The directional control member defines an opening. The opening has a diameter equal to or greater than the diameter of the neck and smaller than a maximum diameter of the head.

[0063] In addition to one or more of the features described above, or as an alternative, in further embodiments, the directional control member is movable in the first direction to increase the diameter of the opening to equal to or greater than the maximum diameter of the head.

[0064] In addition to one or more of the features described above, or as an alternative, in further embodiments, the SIP device includes an energy absorbing structure arranged within an interior of the SIP device.

[0065] In addition to one or more of the features described above, or as an alternative, in further embodiments, the energy absorbing structure is interconnected with the at least one mounting member.

[0066] In addition to one or more of the features described above, or as an alternative, in further embodiments, the energy absorbing structure is a crushable structure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0067] The following descriptions should not be considered limiting in any way. With reference to the accompanying drawings, like elements are numbered alike:

[0068] FIG. 1 is a perspective view of a child restraint system according to an embodiment;

[0069] FIG. 2A is a perspective view of a child seat including at least one head SIP device covered by soft goods according to an embodiment;

[0070] FIG. 2B is a perspective view of a child seat including at least one head SIP device with the soft goods removed according to an embodiment;

[0071] FIG. 3A is a front view of a headrest of a child seat including a plurality of head SIP devices according to an embodiment;

[0072] FIG. 3B is a perspective view of a head SIP device of FIG. 3A according to an embodiment;

[0073] FIG. 4A is a perspective view of a headrest including a head SIP device according to an embodiment;

[0074] FIG. 4B is a detailed perspective view of the head SIP device of FIG. 4A according to an embodiment;

[0075] FIG. 5A is a top perspective view of a headrest including a head SIP device according to an embodiment;

[0076] FIG. 5B is a side perspective view of the head SIP device of FIG. 5A according to an embodiment;

[0077] FIG. 6A is a side perspective view of a headrest including a head SIP device and a secondary body of compressible material in overlapping arrangement with the head SIP device according to an embodiment;

[0078] FIG. 6B is a side perspective view of the head SIP device and secondary body of compressible material of FIG. 6A according to an embodiment;

[0079] FIG. 7A is a top perspective view of a headrest including a head SIP device according to an embodiment;

[0080] FIG. 7B includes a schematic diagram of the head SIP device of FIG. 7A according to an embodiment;

[0081] FIG. 8A is a top perspective view of a headrest including a head SIP device according to an embodiment;

[0082] FIG. 8B includes a schematic diagram of the head SIP device of FIG. 8A according to an embodiment;

[0083] FIG. 9A is a top perspective view of a headrest including a head SIP device according to an embodiment;

[0084] FIG. 9B includes a schematic diagram of the head SIP device of FIG. 9A according to an embodiment;

[0085] FIG. 10A is a front view of a child seat including a headrest having at least one head SIP according to an embodiment;

[0086] FIG. 10B is a perspective view of the headrest of FIG. 10A according to an embodiment;

[0087] FIG. 10C is a side view of the head SIP device of FIG. 10A according to an embodiment;

[0088] FIG. 11A is a front view of a child seat including a headrest having at least one head SIP according to an embodiment;

[0089] FIG. 11B is a perspective view of the headrest of FIG. 11A according to an embodiment;

[0090] FIG. 11C is a side view of the head SIP device of FIG. 11A according to an embodiment;

[0091] FIG. 12A is a perspective view of a headrest of a child seat having a plurality of head SIP devices arranged at an area thereof according to an embodiment;

[0092] FIG. 12B is a perspective view of the headrest of FIG. 12A when an occupant is arranged within the child seat according to an embodiment;

[0093] FIG. 13A is a perspective view of a child seat including a headrest having a head SIP assembly according to an embodiment;

[0094] FIG. 13B is a front view perspective view of the headrest of FIG. 13A according to an embodiment;

[0095] FIG. 13C is a top view of the headrest of FIG. 13A according to an embodiment;

[0096] FIG. 13D is a perspective view of the head SIP assembly of FIG. 13A separated from the headrest according to an embodiment;

[0097] FIG. 13E is a top view of the head SIP assembly of FIG. 13D according to an embodiment;

[0098] FIG. 14 is a top view of a child positioned relative to a headrest of a child seat having a head SIP assembly according to an embodiment;

[0099] FIG. 15A is a perspective view of a child seat including a headrest having a head SIP assembly according to an embodiment;

[0100] FIG. 15B is a front view perspective view of the headrest of FIG. 15A according to an embodiment;

[0101] FIG. 15C is a top view of the headrest of FIG. 15A according to an embodiment;

[0102] FIG. 15D is a perspective view of the head SIP assembly of FIG. 15A separated from the headrest according to an embodiment;

[0103] FIG. 15E is a top view of the head SIP assembly of FIG. 15D according to an embodiment;

[0104] FIG. 16A is a perspective view of a child seat including a headrest having a head SIP assembly according to an embodiment;

[0105] FIG. 16B is a front view perspective view of the headrest of FIG. 16A according to an embodiment;

[0106] FIG. 16C is a top view of the headrest of FIG. 16A according to an embodiment;

[0107] FIG. 16D is a perspective view of the head SIP assembly of FIG. 16A separated from the headrest according to an embodiment;

[0108] FIG. 16E is a top view of the head SIP assembly of FIG. 16D according to an embodiment;

[0109] FIG. 17A is a perspective view of a child seat including a headrest having a head SIP assembly according to an embodiment;

[0110] FIG. 17B is a front view perspective view of the headrest of FIG. 17A according to an embodiment;

[0111] FIG. 17C is a top view of the headrest of FIG. 17A according to an embodiment;

[0112] FIG. 17D is a perspective view of the head SIP assembly of FIG. 17A separated from the headrest according to an embodiment;

[0113] FIG. 17E is a top view of the head SIP assembly of FIG. 17D according to an embodiment;

[0114] FIG. 18A is a perspective view of a child seat including a headrest having a head SIP assembly according to an embodiment;

[0115] FIG. 18B is a front view perspective view of the headrest of FIG. 18A according to an embodiment;

[0116] FIG. 18C is a top view of the headrest of FIG. 18A according to an embodiment;

[0117] FIG. 18D is a perspective view of the head SIP assembly of FIG. 18A separated from the headrest according to an embodiment;

[0118] FIG. 18E is a top view of the head SIP assembly of FIG. 18D according to an embodiment;

[0119] FIG. 19A is a perspective view of a child seat including a headrest having a head SIP assembly having a plurality of head SIP devices arranged to contact the same side of an occupant's head according to an embodiment;

[0120] FIG. 19B is a front view perspective view of the headrest of FIG. 19A according to an embodiment;

[0121] FIG. 19C is a top view of the headrest of FIG. 19A according to an embodiment;

[0122] FIG. 19D is a perspective view of the head SIP assembly of FIG. 19A separated from the headrest according to an embodiment;

[0123] FIG. 19E is a top view of the head SIP assembly of FIG. 19D according to an embodiment;

[0124] FIG. 20A is a perspective view of a child seat including a headrest having a head SIP assembly having a plurality of head SIP devices arranged at the same side of an occupant's head according to an embodiment;

[0125] FIG. 20B is a front view perspective view of the headrest of FIG. 20A according to an embodiment;

[0126] FIG. 20C is a top view of the headrest of FIG. 20A according to an embodiment;

[0127] FIG. 20D is a perspective view of the head SIP assembly of FIG. 20A separated from the headrest according to an embodiment;

[0128] FIG. 20E is a top view of the head SIP assembly of FIG. 20D according to an embodiment;

[0129] FIG. 21A is a perspective view of a child seat including a headrest having a head SIP assembly having a plurality of head SIP devices arranged at the same side of an occupant's head according to an embodiment;

[0130] FIG. 21B is a front view perspective view of the headrest of FIG. 21A according to an embodiment;

[0131] FIG. 21C is a top view of the headrest of FIG. 21A according to an embodiment;

[0132] FIG. 21D is a perspective view of the head SIP assembly of FIG. 21A separated from the headrest according to an embodiment;

[0133] FIG. 21E is a top view of the head SIP assembly of FIG. 21D according to an embodiment;

[0134] FIG. 22A is a perspective view of a child seat including a headrest having a head SIP assembly having a plurality of head SIP devices arranged at the same side of an occupant's head according to an embodiment;

[0135] FIG. 22B is a front view perspective view of the headrest of FIG. 22A according to an embodiment;

[0136] FIG. 22C is a top view of the headrest of FIG. 22A according to an embodiment;

[0137] FIG. 22D is a perspective view of the head SIP assembly of FIG. 22A separated from the headrest according to an embodiment;

[0138] FIG. 22E is a top view of the head SIP assembly of FIG. 22D according to an embodiment;

[0139] FIG. 23A is a perspective view of a child seat including a headrest having a head SIP assembly having a plurality of head SIP devices arranged at the same side of an occupant's head according to an embodiment;

[0140] FIG. 23B is a front view perspective view of the headrest of FIG. 23A according to an embodiment;

[0141] FIG. 23C is a top view of the headrest of FIG. 23A according to an embodiment;

[0142] FIG. 23D is a perspective view of the head SIP assembly of FIG. 23A separated from the headrest according to an embodiment;

[0143] FIG. 23E is a top view of the head SIP assembly of FIG. 23D according to an embodiment;

[0144] FIG. 24A is a side view of a headrest of a child seat including a control mechanism and at least one head SIP assembly in a first configuration according to an embodiment;

[0145] FIG. 24B is a top view of the headrest of FIG. 24A according to an embodiment;

[0146] FIG. 24C is a side view of a headrest of a child seat including a control mechanism and at least one head SIP assembly in a second configuration according to an embodiment;

[0147] FIG. 24D is a top view of the headrest of FIG. 24C according to an embodiment;

[0148] FIG. 25A is a side view of a headrest of a child seat including a control mechanism and at least one head SIP assembly in a first configuration according to an embodiment;

[0149] FIG. 25B is a top view of the headrest of FIG. 25A according to an embodiment;

[0150] FIG. 25C is a side view of a headrest of a child seat including a control mechanism and at least one head SIP assembly in a second configuration according to an embodiment;

[0151] FIG. 25D is a top view of the headrest of FIG. 25C according to an embodiment;

[0152] FIG. 26A is a perspective view of a child seat including a headrest having a head SIP assembly including a plurality of head SIP devices arranged at the same side of an occupant's head in a first configuration according to an embodiment;

[0153] FIG. 26B is a front view perspective view of the headrest of FIG. 26A according to an embodiment;

[0154] FIG. 26C is a top view of the headrest of FIG. 26A according to an embodiment;

[0155] FIG. 26D is a perspective view of the headrest of FIG. 26A in a second configuration according to an embodiment;

[0156] FIG. 26E is a front view perspective view of the headrest of FIG. 26D according to an embodiment;

[0157] FIG. 26F is a top view of the headrest of FIG. 26D according to an embodiment;

[0158] FIG. 27A is a perspective view of a child seat including a headrest having a head SIP assembly including a plurality of head SIP devices arranged at the same side of an occupant's head when an installation belt is arranged at a first position about the child seat according to an embodiment;

[0159] FIG. 27B is a perspective view of the child seat of FIG. 27A when an installation belt is arranged at a second position about the child seat according to an embodiment;

[0160] FIG. 28A is a perspective view of a headrest of a child seat having a head SIP device formed from a friction material according to an embodiment;

[0161] FIG. 28B is a front view of the headrest of FIG. 28A according to an embodiment;

[0162] FIG. 29A is a perspective view of a headrest of a child seat having a head SIP device arranged at a front end of the headrest according to an embodiment;

[0163] FIG. 29B is a perspective view of a headrest of a child seat having another head SIP device arranged at a front end of the headrest according to an embodiment;

[0164] FIG. 30A is a perspective view of a child seat including a headrest having a head SIP device in a first configuration according to an embodiment;

[0165] FIG. 30B is a top view of the child seat of FIG. 30A according to an embodiment;

[0166] FIG. 31A is a perspective view of the child seat of FIG. 30A having a head SIP device in a second configuration according to an embodiment;

[0167] FIG. 31B is a top view of the child seat of FIG. 31A according to an embodiment;

[0168] FIG. 32A is a front perspective view of a headrest of a child seat of having at least one head SIP device covered by soft goods according to an embodiment;

[0169] FIG. 32B is a side perspective view of the headrest of FIG. 32A according to an embodiment;

[0170] FIG. 32C is a top view of the headrest of FIG. 32A according to an embodiment;

[0171] FIG. 33A is a front perspective view of a back portion of a child seat having at least one shoulder SIP device arranged at an interior surface thereof according to an embodiment;

[0172] FIG. 33B is a side perspective view of the back portion including at least one shoulder SIP device of FIG. 33A according to an embodiment;

[0173] FIG. 33C is a side perspective view of at least one shoulder SIP device of FIG. 33A according to an embodiment;

[0174] FIG. 34A is a front view of a shoulder SIP device according to an embodiment;

[0175] FIG. 34B is a front perspective view of the shoulder SIP device of FIG. 34A according to an embodiment;

[0176] FIG. 35A is a perspective view of a child seat including a shoulder SIP device of FIGS. 34A-34B arranged at a back portion according to an embodiment;

[0177] FIG. 35B is a top view of the child seat of FIG. 35A according to an embodiment;

[0178] FIG. 36A is a front view of a shoulder SIP device according to another embodiment;

[0179] FIG. 36B is a front perspective view of the shoulder SIP device of FIG. 36A according to an embodiment;

[0180] FIG. 36C is a perspective view of a child seat including a shoulder SIP device of FIGS. 36A-36B arranged at a back portion according to an embodiment;

[0181] FIG. 36D is a top view of the child seat of FIG. 36C according to an embodiment;

[0182] FIG. 37A is a front view of a child seat having at least one shoulder SIP device arranged at an interior surface of a back portion when a headrest is in a lowered position according to an embodiment;

[0183] FIG. 37B is a front view of the child seat of FIG. 37A when the headrest is in a raised position according to an embodiment;

[0184] FIG. 38A is a top perspective view of a child seat having at least one torso SIP device arranged at an interior surface of a back portion of the child seat according to an embodiment;

[0185] FIG. 38B is a front perspective view of the child seat of FIG. 38A according to an embodiment;

[0186] FIG. 38C is a side perspective view of the child seat of FIG. 38A with soft goods installed about the child seat according to an embodiment;

[0187] FIG. 39 is a top perspective view of a child seat having at least one torso SIP device arranged at an interior surface of a seat portion of the child seat according to an embodiment;

[0188] FIG. 40A is a perspective view of a child seat having at least one torso SIP device arranged at an interior surface of the child seat according to an embodiment;

[0189] FIG. 40B is a front view of the child seat of FIG. 40A according to an embodiment;

[0190] FIG. 41A is a perspective view of a torso SIP assembly including a plurality of torso SIP devices according to an embodiment;

[0191] FIG. 41B is a perspective view of the torso SIP assembly of FIG. 41A installed about an interior surface of a child seat according to an embodiment;

[0192] FIG. 41C is a front view of the torso SIP assembly of FIG. 41A installed about an interior surface of a child seat according to an embodiment;

[0193] FIG. 42A is a perspective view of a torso SIP assembly including a plurality of torso SIP devices according to an embodiment;

[0194] FIG. 42B is a perspective view of the torso SIP assembly of FIG. 42A installed about an interior surface of a child seat according to an embodiment;

[0195] FIG. 42C is a front view of the torso SIP assembly of FIG. 42A installed about an interior surface of a child seat according to an embodiment;

[0196] FIG. 43A is a perspective view of a child seat having at least one torso SIP device arranged at an interior surface of a child seat to form an armrest according to an embodiment;

[0197] FIG. 43B is another perspective view of the child seat of FIG. 43A according to an embodiment;

[0198] FIG. 44A is a perspective view of a child seat having at least one torso SIP device arranged at an interior surface of a back portion of the child seat, the at least one torso SIP device being in a first configuration according to an embodiment;

[0199] FIG. 44B is a front view of the child seat of FIG. 44A according to an embodiment;

[0200] FIG. 44C is a perspective view of the child seat of FIG. 44A with the at least one torso SIP device in a second configuration according to an embodiment;

[0201] FIG. 44D is a front view of the child seat of FIG. 44C according to an embodiment;

[0202] FIG. 45A is a perspective view of a child seat having at least one torso SIP device arranged at an interior surface of a back portion of the child seat, the at least one torso SIP device being in a first configuration according to an embodiment;

[0203] FIG. 45B is a front view of the child seat of FIG. 45A according to an embodiment;

[0204] FIG. 45C is a perspective view of the child seat of FIG. 45A with the at least one torso SIP device in a second configuration according to an embodiment;

[0205] FIG. 45D is a front view of the child seat of FIG. 45C according to an embodiment;

[0206] FIG. 46 is a perspective view of a child seat having at least one torso SIP device in a second configuration according to an embodiment;

[0207] FIG. 47A is a perspective view of a child seat having at least one torso SIP device arranged at an interior surface of the child seat, the at least one torso SIP device being in a first configuration according to an embodiment;

[0208] FIG. 47B is a front view of the child seat of FIG. 47A according to an embodiment;

[0209] FIG. 47C is a perspective view of the child seat of FIG. 47A with the at least one torso SIP device in a second configuration according to an embodiment;

[0210] FIG. 47D is a front view of the child seat of FIG. 47C according to an embodiment;

[0211] FIG. 48A is a perspective view of a child seat having at least one torso SIP device arranged at an interior surface of the child seat, the at least one torso SIP device being in a first configuration according to an embodiment;

[0212] FIG. 48B is a front view of the child seat of FIG. 48A according to an embodiment;

[0213] FIG. 48C is a perspective view of the child seat of FIG. 48A with the at least one torso SIP device in a second configuration according to an embodiment;

[0214] FIG. 48D is a front view of the child seat of FIG. 48C according to an embodiment;

[0215] FIG. 49A is a perspective view of a child seat having at least one torso SIP device arranged at an interior surface of the child seat, the at least one torso SIP device being in a first configuration according to an embodiment;

[0216] FIG. 49B is a front view of the child seat of FIG. 49A according to an embodiment;

[0217] FIG. 49C is a perspective view of the child seat of FIG. 49A with the at least one torso SIP device in a second configuration according to an embodiment;

[0218] FIG. 49D is a front view of the child seat of FIG. 49C according to an embodiment;

[0219] FIG. 49E is a top view of the child seat of FIG. 49C according to an embodiment;

[0220] FIG. 50A is a perspective view of a child seat including at least one external SIP device arranged at a support base according to an embodiment;

[0221] FIG. 50B is a side view of the child seat of FIG. 50A according to an embodiment;

[0222] FIG. 51A is a perspective view of a child seat including at least one external SIP device arranged at a support base according to an embodiment;

[0223] FIG. 51B is a side view of the child seat of FIG. 51A according to an embodiment;

[0224] FIG. 52A is a perspective view of a child seat including at least one external SIP device arranged at an exterior surface of the child seat according to an embodiment;

[0225] FIG. 52B is a side view of the child seat of FIG. 52A according to an embodiment;

[0226] FIG. 53A is a side view of a child seat including at least one external SIP device arranged at an exterior surface of a seat portion of the child seat according to an embodiment;

[0227] FIG. 53B is a perspective view of the child seat of FIG. 53A according to an embodiment;

[0228] FIG. 54A is a side view of a child seat including at least one external SIP device arranged at an exterior surface of a back portion of the child seat near a belt path opening according to an embodiment;

[0229] FIG. 54B is a perspective view of the child seat of FIG. 54A according to an embodiment;

[0230] FIG. 55A is a front perspective view of a child seat including at least one external SIP device arranged at an exterior surface of a back portion of the child seat near a belt path opening according to an embodiment;

[0231] FIG. 55B is a rear perspective view of the child seat of FIG. 55A according to an embodiment;

[0232] FIG. 55C is a front view of the child seat of FIG. 55B according to an embodiment;

[0233] FIG. 55D is a side perspective view of the child seat of FIG. 55A according to an embodiment;

[0234] FIG. 55E is a top view of the child seat of FIG. 55A positioned on a vehicle seat adjacent to a vehicle door according to an embodiment;

[0235] FIG. 55F is another rear perspective view of the at least one external SIP device of FIG. 55A according to an embodiment;

[0236] FIG. 56A is a perspective view of a child seat including at least one external SIP device arranged at an exterior surface of a back portion of the child seat near a belt path opening according to an embodiment;

[0237] FIG. 56B is a side view of the child seat of FIG. 56A according to an embodiment;

[0238] FIG. 57 is a perspective view of an external SIP device having a slot for engaging a vehicle belt according to an embodiment;

[0239] FIG. 58 is a perspective view of an external SIP device having a clip for engaging a vehicle belt according to an embodiment;

[0240] FIG. 59 is a perspective view of an external SIP device having a rotatable clip for engaging a vehicle belt according to an embodiment;

[0241] FIG. 60 is a perspective view of an external SIP device rotatable into engagement with a vehicle belt according to an embodiment;

[0242] FIG. 61A is a perspective view of an infant car seat having at least one external SIP device arranged at a handle hub according to an embodiment;

[0243] FIG. 61B is a side view of an infant car seat having at least one external SIP device arranged at an exterior surface of a seat portion according to an embodiment;

[0244] FIG. 61C is a top perspective view of the at least one external SIP device of FIG. 61B according to an embodiment;

[0245] FIG. 62A is a perspective view of a child including at least one external SIP device arranged at an exterior surface of a back portion of the child seat, the at least one external SIP device being in a first configuration according to an embodiment;

[0246] FIG. 62B is a perspective view of the child seat of FIG. 62A with the at least one external SIP device in a second configuration according to an embodiment;

[0247] FIG. 63A is a perspective view of a child including an external SIP device arranged at an exterior surface of a back portion of the child seat, the external SIP device being in a first configuration according to an embodiment;

[0248] FIG. 63B is a perspective view of the child seat of FIG. 63A with the external SIP device in a second configuration according to an embodiment;

[0249] FIG. 63C is a perspective view of the child seat of FIG. 63A with the external SIP device in a third configuration according to an embodiment;

[0250] FIG. 64A is a perspective view of a child including an external SIP device arranged at an exterior surface of a back portion of the child seat, the external SIP device being in a first configuration according to an embodiment;

[0251] FIG. 64B is a perspective view of the child seat of FIG. 64A with the external SIP device in a second configuration according to an embodiment;

[0252] FIG. 64C is a perspective view of the child seat of FIG. 64A with the external SIP device in a third configuration according to an embodiment;

[0253] FIG. 65A is a front perspective view of a child seat including at least one SIP device and an actuation mechanism operably coupled to the at least one SIP device according to an embodiment;

[0254] FIG. 65B is a perspective view of the actuation mechanism of FIG. 65A in an unactuated configuration and at least one SIP device operably coupled to the actuation mechanism in a first configuration according to an embodiment;

[0255] FIG. 65C is a front perspective view of the child seat of FIG. 65A when the actuation mechanism is actuated and the at least one SIP device is in a second configuration according to an embodiment;

[0256] FIG. 65D is a perspective view of the actuation mechanism in the actuated configuration and at least one SIP device operably coupled to the actuation mechanism in a second configuration according to an embodiment;

[0257] FIG. 66A is a front perspective view of a child seat including at least one SIP device and an actuation mechanism operably coupled to the at least one SIP device according to an embodiment;

[0258] FIG. 66B is a perspective view of the actuation mechanism of FIG. 66A in an unactuated configuration and at least one SIP device operably coupled to the actuation mechanism in a first configuration according to an embodiment;

[0259] FIG. 66C is another front perspective view of the child seat of FIG. 66A when the actuation mechanism is unactuated and the at least one SIP device is in a first configuration according to an embodiment;

[0260] FIG. 66D is a side view of the actuation mechanism in the unactuated configuration and at least one SIP device operably coupled to the actuation mechanism in a first configuration according to an embodiment;

[0261] FIG. 66E is a front perspective view of the child seat of FIG. 66A with the actuation mechanism in an actuated configuration and the at least one SIP device in a second configuration according to an embodiment;

[0262] FIG. 66F is a perspective view of the actuation mechanism of FIG. 66E in the actuated configuration and the at least one SIP device operably coupled to the actuation mechanism in the second configuration according to an embodiment;

[0263] FIG. 66G is another front perspective view of the child seat of FIG. 66E when the actuation mechanism is actuated and the at least one SIP device is in a second configuration according to an embodiment;

[0264] FIG. 66H is a side view of the actuation mechanism in the actuated configuration and at least one SIP device operably coupled to the actuation mechanism in a second configuration according to an embodiment;

[0265] FIG. 67A is a front view of a child seat having at least one SIP device transformable between a first configuration and a second configuration in response to movement of the headrest according to an embodiment;

[0266] FIG. 67B is a rear perspective view of the child seat of FIG. 67A according to an embodiment;

[0267] FIG. 67C is a detailed perspective view of an actuation mechanism of the child seat of FIG. 67A in an unactuated position and of the at least one SIP device in a first configuration according to an embodiment;

[0268] FIG. 67D is a detailed front view of an actuation mechanism of the child seat of FIG. 67A in an unactuated position and of the at least one SIP device in a first configuration according to an embodiment;

[0269] FIG. 67E is a front view of the child seat of FIG. 67A having at least one SIP device in a second configuration and an actuation mechanism in an actuated configuration according to an embodiment;

[0270] FIG. 67F is a rear perspective view of the child seat of FIG. 67E according to an embodiment;

[0271] FIG. 67G is a detailed perspective view of an actuation mechanism of the child seat of FIG. 67E in an actuated configuration and of the at least one SIP device in a second configuration according to an embodiment;

[0272] FIG. 67H is a detailed front view of the actuation mechanism of the child seat of FIG. 67E in an actuated configuration and of the at least one SIP device in a second configuration according to an embodiment;

[0273] FIG. 68A is a perspective view of a child seat including a headrest having a head SIP assembly including a plurality of head SIP devices arranged at the same side of an occupant's head in a first configuration according to an embodiment;

[0274] FIG. 68B is a front view perspective view of the headrest of FIG. 68A according to an embodiment;

[0275] FIG. 68C is a top view of the headrest of FIG. 68A according to an embodiment;

[0276] FIG. 68D is a perspective view of the headrest of FIG. 68A in a second configuration according to an embodiment;

[0277] FIG. 68E is a front view perspective view of the headrest of FIG. 26D according to an embodiment;

[0278] FIG. 68F is a top view of the headrest of FIG. 68D according to an embodiment;

[0279] FIG. 69A is a side view of a headrest having at least one head SIP device according to an embodiment;

[0280] FIG. 69B is a rear view of the headrest of FIG. 69A according to an embodiment;

[0281] FIG. 70A is a front perspective view of a child seat having a headrest in a lowered position and at least one shoulder device operably coupled to the headrest according to an embodiment;

[0282] FIG. 70B is a front perspective view of the child seat of FIG. 70A with the headrest in a raised position according to an embodiment;

[0283] FIG. 71 is a schematic drawings of a child seat system having a combination SIP assembly including a head SIP device and a shoulder SIP device;

[0284] FIG. 72 is a schematic drawings of a child seat system having a combination SIP assembly including a head SIP device and a torso SIP device;

[0285] FIG. 73 is a schematic drawings of a child seat system having a combination SIP assembly including a head SIP device and an external SIP device;

[0286] FIG. 74 is a schematic drawings of a child seat system having a combination SIP assembly including a shoulder SIP device and a torso SIP device;

[0287] FIG. 75 is a schematic drawings of a child seat system having a combination SIP assembly including a shoulder SIP device and an external SIP device;

[0288] FIG. 76 is a schematic drawings of a child seat system having a combination SIP assembly including a torso SIP device and an external SIP device;

[0289] FIG. 77 is a schematic drawings of a child seat system having a combination SIP assembly including a head SIP device, a shoulder SIP device, and a torso SIP device;

[0290] FIG. 78 is a schematic drawings of a child seat system having a combination SIP assembly including a head SIP device, a shoulder SIP device, and an external SIP device;

[0291] FIG. 79 is a schematic drawings of a child seat system having a combination SIP assembly including a head SIP device, a torso SIP device, and an external SIP device;

[0292] FIG. 80 is a schematic drawings of a child seat system having a combination SIP assembly including a shoulder SIP device, a torso SIP device, and an external SIP device;

[0293] FIG. 81 is a schematic drawings of a child seat system having a combination SIP assembly including a head SIP device, a shoulder SIP device, a torso SIP device, and an external SIP device;

[0294] FIG. 82A is a top view of a child positioned relative to a headrest of a child seat having a plurality of head SIP devices according to an embodiment; d

[0295] FIG. 82B is a top view of a child positioned relative to the headrest of FIG. 82A during a side impact event according to an embodiment;

[0296] FIG. 83 is a perspective view of a head SIP device transformable between a stowed configuration and a deployed configuration according to another embodiment;

[0297] FIG. 84A is a front view of a child seat having a plurality of shoulder SIP devices affixed to a movable headrest in a raised position according to an embodiment;

[0298] FIG. 84B is a front view of a child seat having a plurality of shoulder SIP devices affixed to a movable headrest in a lowered position according to an embodiment;

[0299] FIG. 85 is an exploded perspective view of a shoulder SIP device of FIGS. 84A-84B according to an embodiment;

[0300] FIGS. 86A-86D are views of a torso SIP device in various configurations according to an embodiment;

[0301] FIG. 86E is a side view of a torso SIP device in a first configuration;

[0302] FIG. 86F is a side view of the torso SIP device in a second configuration'

[0303] FIG. 87A is a perspective view of a child seat having a torso SIP assembly retained in position about the child seat by a connection assembly according to an embodiment;

[0304] FIG. 87B is a detailed perspective view of the torso SIP assembly when the connection assembly of FIG. 87A is in a first position according to an embodiment;

[0305] FIG. 87C is a detailed perspective view of the torso SIP assembly when the connection assembly of FIG. 87A is in a second position according to an embodiment;

[0306] FIG. 88A is a back view of the torso SIP assembly when the connection assembly is in a first position according to an embodiment;

[0307] FIG. 88B is a back view of the torso SIP assembly when the connection assembly of FIG. 88A is in a second position according to an embodiment;

[0308] FIG. 88C is a side perspective view of the torso SIP assembly when the connection assembly is in a first position according to an embodiment;

[0309] FIG. 88D is a side view of the torso SIP assembly when the connection assembly of FIG. 88C is in a second position according to an embodiment;

[0310] FIG. 89A is a perspective view of a child seat having a torso SIP assembly and a corresponding control device associated with a torso SIP device of the torso SIP assembly according to an embodiment;

[0311] FIG. 89B is a detailed perspective view of the control device according to an embodiment;

[0312] FIG. 89C is a perspective view of a torso SIP device of the torso SIP assembly of FIG. 89A when the control device is in a first position according to an embodiment;

[0313] FIG. 89D is a perspective view of a torso SIP device of the torso SIP assembly of FIG. 89A when the control device is in a first position according to an embodiment;

[0314] FIG. 90A is a perspective view of a child seat including an external SIP device in a first position according to an embodiment;

[0315] FIG. 90B is a perspective view of a child seat including an external SIP device in a second position according to an embodiment;

[0316] FIG. 91 is a detailed perspective view of the external SIP device of FIGS. 90A-90B according to an embodiment;

[0317] FIG. 92A is a front perspective view of the external SIP device of FIG. 91 according to an embodiment;

[0318] FIG. 92B is a back perspective view of the external SIP device of FIG. 92A according to an embodiment;

[0319] FIG. 93 is a side view of the view of the external SIP device of FIG. 92A according to an embodiment;

[0320] FIG. 94 is an exploded side view of the external SIP device of FIG. 93 according to an embodiment;

[0321] FIG. 95 is a cross-sectional exploded view of the external SIP device of FIG. 94 according to an embodiment;

[0322] FIG. 96A is a side view of an external SIP device in a first configuration according to an embodiment;

[0323] FIG. 96B is a side view of the external SIP device of FIG. 96A in a second configuration according to an embodiment;

[0324] FIG. 97A and 97B are perspective views of a child seat system including an engagement member associated with an external SIP device according to an embodiment;

[0325] FIG. 98A is a perspective view of a child seat system in a rearward facing configuration and including an engagement member associated with an external SIP device according to an embodiment;

[0326] FIG. 98B is a perspective view of the child seat system of FIG. 98A in a forward-facing configuration and including an engagement member associated with an external SIP device according to an embodiment;

[0327] FIG. 99 is a perspective view of a child seat system having an external SIP device arranged at the support base according to an embodiment;

[0328] FIG. 100 is a perspective view of a child seat system having a movable external SIP device arranged at the support base according to another embodiment;

[0329] FIG. 101 is a perspective view of a child seat system having a movable external SIP device arranged at the support base according to an embodiment;

[0330] FIG. 102A and 102B are perspective views of a child seat system having a movable external SIP device arranged at the support base according to yet another embodiment;

[0331] FIG. 103 is a perspective view of a child seat system having a translatable external SIP device arranged at the support base according to another embodiment;

[0332] FIG. 104 is a perspective view of a child seat system having a pivotable external SIP device arranged at the support base according to another embodiment;

[0333] FIG. 105 is a perspective view of a child seat system having a telescoping external SIP device arranged at the support base according to another embodiment;

[0334] FIGS. 106A and 106B are perspective view of a support base having an external SIP device according to an embodiment;

[0335] FIGS. 107A and 107B are various view of a child seat system including an actuation mechanism for automatically transforming an SIP device according to an embodiment;

[0336] FIG. 108A is a plan view of a child seat system having an SIP device when the child seat is in a forward-facing configuration according to an embodiment;

[0337] FIG. 108B is a plan view of a child seat system having an SIP device when the child seat is rotating between a rearward-facing configuration and a forward-facing configuration according to an embodiment;

[0338] FIG. 109A is an exploded perspective view of a child seat system in a forward-facing configuration, the child seat having a system for automatically deploying a SIP device based on a position of the child seat relative to a vehicle seat and a configuration of the child seat according to an embodiment;

[0339] FIG. 109B is a plan view of the child seat system of FIG. 109A according to an embodiment;

[0340] FIG. 110A is an exploded perspective view of the child seat system of FIG. 109A as the child seat rotates away from a forward-facing configuration according to an embodiment;

[0341] FIG. 110B is a plan view of the child seat system of FIG. 110A according to an embodiment;

[0342] FIG. 111 is a front view of a control feature for moving an actuator of a support base according to an embodiment;

[0343] FIG. 112 is a side view of a child seat system including a child seat having at least one external SIP device at a seat portion according to an embodiment;

[0344] FIG. 113A is a schematic view of a cupholder of a child seat in an extended configuration according to an embodiment;

[0345] FIG. 113B is a schematic view of a cupholder of a child seat in an extended configuration according to an embodiment;

[0346] FIG. 113C is a schematic view of a cupholder of a child seat during a crash event according to an embodiment;

[0347] FIG. 114A is a schematic view of a cupholder of a child seat in an extended configuration according to an embodiment;

[0348] FIG. 114B is a schematic view of a cupholder of a child seat in an extended configuration according to an embodiment;

[0349] FIG. 114C is a schematic view of a cupholder of a child seat during a crash event according to an embodiment;

[0350] FIG. 115 is a view of a child seat system including a child seat having at least one external SIP device at a seat portion according to an embodiment;

[0351] FIG. 116A is a perspective view of an infant car seat having at least one external SIP device according to an embodiment;

[0352] FIG. 116B is another perspective view of an infant car seat having at least one external SIP device according to an embodiment;

[0353] FIG. 116C is another perspective view of an infant car seat with a handle in a rear position and having at least one external SIP device according to an embodiment;

[0354] FIG. 116D is another perspective view of an infant car seat with a handle in a rear position and having at least one external SIP device according to an embodiment;

[0355] FIG. 117 A is a perspective view of a child seat including an SIP device in a first configuration according to an embodiment;

[0356] FIG. 117B is a plan view of the child seat of FIG. 117A according to an embodiment;

[0357] FIG. 118A is a perspective view of a child seat including an SIP device in a second configuration according to an embodiment;

[0358] FIG. 118B is a plan view of the child seat of FIG. 118A according to an embodiment;

[0359] FIG. 119A is a perspective view of a child seat including an SIP device in a first configuration according to an embodiment;

[0360] FIG. 119B is a plan view of the child seat of FIG. 119A according to an embodiment;

[0361] FIG. 120A is a perspective view of a child seat including an SIP device in a second configuration according to an embodiment;

[0362] FIG. 120B is a plan view of the child seat of FIG. 120A according to an embodiment;

[0363] FIG. 121A is a plan view of a child seat including an SIP device in a first configuration according to an embodiment;

[0364] FIG. 121B is a plan view of a child seat including an SIP device in a second configuration according to an embodiment;

[0365] FIG. 122A is a perspective view of a child seat including an SIP device in a first configuration according to an embodiment;

[0366] FIG. 122B is a perspective view of a child seat including an SIP device in a second configuration according to an embodiment;

[0367] FIG. 123A is a plan view of a child seat including an SIP device in a first configuration according to an embodiment;

[0368] FIG. 123B is a plan view of a child seat including an SIP device in a second configuration according to an embodiment;

[0369] FIG. 124A is a plan view of a child seat including an SIP device in a first configuration according to an embodiment;

[0370] FIG. 124B is a plan view of a child seat including an SIP device in a second configuration according to an embodiment;

[0371] FIG. 125A is a plan view of a child seat including an SIP device in a first configuration according to an embodiment;

[0372] FIG. 125B is a perspective view of the SIP device in the first configuration according to an embodiment;

[0373] FIG. 125C is a perspective view of the SIP device in a second configuration according to an embodiment;

[0374] FIGS. 126A-126C are perspective views of a child seat system having a deformable SIP device at various locations according toa n embodiment;

[0375] FIG. 127A is a side perspective view of a child seat system including a collapsible SIP device in a first configuration according to an embodiment;

[0376] FIG. 127B is a rear perspective view of a child seat system including a collapsible SIP device in a first configuration according to an embodiment;

[0377] FIG. 127C is a rear perspective view of a child seat system including a collapsible SIP device in a second configuration according to an embodiment;

[0378] FIG. 128A is a plan view of a child seat system including a collapsible SIP device in a first configuration according to an embodiment;

[0379] FIG. 128B is a perspective view of a portion of the SIP device in more detail according to an embodiment;

[0380] FIG. 129 is a plan view of a child seat system including a SIP device according to an embodiment;

[0381] FIG. 130 is a perspective view of a child seat system including a SIP device according to an embodiment;

[0382] FIGS. 131A-131C are various perspective views of a child seat system including an external SIP device configured as a foot and movable between a first configuration and a second configuration according to an embodiment;

[0383] FIG. 132A-132C are various views of a head SIP assembly according to an embodiment;

[0384] FIG. 133A-133C are various views of the head SIP assembly of FIGS. 132A-132C affixed to a headrest shell according to an embodiment;

[0385] FIG. 134A-134C are various views of a headrest including at least one head SIP device according to another embodiment;

[0386] FIGS. 134D and 134E are cross-sectional views of the headrest of FIG. 134C taken along lines H-H according to an embodiment;

[0387] FIGS. 135A-135C are various views of a headrest including at least one head SIP device according to another embodiment;

[0388] FIGS. 136A-136B are front and back perspective view of a shoulder SIP device according to an embodiment;

[0389] FIG. 137 is a back perspective view of a shoulder SIP device according to another embodiment;

[0390] FIG. 138 is a front view of a shoulder SIP device according to an embodiment;

[0391] FIG. 139 is a front view of a shoulder SIP device according to another embodiment;

[0392] FIG. 140A is a front perspective view of an inset associated with a shoulder SIP device according to an embodiment;

[0393] FIG. 140B is a rear perspective view of the insert of FIG. 140A according to an embodiment;

[0394] FIG. 141 is a front perspective view of a shoulder SIP device according to another embodiment;

[0395] FIGS. 142A and 142B are various perspective views of a shoulder SIP device surrounded by soft goods according to an embodiment;

[0396] FIGS. 143A and 143B are various perspective views of headrest soft goods having integral soft goods associated with a shoulder SIP device according to an embodiment;

[0397] FIG. 144A is a front view of a headrest soft goods having cutouts to accommodate a shoulder SIP device according to an embodiment;

[0398] FIG. 144B is a front view of a child seat having the headrest soft goods of FIG. 144A mounted thereto according to an embodiment;

[0399] FIGS. 145A-145E are various views of a child seat system having at least one external SIP device in a forward, rearward, and intermediate configuration according to an embodiment;

[0400] FIG. 146A is a perspective view of an external SIP device according to an embodiment;

[0401] FIG. 146B is a front view of the external SIP device of FIG. 146A according to an embodiment;

[0402] FIG. 146C is a side view of the external SIP device of FIG. 146A according to an embodiment;

[0403] FIGS. 147A and 147B are various perspective views of the external SIP device of FIGS. 146A-146C mounted to a child seat according to an embodiment;

[0404] FIG. 148A is a perspective view of an external SIP device according to an embodiment;

[0405] FIG. 148B is a back view of the external SIP device of FIG. 148A according to an embodiment;

[0406] FIG. 148C is a plan view of the external SIP device of FIG. 148A according to an embodiment;

[0407] FIG. 149A is a perspective view of a bracket surrounding a belt path opening of a child seat according to an embodiment;

[0408] FIG. 149B is a perspective view of the bracket of FIG. 149A operably coupled to the external SIP device of FIGS. 148A-148C according to an embodiment;

[0409] FIG. 150 is a perspective view of an interface between an external SIP device and a child seat according to an embodiment;

[0410] FIG. 151A is a perspective view of a child seat system having a removable seat portion and at least one toros SIP device according to an embodiment; and

[0411] FIG. 151B is a detailed view of the torso SIP device of FIG. 151A and the surrounding soft goods according to an embodiment;

[0412] FIG. 152A-152B are various views of a shoulder SIP device arranged relative to a headrest including a head SIP device according to an embodiment;

[0413] FIG. 153 is a perspective view of a child seat system having at least one external SIP device according to an embodiment;

[0414] FIG. 154A is a front view of a child seat system including a collapsible SIP device having a tethered connection to a child seat according to an embodiment;

[0415] FIG. 154B is a perspective view of the child seat system of FIG. 154A including a collapsible SIP device tethered to the child seat according to an embodiment;

[0416] FIG. 155 is a perspective view of a child seat according to an embodiment;

[0417] FIG. 156A is a side view of an extended region of a child seat according to an embodiment;

[0418] FIG. 156B is another view of an extended region of a child seat according to an embodiment;

[0419] FIG. 157 is a plan view of a child seat system according to an embodiment;

[0420] FIG. 158A is a perspective view of a child seat system including a support base having at least one SIP device according to an embodiment;

[0421] FIG. 158B is a side view of the child seat system of FIG. 158A according to an embodiment;

[0422] FIG. 158C is a perspective view of the support base of the child seat system of FIG. 158A according to an embodiment;

[0423] FIG. 159A is a cross-sectional view of the child seat system of FIG. 158B according to an embodiment;

[0424] FIG. 159B is a cross-sectional view of the support base of FIG. 158C according to an embodiment;

[0425] FIG. 160A is a perspective view of a child seat system including a support base having at least one SIP device according to an embodiment;

[0426] FIG. 160B is a side view of the child seat system of FIG. 160A according to an embodiment;

[0427] FIG. 161A is a cross-sectional view of the child seat system of FIG. 160B according to an embodiment;

[0428] FIG. 161B is a cross-sectional view of the child seat system of FIG. 160B with the SIP devices in a retracted configuration;

[0429] FIG. 162 is a cross-sectional view of the support base of FIG. 160B according to an embodiment;

[0430] FIG. 163 is a cross-sectional view of a support base of a child seat system according to an embodiment;

[0431] FIG. 164 is a perspective view of a support base having a stationary portion including at least one SIP device according to an embodiment;

[0432] FIG. 165 is a perspective view of a support base having a rotatable portion including at least one SIP device according to an embodiment;

[0433] FIG. 166 is a perspective view of an infant car seat having at least one external SIP device arranged at the carrying handle according to an embodiment;

[0434] FIG. 167A is a rear perspective view of a child seat system mounted on a vehicle seat according to an embodiment;

[0435] FIG. 167B is a front perspective view of the child seat system and vehicle seat of FIG. 165A according to an embodiment;

[0436] FIG. 168A is a front view of a child set system having an SIP device in a stowed configuration according to an embodiment;

[0437] FIG. 168B is a front view of the child seat system of FIG. 168A having an SIP device in an extended configuration according to an embodiment;

[0438] FIG. 168C is a front view of the child seat system of FIG. 168A having an SIP device in an intermediate configuration according to an embodiment;

[0439] FIG. 169A is a schematic diagram of an SIP device in an intermediate configuration according to an embodiment;

[0440] FIG. 169B is a schematic diagram of the SIP device of FIG. 169B in an extended configuration according to an embodiment;

[0441] FIG. 170A is an exploded front perspective view of a locking mechanism associated with the SIP device of FIGS. 168A-169B according to an embodiment;

[0442] FIG. 170B is an exploded rear perspective view of the locking mechanism associated with the SIP device of FIGS. 168A-169B according to an embodiment;

[0443] FIG. 171A is a rear perspective view of an SIP device according to an embodiment;

[0444] FIG. 171B is a front perspective view of the SIP device of FIG. 171A according to an embodiment;

[0445] FIG. 172A is a rear perspective view of an SIP device according to an embodiment;

[0446] FIG. 172B is a front perspective view of the SIP device of FIG. 172A according to an embodiment;

[0447] FIG. 173A is a rear perspective view of an SIP device according to an embodiment;

[0448] FIG. 173B is a front perspective view of the SIP device of FIG. 173A according to an embodiment;

[0449] FIG. 173C is another front perspective view of the SIP device of FIG. 173A according to an embodiment.

[0450] FIG. 174 is a perspective view of an SIP device according to an embodiment;

[0451] FIG. 175 is a perspective view of a connector formed at a seat shell of a child seat according to an embodiment;

[0452] FIG. 176A is a perspective end view of an SIP assembly including a connection assembly according to an embodiment;

[0453] FIG. 176B is a perspective end view of the SIP assembly of FIG. 176A with the SIP device removed from the soft goods according to an embodiment;

[0454] FIG 177 is a perspective view of an SIP device according to an embodiment;

[0455] FIGS. 178A-178C are various diagrams of a connection assembly according to an embodiment;

[0456] FIG. 179A is a front perspective view of a child seat including a car seat insert having an SIP device according to an embodiment;

[0457] FIG. 179B is a perspective view of the car seat insert of FIG. 179A according to an embodiment;

[0458] FIG. 179C is a perspective view of a pocket containing a torso SIP device formed in the car seat insert of FIGS. 179A-179B according to an embodiment;

[0459] FIG. 180A is a perspective view of a car seat insert according to an embodiment

[0460] FIG. 180B is a detailed perspective view of the insert of FIG. 180A according to an embodiment;

[0461] FIG. 180C is a perspective view of a portion of the insert of FIG. 180A installed within a child seat according to an embodiment;

[0462] FIG. 180D is a front perspective view of child seat including the insert of FIG. 180A and an infant insert in overlapping arrangement with the car seat insert according to an embodiment;

[0463] FIG. 180E is a perspective view of the infant insert of FIG. 180D according to an embodiment;

[0464] FIG. 180F is a schematic diagram of the car seat insert and the infant insert according to an embodiment;

[0465] FIG. 181A is a perspective view of an insert according to an embodiment;

[0466] FIG. 181B is a perspective front view of the insert of FIG. 181A according to an embodiment;

[0467] FIG. 181C is a perspective back view of the insert of FIG. 181A according to an embodiment;

[0468] FIG. 182A is a front perspective view of a child seat including the insert of FIG. 181A according to an embodiment;

[0469] FIG. 182B is a side view of the child seat of FIG. 182A according to an embodiment;

[0470] FIG. 182C is a detailed perspective view of a portion of the insert installed within the child seat of FIG. 182A according to an embodiment;

[0471] FIG. 183A is a perspective front view of an infant insert with an attached headrest according to an embodiment;

[0472] FIG. 183B is a perspective back view of the insert of FIG. 183A according to an embodiment;

[0473] FIG. 184A is a perspective front view of an infant insert with a separated headrest according to an embodiment;

[0474] FIG. 184B is a perspective back view of the insert of FIG. 184A according to an embodiment;

[0475] FIG. 185A is a front perspective view of a child seat including the car seat insert of FIG. 181A and the infant insert of FIG. 183B according to an embodiment;

[0476] FIG. 185B is a side view of the child seat of FIG. 185A according to an embodiment;

[0477] FIG. 186A is a perspective view of a seat shell of a child seat having soft goods including a stiffener according to an embodiment;

[0478] FIG. 186B is a rear view of the soft goods of the seat shell of FIG. 186A positionable adjacent to an SIP device according to an embodiment;

[0479] FIG. 187A is a front view of soft goods of a child seat according to an embodiment;

[0480] FIG. 187B is a rear view of the soft goods of FIG. 187A and a corresponding stiffener according to an embodiment;

[0481] FIG. 187C is rear view of the soft goods of FIG. 187A and a corresponding pocket for receiving a stiffener according to an embodiment;

[0482] FIG. 188A is a rear view of an SIP assembly having at least one connector according to an embodiment;

[0483] FIG. 188B is a perspective view of a portion of a child seat connectable to the at least one connector of the SIP assembly of FIG. 188A according to an embodiment;

[0484] FIG. 189A is a perspective view of a portion of a child seat connectable to at least one connector of an SIP assembly according to an embodiment;

[0485] FIG. 189B includes various views of an SIP assembly and at least one connector thereof according to an embodiment;

[0486] FIG. 190A is a perspective view of an SIP assembly including a connection assembly according to an embodiment;

[0487] FIG. 190B is a perspective view of a portion of a child seat connectable to the connection assembly of the SIP assembly of FIG. 190A according to an embodiment

[0488] FIG. 191A is a perspective view of an SIP assembly including a connection assembly according to an embodiment;

[0489] FIG. 191B is a perspective view of a soft goods panel connectable to the connection assembly of the SIP assembly of FIG. 191A according to an embodiment

[0490] FIG. 192A is a front perspective view of a child seat installed adjacent to a vehicle door according to an embodiment;

[0491] FIG. 192B is a rear perspective view of the child seat of FIG. 192A according to an embodiment;

[0492] FIG. 192C is a detailed rear perspective view of a support base of the child seat of FIG. 192B according to an embodiment;

[0493] FIG. 192D is a bottom view of the support base of the child seat of FIG. 192C according to an embodiment;

[0494] FIG. 193A is a side view of a child seat having an external SIP device in a first, raised position according to an embodiment;

[0495] FIG. 193B is a side view of the child seat of FIG. 193A with the external SIP device in a second, lowered position according to an embodiment;

[0496] FIGS. 194A-194B are detailed perspective views of the external SIP device of FIGS. 193A-193B according to an embodiment;

[0497] FIG. 195A is a detailed side view of a child seat having the external SIP device of FIGS. 194A-194B in the first, raised position according to an embodiment;

[0498] FIG. 195B is a detailed side view of a child seat having the external SIP device of FIGS. 194A-194B in the second, lowered position according to an embodiment;

[0499] FIG. 195C is a detailed side view of a child seat having the external SIP device of FIGS. 194A-194B in the first, raised position and coupled to a vehicle belt according to an embodiment;

[0500] FIG. 195D is a detailed side view of a child seat having the external SIP device of FIGS. 194A-194B in the second, lowered position and coupled to a vehicle belt according to an embodiment;

[0501] FIG. 196A is a side view of a child seat having an external SIP device in a first, raised position according to an embodiment;

[0502] FIG. 196B is a side view of the child seat of FIG. 196A with the external SIP device in a second, lowered position according to an embodiment;

[0503] FIGS. 196C-196D are detailed perspective views of the external SIP device of FIGS. 196A-196B according to an embodiment;

[0504] FIG. 197A is a detailed side view of a child seat having the external SIP device of FIGS. 196A-196B in the first, raised position according to an embodiment;

[0505] FIG. 197B is a detailed side view of a child seat having the external SIP device of FIGS. 196A-196B in the second, lowered position according to an embodiment;

[0506] FIG. 197C is a detailed side view of a child seat having the external SIP device of FIGS. 196A-196D in the first, raised position and coupled to a vehicle belt according to an embodiment;

[0507] FIG. 197D is a detailed side view of a child seat having the external SIP device of FIGS. 196A-196D in the second, lowered position and coupled to a vehicle belt according to an embodiment;

[0508] FIG. 198A is a detailed side view of a child seat having an external SIP device in a first, raised position according to an embodiment;

[0509] FIG. 198B is a detailed side view of a child seat having the external SIP device of FIGS. 198A in the second, lowered position according to an embodiment;

[0510] FIG. 199A is a perspective view of a child seat having an SIP device of a first thickness arranged at a seat portion of the seat shell according to an embodiment;

[0511] FIG. 199B is a perspective view of the child seat of FIG. 199A having an SIP device with a second thickness arranged at a seat portion of the seat shell according to an embodiment;

[0512] FIG. 200A is a perspective view of a child seat having an SIP device at an upright portion of the seat shell in a stowed configuration according to an embodiment;

[0513] FIG. 200B is a perspective view of a child seat having an SIP device at an upright portion of the seat shell in a deployed configuration according to an embodiment;

[0514] FIG. 201A is a detailed view of the SIP device of FIGS. 200A-200B in a stowed configuration according to an embodiment;

[0515] FIG. 201B in a detailed view of the hinge block of the SIP device of FIG. 201A in the stowed configuration according to an embodiment;

[0516] FIG. 202A is a detailed view of the SIP device of FIGS. 200A-200B in a deployed configuration according to an embodiment;

[0517] FIG. 202B in a detailed view of the hinge block of the SIP device of FIG. 202A in the deployed configuration according to an embodiment;

[0518] FIG. 203A is a front view of a portion of a child seat having an SIP device at an upright portion of the seat shell in a stowed configuration according to an embodiment;

[0519] FIG. 203B is a side view of the portion of a child seat of FIG. 203A according to an embodiment;

[0520] FIG. 204A is a front view of a portion of a child seat having an SIP device at an upright portion of the seat shell in a deployed configuration according to an embodiment;

[0521] FIG. 204B is a side view of the portion of a child seat of FIG. 204A according to an embodiment;

[0522] FIG. 205A is a detailed back view of an SIP device in a deployed configuration according to an embodiment;

[0523] FIG. 205B is a detailed back view of the SIP device of FIG. 205A in a stowed configuration according to an embodiment;

[0524] FIG. 206A is a side view of an SIP device in a deployed configuration according to an embodiment;

[0525] FIG. 206B is a side view of the SIP device of FIG. 206A in a stowed configuration according to an embodiment;

[0526] FIG. 207 is a front view of the SIP device of FIGS. 205A and 206A according to an embodiment;

[0527] FIG. 208A is a detailed back view of an SIP device in a deployed configuration according to an embodiment;

[0528] FIG. 208B is a detailed back view of the SIP device of FIG. 208A in a stowed configuration according to an embodiment;

[0529] FIG. 209A is a side view of an SIP device in a deployed configuration according to an embodiment;

[0530] FIG. 209B is a side view of the SIP device of FIG. 209A in a stowed configuration according to an embodiment;

[0531] FIG. 210 is a front view of the SIP device of FIGS. 208A and 209A according to an embodiment;

[0532] FIG. 211A is a detailed back view of an SIP device in a deployed configuration according to an embodiment;

[0533] FIG. 211B is a detailed back view of the SIP device of FIG. 211A in a stowed configuration according to an embodiment;

[0534] FIG. 212A is a front view of the SIP device of FIG. 211A in the deployed configuration according to an embodiment;

[0535] FIG. 212B is a side view of the SIP device of FIG. 211A in the deployed configuration according to an embodiment;

[0536] FIG. 213A is a perspective view of a child seat having a torso SIP device according to an embodiment;

[0537] FIG. 213B is a side view of the child seat of FIG. 213A according to an embodiment;

[0538] FIG. 214A is a side view of the torso SIP device of FIGS. 213A-213B according to an embodiment;

[0539] FIG. 214B is a front view of the torso SIP device of FIGS. 213A-213B according to an embodiment;

[0540] FIG. 215A is front view of a child seat including a torso SIP device according to and embodiment;

[0541] FIG. 215B is an exploded perspective view of the child seat of FIG. 215A according to an embodiment;

[0542] FIG. 216A is a perspective view of a child seat having a torso SIP device according to an embodiment;

[0543] FIG. 216B is another perspective view of the child seat of FIG. 216A according to an embodiment;

[0544] FIG. 216C is a front view of the child seat of FIG. 216A according to an embodiment;

[0545] FIG. 216D is a top view of the child seat of FIG. 216A according to an embodiment;

[0546] FIG. 217A is a top view of a torso SIP device according to an embodiment;

[0547] FIG. 217B is a front view of the torso SIP device of FIG. 217A according to an embodiment;

[0548] FIG. 218A is a perspective view of a torso SIP device installed within a child seat according to an embodiment;

[0549] FIG. 218B is a top view of the torso SIP device of FIG. 218A according to an embodiment;

[0550] FIG. 218C is a front view of the torso SIP device of FIG. 218A according to an embodiment;

[0551] FIG. 219A is a perspective view of a child seat having a torso SIP device in a retracted configuration according to an embodiment;

[0552] FIG. 219B is a side view of the child seat of FIG. 219A according to an embodiment;

[0553] FIG. 219C is a perspective view of the child seat of FIG. 219A with the torso SIP device in an extended configuration according to an embodiment;

[0554] FIG. 219D is a side view of the child seat of FIG. 220A according to an embodiment;

[0555] FIG. 220A is a front view of a child seat including a torso SIP device prior to a crash event according to an embodiment;

[0556] FIG. 220B is a front view of the child seat of FIG. 220A after a crash event according to an embodiment;

[0557] FIGS. 221A and 221B are various perspective views of an SIP assembly of a child seat according to an embodiment;

[0558] FIG. 222 is a perspective view of another SIP assembly of a child seat according to an embodiment;

[0559] FIG. 223A is a perspective view of a child seat having an SIP assembly according to an embodiment;

[0560] FIG. 223B is a perspective view of the child seat of FIG. 223, with the SIP assembly being partially transparent according to an embodiment;

[0561] FIG. 224A is a front view of an SIP device in a stowed configuration according to an embodiment;

[0562] FIG. 224B is a side view of the SIP device of FIG. 224A in a stowed configuration according to an embodiment;

[0563] FIG. 224C is a perspective view of the SIP device of FIGS. 224A and 224B in a deployed configuration according to an embodiment;

[0564] FIG. 225A is a front view of an SIP device in a stowed configuration according to an embodiment;

[0565] FIG. 225B is a side view of the SIP device of FIG. 225A in a stowed configuration according to an embodiment;

[0566] FIG. 225C is a perspective view of the SIP device of FIGS. 225A and 225B in a deployed configuration according to an embodiment;

[0567] FIG. 226 is a top perspective view of a child seat system including a spin lock according to an embodiment;

[0568] FIG. 227A is a detailed perspective view of an SIP device arranged at the child seat system proximate the spin lock according to an embodiment;

[0569] FIG. 227B is a detailed perspective view of the SIP device of FIG. 227A in a compressed configuration according to an embodiment;

[0570] FIGS. 228A and 228B are front views of a child seat system including an SIP device formed by a harness assembly according to an embodiment;

[0571] FIGS. 229A and 229B are front views of the child seat system of FIGS. 228A-228B when a side impact is applied to the child seat system causing tension in the harness assembly according to an embodiment;

[0572] FIG. 230A is a front perspective view of a child seat according to an embodiment;

[0573] FIG. 230B is a rear perspective view of the child seat of FIG. 230A according to an embodiment;

[0574] FIG. FIG. 230C is a side view of the child seat of FIG. 230A according to an embodiment;

[0575] FIG. 230D is another front perspective of the child seat of FIG. 230A according to an embodiment;

[0576] FIG. 231 is a schematic diagram of a frame of the child seat of FIGS. 230A-230D according to an embodiment;

[0577] FIG. 232 is a schematic diagram of a pair of reinforcement bars of the child seat of FIGS. 230A-230D according to an embodiment;

[0578] FIG. 233A is front perspective of the child seat of FIG. 230A according to an embodiment;

[0579] FIG. 233B is a schematic diagram of a pair of reinforcement bars of the child seat of FIGS. 233A according to an embodiment;

[0580] FIG. 234A is a front view of a child seat system including at least one SIP device according to an embodiment;

[0581] FIG. 234B is a rear view of the child seat system of FIG. 234A according to an embodiment;

[0582] FIG. 234C is a side view of the child seat system of FIG. 234A according to an embodiment;

[0583] FIG. 235A is a front perspective view of a child seat system including at least one SIP device according to an embodiment;

[0584] FIG. 235B is a front view of the child seat system of FIG. 235A according to an embodiment;

[0585] FIG. 235C is a rear view of the child seat system of FIG. 235A according to an embodiment;

[0586] FIG. 236A is a side view of the child seat system of FIGS. 235A-235C according to an embodiment;

[0587] FIG. 236B is a side view of the child seat system of FIGS. 236A with the external SIP device removed according to an embodiment;

[0588] FIGS. 237A-237D are perspective view of various external SIP devices including a crushable structure according to an embodiment;

[0589] FIG. 238A is a front view of a child seat system having at least one external SIP device according to an embodiment;

[0590] FIG. 238B is a perspective view of the child seat system of FIG. 238A according to an embodiment;

[0591] FIG. 238C is a top view of the child seat system of FIG. 238A according to an embodiment;

[0592] FIG. 238D is a rear view of the child seat system of FIG. 238A according to an embodiment;

[0593] FIG. 239A is a side view of a child seat system having at least one external SIP device according to an embodiment;

[0594] FIG. 239B is a perspective view of the child seat system of FIG. 239A with the child seat rotated relative to the support base according to an embodiment;

[0595] FIG. 240A is a perspective view of a portion of an infant car seat including an SIP device according to an embodiment;

[0596] FIG. 240B is another perspective view of the infant car seat of FIG. 240A according to an embodiment;

[0597] FIG. 240C is yet another perspective view of the infant car seat of FIG. 240A according to an embodiment;

[0598] FIG. 241 is a perspective view of the infant car seat of FIG. 240A according to another embodiment;

[0599] FIG. 242A is a perspective view of a headrest including a head SIP assembly according to an embodiment;

[0600] FIG. 242B is a front view of the headrest of FIG. 242A according to an embodiment;

[0601] FIG. 242C is a top view of the headrest of FIG. 242A according to an embodiment;

[0602] FIG. 243A is a perspective view of a headrest including a head SIP assembly according to another embodiment;

[0603] FIG. 243B is an exploded front view of the headrest of FIG. 243A according to an embodiment;

[0604] FIG. 244A is a top perspective view of a head SIP assembly according to an embodiment;

[0605] FIG. 244B is a front view of the head SIP assembly of FIG. 244A according to an embodiment;

[0606] FIG. 244C is a side view of the head SIP assembly of FIG. 244A according to an embodiment;

[0607] FIG. 244D is a perspective view of a portion of the head SIP assembly of FIGS. 2442A-244C mounted to a headrest according to an embodiment;

[0608] FIG. 244E is another perspective view of a portion of the head SIP assembly of FIG. 244D according to an embodiment;

[0609] FIG. 244F is a perspective view of a portion of the connector member of the head SIP assembly according to an embodiment;

[0610] FIG. 245A is a top perspective view of a head SIP assembly according to an embodiment;

[0611] FIG. 245B is a front view of the head SIP assembly of FIG. 245A according to an embodiment;

[0612] FIG. 245C is a side view of the head SIP assembly of FIG. 245A according to an embodiment;

[0613] FIG. 246A is a top perspective view of a head SIP assembly according to an embodiment;

[0614] FIG. 246B is a front view of the head SIP assembly of FIG. 246A according to an embodiment;

[0615] FIG. 246C is a side view of the head SIP assembly of FIG. 246A according to an embodiment;

[0616] FIG. 247A is a top perspective view of a head SIP assembly according to an embodiment;

[0617] FIG. 247B is a front view of the head SIP assembly of FIG. 247A according to an embodiment;

[0618] FIG. 247C is a side view of the head SIP assembly of FIG. 247A according to an embodiment;

[0619] FIG. 248A is a top perspective view of a head SIP assembly according to an embodiment;

[0620] FIG. 248B is a front view of the head SIP assembly of FIG. 248A according to an embodiment;

[0621] FIG. 248C is a side view of the head SIP assembly of FIG. 248A according to an embodiment;

[0622] FIG. 249A is a top perspective view of a head SIP assembly according to an embodiment;

[0623] FIG. 249B is a front view of the head SIP assembly of FIG. 249A according to an embodiment;

[0624] FIG. 249C is a side view of the head SIP assembly of FIG. 249A according to an embodiment;

[0625] FIG. 250A is a top perspective view of a head SIP assembly according to an embodiment;

[0626] FIG. 250B is a front view of the head SIP assembly of FIG. 250A according to an embodiment;

[0627] FIG. 250C is a side view of the head SIP assembly of FIG. 250A according to an embodiment;

[0628] FIG. 251A is a top perspective view of a head SIP assembly according to an embodiment;

[0629] FIG. 251B is a front view of the head SIP assembly of FIG. 251A according to an embodiment;

[0630] FIG. 251C is a side view of the head SIP assembly of FIG. 251A according to an embodiment;

[0631] FIG. 252A is a perspective view of a headrest according to an embodiment;

[0632] FIG. 252B is a perspective view of a first region of a side portion of the connector member of the headrest according to an embodiment;

[0633] FIG. 253A is a perspective view of a headrest according to an embodiment;

[0634] FIG. 253B is a front view of the headrest of FIG. 253A according to an embodiment;

[0635] FIG. 254 is a perspective view of a stiffener layer connectable to soft goods of a headrest according to an embodiment;

[0636] FIG. 255A is a front perspective view of an infant car seat according to an embodiment;

[0637] FIG. 255B is a top perspective view of the infant car seat of FIG. 255A according to an embodiment;

[0638] FIG. 256 is a perspective view of an upright side member of the infant car seat of FIGS. 255A and 255B with the soft goods removed according to an embodiment;

[0639] FIG. 257A is a front view of a child seat system having a shoulder SIP device in a first position according to an embodiment;

[0640] FIG. 257B is a front view of the child seat system of FIG. 257A having a shoulder SIP device in a second position according to an embodiment;

[0641] FIG. 258A is a front view of a headrest of a child seat having a shoulder SIP device in a first position according to an embodiment;

[0642] FIG. 258B is a front view of the headrest of FIG. 258A having a shoulder SIP device in a second position according to an embodiment;

[0643] FIG. 259A is a perspective view of the headrest of FIG. 258A according to an embodiment;

[0644] FIG. 259B is a plan view of the headrest of FIG. 258A according to an embodiment;

[0645] FIG. 260A is a perspective view of the headrest of FIG. 259A according to an embodiment;

[0646] FIG. 260B is a plan view of the headrest of FIG. 259A according to an embodiment;

[0647] FIG. 261A is a perspective view of a child seat according to an embodiment;

[0648] FIG. 261B is a front view of the child seat of FIG. 261A according to an embodiment;

[0649] FIG. 261C is a back view of the child seat of FIG. 261A according to an embodiment;

[0650] FIG. 261D is a side view of the child seat of FIG. 261A according to an embodiment;

[0651] FIG. 261E is a plan view of the child seat of FIG. 261A according to an embodiment;

[0652] FIG. 262A is a perspective view of a child seat according to an embodiment;

[0653] FIG. 262B is a rear perspective view of the child seat of FIG. 262A according to an embodiment;

[0654] FIG. 262C is a bottom perspective view of the child seat of FIG. 262A according to an embodiment;

[0655] FIG. 262D is a rear perspective view of the child seat of FIG. 262A with a detailed view of the back portion of the child seat with the external SIP devices removed according to an embodiment;

[0656] FIG. 263A is a detailed perspective view of the headrest of FIGS. 262A-262D according to an embodiment; and

[0657] FIG. 263B is a side view of the headrest of FIG. 262A according to an embodiment.

[0658] FIG. 264A is a perspective view of a child seat having a connector member according to an embodiment;

[0659] FIG. 264B is a rear perspective view of the child seat of FIG. 264A according to an embodiment;

[0660] FIG. 265A is a perspective view of a child seat according to an embodiment;

[0661] FIG. 265B is a side view of the child seat of FIG. 265A according to an embodiment;

[0662] FIG. 266 is a partially exploded perspective view of the child seat of FIG. 265A according to an embodiment;

[0663] FIG. 267 is a perspective view of the external SIP device of FIGS. 265-266 according to an embodiment;

[0664] FIG. 268A is a perspective view of a portion of a child seat according to an embodiment; and

[0665] FIG. 268B is a detailed view of a connection of an external SIP device of the child seat of FIG. 268A according to an embodiment.

DETAILED DESCRIPTION

[0666] A detailed description of one or more embodiments of the disclosed apparatus and method are presented herein by way of exemplification and not limitation with reference to the Figures.

[0667] With reference now to FIG. 1, an example of a child seat system 20 according to an embodiment is illustrated. The child seat system 20 can be detachably fixed to a vehicle seat (see FIG. 55E), such as via a latch or anchor mechanism (not shown). This latch or anchor system often used is sometimes referred to as a "lower anchor and tether for children" e.g., LATCH system. Alternatively, or in addition, the child seat system 20 may be detachably fixed to a vehicle seat via a vehicle belt (not shown) associated with the vehicle seat.

[0668] The child seat system 20 may include a support base or bottom 22 and a child seat 23 having a rigid seat shell 24 coupled to the support base 22, the seat shell 24 being adapted to receive a child. In an embodiment, the seat shell 24 is detachably connected to the support base 22, thereby allowing the seat shell 24 to be separated from the support base 22. Alternatively, the support base 22 and the seat shell 24 may be permanently connected or affixed together. As used herein the term "permanently connected" represents embodiments where the seat shell 24 is not intended to be disassembled from the support base 22 by a user and is perhaps of unitary or non-separable construction.

[0669] The seat shell 24 may include a seat portion 26 and a backrest or upright portion 28 arranged at an angle relative to the seat portion 26. The seat portion 26 and the upright portion 28 may be detachably coupled, or alternatively, may be permanently coupled. In the illustrated, non-limiting embodiment, the upright portion 28 and the seat portion 26 are integrally formed as a single unitary body. In another alternative aspect, the upright portion 28 can be rotationally connected to the seat portion 26 such that the upright portion 28 can incline and recline relative to the seat portion 26.

[0670] As shown, the upright portion 28 of the seat shell 24 includes an upright support surface 30 generally facing forward and that extends from a first end or top 32 to a second, opposite end or bottom 34 of the upright portion 28. A first upright side member 36 may be arranged at a first side 38 of the upright support surface 30 and a second upright side member 40 may be arranged at a second, opposite side 42 of the upright support surface 30. The first and second upright side members 36, 40 therefore form the left side and the right side of the

upright portion 28, respectively. As shown, the first and second upright side members 36, 40 extend forward from the upright support surface 30. The first and second upright side members 36, 40 may extend generally orthogonally to the upright support surface 30, or alternatively, may extend therefrom at another angle, such as an angle greater than 90° for example (the respective angles therefore being at least 90° for example). Accordingly, the upright support surface 30 and the first and second upright side members 36, 40 define a backrest region or upright support cavity within which an upper body of a child is received.

[0671] In embodiments where the child seat is a toddler seat, the upright side members 36, 40 may facilitate the correct positioning of a vehicle belt when the child seat system 20 is installed in a vehicle. In some embodiments, each upright side member 36, 40 has an opening 44 formed therein. The opening 44 may be configured to receive a vehicle seatbelt (not shown) to secure the child seat system 20 to a vehicle seat in a forward-facing high-back configuration.

[0672] In the illustrated, non-limiting embodiment, the upright portion 28 of the seat shell 24 includes a headrest 46. The headrest 46 is attached to or integral with the upright portion 28. The headrest 46 may be stationary or in some embodiments, may be configured to move relative to the upright support surface 30. For example, the headrest 46 may be configured to translate relative to the upright support surface 30 between a vertically retracted position and a vertically extended position, allowing for adjustment based on the size of the child positioned within the child seat system 20.

[0673] The seat portion 26 includes a seat support surface 50 facing generally upwardly and that extends from a first end or front 52 to a second end or back 54 of the seat portion 26. A first seat side member 56 may be arranged at a first side 58 of the seat support surface 50 and a second seat side member 60 may be arranged at a second, opposite side (not shown) of the seat support surface 50. The first seat side member 56 and the second seat side member 60 extend upwardly and form the left side and the right side of the seat portion 26. The seat support surface 50 and the first and second seat side member 56, 60 in combination define a region within which at least part of a lower body of a child may be received.

[0674] As shown, the seat side members 56, 60 extend at an angle from the seat support surface 50. The angle of the first seat side member 56 relative to the seat support surface 50 may but need not be the same as the angle of the first upright side member 36 relative to the upright support surface 30. Similarly, the angle of the second seat side member 60 relative to the seat support surface 50 may but need not be the same as the angle of the second upright side member 40 relative to the upright support surface 30. In an embodiment, the first upright side member 36 and the first seat side member 56 are integrally formed with each other and the

seat shell 24, and the second upright side member 40 and the second seat side member 60 are integrally formed with each other and the seat shell 24.

[0675] In the illustrated, non-limiting embodiment, each seat side member 56, 60 has a slot 66 formed therein configured to function as a lap belt guide during at least one mode of use of the child seat 23. The slot 66 may be configured to receive and position a lap belt portion of a vehicle restraint or a separate restraint belt to attach the child seat system 20 to a vehicle seat 10 when the child seat 23 is in a forward-facing high-back configuration as illustrated in FIG. 1.

[0676] The child seat 23 may be movable relative to the support base 22 while the child seat 23 is coupled to the support base 22. In an embodiment, the child seat 23 is rotatable relative to the support base 22 between a plurality of configurations. For example, the child seat 23 may be rotatable between a first rotational configuration, such as a configuration in which the child seat 23 is in a facing-forward position, and a second rotational configuration, such as a configuration in which the child seat 23 is in a rearward-facing position. However, it should be appreciated that embodiments where the child seat 23 is positionable in one or more additional configurations between the first rotational configuration and a second rotational configuration are also within the scope of the disclosure. Further, embodiments where the child seat 23 is not rotatable relative to the support base 22 are also contemplated herein.

[0677] Alternatively, or in addition, the child seat 23 may be movable relative to the support base 22 to adjust an incline of the child seat 23. The child seat 23 may be movable along an incline path between a first position, such as an upright position, and a second position, such as a reclined position. However, it should be appreciated that the first position and the second position may both be positions arranged at an incline, the positions having varying degrees of incline. Embodiments where the child seat 23 may be arranged in any of a plurality of positions between the upright position and the reclined position, as well as embodiments where the incline of the child seat 23 is not adjustable relative to the support base 22, are also contemplated herein. It should be appreciated that a child seat system 20 as illustrated and described herein with reference to FIG. 1, is intended as an example only, and that a child seat system 20 having other configurations are also within the scope of the disclosure. For example, although the child seat 23 of the child seat system 20 is illustrated and described as a toddler seat, in other embodiments, the child seat may be an infant car seat for use by a child less than 2 years old, having a height less than or equal to than 35 inches and/or a weight less or equal to 40 pounds.

[0678] A child seat system, such as child seat system 20 for example, may include at least one side impact protection device. The at least one side impact protection (SIP) device may be removably connected to the child seat system 20, such as via double-sided tape, adhesive, or a mechanical fastener for example. Alternatively, the at least one SIP device may be permanently connected to or integral therewith, such that a structure of the child seat system 20, such as the seat shell 24 of the child seat 23 for example, and the one or more SIP devices form a single unitary part. As will be described in more detail below, the one or more SIP devices may be mounted at various locations about the support base 22 and/or the child seat 23. For example, an SIP device may be located at the upright portion 28, the seat portion 26, or the headrest 46 of the child seat 23 for example. Further, such an SIP device may be arranged at an interior surface or an exterior surface of the child seat 23.

[0679] An SIP device associated with a child seat system, such as child seat system 20 for example, may be formed from a material having a hardness less than the hardness of the seat shell 24 or the support base 22. The use of a material having a reduced hardness may facilitate the absorption of energy applied to the child seat system 20 during an accident, such as a side impact collision. In some embodiments, the material of an SIP device of the child seat system 20 also has a hardness greater than the hardness of the soft goods mounted about the seat shell 24 and/or the headrest 46 to provide additional energy absorption beyond that of the soft goods. In an embodiment, an SIP device may be constructed with sacrificial features that are configured to break or deform during a collision to help absorb energy. In some embodiments, SIP devices or portions thereof may be formed of foam materials such as expanded polypropylene (EPP), expanded polystyrene (EPS), and/or expanded polyolefin (EPO) with example densities such as 30 g/l, 45 g/l, and 50 g/l. Various other materials and specifications thereof are contemplated. It should be understood that any of these materials or another material that has a reduced hardness relative to the seat shell of a child seat could be used in any exemplary embodiment of an SIP device described herein.

[0680] With continued reference to FIG. 1, in an embodiment, the child seat system 20 includes one or more SIP devices 70a, 70b operable to restrict or control movement of the head of an occupant of the child seat system 20 during a side impact collision. Such a head SIP device 70a, 70b may be arranged at an area of the child seat 23 surrounding or located adjacent to an occupant's head. In an embodiment, the at least one head SIP device 70a, 70b is associated with, and in some embodiments is mounted to, the headrest 46 of the child seat 23. As discussed further below, in some embodiments, the child seat system 20 may include one or more

additional SIP devices, such as shoulder SIP devices 72a, 72b, external SIP devices 74, and/or torso SIP devices (not shown).

[0681] It should be appreciated that a configuration of a head SIP device, such as head SIP device 70 for example, as well as its positioning relative to the child seat 23, may vary based on the orientation of the child seat 23, such as relative to a vehicle or a direction of travel. A headrest typically includes a rigid body or structure with soft goods, such as padding, cushioning, fabric, or the like, positioned about one or more surfaces of the rigid body, such as the surfaces of the rigid body that the head of an occupant of the child seat may contact. As will be described in more detail below, a head SIP device may be positioned adjacent to an inner surface of a headrest or within a head receiving region of a headrest. Unless another arrangement is noted, any embodiment described herein that includes a head SIP device locatable at such an inner surface region should be understood to position the head SIP device generally between a structural body or shell of the headrest (e.g., the relatively rigid portion of the headrest) and the soft goods that cover the headrest. Such a head SIP device may be attached to the structural body of the headrest or to the soft goods positionable thereabout.

[0682] With reference now to FIGS. 2A and 2B, a headrest 102 of a child seat 100, similar to headrest 46 of child seat 23, is shown. The headrest 102 includes a headrest back portion 104 having a headrest support surface 106, such as oriented generally parallel to the upright support surface (not shown) of an upright portion 110 of the child seat 100 for example. Additionally, the headrest 102 includes at least one headrest side member. For example, a first headrest side member 112 may extend from a first side 114 of the headrest back portion 104 and a second headrest side member 116 may extend in an opposite direction from a second side 118 of the headrest back portion 104.

[0683] The first and second headrest side members 112, 116 include inward facing surfaces 120, 122. In combination with the headrest support surface 106 of the headrest back portion 104, the inward facing surfaces 120, 122 form an inner surface of the headrest 102, and define a head receiving region 124 (please see FIG. 2B). The headrest support surface 106 may form a back portion of the inner surface, while the inward facing surfaces 120, 122 of the headrest side members 112, 116 may form a first and second headrest side portions of the inner surface. In an embodiment, the headrest support surface 106 defines the back of the head receiving region 124. The inward facing surfaces 120, 122 extend from the headrest support surface 106 to a distal first front end 126a and second front end 126b, respectively. The front ends 126a, 126b, such as arranged at the ends of the first and second headrest side members 112, 116 for example, may define a front of the head receiving region 124. In the illustrated,

non-limiting embodiment, the headrest back portion 104, first headrest side member 112, and second headrest side member 116 as described herein may refer to portions of the rigid body or structure of the headrest 102. Accordingly, soft goods may be positioned in overlapping arrangement with the corresponding headrest support surface 106 and the inward facing surfaces 120, 122 of the headrest side members 112, 116 facing the head receiving region 124 of the rigid body.

[0684] When an occupant is seated within the child seat 100, an occupant's head is arranged within the head receiving region 124 between the inward facing surfaces 120, 122 of the headrest side members 112, 116 and a back of the occupant's head is typically arranged proximate to or in contact with the headrest support surface 106 It should be appreciated that the headrest embodiments shown throughout the FIGS. herein may all include headrest back portions and headrest side members similar to those described above with reference to headrest back potion 104 and headrest side portions 112, 116 respectively. These headrests as shown throughout the FIGS. may also include head receiving regions similar to that described above with reference to head receiving region 124.

[0685] The headrest 102 may have at least one side impact protection portion arranged at any suitable position about the headrest 102. In an embodiment, the head side impact protection (SIP) portion is located within the head receiving region 124 of the headrest 102, such as between the back and the front thereof. Embodiments including a plurality of side impact protection portions are also contemplated herein. In the illustrated, non-limiting embodiment, a first head SIP portion 130a is positioned near the first headrest side member 112 and a second head SIP portion 130b is arranged near the second headrest side member 116, opposite side of the headrest 102. The head SIP portions 130a, 130b of the headrest 102 may include a protrusion generally arranged at the inner surface of the headrest 102 that that extends inwardly toward the head receiving region 124. As will be described in more detail below, a head SIP portion, such as head SIP portions 130a, 130b, may include one or more head SIP devices, and in some embodiments, one of the head SIP devices may form the protrusion extending from the inner surface.

[0686] At least one head SIP device 132a, 132b may be arranged at any suitable position about the headrest. In an embodiment, a first head SIP device 132a is arranged at or adjacent to a first side portion of the inner surface of the headrest 102, such as at the first headrest side member 112, and a second head SIP 132b device is arranged at or adjacent to a second side portion of the inner surface of the headrest 102, such as the second headrest side member 116. It should be appreciated that the functionality of the head SIP devices 132a, 132b,

and any further head SIP device described herein, may depend not only on the position of the head SIP devices 132a, 132b relative to the headrest 102, but also on the height and/or shape of the head SIP devices 132a, 132b. A configuration of the first head SIP device 132a and the second head SIP device 132b may but need not be substantially identical. Further, embodiments where the headrest 102 includes only a single head SIP device, or more than two SIP devices are also within the scope of the disclosure. The at least one head SIP device 132a, 132b may be permanently or removably affixed to the headrest 102, such as to a portion of the inner surface of the headrest 102.

[0687] In an embodiment, such as shown in FIG. 2B the at least one head SIP device 132a, 132b is located at or adjacent to a surface of the rigid body, such as at a position between the rigid body and the soft goods configured to overlap the rigid body. In such embodiments, the at least one head SIP device 132a, 132b may be integrally formed with the rigid body, or alternatively, may be a separate component mounted to the rigid body. The at least one head SIP device 132a, 132b may be mountable directly to the rigid body, or may be mounted to or formed within the soft goods connectable to the rigid body. In other embodiments, the at least one head SIP device 132a, 132b may be mounted at an exterior surface of the soft goods, such that the at least one head SIP device 132a, 132b is positionable in direct contact with the occupant's head. It should be appreciated that any of the other SIP devices disclosed herein, such as with reference to FIGS. 3-33B, 68A-69B, 82A-83, 117A-118B, 122A-124B, 129and 132A-134D for example, may be arranged at any of position about the headrest as described herein.

[0688] Examples of various head SIP devices, such as positionable within a head SIP portion of a headrest, similar to head SIP portions 130a, 130b for example, are shown in FIGS. 3A-23E and will be described in more detail below. A head SIP device may extend over the full height, or alternatively, over only a portion of a height of a headrest. In an embodiment, a height of a head SIP device, measured along a vertical axis, is at least 2 inches, and in some embodiments, at least about 2.5 inches, at least about 3 inches, at least about 3.5 inches, at least about 4 inches, at least about 4.5 inches, and at least about 5 inches.

[0689] With reference now to FIGS. 3A and 3B, the illustrated headrest 200 includes a first head SIP portion 201a including a first head SIP device arranged at a first portion of an inner surface of the headrest 200, such as at an inwardly facing surface 212 of a first headrest side member 204. Further, A second head SIP portion 201b may include a second head SIP device 202b mounted to and positioned in overlapping arrangement with a second portion of the headrest 200, such as an inwardly facing surface 214 of a second headrest side member

206. However, embodiments where at least one head SIP device 202a, 202b is arranged at another part of the headrest 200, such as a back portion 208 for example are also contemplated herein. The at least one head SIP device, 202a, 202b may have a base 210a, 210b mountable to the inwardly facing surface 212, 214 of the first headrest side member 204 and/or the second headrest side member 206, respectively. The at least one head SIP device, 202a, 202b may alternatively or additionally have an inwardly facing surface 216a, 216b facing toward the interior of the headrest 200. The base surface 210a, 210b may but need not have a contour complementary to one or more corresponding surfaces of the headrest 200. Further, in the illustrated, non-limiting embodiment, a contour of the outer periphery of the at least one head SIP device 202a, 202b may be different than the corresponding portion of the headrest 200 to which the head SIP device 202a, 202b is mounted. For example, as shown in the FIGS., the head SIP devices 202a, 202b may be general squircle (a square with rounded corners) in shape or may be rectangular or rectangular with rounded corners.

[0690] In other embodiments, such as shown with headrest 300 in FIGS. 4A and 4B, a head SIP portion 301 of the headrest 300 may include a head SIP device 302 having a contour complementary to an adjacent portion of the headrest 300. As previously described, the headrest 300 may include a back portion 304, a first headrest side member 306 and a second headrest side member 308. In the illustrated, non-limiting embodiment, the head SIP device 302 is positioned adjacent to an interior surface 310 of the second headrest side member 308. Accordingly, the contour of an outer periphery of the head SIP device 302 may be similar, for example equal in size and/or shape, to the interior surface 310of the headrest side member 308. In such embodiments, the head SIP device 302 may be arranged generally centrally about a headrest side member 308 and may be sized to cover or overlap a substantial majority of the surface 310 of the headrest side member 308 extending between a lateral edge of the headrest support surface 312 at the back portion 304 of the headrest 300 and a front end 314 of a headrest side member 308. In such embodiments, an outer periphery of the head SIP device 302 may be substantially flush or aligned with one or more edges, such as the front end 314 for example, of the headrest side member 308. Although not shown, it should be appreciated that another head SIP device may be arranged at another portion of the headrest 300, such as at the first headrest side member 306 for example. In such embodiments, a configuration of an additional head SIP device may, but need not be identical to the head SIP device 302 illustrated and described herein.

[0691] However, in other embodiments, such as with a headrest 400 as shown in FIGS. 5A and 5B, only a portion of a head SIP device 402 of a head SIP portion 401 (FIG. 5B) may

have a contour complementary to an adjacent portion of the headrest 400, such as a headrest side member. The headrest 400 may include a back portion 404, a first headrest side member 406, and a second headrest side member (not shown), as previously described. In the illustrated, non-limiting embodiment, a head SIP device 402 is mounted to an interior surface 408 of the first headrest side member 406. Although not shown, it should be appreciated that another head SIP device may be arranged at another portion of the headrest 400, such as at the second headrest side member for example. In such embodiments, a configuration of an additional head SIP device may, but need not be identical to the head SIP device 402 illustrated and described herein.

[0692] In the illustrated, non-limiting embodiment, only a distal end 410 of the head SIP device 402 has a contour complementary to the corresponding end 412 of the headrest side member 406. In such embodiments, the head SIP device 402a may extend over only a portion of the distance between a headrest support surface 414 of a back portion 404 of the headrest 400 and a front end 412 of a headrest side member 406. Alternatively, or additionally, the head SIP device 402 may extend over only a portion of the height of the headrest side member 406, such as between a top 416 and a bottom 418 thereof. However, in embodiments where the head SIP device 402 extends over only a portion of the headrest side member 406, the head SIP device 402 need not be arranged adjacent to the front end 412 of the headrest side member 406.

[0693] In the illustrated, non-limiting embodiment of FIGS. 3A and 3B, the thickness of the first and second head SIP devices 202a, 202b is substantially uniform over the width of each head SIP device 202a, 202b (the width being measured between a headrest support surface 209 and a front end 220 of the headrest side member 204, 206). Accordingly, when the head SIP device 202a, 202b is mounted to the headrest 200, the inwardly facing surface 216 of the head SIP device 202a, 202b is arranged at substantially the same angle relative to the headrest support surface 209 as the headrest side member 204, 206. The head SIP device 202a, 202b is illustrated as being formed from a flexible or semi-rigid foam material. However, any suitable material configured to absorb energy is within the scope of the disclosure.

[0694] In some embodiments, a head SIP device of a child seat is contoured to induce a roll of an occupant's head in the event of a side impact collision. In the non-limiting embodiment of FIGS. 4A-5B, a thickness of the illustrated respective head SIP devices 302, 402, measured between an outwardly facing surface 420 of the head SIP device 302b, 402 and an inwardly facing surface 322, 422 of the head SIP device 302, 402, may vary between opposite ends of the head SIP device 302, 402. In FIGS. 4A-4B, the thickness of the head SIP device 302 is wedge-shaped and the thickness of the head SIP device 302 gradually increases

from the end closest to the headrest support surface 312 toward the front end 314 of the headrest side member 308.

[0695] The increase in thickness over the width of the head SIP device 302 may be selected to achieve a desired angle of the inwardly facing surface 322 relative to the headrest support surface 312. In an embodiment, a maximum thickness of a wedge-shaped head SIP device 302 is about 2 inches, and in some embodiments is less than 1.5 inches, such as about 1¼ inches, about 1 inch, or about ½ inch. However, embodiments where a wedge-shaped head SIP device 302 has a maximum thickness greater than 2 inches are also within the scope of the disclosure.

[0696] In other embodiments, such as shown in FIGS. 5A and 5B, the head SIP device 402 is wedge-shaped and the thickness of the head SIP device 402 gradually decreases from the end closest to the headrest support surface 414 towards the front end 412 of the headrest side member 406. As a result, the inwardly facing surface 422 of the head SIP device 402 tapers outwardly away from a center of the headrest 400. In an embodiment, a maximum thickness of a wedge-shaped head SIP device 402 is about 1 inch, and in some embodiments is less than 1 inch, such as about ¾ inch, about .5 inch, or about ¼ inch. However, embodiments where a wedge-shaped head SIP device 402 has a maximum thickness greater than 1 inch are also within the scope of the disclosure. Although the wedge-shaped head SIP devices 302, 402 are illustrated as being formed from expanded polystyrene in the FIGS. in other embodiments, the head SIP device 302, 402 may be formed from other materials.

[0697] In an embodiment, a head SIP device of a headrest as described herein is configured to induce a roll of an occupant's head in the event of a side impact collision, such as by defining a contoured recess associated with the head receiving region of the headrest. With reference to FIGS. 5A and 5B, a recess 432 associated with the head SIP device 402 may be located immediately adjacent to the head SIP device 402. The recess 432 may be defined in part by the inwardly facing surface 422 of the head SIP device 402 and by a plane extending laterally from an inner edge of the front end 412 of the headrest 400. Further, the recess 432 may extend from a portion of the head SIP device 402 positioned closest laterally to a central longitudinal axis CLA of a head receiving region 430 to the plane extending laterally from an inner edge of the front end 412 of the headrest 400. In the non-limiting embodiment of FIGS. 5A and 5B, the portion of the head SIP device 402 positioned closest to the CLA is located at a line of intersection L between the inwardly facing surface 422 and the back portion 404. Accordingly, the line of intersection L is positioned closer to the back portion than the front end 412 of the headrest 400.

[0698] The recess 430 may further be defined by a vertical plane extending from the line of intersection L toward the plane extending laterally from an inner edge of the front end 412. This vertical plane is represented by a line 434 in FIG. 5A. In an embodiment, the line 434 is oriented substantially parallel to the CLA. At least in part due to this tapered or sloped configuration of the head SIP device 402, the lateral dimension of the recess 432 gradually increases in a direction toward the front 412 of the headrest 400. The gradual reduction in thickness of the head SIP device 402, along with the corresponding increase in the recess 432 formed thereby, facilitates a forward roll of an occupant's head during a side impact event.

[0699] Further, in an embodiment, such as shown in FIGS. 6A and 6B, the head SIP device 502 associated with a headrest 500 may alternatively or additionally include a body of compressible material, illustrated at 504, such as a flexible foam for example. In the non-limiting embodiment illustrated in the FIGS., the body of compressible material 504 is positioned directly adjacent to the inwardly facing surface 506 of a head SIP device 502, such as a wedge-shaped member similar to 302. Although the body of compressible material 504 is illustrated as being mounted directly to the head SIP device 502, in other embodiments, such a body may be integrated into the soft goods positionable about the headrest 500 and the head SIP device 502. The compressible material 504 may provide cushioning for an occupant's head during a crash event additional to the padding of the soft goods. Although the body of compressible material 504 is illustrated as being positioned adjacent to a head SIP device 502 arranged at a second headrest side member 510, it should be understood that such a body 504 may be arranged adjacent to another head SIP device positioned at another location about the headrest 500, such as adjacent to a first headrest side member 512. Alternatively, or in addition, the body of compressible material 504 may be located at any position relative to the headrest 500 including locations where a head SIP device is not present.

[0700] With reference now to FIGS. 7A-9B, embodiments of a headrest 600, 700, 800 having a head SIP device 602, 702, 802 mountable to both a headrest support surface 604, 704, 804 of a headrest back portion 606, 706, 806 and an interior surface 608, 708, 808 of a headrest side member 610, 710, 810 are illustrated. Although not shown, it should be appreciated that another head SIP device may be arranged at another portion of each headrest 600, 700, 800, such as at the second headrest side member for example. In such embodiments, a configuration of an additional head SIP device may, but need not be identical to the head SIP device 602, 702, 802 illustrated and described herein.

[0701] In each of the embodiments, an SIP base 620, 720, 820 of the head SIP device 602, 702, 802 may have a contour complementary to a portion of both the headrest support

surface 604, 704, 804 and the surface 608, 708, 808 of the headrest side member 610, 710, 810. In such embodiments, the head SIP device 602, 702, 802 may extend over only a portion of a headrest side member 610, 710, 810 between the headrest support surface 604, 704, 804 and a front end 614 of the headrest side member 610, 710, 810.

[0702] In the illustrated, non-limiting embodiment of FIGS. 7A and 7B, an inwardly facing surface 622 of the head SIP device 602 has a smooth, continuous contour, such as formed by a curvature for example. However, in other embodiments, the inwardly facing surface 722, 822 of the head SIP device 702, 802 may include one or more side impact protection portions or areas arranged at various angles relative to one another and to the headrest support surface 704, 804. In the non-limiting embodiments of FIGS. 8A and 8B and FIGS. 9A and 9B, the inwardly facing surface 722, 822 includes a first side impact protection area 724, 824 and a second side impact protection area 726, 826 arranged at a non-parallel angle to one another. An axial length of the first side impact protection area 724, 824 may be the same as an axial length of the second side impact protection area 726, 826. However, in other embodiments, the first side impact protection area 724, 824 may have a longer axial length than the second side impact protection area 726, 826, or the first side impact protection area 724, 824 may have a shorter axial length than the second side impact protection area 726, 826. In some embodiments, the first side impact protection area 724, 824 is arranged at an obtuse angle relative to the second side impact protection area 726, 826. As shown, the overall size of the first and second side impact protection area 724, 824, 726, 826 and the angle defined therebetween varies between the embodiments of FIGS. 8A-8B and the embodiment of FIGS. 9A and 9B. The overall size of the first side impact protection area 724, 824 may also be relatively larger or smaller than the overall size of the second side impact protection area 726, 826.

[0703] In a crash event, movement of an occupant's head will be driven along a path defined by the inwardly facing surface 622, 722, 822 of the head SIP devices 602, 702, 802. In embodiments where the inwardly facing surface includes a plurality of side impact protection areas, movement of an occupant's head will be driven from the first side impact protection area 724, 824 to the second side impact protection area 726, 826.

[0704] With reference to FIGS. 7A and 7B, the inwardly facing surface 622 may extend continuously from the headrest support surface 604 of the headrest 600 to a surface 608 of a headrest side member 610. As shown in FIG. 7A, a recess 630 may be at least partially defined within the head receiving region 628 by the head SIP device 602. In the illustrated, non-limiting embodiment, the recess 630 is defined in part by the inwardly facing surface 622 of the head

SIP device 602 and by a plane extending laterally from an inner edge of the front end 612 of the headrest 600. Further, the recess 630 may extend from a portion of the head SIP device 602 positioned closest laterally to a central longitudinal axis CLA of a head receiving region 628 to the plane extending laterally from an inner edge of the front end 612 of the headrest 600. In the non-limiting embodiment of FIGS. 7A and 7B, the portion of the head SIP device 602 positioned closest to the CLA is located at a line of intersection L0 (FIG. 7A) between the inwardly facing surface 622 and the headrest support surface 604 of the back portion 606. Accordingly, the line of intersection L0 is positioned closer to the back portion 606 than the front end 612 of the headrest 600. The recess 630 may further be defined by a vertical plane extending from the line of intersection L0 toward the plane extending laterally from an inner edge of the front end 612. This vertical plane, represented by a line 632 in FIG. 7A, may be oriented substantially parallel to the CLA.

[0705] With reference to the non-limiting embodiment of a head SIP device 702 of a headrest 700 illustrated in FIGS. 8A and 8B, the inwardly facing surface 722 may include the first side impact protection area 724 arranged closest to the back portion 706 of the headrest 700 and the second side impact protection area 726 extending from the first side impact protection area 724 toward the front end (not shown) of the headrest 700. The first side impact protection area 724 may converge with the second side impact protection area 726 along a vertical line of intersection, represented in FIG. 8A by L1. The line of intersection L1 may be arranged at any suitable angle relative to the back portion 706. In an embodiment, the line of intersection L1 is the portion of the head SIP device 702 positioned closest to a central longitudinal axis CLA of a head receiving region 728 (in a lateral direction).

[0706] A recess 730 is at least partially defined within the head receiving region 728 of the headrest 700 by the head SIP device 702. In the illustrated, non-limiting embodiment, the recess 730 extends from the line of intersection, L1, towards a plane extending laterally from an inner edge of the front end (not shown) of the headrest 700. A plane of the recess 730 extending between the line of intersection L1 and the plane extending laterally from an inner edge of the front end, illustrated at P1, may be coplanar with the first side impact protection area 724. The recess 730 may further be defined by the second side impact protection area 726 of the inwardly facing surface 722, and a surface 708 of the headrest side member 710 extending between an edge of the second side impact protection area 726 and the front end of the headrest 700.

[0707] In the illustrated, non-limiting embodiment, a vertical plane, represented by axis X1 in FIG. 8A extends from the front end and is positioned tangent to the inwardly facing

surface 722 at the line of intersection L1 between the first and second side impact protections areas 724, 726. The axis X1 intersects the headrest support surface 704 at an intersection location I1. In an embodiment, a distance between the headrest support surface 704 and the line of intersection L1 measured along the axis X1 is shorter than a distance between the line of intersection L1 and the front end of the headrest 700 measured along the axis X1.

[0708] With reference to FIGS. 9A and 9B, the inwardly facing surface 822 of the illustrated head SIP device 802 similarly includes a first side impact protection area 824 adjacent to the headrest support surface 804 and a second side impact protection area 826 extending from the first side impact protection area 824 toward a front end 814 of the headrest 800. In the illustrated, non-limiting embodiment, the inwardly facing surface 822 additionally includes a third side impact protection area 828 extending from an edge of the second side impact protection area 826. Although the third side impact protection area 828 is illustrated as extending substantially perpendicular to an interior surface 808 of the headrest side member 810, embodiments where the third side impact protection area 828 is angled toward a front 814 of the headrest 800 are also contemplated herein. The first side impact protection area 824 may be converge with the second side impact protection area 826 along a first vertical line of intersection, represented in FIG. 9A by L2a and the second side impact protection area 826 may converge with the third side impact protection area 828 along a second vertical line of intersection, represented by L2b. The line of intersection L2a of the head SIP device 802 may be positioned laterally closest to a central longitudinal axis CLA of a head receiving region 832.

[0709] A recess 830 is at least partially defined within the head receiving region 832 of the headrest 800 between the head SIP device 802 and the front 814 of the headrest 800. In the illustrated, non-limiting embodiment, the recess 830 extends from the first line of intersection, L2a, towards a plane extending laterally from an inner edge of the front end 814 of the headrest 800. This plane, represented by line P2, extending between the line of intersection L2a and the plane extending laterally from an inner edge of the front end 814 may be coplanar with the first side impact protection area 824. The recess 830 may further be defined by the plane extending laterally from an inner edge of the front end 814 of the headrest 800, the second side impact protection area 826, and the third side impact protection area 828 of the inwardly facing surface 822, as well as the surface 808 of the headrest side member 810 extending between an edge of the third side impact protection area 828 and the front end 814 of the headrest 800.

[0710] In the illustrated, non-limiting embodiment, a vertical plane, represented by axis X2 in FIG. 9A extends from the front end 814 and is positioned tangent to the inwardly facing

surface 822 at the first line of intersection L2a of the inwardly facing surface 822. The axis X2 intersects the headrest support surface 804 at an intersection location I2. In an embodiment, a distance between the headrest support surface 804 and the first line of intersection L2a measured along the axis X2 is shorter than a distance between the line of intersection L2a and the front end 814 measured along the axis X2.

[0711] Each of the embodiments illustrated in FIGS. 2A- 9B, discloses at least one head SIP device formed from a rigid or semirigid material, such as expanded polystyrene for example. However, with reference to FIGS. 10A-11C in other embodiments, a head SIP device 902, 1002 associated with a head side impact protection portion 903, 1003 of a headrest 901, 1001 of a child seat 900, 1000 may be formed from a flexible or resilient material. In an embodiment, the one or more head SIP devices 902, 1002 arranged at the head SIP portion 903, 1003 illustrated are or include a structurally modifiable body that can be transformed into different configurations via changes in shape and/or structure. Examples of a structurally modifiable body include but are not limited to an expandable bladder or air bag. The structurally modifiable body 902, 1002 may be filled with a fluid, such as a liquid or air for example.

[0712] Similar to the previously disclosed embodiments, the headrest 901, 1001 may include a back portion 904, 1004, a first headrest side member 906, 1006, and a second headrest side member 908, 1008. An outwardly facing surface 910, 1010 of the structurally modifiable body 902, 1002 may be permanently or removably fixed to a portion of the headrest 901, 1001, such as an interior surface 912, 1012 of a headrest side member 908, 1008 for example. Although not shown, it should be appreciated that another head SIP device may be arranged at another portion of each headrest 901, 1001, such as at the first headrest side member 906, 1006 for example. In such embodiments, a configuration of the additional head SIP device may, but need not be identical to the head SIP device 902, 1002 illustrated and described herein.

[0713] The structurally modifiable body 902, 1002 when filled protrudes from the interior surface 912, 1012 of the headrest side member 908, 1008. Further, the structurally modifiable body 902, 1002 may be elastically deformable to absorb energy applied thereto during a crash event. As will be described in more detail below, the structurally modifiable body 902, 1002 may be permanently filled or inflated. Alternatively, the structurally modifiable body 902, 1002 may be transformable between a deflated or retracted configuration and an inflated or extended configuration, such as while an occupant is present within the child seat 900, 1000.

[0714] As shown in FIGS. 11A-11C, in an embodiment, the contour of the head SIP device 1002 is generally complementary to a portion of a headrest 1001 overlapped by the head SIP device 1002. For example, a portion 1014 of the head SIP device 1002 located near the front end 1016 and a bottom 1018 of a headrest side member 1008 may have generally rounded contours, and a portion 1020 of the head SIP device 1002 positioned closest to a headrest upright support surface 1022 of the back portion 1004 may have a generally linear contour. In another embodiment shown in FIGS. 10A-10C, the head SIP device 902 has a substantially circular configuration. As shown, the head SIP device 902, 1002 may be positioned to substantially overlap with a majority of the headrest side member 908, 1008. The contours of a head SIP device 902, 1002 formed via a structurally modifiable body, such as a bladder or air bag for example, as described herein are intended as an example only. It should be understood that any of the other configurations of a head SIP device described herein, such as described with respect to FIGS. 2A-9B could alternatively be formed as a structurally modifiable body having the previously described shape in at least one configuration of the body.

[0715] Although each of the embodiments of FIGS. 2B-11C, illustrates only a single head SIP device at any given area of a headrest, in an embodiment, a plurality of head SIP devices may be arranged at the same area of a headrest, such as at the back portion or a respective side member of the headrest. For example, in the illustrated, non-limiting embodiment of FIGS. 12A and 12B, a first head SIP device 1102 and a second head SIP device 1104 are associated with or mounted to the same headrest side member 1106 of a headrest 1100. In such embodiments, the material, contour, shape, and/or hardness of the first and second head SIP devices 1102, 1104 may be the same, or alternatively, may be different. Indeed, the first and second head SIP devices 1102, 110 may include the material, contour, shape, and/or hardness of any of the other head SIP devices shown and discussed herein. Further, such first and second head SIP devices 1102, 1104 may be mounted to the headrest 1100 independently of one another.

[0716] In an embodiment, both the first and second head SIP devices 1102, 1104 are part of a single head SIP portion 1101. Although the first and second head SIP devices 1102, 1104 are illustrated and described at a respective headrest side member 1106, it should be appreciated that in other embodiments, another first head SIP device 1102 and second head SIP device 1104, may be arranged at another portion of the headrest 1100, such as at an opposite headrest side member (not shown). In such embodiments, a configuration of the first head SIP devices 1102 may but need not be identical and/or a configuration of the second head SIP devices 1104 may but need not be identical.

[0717] In embodiments including a plurality of head SIP devices arranged at a single surface of the headrest 1100, such as head SIP device 1102 and head SIP device 1104 for example, a recess 1110 (see FIG. 12A) may be at least partially defined within a head receiving region 1112 of the headrest 1100 by the plurality of head SIP devices 1102, 1104. As shown, each of the first head SIP device 1102 and the second head SIP device 1104 has a respective inwardly facing surface 1120, 1122. Although the inwardly facing surfaces 1120, 1122 are illustrated as having a generally planar configuration, embodiments where at least one of the inwardly facing surfaces 1120, 1122 has a plurality of side impact protection areas (such as those discussed above in FIGS. 7A-9B) are also contemplated herein. The recess 1110 may be defined by a plane connecting a portion of the inwardly facing surface 1120 positioned laterally closest to a central longitudinal axis CLA of the headrest 1100 to the inwardly facing surface 1122 at the end of the second head SIP device 1104 positioned closest to first head SIP device 1102. The recess 1110 may further be defined by an end 1124 of the first head SIP device 1102 facing the second head SIP device 1104, the end 1126 of the second head SIP device 1104 facing the first head SIP device 1102, and a surface of the headrest side member 1106 extending therebetween.

[0718] In the previously described embodiments, the head SIP devices disposed at or adjacent to different portions of a headrest, such as opposite headrest side members for example, are separate devices individually mounted thereto. However, in other embodiments, a plurality of head SIP devices may be integrally formed as a unitary body, also referred to herein as a head SIP assembly. For example, in the non-limiting embodiment illustrated in FIGS. 13A-13E, a head SIP assembly 1202 includes a head SIP device 1204a positionable at or adjacent to a first headrest side member 1206, another head SIP device 1204b positionable at or adjacent to a second headrest side member 1208, and a connector member 1210 coupled to both head SIP devices 1204a, 1204b. In such embodiments, the head SIP devices 1204a, 1204b arranged at the opposite headrest side members 1206, 1208 may be substantially identical or may vary.

[0719] It should be appreciated that a head SIP assembly such as head SIP assembly 1202 may be associated with one or more head SIP portions of a headrest. For example, the headrest 1201 may include a first head SIP portion 1230a arranged proximate to a first headrest side member 1206, and a second head SIP portion 1230b arranged proximate to a second headrest side member 1208. When the head SIP assembly 1202 is installed within a head receiving region 1228 of the headrest 1201, the first head SIP device 1204a of the head SIP assembly 1202 may be arranged within and form at least part of the first head SIP portion 1230a

and the second head SIP device 1204b may be arranged within and form at least part of the second head SIP portion 1230b.

[0720] As shown, a head SIP assembly 1202 as described herein may be configured as an insert removably connected to a child seat 1200, or alternatively, permanently connected to the child seat 1200. The head SIP devices 1204a, 1204b of a head SIP assembly 1202 may be formed from at least one material, and the connector member 1210 may be formed from a material different than the head SIP devices 1204a, 1204b. However, embodiments where the head SIP devices 1204a, 1204b and the connector member 1210 are formed from the same material are also within the scope of the disclosure.

[0721] In an embodiment, the connector member 1210 includes a body portion 1212, positionable adjacent to a headrest support surface 1223 of the back portion 1214 of the headrest 1201, and two side portions 1216, 1218, positionable in overlapping arrangement with each headrest side member 1206, 1208, respectively. In such embodiments, an outer surface of the head SIP assembly 1202 may include a complementary contour to one or more surfaces of the headrest 1201 to which the head SIP assembly 1202 is connectable. For example, the outer surface of the head SIP assembly 1202 may be contoured to match the headrest support surface 1223, the surface of the first headrest side member 1206, and/or the surface of the second headrest side member 1208, and contact each of the headrest support surface 1223, the surface of the first headrest side member 1206, and the surface of the second headrest side member 1208. However, embodiments where the connector member 1210 is only configured to contact a portion of the headrest 1201, such as one or more of the headrest support surface, and the two headrest side members are also contemplated herein.

[0722] In the illustrated, non-limiting embodiment of FIGS. 13A-13E, each head SIP device 1204a, 1204b of the head SIP assembly 1202 may extend from the body portion 1212 of the connector member 1210, over a substantial length or even the entire length of a side portion 1216, 1218 of the head SIP assembly 1202. In the illustrated, non-limiting embodiment, the head SIP devices 1204a, 1204b extend to or substantially to the front end 1234a, 1234b of the side portions 1216, 1218. It should be appreciated that when the head SIP assembly 1202 is installed about a headrest 1201, an end of the head SIP devices 1204a, 1204b may be flush with the front ends 1233a, 1233b of the headrest 1201, or alternatively, may be offset therefrom by a distance. An outwardly facing surface 1220a, 1220b of a head SIP device 1204a, 1204b may be complementary to and abut the side portion 1216, 1218, and in some embodiments, the body portion 1212 of the connector member 1210. As shown in FIGS. 13D and 13E, the inwardly facing surface 1222a, 1222b of the head SIP devices 1204a, 1204b may be defined

by a plurality of different side impact protection areas arranged at different angles relative to the headrest support surface 1223. A first side impact protection area 1224a, 1224b of each inwardly facing surface 1222a, 1222b is positioned closest to, and in some embodiments is directly adjacent to, the body portion 1212 of the connector member 1210. In the illustrated, non-limiting embodiment, the first side impact protection area 1224a, 1224b is oriented substantially perpendicular to the body portion 1212 and the headrest support surface 1223.

[0723] As shown, a second side impact protection area 1226a, 1226b extending from the first side impact protection area 1224a, 1224b to the end of the side portions 1216, 1218 may be arranged at a non-parallel angle relative to the first side impact protection area 1224a, 1224b. In an embodiment, the angle α between the first side impact protection area 1224a, 1224b and the respective second side impact protection area 1226a, 1226b is obtuse. As shown, the thickness at the second side impact protection area 1226a, 1226b of a head SIP devices 1204a, 1204b may gradually reduce toward the forward end 1230 of the head SIP assembly 1202. The angle α and variation in thickness form an outward slope that increases the clearance defined by the opposing head SIP devices 1204a, 1204b over the length of the head SIP devices 1204a, 1204b.

[0724] In an embodiment, each of the head SIP devices 1204a, 1204b may form a recess 1232a, 1232b within the head receiving region 1228 of the headrest 1201, such as between the head SIP device 1204a, 1204b and a front end 1234a, 1234b of the headrest 1201. The first side impact protection areas 1224a, 1224b may abut the second side impact protection areas 1226a, 1226b at a line of intersection represented by L3a and L3b, respectively. The lines of intersection L3a and L3b may be opposing portions of the head SIP device 1204a, 1204b that are positioned laterally closest to a central longitudinal axis CLA of a head receiving region 1228. Each recess 1232a, 1232b extends from a corresponding generally vertically oriented line of intersection L3a, L3b toward a plane extending laterally from an inner edge of the front ends 1234a, 1234b of the headrest side members 1206, 1208. A plane of each recess 1232a, 1232b extending from the lines of intersection L3a, L3b toward the planes including the front ends 1233a, 1233b, represented by lines P3a and P3b, may be coplanar with the first side impact protection surfaces 1224a, 1224b of each respective head SIP device 1204a, 1204b. The recess 1232a, 1232b may further be defined by the second side impact protection area 1226a, 1226b and the plane extending laterally from an inner edge of the front ends 1233a, 1233b.

[0725] In the illustrated, non-limiting embodiment, a vertical plane, represented by axis X3a in FIG. 13E extends from the front end 1233a of the headrest side member 1206 or the front end 1234a of a side portion 1216 and is positioned tangent to the inwardly facing surface

1222a at the line of intersection L3a. The axis X3a may intersect the headrest support surface 1204 at an intersection location I3a. Similarly, a vertical plane, represented by axis X3b extends from the front end 1233b of the headrest side member 1208 or the front end 1234b of a side portion 1218 and is positioned tangent to the inwardly facing surface 1222b at the line of intersection L3b. The axis X3b may intersect the headrest support surface 1204 at an intersection location I3b. In an embodiment, a distance between the headrest support surface 1204 and the line of intersection L3a, L3b, is less than the distance between the line of intersection L3a, L3b and the front end 1234a, 1234b of a headrest side member 1206, 1208 measured along a respective axis X3a, X3b.

[0726] Another embodiment of a head SIP assembly 1302 mounted to a headrest 1301 is illustrated in FIG. 14. Similar to the previous embodiment, the head SIP assembly 1302 includes a connector member 1306 having a body portion 1308, a first side portion 1310 and a second side portion 1312, and head SIP devices 1304a, 1304b. The head SIP devices 1304a and 1304b are arranged adjacent to the first and second side portions 1310, 1312 of the connector member 1306, respectively, as previously described. When the head SIP assembly 1302 is mounted to a headrest 1301, the first side portion 1310 may be arranged at or adjacent to a first headrest side member 1314, the second side portion 1312 may be in overlapping arrangement with a second headrest side member 1316, and the body portion 1308 is arranged at a headrest support surface of a back portion 1318 of the headrest 1301. In the illustrated, non-limiting embodiment of FIG. 14, each head SIP device 1304a, 1304b of the head SIP assembly 1302 may extend from the body portion 1308 of the connector member 1306, over at least half of a length of a side portion 1310, 1312 of the head SIP assembly 1302, and in some embodiments, over a substantially entire length of a side portion 1310, 1312 of the head SIP assembly 1302. However, the side portion 1310, 1312 of the connector member 1306 may have a length equal to or different from a length of a corresponding headrest side member 1314, 1316.

[0727] Similar to the previous embodiment, each head SIP device 1304a, 1304b includes an inwardly facing surface 1320a, 1320b including a first side impact protection area 1322a, 1322b positioned closest to the body portion 1308 of the connector member 1306 and a second side impact protection area 1324a, 1324b extending forward, away from the first side impact protection area 1322a, 1322b. In the illustrated, non-limiting embodiment, the first side impact protection area 1322a, 1322b is arranged at a non-perpendicular angle relative to the body portion 1308. In an embodiment, the angle β between the body portion 1308 and the first side impact protection area 1322a, 1322b may be between about 65 and about 85 degrees. The

second side impact protection area 1324a, 1324b extending from the first side impact protection area 1322a, 1322b at a line of intersection L4a, L4b may have a curved configuration, such as a concave curvature for example. As a result, the thickness of the head SIP device 1304a, 1304b gradually decreases over the second side impact protection area 1324a, 1324b toward a front end 1326a, 1326b of the headrest 1301. The line of intersection L4a, L4b may be the portion of the head SIP device 1304a, 1304b positioned closest to a central longitudinal axis CLA of a head receiving region 1328 (in a lateral direction).

[0728] In an embodiment, each of the head SIP devices 1304a, 1304b may form a recess 1330a, 1330b within the head receiving region 1328 of the headrest 1201 for guiding movement of an occupant's head during a side impact event. Each recess 1330a, 1330b extends from a corresponding line of intersection L4a, L4b toward a plane extending laterally from an inner edge of the front ends 1326a, 1326b of the headrest side members 1314, 1316. The plane of the recess 1330a, 1330b extending from the line of intersection L4a, L4b toward the plane extending laterally from an inner edge of the front ends 1326a, 1326b, represented by lines P4a and P4b, may be coplanar with the first side impact protection surface 1322a, 1322b of each respective head SIP device 1304a, 1304b. The recess 1330a, 1330b may further be defined by the second side impact protection area 1324a, 1324b, and by a surface of at least one of the side portions 1310, 1312 and the headrest side members 1314, 1316 extending between the edge of a respective second side impact protection area 1324a, 1324b and a front end 1326a, 1326b of the headrest 1301.

[0729] In the illustrated, non-limiting embodiment, a vertical plane, represented by axis X4a from the front end 1326a of the headrest side member 1314 and is positioned tangent to the inwardly facing surface 1320a at the line of intersection L4a. Further, the axis X4a may intersect the headrest support surface 1304, or the adjacent body portion 1308 of the connector member 1306, at an intersection location I4a. Another vertical plane, represented by axis X4b extends from the front end 1326b of the headrest side member 1316 and is positioned tangent to the inwardly facing surface 1320b at the line of intersection L4b. The axis X4b may intersect the headrest support surface 1304 or the adjacent body portion 1308 at an intersection location I5b. In an embodiment a distance between the headrest support surface 1304 and the line of intersection L4a, L4b, is less than the distance between the line of intersection L5a, L5b and the front end 1326a, 1326b of a headrest side member 1314, 1316 measured along a respective axis X4a, X4b.

[0730] With reference now to FIGS. 15A-15E, another example of a head SIP assembly 1402 having head SIP devices 1404a, 1404b is shown. The head SIP devices 1404a and 1404b

are respectfully arranged adjacent to a first side portion 1408 and the second side portion 1410 of a connector member 1406 of the head SIP assembly 1402. The connector member 1406 also includes a body portion 1416 that connects the first side portion 1408 and second side portion 1410. As shown, the head SIP assembly 1402 is positionable adjacent to a headrest 1401 such that the first side portion 1408 is arranged at or adjacent to a first headrest side member 1412, the second side portion 1410 is arranged at or adjacent to a second headrest side member 1414, and the body portion 1416 is arranged at a headrest support surface 1418 of a back portion 1420 of the headrest 1401.

[0731] Each head SIP device 1404a, 1404b includes an inwardly facing surface 1420a, 1420b including a first side impact protection area 1422a, 1422 positioned closest to the body portion 1416 and a second side impact protection area 1424a, 1424b extending forward, away from the first side impact protection area 1422a, 1422. As shown, the first side impact protection area 1422a, 1422 may be arranged substantially perpendicular to the body portion 1416 of the connector member 1406 and the headrest support surface 1418. A second side impact protection area 1424a, 1424b extending from the first side impact protection area 1422a, 1422 may be arranged at a non-parallel angle relative to the first side impact protection area 1422a, 1422. In an embodiment, the angle α (see FIG. 15E) between the first side impact protection area 1422a, 1422 and the second side impact protection area 1424a, 1424b is obtuse (e.g., greater than 90 degrees).

[0732] In the illustrated, non-limiting embodiment, the head SIP devices 1404a, 1404b are mounted near a rear of the head SIP assembly 1402, such as at an interface between the body portion 1416 and the side portions 1408, 1410 of the connector member 1406 for example. Each head SIP device 1404a, 1404b may extend over only a portion of a length of each side portion 1408, 1410 and/or headrest side member 1412, 1414. As shown, the head SIP devices 1404a, 1404b may extend to a center of a side portion 1408, 1410 and/or headrest side member 1412, 1414. In the illustrated, non-limiting embodiment, at least one head SIP device 1404a, 1404b extends over less than half of the length of a respective side portion 1408, 1410. However, embodiments where the at least one head SIP device 1404a, 1404b is longer or shorter are also contemplated herein.

[0733] As a result of the positioning and configuration of the head SIP devices 1404a, 1404b, the side portions 1408, 1410 of the connector member 1406 may extend beyond an end of the head SIP devices 1404a, 1404b toward a front end of the headrest 1401 as shown. In other embodiments, an end of the side portions 1408, 1410 of the connector member 1406 may be flush with the head SIP devices 1404a, 1404b. As shown in FIGS. 15A-15E, a length of the

side portions 1408, 1410 of the connector member 1406 may be equal to the headrest side members 1412, 1414. However, in other embodiments, the side portions 1408, 1410 will be shorter than the headrest side members 1412, 1414. Accordingly, in such a configuration, the headrest side members 1412, 1414 will extend beyond the side portions 1408, 1410 of the connector member 1406.

[0734] In the illustrated, non-limiting embodiment, the head SIP device 1404a forms a first recess 1430a within the head receiving region 1428 and the head SIP device 1404b forms a second recess 1430b within the head receiving region 1428. The first side impact protection area 1422a, 1422b may abut the second side impact protection area 1424a, 1424b of each head SIP device 1401a, 1404b at a generally vertical line of intersection represented by L5a and L5b (FIG. 15C), respectively. The line of intersection L5a, L5b may be the portion of the head SIP device 1404a, 1404b positioned laterally closest to a central longitudinal axis CLA of a head receiving region 1428.

[0735] The first recess 1430a is partially defined by the second side impact protection area 1424a and a plane extending laterally from an inner edge of the front ends 1432a, 1432b of the headrest side members 1412, 1414. A surface of either the side portion 1408 or the headrest side member 1412 extending between the edge of a respective second side impact protection area 1424a and the front end 1432a may also partly define the first recess 1430a. The recess 1430a may further be defined by a plane, represented by line P5a, extending from the line of intersection L6a to the plane extending laterally from an inner edge of the front ends 1232a, 1432b of the headrest side members 1412, 1414. This plane of the recess 1430a, extending from the line of intersection L5a toward the plane extending laterally from an inner edge of the front end 1432a may be coplanar with the first side impact protection area 1422a of the head SIP device 1404a.

[0736] Similarly, the second recess 1430b extends from the line of intersection L6b toward the plane extending laterally from an inner edge of the front ends 1432a, 1432b of the headrest side members 1412, 1414. The plane of the recess 1430b extending from the line of intersection L5b toward the plane extending laterally from an inner edge of the front ends 1432b, represented by line P5b, may be coplanar with the first side impact protection area 1422b of the head SIP device 1404b. The recess 1430b may further be defined by the plane extending laterally from an inner edge of the front ends 1432a, 1432b, the second side impact protection area 1424b, and by a surface of at least one of a side portion 1410 and a headrest side member 1414 extending between the edge of a respective second side impact protection area 1424b and the front end 1432b.

[0737] With reference to FIG. 15C, a vertical plane, represented by axis X5a extends from the front end 1432a of the headrest side member 1412 and is positioned tangent to the inwardly facing surface 1420a at the line of intersection L5a. Further, the axis X5a may intersect the headrest support surface 1404 or the adjacent body portion 1416 of the connector member 1406 at an intersection location I5a. Another vertical plane, represented by axis X5b extends from the front end 1432b of the headrest side member 1414 and is positioned tangent to the inwardly facing surface 1420b at the line of intersection L5b. The axis X5b may intersect the headrest support surface 1404 or the adjacent body portion 1416 at an intersection location I5b. In an embodiment a distance between the intersection location I5a, I5b and the line of intersection L5a, L5b, is less than the distance between the line of intersection L5a, L5b and the front end 1432a, 1432b of a headrest side member 1412, 1414 measured along a respective axis X5a, X5b.

[0738] It should be appreciated that each of the embodiments disclosed in FIGS. 5A-9B and 12A-15E includes a head SIP device positioned at or adjacent to the back portion of the headrest. Embodiments where a head SIP device is located at the body portion of a head SIP assembly may similarly be considered positionable adjacent to the back portion of the headrest. A head SIP device having such a configuration defines a recess within the head receiving region of the headrest extending between at least one surface of the head SIP device and the front of the headrest.

[0739] With reference now to FIGS. 16A-16E, embodiments where a head SIP device is spaced or offset from the front of the headrest, such as toward the back of the head receiving region are also configured to define a recess within the head receiving region of the headrest. A head SIP assembly 1502 of a headrest 1501 shown in FIGS. 16A-16E includes head SIP devices 1504a and 1504b. The head SIP devices 1504a and 1504b are respectfully arranged adjacent to a first side portion 1508 and the second side portion 1510 of a connector member 1506 of the head SIP assembly 1502. The connector member 1506 also includes a body portion 1512 that connects the first side portion 1508 and second side portion 1510. Similar to the previous embodiments, the head SIP assembly 1502 is positionable adjacent to a headrest 1501 such that the first side portion 1508 is arranged at or adjacent to a first headrest side member 1514, the second side portion 1510 is arranged at or adjacent to a second headrest side member 1516, and the body portion 1512 is arranged at a headrest support surface 1518 of a back portion 1519 of the headrest 1501.

[0740] In the illustrated, non-limiting embodiment, a first and second head SIP device 1504a, 1504b of the head SIP assembly 1502 may be considered to be mounted near a front

1503a, 1503b of a headrest 1501, such as via the connector member 1506. Such a configuration of a head SIP device 1504a, 1504b may be particularly suitable for embodiments where the child seat 1500 is in a forward-facing orientation relative to a vehicle seat. As shown, the head SIP devices 1504a, 1504b may be respectively positioned at locations at or proximate to front ends 1511a, 1511b of a side portion 1508, 1510 of the connector member 1506. The head SIP devices 1504a and 1504b may respectively extend from a center of the side portions 1508, 1510 to the front ends 1511a and 1511b. In the illustrated, non-limiting embodiment, at least one head SIP device 1504a, 1504b extends over less than half of the length of a respective side portion 1508, 1510. However, embodiments where the at least one head SIP device 1504a, 1504b is longer or shorter are also contemplated herein.

[0741] An outwardly facing surface 1520a, 1520b of a respective head SIP device 1504a, 1504b may be parallel with and mounted to a respective side portion 1508, 1510 of the connector member 1506. The inwardly facing surfaces 1522a, 1522b of a head SIP device 1504a, 1504b may be defined by a plurality of different side impact protection areas arranged at different angles relative to the headrest support surface 1518. In the illustrated, non-limiting embodiment, the surface 1522a, 1522b includes a first side impact protection area 1524a, 1524b oriented parallel to, or substantially parallel to, the body portion 1512 of the connector member 1506 and the headrest support surface 1518. In other embodiments, the first side impact protection area 1524a, 1524b may be arranged at an angle β between 3 degrees and 30 degrees relative to the body portion 1512. A second side impact protection area 1526a, 1526b of the inwardly facing surface 1522a, 1522b extending from the first side impact protection area 1524a, 1524b may have a generally rounded or curved contour, such as a convex curvature for example. In an embodiment, a thickness of the head SIP devices 1504a, 1504b may gradually reduce from the first side impact protection area 1524a, 1524b toward a respective forward end 1511a, 1511b of the head SIP assembly 1502. A first side impact protection area 1524a, 1524b may abut an adjacent second side impact protection area 1526a, 1526b at a generally vertically oriented line of intersection, illustrated at L6a, L6b. The lines of intersection L6a, L6b may be the portion of the head SIP device 1504a, 1504b positioned laterally closest to a central longitudinal axis CLA of a head receiving region 1528.

[0742] In the illustrated, non-limiting embodiment, a recess is formed within the head receiving region between a head SIP device 1504a, 1504b and a front 1503a, 1503b of the headrest 1501. As shown in FIG. 16E, each recess 1530a, 1530b may extend from a portion of the head SIP device 1504a, 1504b positioned closest to a central longitudinal axis CLA of a head receiving region 1528 to a plane extending laterally from an inner edge of the front ends

1503a, 1503b of the headrest 1501. In the illustrated, non-limiting embodiment, the portion of the head SIP device 1504a, 1504b positioned closest to a central longitudinal axis CLA is the respective line of intersection L6a, L6b. A plane defining a side of the recess 1530a, 1530b extending from the line of intersection L6a, L6b toward the plane extending laterally from an inner edge of the front 1503a, 1503b, represented by lines 1540a, 1540b, respectively, may be parallel to the central longitudinal axis CLA. The recesses 1530a, 1530b may be further defined by the plane extending laterally from an inner edge of the front end 1503a, 1503b of the headrest 1501, the second side impact protection area 1526, 1526b, and at least one of a surface of a side portion 1508, 1510 and a headrest side member 1514, 1516 extending between the edge of a respective second side impact protection area 1526, 1526b and the front 1503a, 1503b of the headrest 1501.

[0743] As shown in FIG. 16C, a vertical plane, represented by axis X6a extends from the front 1503a of the headrest 1501 and is positioned tangent to the inwardly facing surface 1522a at the line of intersection L6a and another vertical plane, represented by axis X6b extends from the front 1503b of the headrest 1501 and is positioned tangent to the inwardly facing surface 1522b at the line of intersection L6b. The axes X6a, X6b intersect the headrest support surface 1504 or the adjacent body portion 1512 of the connector member 1506 at an intersection location I6a, I6b, respectively. In an embodiment, a distance between the intersection location I6a, I6b and the line of intersection L6a, L6b of each head SIP device 1504a, 1504b, is greater than the distance between the line of intersection L6a, L6b and the front 1503a, 1503b of the headrest 1501.

[0744] Yet another embodiment of a head SIP assembly 1602 mountable to a headrest 1601 of a child seat 1600 is illustrated in FIGS. 17A-17E. Similar to the previous embodiment, first and second head SIP devices 1604a, 1604b are mounted at an end of a connector member 1606, such as at or proximate a front end 1608 of the side portions 1610, 1612 of the connector member 1606. In an embodiment, when the head SIP assembly 1602 is installed about the headrest 1601, the head SIP devices 1604a, 1604b are positioned at or near a front 1603 of the headrest 1601. In the illustrated, non-limiting embodiment, at least one head SIP device 1604a, 1604b extends over less than half of the length of a respective side portion 1610, 1612. However, embodiments where the at least one head SIP device 1604a, 1604b is longer or shorter are also contemplated herein.

[0745] A surface 1620a, 1620b of a head SIP device 1604a, 1604b may be positioned in contact with and parallel to a side portion 1610, 1612 of the connector member 1606. An inwardly facing surface 1622a, 1622b of a head SIP device 1604a, 1604b according to the

present embodiment includes a first side impact protection area 1624a, 1624b positioned closest to a body portion 1614 of the connector member 1606 and a second side impact protection area 1626a, 1626b located near a respective front end 1608a, 1608b of the connector member 1606.

[0746] The first side impact protection area 1624a, 1624b may be oriented at a non-parallel angle relative to both a respective side portion 1610, 1612 of the connector member 1606 and the body portion 1614 extending between and connecting the side portions 1610, 1612. In an embodiment, the first side impact protection area 1624a, 1624b extends relatively inwardly, away from a respective side portion 1610, 1612. However, in other embodiments, the first side impact protection area 1624a, 1624b of a head SIP device 1604a, 1604b may have a curved configuration, such as a concave curvature or configuration or a convex curvature or configuration for example. The second side impact protection area 1626a, 1626b of the inwardly facing surface 1622a, 1622b extends from and is arranged at an angle relative to the first side impact protection area 1624a, 1624b. In an embodiment, the second side impact protection area 1626a, 1626b is oriented substantially perpendicular to the body portion 1614, or alternatively or additionally, is arranged substantially parallel to the adjacent side portion 1610, 1612 of the connector member 1606. However, embodiments where the second side impact protection area 1626a, 1626b is arranged at a non-parallel angle, such as an acute angle for example, are also contemplated herein. As shown, a distance between the head SIP devices 1604a, 1604b generally decreases toward a front end 1603 of the headrest.

[0747] With reference now to FIGS. 18A-18E, another embodiment of a head SIP assembly 1702 of a headrest 1701 of a child seat 1700 is illustrated. Similar to the embodiment of FIGS. 17A-17E, , the head SIP assembly 1702 includes first and second head SIP devices 1704a, 1704b located at distal ends of a connector member 1706, such as near front ends 1708a, 1708b of a respective side portion 1709, 1710. In the illustrated, non-limiting embodiment, a contour of inwardly facing surfaces 1720a, 1720b of a head SIP device 1704a, 1704b may vary between relative tops 1712a, 1712b and bottoms 1714a, 1714b of the head SIP device 1704a, 1704b. For example, a first side impact protection area 1722a, 1722b, located near the first, upper end 1712 of a head SIP device 1704a, 1704b may be oriented substantially parallel to the adjacent side portion 1709, 1710 of the connector member 1706. A second side impact protection area 1724a, 1724b, extending from the first side impact protection area 1722a, 1722b toward the relative bottoms 1714 of the head SIP device 1704a, 1704b may be arranged at a non-parallel angle relative to the first side impact protection area 1722. In an embodiment, the angle between the first side impact protection area 1722 and the second area 1724 is obtuse.

[0748] Although the second side impact protection area 1724 is illustrated as having a planar surface or configuration, in other embodiments, the second side impact protection area 1724 of the head SIP device 1704a, 1704b may have a curved configuration, such as a convex curvature for example. Regardless of whether the second side impact protection area 1724 has a linear or curved configuration, a thickness of the head SIP device 1704a, 1704b at the second side impact protection area 1724 may gradually reduce toward the bottom of the headrest 1701. This variation over the height of the head SIP device 1704a, 1704b may be combined with any of the other configurations extending between a front and back of a head SIP device as previously described (or as will be described later).

[0749] As an alternative to, or in addition to a head SIP assembly having a plurality of head SIP devices arranged at opposite and interconnected side portions of a connector member as previously described herein, the head SIP assembly may include a plurality of head SIP devices arranged at the same surface of the connector member, such as at the same side portion for example. In such embodiments, the plurality of head SIP devices arranged at the same side portion of a connector member may but need not be mounted to form a continuous inwardly facing surface.

[0750] With reference to FIGS. 19A-19E, a head SIP assembly 1802 mountable to a headrest 1801 is shown. A plurality of head SIP devices are arranged at a same surface of a connector member 1808. In the illustrated, non-limiting embodiment, a first head SIP device 1804a and a second head SIP device 1806a are arranged at a first side portion 1810 of a connector member 1808, and a first head SIP device 1804b and a second head SIP device 1806b area arranged at a second side portion 1812 of a connector member 1808. In such embodiments, the first head SIP devices 1804a, 1804b may include configurations (size and/or shape) that are the same or different from each other and/or the second head SIP device s1806a, 1806b at the same side portions 1810 or 1812. Further, the first head SIP devices 1804a, 1804b may include materials that are the same or different from each other and/or the second head SIP devices 1806a, 1806b arranged at the same side portions 1810, 1812. In an embodiment, the second head SIP devices 1806a, 1806b have a reduced hardness compared to the first head SIP devices 1804a, 1804b. However, all of the first and second head SIP devices 1804a, 1804b, 1806a, 1806b are configured to absorb energy during a crash event. Although not shown, it should be understood that the first and second head SIP devices 1804a and 1806a may be arranged within a first SIP head portion and the first and second head SIP devices 1804b and 1806b are arranged within a second SIP portion.

[0751] The first head SIP devices 1804a, 1804b and the second head SIP devices 1806a, 1806b may have any suitable configuration. In the illustrated, non-limiting embodiment, the first head SIP devices 1804a and 1804b have a configuration substantially similar to that of FIGS. 15A-15E. As shown in FIG. 19E, each head SIP device 1804a, 1804b includes an inwardly facing surface 1820a, 1820b including a first side impact protection area 1822a, 1822b positioned closest to a body portion 1814 of the connector member 1808 and a second side impact protection area 1824a, 1824b extending forward, away from the first side impact protection area 1822a, 1822b. As shown, the first side impact protection area 1822a, 1822b may be arranged substantially perpendicular to the body portion 1814. The second side impact protection area 1824a, 1824b extending from the first side impact protection area 1822a, 1822b may be arranged at a non-parallel angle relative to the first side impact protection area 1822a, 1822b. The angle between the first side impact protection area 1822a, 1822b and the second side impact protection area 1824a, 1824b may be greater than 90 degrees.

[0752] The second head SIP devices 1806a, 1806b may have an outer surface 1830a, 1830b complementary to the side portion 1810, 1812. An inwardly facing surface 1832a, 1832b of the second head SIP devices 1806a, 1806b may be oriented substantially parallel to the outer surface 1830a, 1830b and/or the side portion 1810, 1812 over a length of the second head SIP device 1806a, 1806b. Accordingly, a thickness of a second head SIP device 1806a, 1806b may be substantially uniform over a length thereof. Although respective back ends 1834a, 1834b of the second head SIP device 1806a, 1806b are shown abutting only a portion of an adjacent first head SIP device 1804a, 1804b, in some embodiments, the back end 1834a, 1834b of a second head SIP device 1806a, 1806b may have a contour complementary to the adjacent end of a respective first head SIP device 1804a, 1804b.

[0753] In an embodiment, each of the first head SIP devices 1804a, 1804b may form a recess 1840a, 1840b within the head receiving region 1842 of the headrest 1801 for guiding movement of an occupant's head during a side impact event. A first side impact protection area 1822a, 1822b of an inwardly facing surface 1820a, 1820b of a respective first head SIP device 1804a, 1804b may abut the second side impact protection area 1824a, 1824b at a generally vertical line of intersection represented by L7a and L7b, respectively. The line of intersection L7a, L7b may be the portion of the head SIP device 1804a, 1804b positioned laterally closest to a central longitudinal axis CLA of a head receiving region 1842.

[0754] A side of each recess 1840a, 1840b may extend from a corresponding line of intersection L7a, L7b toward a plane extending laterally from an inner edge of the front ends 1842a, 1842b of the headrest side members 1844, 1846. The plane of the recess 1840a, 1840b

extending from the line of intersection L7a, L7b toward the plane extending laterally from an inner edge of the front ends 1842a, 1842b, represented by lines P7a and P7b respectively, may be coplanar with the first side impact protection surface 1822a, 1822b of each respective first head SIP device 1804a, 1804b. The recess 1840a, 1840b may further be defined by the second side impact protection area 1824a, 1824b, the plane extending laterally from the inner edge of the front ends 1842a, 1842b, and by a surface of at least one of the side portions 1810, 1812 and the headrest side members 1844, 1846 extending between the edge of a respective second side impact protection area 1824a, 1824b and a front end 1842a, 1842b.

[0755] In the illustrated, non-limiting embodiment, a vertical plane, represented by axis X7a extends from the front end 1842a of the headrest side member 1844 and is positioned tangent to the inwardly facing surface 1820a at the line of intersection L7a. Further, the axis X7a may intersect the headrest support surface 1804, or the adjacent body portion 1814 of the connector member 1808 at an intersection location I7a. Another vertical plane, represented by axis X7b extends from the front end 1842b of the headrest side member 1846 and is positioned tangent to the inwardly facing surface 1820b at the line of intersection L7b. The axis X7b may intersect the headrest support surface 1804 or the adjacent body portion 1814 at an intersection location I7b. In an embodiment a distance between the headrest support surface 1804 and the line of intersection L7a, L7b, is less than the distance between the line of intersection L7a, L7b and the front end 1842a, 1842b of a headrest side member 1844, 1846 measured along a respective axis X7a, X7b. In the illustrated, non-limiting embodiment, the second head SIP device 1806a is arranged within the recess 1840a formed by the first heat SIP device 1804a. Similarly, the second head SIP device 1806b is arranged within the recess 1840b formed by the first heat SIP device 1804b.

[0756] In the non-limiting embodiment of a head SIP assembly 1902 illustrated in FIGS. 20A-20E, each side portion 1906, 1908 of a connector member 1904 of the head SIP assembly 1902 is similarly associated with a plurality of head SIP devices. As shown, the head SIP assembly 1902 includes a plurality of first head SIP devices 1910a, 1910b positioned proximate a relative rear of the connector member 1904, such as proximate interfaces between respective side portions 1906, 1908 and a body portion 1909. In an embodiment, the first head SIP devices 1910a, 1910b have a configuration substantially identical to those of the previous embodiment (FIGS. 19A-19E) and disclosed in FIGS. 15A-15E. In such a configuration, each first head SIP device 1910a, 1910b includes an inwardly facing surface 1912a, 1912b including a first side impact protection area 1914a, 1914b positioned closest to the body portion 1909 of the connector member 1904 and a second side impact protection area 1916a, 1916b extending

forward, away from the first side impact protection area 1914a, 1914b. As shown, the first side impact protection area 1914a, 1914b may be arranged substantially perpendicular to the body portion 1909. The second side impact protection area 1916a, 1916b extending from the first side impact protection area 1914a, 1914b may be arranged at a non-parallel angle relative to the first side impact protection area 1914a, 1914b. The angle between the first side impact protection area 1914a, 1914b and the second side impact protection area 1916a, 1916b may be greater than 90 degrees.

[0757] In addition, respective second head SIP devices 1920a, 1920b may be mounted to each side portion 1906, 1908 of the head SIP assembly 1902, such that the second head SIP devices 1920a, 1920b are proximate the front ends 1918a, 1918b of headrest side members 1940, 1942 when the head SIP assembly 1902 is mounted to the headrest 1901. The second head SIP devices 1920a, 1920b may have a configuration substantially identical to the SIP devices previously disclosed in FIGS. 16A-16E. An inwardly facing surface 1922a, 1922b of a respective second head SIP device 1920a, 1920b may be defined by a plurality of different areas arranged at different angles relative to the body portion 1909. In the illustrated, non-limiting embodiment, the surface 1922a, 1922b includes a first side impact protection area 1924a, 1924b oriented parallel to, or substantially parallel to, the body portion 1909 of the connector member 1904. A second side impact protection area 1926a, 1926b of the inwardly facing surface 1922a, 1922b extending from the first side impact protection area 1924a, 1924b may have a generally rounded or curved contour, such as a convex curvature for example. In an embodiment, a thickness of the head SIP devices 1920a, 1920b may gradually reduce from the first side impact protection area 1924a, 1924b toward a respective forward end 1918a, 1918b of the head SIP assembly 1902.

[0758] As shown, a clearance may exist between the first head SIP devices 1910a, 1910b and the second head SIP devices 1920a, 1920b at each side portion 1906, 1908. A combination of separate first and second head SIP devices 1910a, 1910b, 1920a, 1920b positioned near the front and rear of the connector member 1904 may be suitable to absorb energy during a crash, regardless of a direction that the child seat is mounted relative to a vehicle seat.

[0759] A first recess 1930a, 1930b (see FIGS. 20C and 20E) may be at least partially defined within a head receiving region 1928 of the headrest 1901 by the plurality of head SIP devices 1910a, 1910b, 1920a, 1920b. As shown, each first head SIP device 1910a, 1910b and each second head SIP device 1920a, 1920b has a respective inwardly facing surface 1912a, 1912b, 1922a, 1922b. The first recess 1930a, 1930b may be defined, in part, by a plane

extending from a respective line of intersection L8a, L8b of the first head SIP devices 1910a, 1910b, to a respective line of intersection L9a, L9b of the second head SIP devices 1920a, 1920b. The generally vertical lines of intersection L8a, L8b may be the portion of the head SIP device 1910a, 1910b positioned laterally closest to a central longitudinal axis CLA of a head receiving region 1928. Similarly, the generally vertical lines of intersection L9a, L9b may be the portion of the head SIP device 1920a, 1920b positioned laterally closest to a central longitudinal axis CLA of a head receiving region 1928.

[0760] The first recesses 1930a, 1930b may be further defined by the second side impact protection area 1916a, 1916b of the first head SIP devices 1910a, 1910b, the first side impact protection area 1924a, 1924b of the second head SIP devices 1920a, 1920b, and a surface of the side portion 1906, 1908 extending therebetween. In an embodiment, each of the second head SIP devices 1920a, 1920b may form a recess 1932a, 1932b within the head receiving region 1928 of the headrest 1901. The first side impact protection area 1924a, 1924b of the inwardly facing surface 1922a, 1922b of a respective second head SIP device devices 1920a, 1920b may abut the second side impact protection area 1926a, 1926b at a line of intersection represented by L9a and L9b, respectively.

[0761] Each recess 1932a, 1932b may extend from a corresponding line of intersection L9a, L9b toward a plane extending laterally from an inner edge of the front ends 1918a, 1918b of the headrest side members 1940, 1942. This plane extending from the line of intersection L9a, L9b toward the plane extending laterally from an inner edge of the front ends 1918a, 1918b, represented by lines 1939a, 1939b, may be parallel to the CLA. The recess 1932a, 1932b may further be defined by the second side impact protection area 1926a, 1926b, the plane extending laterally from an inner edge of the front ends 1918a, 1918b, and by at least one of a surface of the side portions 1906, 1908 and a surface of the headrest side members 1940, 1942 extending between the edge of a respective second side impact protection area 1926a, 1926b and a front end 1918a, 1918b.

[0762] Similar to the previous embodiment, in the non-limiting embodiment illustrated in FIGS. 21A-21E, each side portion 2006, 2008 of a connector member 2004 of the head SIP assembly 2002 is associated with a plurality of head SIP devices. As shown, the head SIP assembly 2002 includes a plurality of first head SIP devices 2010a, 2010b positioned proximate a relative rear of the connector member 2004, such as proximate interfaces between respective side portions 2006, 2008 and a body portion 2009. A plurality of second head SIP devices 2012a, 2012b may be positioned proximate a front of the connector member 2004, such as proximate ends 2014a, 2014b of the side portions 2006, 2008. In an embodiment, the first head

SIP devices 2010a, 2010b arranged proximate the rear of the connector member 2004 are interconnected with the second head SIP devices 2012a, 2012b arranged proximate respective front ends 2014a, 2014b of the connector member 2004. The first head SIP devices 2010a, 2010b may include configurations substantially similar to the head SIP device disclosed in FIGS. 15A-15E, 19A-19E, and 20A-20E.

[0763] For example, each first head SIP device 2010a, 2010b includes an inwardly facing surface 2013a, 2013b including a first side impact protection area 2016a, 2016b positioned closest to the body portion 2009 and a second side impact protection area 2018a, 2018b extending forward, away from the first area 2016a, 2016b. As shown, the first side impact protection area 2016a, 2016b may be arranged substantially perpendicular to the body portion 2009 of the connector member 2004. The second side impact protection area 2018a, 2018b extending from the first side impact protection area 2016a, 2016b may be arranged at a non-parallel angle relative to the first side impact protection area 2016a, 2016b. In an embodiment, the angle α between the first side impact protection area 2016a, 2016b and the second side impact protection area 2018a, 2018b is greater than 90 degrees.

[0764] The second head SIP devices 2012a, 2012b may have configurations substantially similar to the SIP device illustrated in described in FIGS. 13A-13E. However, as shown, the second SIP devices 2012a, 2012b may extend from the first head SIP devices 2010a, 2010b to or proximate to the front ends 2034a, 2034b of the headrest side members 2036, 2038. . Surfaces 2020a, 202b of the second head SIP devices 2012a, 2012b may include a plurality of different side impact protection areas arranged at different angles. First side impact protection areas 2022a, 2022b of a respective surface 2020a, 2020b of the second head SIP device 2012a, 2012b may be oriented substantially perpendicular to the body portion 2009. The first side impact protection area 2022a, 2022b of the second head SIP devices 2012a, 2012b may be laterally offset from a first side impact protection area 2016a, 2016b of the adjacent first head SIP devices 2010a, 2010b such that a lateral clearance D1 between the first side impact protection area 2022a, 2022b of aligned second head SIP devices 2012a, 2012b of the head SIP assembly 2002 is greater than a lateral clearance D2 between the first side impact protection area 2016a, 2016b of aligned first head SIP devices 2010a, 2010b of the head SIP assembly 2002. Respective second side impact protection areas 2024a, 2024b of the surfaces 2020a, 2020b of the second head SIP device 2012a, 2012b extend from the first side impact protection areas 2022a, 2022b toward the front of the headrest 2001. Further, the second side impact protection area 2024a, 2024b may have a smooth or curved contour, such as a convex curvature. In an embodiment, a thickness of the second SIP device 2012a, 2012b at the second

side impact protection area 2024a, 2024b gradually reduces toward the front end 2013a, 2013b of the connector member 2004.

[0765] It should be appreciated that the material or hardness of the first head SIP devices 2010a, 2010b may be the same or may be different than the hardness of the second head SIP devices 2012a, 2012b, regardless of whether the first head SIP device 2010a, 2010b and the second head SIP device 2012a, 2012b are separately located about a connector member 2004 or are interconnected.

[0766] A contoured recess 2030a, 2030b for controlling movement of an occupant's head during a side impact event (see FIGS. 21C and 21E) may be at least partially defined within a head receiving region 2028 of the headrest 2001 by the plurality of head SIP devices 2010a, 2010b, 2012a, 2012b. As shown, each first head SIP device 2010a, 2010b and each second head SIP device 2012a, 2012b has a respective inwardly facing surface 2013a, 2013b, 2020a, 2020b. The first recess 2030a, 2030b may be defined, in part, by a plane extending from a respective line of intersection L10a, L10b of the first head SIP devices 2010a, 2010b, to a respective line of intersection L11a, L11b of the second head SIP devices 2012a, 2012b. The generally vertical lines of intersection L10a, L10b, L11a, L11b may represent a portion of each head SIP device 2010a, 2010b, 2012a, 2012b positioned laterally closest to a central longitudinal axis CLA of the head receiving region 2028 of the headrest 2001. The first recesses 2030a, 2030b may be further defined by the second side impact protection area 2018a, 2018b of the first head SIP devices 2010a, 2010b, the first side impact protection area 2022a, 2022b of the second head SIP devices 2012a, 2012b, and a surface of the side portion 2006, 2008 extending therebetween.

[0767] Each of the second head SIP devices 2012a, 2012b may also form a recess 2032a, 2032b within the head receiving region 2028 of the headrest 1901. The first side impact protection area 2022a, 2022b of the inwardly facing surface 2020a, 2020b of a respective second head SIP device devices 2012a, 2012b may abut the second side impact protection area 2018a, 2018b at a line of intersection represented by L11a and L11b, respectively. Each recess 2032a, 2032b may be partially defined by a plane extending from a corresponding line of intersection L11a, L11b toward a plane extending laterally from an inner edge of the front ends 2034a, 2034b of the headrest side members 2036, 2038. This plane extending from the line of intersection L11a, L11b toward the plane extending laterally from the inner edge of the front ends 2034a, 2034b may be coplanar with the first side impact protection surface 2022a, 2022b of each respective second head SIP device 2012a, 2012b. The recess 2032a, 2032b may further be defined by the second side impact protection area 2024a, 2024b, the plane extending

laterally from the inner edge of the front ends 2034a, 2034b, and at least one of a surface of the side portions 2006, 2008 and a surface of the headrest side members 2036, 2038 extending between the edge of a respective second side impact protection area 2024a, 2024b and a front end 2034a, 2034b.

[0768] With reference now to FIGS. 22A-22E, another embodiment of a head SIP assembly 2102 having a first head SIP device 2104a, 2104b and a second head SIP device 2106a, 2106b arranged at respective side portions 2108, 2110 of a connector member 2111 is illustrated. The first head SIP devices 2104a, 2104b may have an inwardly facing surface 2112a, 2112b including a first side impact protection area 2114a, 2114b and a second side impact protection area 2116a, 2116b arranged at a non-parallel angle to one another. A generally vertical line of intersection L12a, L12b is arranged at the interface between the first and second side impact protection areas 2114a, 2114b, 2116a, 2116b, respectively. The line of intersection L12a, L12b may be the portion of the first head SIP device 2104a, 2104b positioned laterally closest to a central longitudinal axis CLA of a head receiving region. Further, a distance between the line of intersection L12a, L12b and the back portion 2138 of the headrest 2101 may be less than a distance between the line of intersection L12a, L12b and a front end 2130a, 2130b of the headrest side members 2132, 2134 measured along a line extending from a respective front end 2130a, 2130b and positioned tangent to the line L12a, L12b.

[0769] The second head SIP devices 2106a, 2106b have an inwardly facing surface 2118a, 2118b including a first side impact protection area 2120a, 2120b and a second side impact protection area 2122a, 2122b arranged at a non-parallel angle to one another. A generally vertical line of intersection L13a, L13b is arranged at the interface between the first and second side impact protection areas 2120a, 2120b, 2122a, 2122b, respectively. The line of intersection L13a, L13b may be the portion of the second head SIP device 2106a, 2106b positioned laterally closest to a central longitudinal axis CLA of a head receiving region 2126. Further, a distance between the line of intersection L13a, L13b and the back portion 2138 of the headrest 2101 may be greater than a distance between the line of intersection L13a, L13b and a front end 2130a, 2130b of the headrest side members 2132, 2134 measured along a line extending from a respective front end 2130a, 2130b and positioned tangent to the line L13a, L13b.

[0770] Similar to the previous embodiment, a first recess 2124a, 2124b (see FIGS. 21C and 21E) may be defined within a head receiving region 2126 of the headrest 2101 by the plurality of head SIP devices 2104a, 2104b, 2106a, 2106b. As shown, a side of the first recess

2124a, 2124b may be defined by a plane extending from a respective line of intersection L12a, L12b of the first head SIP devices 2104a, 2104b, to a respective line of intersection L13a, L13b of the second head SIP devices 2106a, 2106b. The first recesses 2124a, 2124b may be further defined by the second side impact protection area 2116a, 2116b of the first head SIP devices 2104a, 2104b, the first side impact protection area 2120a, 2120b of the second head SIP devices 2106a, 2106b, and a surface of the side portion 2106, 2108 extending therebetween.

[0771] In an embodiment, each of the second head SIP devices 2106a, 2106b may form a recess 2128a, 2128b within the head receiving region 2126 of the headrest 2101. Each recess 2128a, 2128b may have a side defined by a plane extending from a corresponding line of intersection L13a, L13b toward a plane extending laterally from an inner edge of the front ends 2130a, 2130b of the headrest side members 2132, 2134. This plane extending from the line of intersection L13a, L13b toward the plane extending laterally from the inner edge of the front ends 2130a, 2130b, represented by line 2150a, 2150b (see FIG. 22E), may be parallel to the central longitudinal axis CLA. The recess 2128a, 2128b may further be defined by the second side impact protection area 2122a, 2122ba, and the plane extending laterally from the inner edge of the front ends 2130a, 2130b of the headrest side members 2132, 2134. In embodiments where the end of the second head SIP devices 2106a, 2106b is offset from the front ends 2130a, 2130b of the headrest 2101, the second recesses 2128a, 2128b may also be defined by at least one of a surface of the side portions 2108, 2110 and a surface of the headrest side members 2132, 2134 extending between the edge of a respective second side impact protection area 2122a, 2122b and a front end 2130a, 2130b.

[0772] In the illustrated embodiment, the head SIP assembly 2102 includes a third head SIP device 2140a, 2140b arranged at a same side portion 2108, 2110 of a connector body 2112 as a first head SIP device 2104a, 2104b and a second head SIP device 2106a, 2106b. In such an embodiment, the third head SIP devices 2140a, 2140b may have a similar material or hardness, or alternatively, a different hardness or hardness than at least one of the first head SIP device 2104a, 2104b and the second head SIP device 2106a, 2106b. As shown, the third head SIP devices 2140a, 2140b may be positioned forward of at least one of the first and second head SIP devices 2104a, 2104b, 2106a, 2106b. In the non-limiting embodiment, the third head SIP device 2108a, 2108b is installed within the first recess 2124a, 2124b. A configuration of the third head SIP device 2140a, 2140b may be substantially equal to the contour of the first recess 2124a, 2124b such the respective first head SIP device 2104a, 2104b, the second head SIP device 2106a, 2106b, and the third head SIP device 2140a, 2140b, in combination, form a smooth, substantially continuous inwardly facing surface. Further, the third head SIP device

2140a, 2140b may be permanently or removably connected to the connector member 2111 or to the first and second head SIP devices 2104a, 2104b, 2106a, 2106b.

[0773] In yet another embodiment of a head SIP assembly 2202 mountable to a headrest 2201 of a child seat 2200 illustrated in FIGS. 23A-23E, each side portion 2206, 2208 of the connector member 2204 includes a first head SIP device 2210a, 2210b, a second head SIP device 2212a, 2212b, a third head SIP device 2214a, 2214b, and a fourth head SIP device 2216a, 2216b. The first head SIP device 2210a, 2210b may be arranged proximate a relative rear of the connector member 2204, such as at interfaces between the respective side portion 2206, 2208 and a body portion 2218. the third head SIP devices 2214a, 2214b may be arranged proximate, but offset from, a front end 2226a, 2226b of a headrest side member 2228, 2230. The first and third head SIP devices 2210a, 2210b, 2214a, 2214b may have any suitable configuration, such as similar to any of the head SIP devices of previous embodiments described herein. Further, the first and third head SIP devices 2210a, 2210b, 2214a, 2214b may include the same or different materials of the same or different hardnesses.

[0774] As shown, the first head SIP devices 2210a, 2210b may have an inwardly facing surface 2220a, 2220b including a respective first and second side impact protection areas arranged at a non-parallel angle to one another. A generally vertical line of intersection L14a, L14b is arranged at the interface between the first and second side impact protection areas, respectively. The line of intersection L14a, L14b may be the portion of the first head SIP device 2210a, 2210b positioned laterally closest to a central longitudinal axis CLA of a head receiving region 2222. Further, a distance between the line of intersection L14a, L14b and the back portion 2224 of the headrest 2201 may be less than a distance between the line of intersection L14a, L14b and a front end 2226a, 2226b of the headrest side members 2228, 2230b along a line extending from a respective front end 2226a, 2226b and positioned tangent to the line L14a, L14b.

[0775] The third head SIP devices 2214a, 2214b have an inwardly facing surface 2231a, 2231b including a first and second side impact protection area arranged at a non-parallel angle to one another. A generally vertical line of intersection L15a, L15b is arranged at the interface between the first and second side impact protection areas, respectively. The line of intersection L15a, L15b may be the portion of the second head SIP device 2214a, 2214b positioned laterally closest to a central longitudinal axis CLA of a head receiving region 2222. Further, a distance between the line of intersection L15a, L15b and the back portion 2224 of the headrest 2201 may be greater than a distance between the line of intersection L15a, L15b and a front end 2226a, 2226b of the headrest side members 2228, 2230 measured along a line

extending from a respective front end 2226a, 2226b and positioned tangent to the line L15a, L15b.

[0776] Similar to the previous embodiment, a first recess 2232a, 2232b (see FIGS. 23C and 23E) may be at least partially defined within a head receiving region 2222 of the headrest 2201 by the plurality of head SIP devices 2210a, 2210b, 2214a, 2214b. As shown, the first recess 2232a, 2232b may be partially defined by a plane extending from a respective line of intersection L14a, L14b of the first head SIP devices 2210a, 2210b, to a respective line of intersection L15a, L15b of the third head SIP devices 2214a, 2214b. The first recesses 2232a, 2232b may be further defined by the side impact protection areas of the respective head SIP devices 2210a, 2110b, 2214a, 2214b arranged therebetween and the corresponding surface of the side portion 2206, 2208.

[0777] Each of the third head SIP devices 2214a, 2214 may form a recess 2234a, 2234b within the head receiving region 2222 of the headrest 2201. Each recess 2234a, 2234b may extend from a corresponding line of intersection L15a, L15b toward a plane extending laterally from an inner edge of the front ends 2226a, 2226b of the headrest side members 2228, 2230. The side of the recess 2234a, 2234b formed by this plane extending from the line of intersection L15a, L15b toward the plane extending laterally from an inner edge of the front ends 2226a, 2226b, represented by line 2240a, 2240b, may be parallel to the central longitudinal axis CLA of the head receiving region 2222. The recess 2234a, 2234b may further be defined by part of the inwardly facing surface 2231a, 2231b, the plane extending laterally from an inner edge of the front ends 2226a, 2226b of the headrest side members 2228, 2230, and by at least one of a surface of the side portions 2206, 2208 and a surface of the headrest side members 2228, 2230 extending between an edge of third head SIP devices 2214a, 2214 and a front end 2130a, 2130b.

[0778] The second head SIP devices 2212a, 2212b may be positioned between the first and third head SIP devices 2210a, 2210b, 2214a, 2214b, such as within the first recesses 2232a, 2232b, respectively. Accordingly, a contour of the second head SIP devices 2212a, 2212b may but need not match the contour of the first recesses 2232a, 2232b. The fourth head SIP devices 2216a, 2216b may be positioned between the third head SIP devices 2214a, 2214b and the front ends 2226a, 2226b of the headrest side members 2228, 2230. In an embodiment, the fourth head SIP devices 2216a, 2216b are located within a respective recess 2234a, 2234b. A contour of the fourth head SIP devices 2216a, 2216b may but need not match the contour of the recesses 2234a, 2234b. The second and fourth head SIP devices 2212a, 2212b, 2216a, 2216b may have any suitable configuration. Further, the second and fourth head SIP devices 2212a, 2212b, 2216a, 2216b may include the same or different materials of the same or different hardnesses.

It should be appreciated that the second and fourth head SIP devices may be removably mounted to the headrest, and that in some embodiments neither the second nor the fourth head SIP device or only one of the second head SIP device and the fourth head SIP Device may be connected to the connector member.

[0779] In an embodiment, the second head SIP devices 2212a, 2212b may be connected to the respective first head SIP devices 2210a, 2210b, and a hardness of the second head SIP devices 2212a, 2212b may be less than a hardness of the first head SIP devices 2210a, 2210b. Alternatively, or in addition, the fourth head SIP devices 2216a, 2216b may be connected to the third head SIP devices 2214a, 2214b, and a hardness of the fourth head SIP devices 2216a, 2216b may be less than a hardness of the third head SIP device 2214a, 2214b. It should be appreciated that any head SIP devices, or combination of head SIP devices described herein with respect to a head SIP assembly may alternatively be mounted directly to the headrest absent a connector member.

[0780] With reference now to FIGS. 132A-133C, another embodiment of a head SIP assembly 11800 is illustrated. As shown, the head SIP assembly 11800 includes a connector member 11802 having a central body portion 11804, a first side portion 11806 extending from a first side of the body portion 11804, and a second side portion 11808 extending from a second opposite side of the body portion 11804. A first head SIP device 11810a may be arranged at or adjacent to the first side portion 11806 of the connector member 11802 and a second head SIP device 11810b may be arranged at or adjacent to the second side portion 11808 of the connector member 11802. In the illustrated, non-limiting embodiment, the head SIP devices 11810a, 11810b are mounted near a rear of the head SIP assembly 11800, such as at an interface between the body portion 11804 and the respective side portions 11806, 11808 of the connector member 11802 for example.

[0781] In an embodiment, a cutout or notch is formed at the bottom of the head SIP assembly 11800. As shown, a first cutout 11817a is formed directly underneath the first head SIP device 11810a, and a second cutout 11817b is formed directly underneath the second head SIP device 11810b. The cutouts 11817a, 11817b may form part of a vehicle belt path when the child seat system is in a forward-facing configuration, such as in a booster mode of operation. Accordingly, a bottom 11821a, 11821b of the first head SIP device 11810a and the second head SIP device 11810b may define a portion of the vehicle belt path.

[0782] As shown in FIGS. 133A-133C, the head SIP assembly 11800 may be removably or permanently connectable to the structural shell 11820 of a headrest. The headrest shell 11820 may include a shell back portion 11822 and at least one headrest shell side member,

such as a first headrest shell side member 11824 and a second headrest shell side member 11826 disposed at opposite sides of the back portion 11822 and extending toward a front of the headrest shell 11820. The head SIP assembly 11800 is positionable directly adjacent to the inner surface of the shell 11820 of the headrest. For example, the body portion 11804 of the connector member 11802 is positionable adjacent to a back portion 11822 of the headrest shell 11820, the first side portion 11806 of the connector member 11802 and the first head SIP device 11810a may be positionable adjacent to a first headrest shell side member 11824 of the headrest shell 11820 (the first side portion 11806 being in direct contact with the first headrest shell side member 11824), and the second side portion 11808 of the connector member 11802 and the second head SIP device 11810b may be positionable adjacent to a second headrest shell side member 11826 (the second side portion 11808 being in direct contact with the second headrest shell side member 11826). At least a portion of the back or outer surface 11816 of the head SIP assembly 11800 may have a contour complementary to a contour of the inner surface of the back portion 11822 and the headrest shell side members 11824, 11826 to facilitate engagement therebetween.

[0783] The headrest shell 11820 may include or be formed from a first material having a first hardness and the connector member 11802 may be formed from a second material having a second hardness. In an embodiment, the hardness of the second material is less than the hardness of the first material. In the illustrated, non-limiting embodiment, the side portions 11806, 11808 of the connector member 11802 are elongated such that a distal ends 11812a, 11812b of each side portion 11806, 11808 extend beyond respective front ends 11828a, 11828b of corresponding headrest shell side members 11824, 11826 of the headrest shell 11820. Accordingly, the distal ends 11812a, 11812b of each side portion 11806, 11808 may define a front or forward-facing extent of the headrest.

[0784] The connector member 11802 includes one or more reinforcing regions11814a, 11814b. These reinforcing regions 11814a, 11814b may be arranged at portions of the connector member 11802 positioned near the front ends 11828a, 11828b of the headrest shell side members 11824, 11826, such as near the distal ends 11812a, 11812b of each side portion 11806, 11808 for example. As shown, the reinforcing regions 11814a, 11814b may have an increased thickness compared to an adjacent portion of the connector member 11802. This increased thickness may increase the rigidity of the connector member 11802, thereby strengthening the portion of the connector member 11802 that extends beyond the headrest shell 11820. Further, in an embodiment, the reinforcing regions 11814a, 11814b may be contoured to define one or more features configured to abut or engage the headrest shell 11820

to properly position the head SIP assembly 11800 relative thereto. Although the reinforcing regions 11814a and 11814b are illustrated as being arranged at the outer surface of the connector member 11802, embodiments where the reinforcing regions are formed at an inner surface thereof are also contemplated herein.

[0785] Each head SIP device 11810a, 11810b may extend over only a portion of a length of each side portion 11806, 11808. As shown, the head SIP devices 11810a, 11810b may extend to a center of a side portions 11806, 11808. In the illustrated, non-limiting embodiment, at least one head SIP device 11810a, 11810b extends over about half of the length of a respective side portions 11806, 11808. However, embodiments where the at least one head SIP device 11810a, 11810b is longer or shorter are also contemplated herein.

[0786] Similar to the previously disclosed embodiments, each head SIP device 11810a, 11810b includes an inwardly facing surface 11818a, 11818b having a first side impact protection area 11830a, 11830b positioned closest to the body portion 11804, as well as a second side impact protection areas 11832a, 11832b extending forward, away from the first side impact protection areas 11830a, 11830b. As shown, the first side impact protection areas 11830a, 11830b may be arranged at an angle to the body portion 11804 of the connector member 11802. The second side impact protection areas 11832a, 11832b may be arranged at a non-parallel angle relative to respective first side impact protection areas 11830a, 11830b.

[0787] In the illustrated, non-limiting embodiment, the head SIP device 11810a forms a first recess 11834a within the head receiving region 11829 of the structural shell 11820, and the head SIP device 11810b forms a second recess 11834b within the head receiving region 11829. The first side impact protection areas 11830a, 11830b may abut respective second side impact protection areas 11832a, 11832b of each head SIP device 11810a, 11810b at a generally vertical line of intersection represented by L16a and L16b (FIG. 133C), respectively. The lines of intersection L16a, L16b may be disposed at the portions of the head SIP device 11810a, 11810b positioned laterally closest to a central longitudinal axis CLA of a head receiving region.

[0788] The first recess 11834a is partially defined by the second side impact protection area 11832a and a plane extending laterally from an inner edge of the front ends 11812a, 11812b of the side portions 11806, 11808 of the connector member 11802. A surface of the first side portion 11806 extending between the edge of a respective second side impact protection area 11832a and the front end 11812a may also partly define the first recess 11834a. The recess 11834a is further defined by a plane extending from the line of intersection L16a to the plane extending laterally from an inner edge of the front ends 11812a, 11812b of the side

portions 11806, 11808. This plane is represented in FIG. 133C by line P16a. This plane of the recess 11834a, extending from the line of intersection L16a toward the plane extending laterally from an inner edge of the front end 11182a may but need not be coplanar with the first side impact protection area 11830a of the head SIP device 11810a.

[0789] Similarly, the second recess 11834b extends from the line of intersection L16b toward the plane extending laterally from an inner edge of the front end 11812a, 11812b of the side portions 11806, 11808. The plane of the recess 11834b extending from the line of intersection L16b toward the plane extending laterally from an inner edge of the front ends 11812b, represented by line P16b, may but need not be coplanar with the first side impact protection area 11830b of the head SIP device 11810b. The recess 11834b may further be defined by the plane extending laterally from an inner edge of the front ends 11812a, 11812b, the second side impact protection area 11832b, and by a surface of the second side portion 11808 extending between the edge of a respective second side impact protection area 11832b and the front end 11812b.

[0790] With further reference to FIG. 133C, a vertical plane, represented by axis X16a extends from the front end 11812a of the first side portion 11806 and is positioned tangent to the inwardly facing surface of the head SIP device 11810a at the line of intersection L16a. Further, the plane X16a may intersect the body portion 11804 of the connector member 11802 at an intersection location I16a. Another vertical plane, represented by axis X16b extends from the front end 11812b of the second side portion 11808 and is positioned tangent to the inwardly facing surface of the head SIP device 11810b at the line of intersection L16b. The plane X16b may intersect the body portion 11804 of the connector member 11802 at an intersection location I16b. In an embodiment a distances between the intersection locations I16a, I16b and the respective lines of intersection L16a, L16b, are less than the distances between the lines of intersection L16a, L16b and the respective front ends 11812a, 11812b of side portions 11806, 11808 measured along axes X16a, X16b.

[0791] With to FIGS. 132A-133C, in an embodiment, an upper transition 11819a, 11819b and/or a lower transition 11821a, 11821b may extend between the inwardly facing surfaces 11818a, 11818b and the adjacent surface of the connector member 11802. However, it should be understood that in embodiments where a head SIP device 11810a, 11810b is mounted directly to the headrest, the upper transition 11819a, 11819b and/or the lower transition 11821a, 11821b may extend between the inwardly facing surfaces 11818a, 11818b and the inner surface of the headrest. The upper transition and/or the lower transition may be shaped or contoured such as to create a smooth profile. Further, head SIP devices 11810a,

11810b may but need not extend over an entire height of the SIP assembly 11800 and/or the headrest 11820. For example, the head SIP devices 11810a, 11810b, such as the upper transition 11819a, 11819b thereof, may extend to a top of the SIP assembly 11800 and/or the headrest 11820 and/or the head SIP devices 11810a, 11810b, such as the lower transition 11821a, 11821b thereof, may extend to a bottom of the SIP assembly 11800 and/or the headrest 11820.

[0792] With reference now to FIGS. 134A-134D, another embodiment of a headrest 11900 including at least one head SIP device is illustrated. As shown, the headrest 11900 a back portion 11902, a first headrest side member 11904, and a second headrest side member 11906. The back portion 11902, first headrest side member 11904, and second headrest side member 11906 in combination define a head receiving region 11908 of the headrest 11900. A first head SIP device 11910a may be arranged at or adjacent to the first headrest side member 11904 and a second head SIP device 11910b may be arranged at or adjacent to the second headrest side member 11906. In the illustrated, non-limiting embodiment, the head SIP devices 11910a, 11910b are mounted near the rear of the headrest 11900, such as at an interface between the back portion 11902 and the respective headrest side members 11904, 11906 for example.

[0793] Each head SIP device 11910a, 11910b includes an inwardly facing surface 11912a, 11912b. In an embodiment, as shown, the inwardly facing surfaces 11912a, 11912b may each include a single side impact protection area. As shown, a first end 11916a, 11916b of the inwardly facing surfaces 11912a, 11912b positioned closest to the back portion 11902 may be arranged at a non-parallel angle relative thereto. The inwardly facing surfaces 11912a, 11912b may also extend at a non-parallel angle to a vertical axis. A plane of the inwardly facing surfaces 11912a, 11912b may be skewed relative to a vertical axis such that the bottom ends 11918a, 11918b of the inwardly facing surfaces 11912a, 11912b located closest to the bottom of the headrest 11900 may be positioned closer to a central longitudinal axis CLA of the head receiving region 11908 of the headrest 11900 than the ends 11920a, 11920b of the inwardly facing surface 11912a, 11912b located closest to a top of the headrest 11900.

[0794] Alternatively, or in addition, a length of the inwardly facing surface 11912a, 11912b measured parallel to the CLA may vary over a height of the inwardly facing surface 11912a, 11912b. As shown, a forward edge 11922a, 11922b of the inwardly facing surface 11912a, 11912b may be defined by a tip-over line T1. In the illustrated, non-limiting embodiment, the tip-over line T1 is arranged at an angle relative to the back portion 11902 of the headrest. For example, the tip-over line T1 may have a forward-facing configuration.

Accordingly, the length of the inwardly facing surface 11912a, 11912b extending between the back portion 11902 of the headrest and the tip-over line T1 near a top of the forward edge 11922a, 11922b of the inwardly facing surface 11912a, 11912b, illustrated by LI1, is greater than a length of the inwardly facing surface 11912a, 11912b extending between the back portion 11902 of the headrest and the tip-over line T1 near a bottom of the forward edge 11922a, 11922b of the inwardly facing surface 11912a, 11912b, represented by LI2. The length LI1 may be between about 90mm and about 140mm, such as about 95mm, about 100mm, about 110mm, or about 130mm for example. The length LI2 may be between about 40 and about 90mm, such as about 50mm, about 60mm, about 70mm, about 80mm, and about 85mm for example. It should be appreciated that the ranges of LI1 and LI2 are intended as an example only and that other suitable values outside of the provided ranges are contemplated herein.

[0795] Each of the head SIP devices 11910a, 11910b may have a base surface 11914a, 11914b facing or integral with a corresponding portion of the headrest 11900. In an embodiment, the base surfaces 11914a, 11914b of the head SIP devices 11910a, 11910b, such as the surfaces near respective forward ends of the head SIP devices 11910a, 11910b for example, extend away from corresponding surfaces of the adjacent headrest side members 11904, 11906. Such a contour forms a gap or pocket between the base surfaces 11914a, 11914b near a front of each head SIP device 11910a, 11910b and a respective front end 11922a, 11922b of the headrest 11900. Inclusion of these pockets may improve the impact on an occupant's head during a crash event by facilitating a roll thereof.

[0796] With reference to FIGS. 135A-135C, another embodiment of a headrest 11950 is illustrated. As shown, the headrest 11950 includes a back portion 11952 having a headrest support surface (not shown), a first headrest side member 11954 and a second headrest side member 11956. A head SIP assembly 11960 is positionable about the headrest 11950 and includes a connector member 11962 having a central body portion 11964, a first side portion 11966 extending from a first side of the body portion 11964, and a second side portion 11968 extending from a second opposite side of the body portion 11964. A first head SIP device 11970a may be arranged at or adjacent to the first side portion 11966 of the connector member 11962 and a second head SIP device 11970b may be arranged at or adjacent to the second side portion 11968 of the connector member 11962. In the illustrated, non-limiting embodiment, the head SIP devices 11970a, 11970b are mounted near a rear of the head SIP assembly 11960, such as at an interface between the body portion 11964 and the respective side portions 11966, 11968 of the connector member 11962 for example.

[0797] Each head SIP device 11970a, 11970b may extend over only a portion of a length of each side portion 11966, 11968. As shown, the head SIP devices 11970a, 11970b may extend generally to a center of a side portions 11966, 11968. In the illustrated, non-limiting embodiment, at least one head SIP device 11970a, 11970b extends less than half of the length of a respective side portion 11966, 11968. However, embodiments where the at least one head SIP device 11970a, 11970b is longer or shorter are also contemplated herein.

[0798] Similar to the previously disclosed embodiments, each head SIP device 11970a, 11970b includes an inwardly facing surface 11972a, 11972b having a first side impact protection area 11974a, 11974b positioned closest to the body portion 11964, as well as a second side impact protection areas 11976a, 11976b extending forward, away from the first side impact protection areas 11974a, 11974b. As shown, the first side impact protection areas 11974a, 11974b may be arranged at a non-parallel angle relative to the body portion 11964 of the connector member 11962. The second side impact protection areas 11976a, 11976b may also be arranged at a non-parallel angle relative to respective first side impact protection areas 11974a, 11974b.

[0799] In the illustrated, non-limiting embodiment, the head SIP device 11970a forms a first recess 11980a (see FIG. 135C) within the head receiving region 11961 of the head SIP assembly 11960, and the head SIP device 11970b forms a second recess 11980b within the head receiving region 11961. The first side impact protection areas 11974a, 11974b may abut respective second side impact protection areas 11976a, 11976b of each head SIP device 11970a, 11970b at a generally vertical line of intersection represented by L17a and L17b (see FIG. 135B and 135C), respectively. The lines of intersection L17a, L17b may be disposed at the portions of the head SIP device 11970a, 11970b positioned laterally closest to a central longitudinal axis CLA of a head receiving region 11961.

[0800] The first recess 11980a is partially defined by the second side impact protection area 11976a and a plane extending laterally from an inner edge of the front ends 11982a, 11982b of the side portions 11966, 11968 of the connector member 11962. A surface of the first side portion 11966 extending between the second side impact protection area 11976a and the front end 11982a may also partly define the first recess 11980a. The recess 11980a is further defined by a plane extending from the line of intersection L17a to the plane extending laterally from an inner edge of the front ends 11982a, 11982b of the side portions 11966, 11968. This plane is represented in FIG. 135C by line P17a. This plane P17a of the recess 11980a, extending from the line of intersection L17a toward the plane extending laterally from an inner edge of

the front end 11982a may but need not be coplanar with the first side impact protection area 11974a of the head SIP device 11970a.

[0801] Similarly, the second recess 11980b extends from the line of intersection L17b toward the plane extending laterally from an inner edge of the front end 11982a, 11982b of the side portions 11966, 11968. The plane of the recess 11980b extending from the line of intersection L17b toward the plane extending laterally from an inner edge of the front ends 11982a, 11982b, represented by line P17b, may but need not be coplanar with the first side impact protection area 11974a of the head SIP device 11970b. The recess 11980b may further be defined by the plane extending laterally from an inner edge of the front ends 11982a, 11982b, the second side impact protection area 11976b, and by a surface of the second side portion 11968 extending between the second side impact protection area 11976b and the front end 11982b.

[0802] With further reference to FIG. 135C, a vertical plane, represented by axis X17a extends from the front end 11982a of the first side portion 11966 and is positioned tangent to the inwardly facing surface 11972a of the head SIP device 11970a at the line of intersection L17a. Further, the plane X17a may intersect the body portion 11964 of the connector member 11962 at an intersection location I17a. Another vertical plane, represented by axis X17b extends from the front end 11982b of the second side portion 11968 and is positioned tangent to the inwardly facing surface 11972b of the head SIP device 11970b at the line of intersection L17b. The plane X17b may intersect the body portion 11964 of the connector member 11962 at an intersection location I17b. In an embodiment a distances between the intersection locations I17a, I17b and the respective lines of intersection L17a, L17b, are less than the distances between the lines of intersection L17a, L17b and the respective front ends 11982a, 11982b of a side portions 11966, 11968 measured along axes X17a, X17b.

[0803] With continued reference to FIGS. 135A-135C, in an embodiment, a clearance between the first side portion 11966 and the second side portion 11968 varies over a height of the head SIP assembly. For example, a clearance formed between the top of the first side portion 11966 and the second side portion 11968 of the head SIP assembly may be greater than a clearance formed between the first side portion 11966 and the second side portion 11968 near a bottom of the head SIP assembly. Inclusion of such a taper over a height of the head SIP assembly 11960 may control the roll of an occupant's head during a crash event.

[0804] Another embodiment, of a headrest 17300 is illustrated in FIGS. 242A-242C. As shown, the headrest 17300 includes a structural shell 17320 and an inner member 17302 The inner member 17302 has a central body portion 17304, a first side portion 17306 extending

from a first side of the central body portion 17304, and a second side portion 17308 extending from a second opposite side of the central body portion 17304. In an embodiment, the central body portion 17304 forms a back portion of the inner member 17302. The central body portion 17304, first side portion 17306 and second side portion 17308 may define a head receiving region 17328 of the headrest 17300.

[0805] The inner member 17302 may be permanently or removably mounted to the structural shell 17320 of a headrest 17300. The headrest shell 17320 may include a shell back portion 17322 and at least one headrest shell side member, such as a first headrest shell side member 17324 and a second headrest shell side member 17326 disposed at opposite sides of the back portion 17322 and extending toward a front of the headrest shell 17320. The inner member 17302 is positionable directly adjacent to an inner surface of the headrest shell 17320 of the headrest 17300. For example, the central body portion 17304 of the inner member 17302 is positionable adjacent to the back portion 17322 of the headrest shell 17320, the first side portion 17306 of the inner member 17302 and the first head SIP device 17310a may be positionable adjacent to the first headrest shell side member 17324 of the headrest shell 17320 (the first side portion 17306 being in direct contact with the first headrest shell side member 17324), and the second side portion 17308 of the inner member 17302 and the second head SIP device 17310b may be positionable adjacent to the second headrest shell side member 17326 (the second side portion 17308 being in direct contact with the second headrest shell side member 17326). At least a portion of the back or outer surface 17316 of the inner member 17302 may have a contour complementary to a contour of the inner surface of the back portion 17322 and the headrest shell side members 17324, 17326 to facilitate engagement therebetween.

[0806] The headrest 17300 includes at least one head SIP device 17310a, 17310b, such as arranged at the inner member 17302 for example. In the illustrated, non-limiting embodiment, a first head SIP device 17310a is arranged at or adjacent to the first side portion 17306 of the inner member 17302 and a second head SIP device 17310b may be arranged at or adjacent to the second side portion 17308 of the inner member 17302. The head SIP devices 17310a, 17310b may be mounted near a rear of the inner member 17302, such as at an interface between the central body portion 17304 and the respective side portions 17306, 17308 of the inner member 17302 for example. In an embodiment, the first and second head SIP devices 17310a, 17310b are integrally formed with the inner member 17302. In such embodiments, the inner member 17302 and the head SIP devices 17310a, 17310b, in combination, may be considered a head SIP assembly 17301.

[0807] As described in previous embodiments, the headrest shell 17320 may include or may be formed from a first material having a first hardness and/or stiffness and the inner member 17302 may be formed from a second material having a second hardness and/or stiffness less than the first hardness and/or stiffness. In the illustrated, non-limiting embodiment, the side portions 17306, 17308 of the inner member 17302 are elongated such that a distal end 17312a, 17312b of each side portion 17306, 17308 extends beyond respective front ends 17328a, 17328b of corresponding headrest shell side members 17324, 17326 of the headrest shell 17320. Accordingly, the distal ends 17312a, 17312b of each side portion 17306, 17308 may define a front or forward-facing extent of the headrest 17300. Each head SIP device 17310a, 17310b may extend over an entire length, or over only a portion of a length of each side portion 17306, 17308. In the illustrated, non-limiting embodiment, at least one head SIP device 17310a, 17310b extends over about half of the length of a respective side portions 17306, 17308. However, embodiments where the at least one head SIP device 17310a, 17310b is longer or shorter are also contemplated herein.

[0808] Similar to the previously disclosed embodiments, each head SIP device 17310a, 17310b includes an inwardly facing surface 17318a, 17318b having a first side impact protection area 17330a, 17330b positioned closest to the body portion 17304, as well as a second side impact protection area 17332a, 17332b extending forward, away from the first side impact protection area 17330a, 17330b. As shown, the first side impact protection areas 17330a, 17330b may be arranged at an angle to the body portion 17304 of the inner member 17302. The second side impact protection areas 17332a, 17332b may be arranged at a non-parallel angle relative to respective first side impact protection areas 17330a, 17330b. The first and second head SIP devices 17310a, 17310b may define respective recesses (not shown) within the head receiving region 17328 of the inner member 17302 as previously described herein.

[0809] In the illustrated, non-limiting embodiment, the headrest 17300 additionally includes a back head SIP device 17340, also referred to herein as a headrest support member. As shown, the back head SIP device 17340 may be located in direct contact with the central body portion 17304 of the inner member 17302, such as between the first head SIP device 17310a and the second head SIP device 17310b. In an embodiment, the back head SIP device 17340 is positioned between the respective first side impact protection areas 17330a, 17330bof the first and second head SIP devices 17310a, 17310b. A gap may be formed between a portion of the back head SIP device 17340 and an adjacent head SIP device 17310a, 17310b. Alternatively, the back head SIP device 17340 may directly contact one or both of the first and

second head SIP devices 17310a, 17310b over at least a portion, and in some embodiments, an entire side thereof. Although the back head SIP device 17340 is illustrated in the FIGS. as a separate component affixed to the inner member 17302, it should be appreciated that in other embodiments, the back head SIP device 17340 may be integrally formed with the inner member 17302 and/or the head SIP devices 17310a, 17310b, such as by varying a thickness of the inner member. Alternatively, in other embodiments, the back head SIP device 17340 may be integrated into the soft goods (not shown) positionable in overlapping arrangement with the inner member 17302. In embodiments, where the back head SIP device 17340 is integrally formed with the inner member 17302, the back head SIP device 17340 and the inner member 17302 may be formed from the same material. However, in other embodiments, the inner member 17302 and the back head SIP device 17340 may be made from different materials. For example, the inner member 17302 may be formed from a material have a greater hardness than the material of the back head SIP device 17340. In an embodiment, the inner member 17302 is formed form an expanded polypropylene and the back head SIP device 17340 is formed from a foam material.

[0810] The back head SIP device 17340 may but need not have a shape complementary to the adjacent side portions 17306, 17308 and/or head SIP devices 17310a, 17310b of the inner member 17302. Although a rectangular back head SIP device 17340 is illustrated, it should be appreciated that a back head SIP device 17340 with another contour, such as tapered or angled sides proximate the first and second head SIP devices 17310a, 17310b for example, are also contemplated herein. The back head SIP device 17340 may, but need not have a uniform thickness, measured parallel to the central longitudinal axis CLA of the headrest 17300. In the illustrated, non-limiting embodiment, the thickness of the back head SIP device 17340 is less than the thickness of the first side impact protection areas 17330a, 17330b measured parallel to the CLA. Inclusion of the back head SIP device 17340 positions an occupant's head further forward along the CLA than if the back head SIP device 17340 were not included. As a result, the back head SIP device 17340 may facilitate a forward roll of an occupant's head during a side impact event.

[0811] With reference now to FIGS. 243A-243B, a headrest 17400 according to another embodiment is illustrated. Similar to the previous embodiments of FIGS. 132A-135C, the headrest 17400 may include an inner member 17402 including having a central body portion 17404, a first side portion 17406 extending from a first side of the central body portion 17404, and a second side portion 17408 extending from a second opposite side of the central

body portion 17404. The central body portion 17404, a first side portion 17406, and second side portion 17408 may define a head receiving region 17407 of the inner member 17402.

[0812] The inner member 17402 may be removably connectable or may be permanently connectable to the structural shell 17410 of the headrest 17400. As in previous embodiments, the headrest shell 17410 may include a shell back portion 17412 and at least one headrest shell side member, such as a first headrest shell side member 17414 and a second headrest shell side member 17416 disposed at opposite sides of the back portion 17412 and extending toward a front of the headrest shell 17410. The inner member 17402 is positionable directly adjacent to an inner surface of the shell 17410 of the headrest 17400. For example, the central body portion 17404 of the inner member 17402 is positionable adjacent to the back portion 17412 of the headrest shell 17410, the first side portion 17406 of the inner member 17402 may be positionable adjacent to the first headrest shell side member 17414 of the headrest shell 17410 (the first side portion 17406 being in direct contact with the first headrest shell side member 17414), and the second side portion 17408 of the inner member 17402 may be positionable adjacent to the second headrest shell side member 17416 (the second side portion 17408 being in direct contact with the second headrest shell side member 17416). At least a portion of the outer surface 17417 of the inner member 17402 may have a contour complementary to a contour of the inner surface of the back portion 17412 and the headrest shell side members 17414, 17416 to facilitate engagement therebetween.

[0813] The inner member 17402 may be an assembly including a plurality of components. In an embodiment, the inner member 14702 includes a connector member 17420 having a central body 17422, a first side 17424 extending from a first side of the central body 17422, and a second side 17426 extending from a second opposite side of the central body 17422. The central body 17422 of the connector member 17420 may form the central body portion 17404 of the inner member 17402, the first side 17424 of the connector member 17420 may form part of the first side portion 17406 of the inner member 17402, and the second side 17426 of the connector member 17420 may form part of the second side portion 17408 of the inner member 17402.

[0814] As described in previous embodiments, the headrest shell 17410 may include or may be formed from a first material having a first hardness or stiffness and the connector member 17420 may be formed from a second material having a second hardness or stiffness less than the first hardness or stiffness. In the illustrated, non-limiting embodiment, the sides 17424, 17426 of the connector member 17420 are shortened such that the front ends 17418a,

17418b of the headrest shell side members 17414, 17126 extend beyond the distal end 17412a, 17412b of each respective side 17424, 17426 of the connector member 17420.

[0815] A first head SIP device 17430a may be arranged at or adjacent to the first side 17424 of the connector member 17420 and another first head SIP device 17430b may be arranged at or adjacent to the second side portion 17426 of the connector member 17420. In the illustrated, non-limiting embodiment, the first head SIP devices 17430a, 17430b are mounted near a rear of the connector member 17420, such as at an interface between the body portion 17422 and the respective sides 17424, 17426 of the connector member 17420 for example. Each first head SIP device 17430a, 17430b includes an inwardly facing surface 17432a, 17432b having a first side impact protection area 17434a, 17434b positioned closest to the body portion 17322, as well as a second side impact protection area 17436a, 17436b extending forward, away from the first side impact protection area 17434a, 17434b. As shown, the first side impact protection areas 17434a, 17434b may be arranged at an angle to the central body portion 17422 of the connector member 17420. The second side impact protection areas 17436a, 17436b may be arranged at a non-parallel angle relative to respective first side impact protection areas 17434a, 17434b.

[0816] The first side impact protection areas 17434a, 17434b may abut respective second side impact protection areas 17436a, 17436b of each head SIP device 17430a, 17430b at a generally vertical line of intersection represented by L18a and L18b, respectively. The lines of intersection L18a and L18b may be disposed at the portions of the head SIP device 17430a, 17430b positioned laterally closest to a central longitudinal axis CLA of a head receiving region 17407.

[0817] The first head SIP devices 17430a, 17430b may define respective recesses (not shown) within a head receiving region 17407 of the inner member 17402. Each of these recesses may be partially defined by the second side impact protection area 17436a, 17436b, by a plane extending laterally from an inner edge of the front ends 17418a, 17418b of the headrest shell side portions 17414, 17416, and by a plane extending from the line of intersection L18a, L18b to the plane extending laterally from an inner edge of the front ends 17418a, 17418b of the headrest shell side portions 17414, 17416.

[0818] The inner member 17402 additionally includes at least one second component, such as a secondary side member. As shown, a secondary side member 17450a, such as an outer surface 17454a thereof, may be positioned in direct contact with the first headrest shell side member 17414. The secondary side member 17450a may extend from the front end 17428a of the adjacent first side 17242 of the connector member 14720 and/or the first head SIP device

17430a to the front end 17418a of the first headrest shell side member 17414. Similarly, another secondary side member 17450b, such as an outer surface 17454b thereof, may be positioned in direct contact with the second headrest shell side member 17416 at a position between the front end 17418b of the second headrest shell side member 17416 and the front end 17428b of the adjacent second side 17244 of the connector member 17420 and/or the adjacent first head SIP device 17430b. In an embodiment, a shape of each secondary side member 17450a, 17450b is complementary to a shape of the first and second headrest shell side members 17414, 17416, respectively, forward of the sides 17424, 17426 of the connector member 17420. Accordingly, the connector member 17420 and the secondary side members 17450a, 17450b, in combination, may overlap an entirety of the inner surface of the headrest shell 17410 defined by the back portion 17412 and the headrest shell side members 17414, 17416.

[0819] The inner member 17402 of the headrest 17400 may additionally include at least one third component, such as another head SIP device. In an embodiment, one head SIP device 17452a is arranged proximate the first side portion 17406 of the inner member 17402, and another head SIP device 17452b is arranged proximate the second side portion 17408 of the inner member 17402. Each secondary side member 17450a, 17450b of the inner member 17402 has a generally planar inward surface 17456a, 17456b facing toward the head receiving region 17407. In an embodiment, the head SIP devices 17452a, 17452b are positioned in overlapping arrangement with the inward facing surface 17456a, 17456b of a respective secondary side member 17450a, 17450b. For example, the head SIP device 17452a may be positioned near the first side 17424 of the connector member 17420, in contact with the inward surface 17456a of secondary side member 17450a and the head SIP device 17452b may be positioned near the second side 17426 of the connector member 17420, in contact with the inward surface 17456b of secondary side member 17450b. A size and shape of each head SIP device 17452a, 17452b may be complementary to the size and/or shape of the corresponding secondary side member 17450a, 17450b to which the head SIP device 17452a, 17452b is mounted. Accordingly, a distal end 17412a, 17412b of each headrest shell side member 17414, 17416, in combination within a distal end 17460a, 17460b of each secondary side member 17450a, 17450b and a distal end 17462a, 17462b of each head SIP device 17452a, 17452b may define a front or forward-facing extent of the headrest 17400. However, embodiments where the side portions 17406, 17408 of the inner member 17402 extend beyond the ends 17418a, 17418b of the headrest shell 17420 are also contemplated herein.

[0820] In an embodiment, an end 17458a, 17458b of each head SIP device 17452a, 17452b is configured to abut the second side impact protection areas 17436a, 17436b of a

respective first head SIP device 17430a, 17430b. In embodiments where the second side impact protection areas 17436a, 17436b are angled relative to the CLA, the ends 17458a, 17458b of the head SIP devices 17452a, 17452b may have a complementary angled surface to maintain contact with the second side impact protection areas 17436a, 17436b over the entire surface of the end 17458a, 17458b. A thickness of each head SIP devices 17452a, 17452b measured perpendicular to the headrest shell side member 17414, 17416 may be less than the thickness of the first head SIP device 17430a, 17430b at the interface formed between a respective first side impact protection area 17434a, 17434b and a second side impact protection area 17436a, 17436b. Further, the thickness of the head SIP device 17452a, 17452b may be uniform over its length (parallel to the CLA) or may vary over its length.

[0821] The connector member 17420, and in some embodiments the first head SIP devices 17430a, 17430b may be formed form a first material. The first material may be an expanded polypropylene. In an embodiment, the first head SIP devices 17430a, 17430b are integrally formed with the connector member 17420. The secondary side members 17450a, 17450b may be formed from a second material. In an embodiment, the first material and the second material are substantially identical. However, in other embodiments, the first material and the second material may be different. In an embodiment, the secondary side members 17450a, 17450b are formed from an expanded polypropylene material. However, the expanded polypropylene of the connector member 17420 may have different mechanical properties than the expanded polypropylene material of the secondary side members 17450a, 17450b. The head SIP devices 17452a, 17452b are formed from a third material. The third material may be the same or different from the first material and the second material. In an embodiment, the third material has a hardness or stiffness less than the hardness or stiffness of the second material, and in some embodiments, less than a hardness or stiffness of the first material. In an embodiment, the third material is a foam material, such as a polyurethane foam for example.

[0822] With reference now to FIGS. 244A-245C, an example of a head SIP assembly 17500 suitable for use with a headrest (not shown) of a child seat is illustrated. The head SIP assembly 17500 includes a body having a back portion 17502, a first side portion 17504 extending from a first side of the back portion 17502, and a second side portion 17506 extending from a second opposite side of the back portion 17502. The back portion 17502, first side portion 17504, and second side portion 17506 may cooperate to define a head receiving area 17508 of the head SIP assembly 17500. The head SIP assembly 17500 may be removably connectable or may be permanently connectable to the structural shell (not shown) of a headrest.

[0823] The body of the head SIP assembly 17500 is formed at least partially by an inner member or connector member 17510 having a central body 17512, a first side 17514 extending from a first side of the central body 17512, and a second side 17516 extending from a second opposite side of the central body 17512. A first head SIP device 17520a may be arranged at or adjacent to the first side 17514 of the connector member 17510 and a second head SIP device 17520b may be arranged at or adjacent to the second side 17516 of the connector member 17510. In the illustrated, non-limiting embodiment, the head SIP devices 17520a, 17520b are mounted near a rear of the head SIP assembly 17500, such as at an interface between the body 17512 and the respective sides 17514, 17516 of the connector member 17510 for example.

[0824] Each head SIP device 17520a, 17520b may extend over an entire length, or over only a portion of a length of each side 17514, 17516. In the illustrated, non-limiting embodiment, at least one head SIP device 17520a, 17520b extends over about half of the length of a respective side 17514, 17516. However, embodiments where the at least one head SIP device 17520a, 17520b is longer or shorter are also contemplated herein. Each head SIP device 17520a, 17520b includes an inwardly facing surface 17522a, 17522b having a first side impact protection area 17524a, 17524b positioned closest to the body 17512, as well as a second side impact protection area 17526a, 17526b extending forward, away from the first side impact protection area 17524a, 17524b. As shown, the first side impact protection areas 17524a, 17524b may be arranged at an angle to the body 17512 of the connector member 17510. The second side impact protection areas 17526a, 17526b may be arranged at a non-parallel angle relative to respective first side impact protection areas 17524a, 17524b.

[0825] In the illustrated, non-limiting embodiment, the first head SIP device 17520a forms a first recess 17530a (see FIG. 244A) within the head receiving region of the head SIP assembly 17500, and the second head SIP device 17520b forms a second recess 17530b within a head receiving region 17508 of the head SIP assembly 17500. The first side impact protection areas 17524a, 17524b may abut respective second side impact protection areas 17526a, 17526b of each head SIP device 17520a, 17520b at a generally vertical line of intersection represented by L19a and L19b, respectively. The lines of intersection L19a, L19b may be disposed at the portions of the head SIP device 17520a, 17520b positioned laterally closest to a central longitudinal axis CLA of a head receiving region.

[0826] The first recess 17530a is partially defined by the second side impact protection area 17526a and a plane extending laterally from an inner edge of the front ends 17528a, 17528b of the side portions 17504, 17506 of the head SIP assembly 17500. A surface of the first side portion 17506 extending between the second side impact protection area 17526a and

the front end 17528a may also partly define the first recess 17530a. The recess 17530a is further defined by a plane P19a extending from the line of intersection L19a to the plane extending laterally from an inner edge of the front ends 17528a, 17528b of the side portions 17504, 17506. This plane P19a of the recess 17530a may but need not be coplanar with the first side impact protection area 17524a of the head SIP device 17530a. Similarly, the second recess 17530b is partially defined by the second side impact protection area 17526b, and in some embodiments, by a surface of the second side portion 17506 extending between the second side impact protection area 17526b and the front end 17528b of the head SIP assembly 17500. The recess 17530b further extends from the line of intersection L19b toward the plane extending laterally from an inner edge of the front ends 17528a, 17528b of the side portions 17504, 17506. The plane of the recess 17530b extending from the line of intersection L19b toward the plane extending laterally between the front ends 17528a, 17528b, represented by line P19b, may but need not be coplanar with the first side impact protection area 17524b of the head SIP device 17520b.

[0827] In each of the embodiments illustrated in FIGS. 244A-244C and FIGS. 245A-245C, the body of the head SIP assembly 17500 is additionally formed by at least one energy absorption assembly 17540. An energy absorption assembly 17540 may be arranged proximate a side portion 17504, 17506 of the head SIP assembly 17500. Although an energy absorption assembly 17540 is illustrated in the FIGS. proximate only the first side portion 17504 of the head SIP assembly 17500, it should be understood that in some embodiments, a similar energy absorption assembly may be arranged at the second side portion 17506 of the head SIP assembly 17500 as well.

[0828] The energy absorption assembly 17540 includes an energy absorption member 17542. The energy absorption member 17542 may be located proximate a side 17514, 17516 of the connector member 17510. The energy absorption member 17542 may be formed from a different material than the connector member 17502. A hardness or stiffness of energy absorption member 17542 may be less than a hardness or stiffness of the connector member 17502. For example, the energy absorption member 17542 may be formed from a foam material.

[0829] In an embodiment shown in FIGS. 244A-244F, a length of the first side 17514 of the connector member 17510 is less than the length of the first side portion 17504 of the head SIP assembly 17500. Accordingly, an end 17517a of the first side 17514 of the connector member 17510 is offset from the end 17528a of the head SIP assembly 17500. As shown, the energy absorption member 17542 may extend between the front end 17528a of the first side

portion 17514 and the end 17517a of the first side 17514 of the connector member 17510. In an embodiment, the end of the first side 17514 is offset from the head SIP device 17520a. However, in other embodiment, the end of the 17517a may be arranged at the head SIP device 17520a. In such embodiments, the energy absorption member 17542 may form a portion of the head SIP device 17520a, as shown in FIGS. 244A-244C.

[0830] In the illustrated, non-limiting embodiment, the energy absorption assembly 17540 additionally includes an energy absorption sheet or outer stiffening layer 17544 positioned about the energy absorption member 17542. As shown, the outer stiffening layer 17544 may be arranged in direct contact with an inward facing surface 17546 of the energy absorption member 17542. In an embodiment, the outer stiffening layer 17544 overlaps a substantial entirety of the inward facing surface of the energy absorption member 17542 (see FIGS. 245A-245C); however, as shown in FIGS. 244A-244C, the outer stiffening layer 17544 need not extend to the front end 17528a of the side portion 17504 and/or need not cover the entirety of the energy absorption member 17542. The outer stiffening layer 17544 may further overlap part of the connector member 17510. For example, the outer stiffening layer 17544 may overlap a surface of the first side 17514 and/or a surface of the head SIP device 17520a (FIGS. 245A-245C) located adjacent to the energy absorption member 17542, such as part of the second side impact area 17526a for example. The outer stiffening layer 17544 may be formed from a different material than the energy absorption member 17542, and in some embodiments, from a different material than the connector member 17502. In an embodiment, the outer stiffening layer 17544 is formed form a polypropylene material, such as a sheet of polypropylene for example. Inclusion of the outer stiffening layer 17544 over the energy absorption member 17542 spreads the impact force of an occupant's head over the surface of the energy absorption member 17542.

[0831] In other embodiments, the head SIP assembly may include a weakened region that facilitates movement or flexure of the head SIP assembly to absorb energy in response to an impact of an occupant's head. With reference now to the embodiments illustrated in FIGS. 246A-247C, a head SIP assembly 17600 may include a connector member 17602 having a central body portion 17604, a first side portion 17606 extending from a first side of the central body portion 17604, and a second side portion 17608 extending from a second opposite side of the central body portion 17604. The connector member 17602 may be removably connectable or may be permanently connectable to the structural shell (not shown) of a headrest. A first head SIP device 17610a may be arranged at or adjacent to the first side portion 17606 of the connector member 17502 and a second head SIP device 17610b may be arranged at or adjacent

to the second side portion 17608 of the connector member 17602. In the illustrated, non-limiting embodiment, the head SIP devices 17610a, 17610b are mounted near a rear of the head SIP assembly 17600, such as at an interface between the central body portion 17604 and the respective side portions 17606, 17608 of the connector member 17602 for example.

[0832] Each head SIP device 17610a, 17610b may extend over an entire length, or over only a portion of a length of each side portion 17606, 17608. In the illustrated, non-limiting embodiment, at least one head SIP device 17610a, 17610b extends over about half of the length of a respective side portions 17606, 17608. However, embodiments where the at least one head SIP device 17610a, 17610b is longer or shorter are also contemplated herein. Similar to several embodiments previously disclosed herein, each head SIP device 17610a, 17610b includes an inwardly facing surface 17618a, 17618b having a first side impact protection area 17620a, 17620b positioned closest to the body portion 17604, as well as a second side impact protection area 17622a, 17622b extending forward, away from the first side impact protection area 17620a, 17620b. As shown, the first side impact protection areas 17620a, 17620b may be arranged at an angle to the body portion 17604 of the connector member 17602. The second side impact protection areas 17622a, 17622b may be arranged at a non-parallel angle relative to respective first side impact protection areas 17620a, 17620b.

[0833] In the illustrated, non-limiting embodiment, the first head SIP device 17610a forms a first recess 17630a within a head receiving region 17612 of the head SIP assembly 17600, and the second head SIP device 17610b forms a second recess 17630b within the head receiving region. The first side impact protection areas 17620a, 17620b may abut respective second side impact protection areas 17622a, 17622b of each head SIP device 17610a, 17610b at a generally vertical line of intersection represented by L20a and L20b, respectively. The lines of intersection L20a, L20b may be disposed at the portions of the head SIP device 17610a, 17610b positioned laterally closest to a central longitudinal axis CLA of the head receiving region 17612.

[0834] The first recess 17630a is partially defined by the second side impact protection area 17622a and a plane extending laterally from an inner edge of the front ends 17524a, 17624b of the side portions 17606, 17608 of the connector member 17602. A surface of the first side portion 17606 extending between the second side impact protection area 17622a and the front end 17624a may also partly define the first recess 17630a. The recess 17630a is further defined by a plane P20a extending from the line of intersection L20a to the plane extending laterally from an inner edge of the front ends 17624a, 17624b of the side portions 17604, 17606. This plane P20a of the recess 17630a may but need not be coplanar with the first side impact

protection area 17620a of the head SIP device 17610a. Similarly, the second recess 17630b is partially defined by the second side impact protection area 17622b, and in some embodiments, by a surface of the second side portion 17606 extending between the second side impact protection area 17622b and the front end 17624b.The recess 17630b further extends from the line of intersection L20b toward the plane extending laterally from an inner edge of the front ends 17624a, 17624b of the side portions 17606, 17608. The plane of the recess 17630b extending from the line of intersection L20b toward the plane extending laterally between the front ends 17624a, 17624b, represented by line P20b, may but need not be coplanar with the first side impact protection area 17620b of the head SIP device 17610b.

[0835] In the illustrated, non-limiting embodiments, the head SIP assembly 17600 includes at least one weakened region defined by an area of material removed from the connector member 17602. The term "area of removed material" is intended to identify an area of removed material that forms a hollow pocket or channel 17640 in the connector member 17602 having a reduced thickness compared to the surrounding areas. These pockets or areas of removed material 17640 may extend through only a small portion of the thickness of the connector member 17602, or alternatively, may extend over substantially the entire thickness of the connector member 17602 while leaving a solid opposing surface thereat. Although each of the head SIP assemblies 17600 illustrated in FIGS. 246A-248C has a single weakened region or area of removed material 17640 arranged at only one of the first side portion 17606 and the second side portion 17608 of the connector member 17602, it should be understood that in some embodiments, one or more similar areas of removed material 17640 may be arranged at both the first and second side portions 17606, 17608 of the connector member 17602.

[0836] In the non-limiting embodiments illustrated in FIGS. 246A-247C, the area of removed material 17640 forms an elongated pocket 17641 at a respective side portion 17606, 17608. In FIGS. 246A-246C, the area of removed material 17640 has had material removed from the inwardly facing surface 17634 of the second side portion 17608 of the connector member 17602 resulting in the formation of the hollow channel 17641 at the inwardly facing surface 17632. In FIGS. 247A-247C, the area of material 17640 is removed from the outwardly facing surface 17632 of the first side portion 17606 resulting in the formation of a hollow channel 17641 at the outwardly facing surface 17632. As shown, the area of removed material 17640 and resulting hollow channel 17641 may extend generally from a top surface 17642 of a respective side portion 17606, 17608 to a bottom surface 17644 of the side portion 17606, 17608. The hollow channel 16741 may have a linear configuration, or alternatively, may have another configuration, such as a curvilinear configuration for example. While the hollow

channels 17641 of FIGS. 246A-246C and FIGS. 247A-247C are both positioned between a respective head SIP device 17610a, 17610b and the front end 17642a,17642b of the corresponding side portion 17606, 17608, it should be appreciated that embodiments where a hollow channel 17641 is formed at a portion of the head SIP device 17610a, 17610b are also contemplated herein. The connector member 17602 is configured to flex at the weakened region defined by the hollow channel 17641 in response to an impact force of an occupant's head, thereby absorbing energy from the impact.

[0837] The head SIP assembly 17700 illustrated in FIGS. 248A-248C similarly includes weakened region defined by an area of removed material 17740 resulting in the formation of a pocket 17742. As in the previous embodiment, the non-limiting head SIP assembly 17700 may include a connector member 17702 having a central body portion 17704, a first side portion 17706 extending from a first side of the central body portion 17704, and a second side portion 17708 extending from a second opposite side of the central body portion 17704. The connector member 17702 may be removably connectable or may be permanently connectable to the structural shell (not shown) of a headrest. A first head SIP device 17710a may be arranged at or adjacent to the first side portion 17706 of the connector member 17702 and a second head SIP device 17710b may be arranged at or adjacent to the second side portion 17708 of the connector member 17702. In the illustrated, non-limiting embodiment, the head SIP devices 17710a, 17710b are arranged at a rear of the head SIP assembly 17700, such as extending between a surface of the central body portion 17704 and the respective side portions 17706, 17708 of the connector member 17702 for example.

[0838] Each head SIP device 17710a, 17710b may extend over an entire length, or over only a portion of a length of each side portion 17706, 17708. In the illustrated, non-limiting embodiment, at least one head SIP device 17710a, 17710b extends over less than half of the length of a respective side portions 17706, 17708. However, embodiments where the at least one head SIP device 17710a, 17710b is longer or shorter are also contemplated herein. Each head SIP device 17710a, 17710b includes an inwardly facing surface 17718a, 17718b. In the illustrated, non-limiting embodiment, the inwardly facing surfaces 17718a, 17718b each have a single side impact protection area 17720a, 17720b. As shown, the side impact protection areas 17720a, 17720b may be arranged at an angle to the body portion 17704 of the connector member 17702 and to the first and second side portions 17706, 17708, respectively.

[0839] In the illustrated, non-limiting embodiment, the first head SIP device 17710a forms a first recess 17730a within a head receiving region 17712 of the head SIP assembly 17700, and the second head SIP device 17710b forms a second recess 17730b within the head

receiving region 17712. The side impact protection areas 17720a, 17720b may abut the central body portion 17704 at a generally vertical line of intersection represented by L21a and L21b, respectively. The lines of intersection L21a, L21 may be disposed at the portions of the head SIP device 17710a, 17710b positioned laterally closest to a central longitudinal axis CLA of the head receiving region 17712.

[0840] The first recess 17730a is partially defined by the side impact protection area 17720a, by a surface of the first side portion 17706 extending between the side impact protection area 17620a and the front end 17724a, and by a plane extending laterally from an inner edge of the front ends 17724a, 17724b of the side portions 17706, 17708 of the connector member 17702. The recess 17730a may be further defined by a plane P21a extending from the line of intersection L21a to the plane extending laterally from an inner edge of the front ends 17724a, 17724b of the side portions 17704, 17706. Similarly, the second recess 17730b is partially defined by the side impact protection area 17720b, by a surface of the second side portion 17706 extending between the second side impact protection area 17622b and the front end 17624b, and by the plane extending laterally from an inner edge of the front ends 17724a, 17724b of the side portions 17706, 17708. The recess 17730b further extends from the line of intersection L21b toward the plane extending laterally from an inner edge of the front ends 17724a, 17724b of the side portions 17706, 17708.

[0841] Similar to the embodiments illustrated in FIGS. 246A-247C, the head SIP assembly 17700 includes at least one area of removed material 17740. In the illustrated, non-limiting embodiment, an area of material 17740 is removed from the outer surface 17732 of the first side portion 17706 of the connector member 17702, resulting in the formation of a hollow pocket 17742. As in the previous embodiments, although a single hollow pocket 17742 is shown arranged at only the first side portion 17706, it should be understood that in some embodiments, one or more areas of material 17740 may alternatively or additionally be removed from the second side portion 17708 of the connector member 17702 to form a hollow pocket 17742 at the second side portion 17708. As shown, the hollow pocket 17742 may be formed near the front end 17724a of the side portion 17706, such as between the head SIP device 17710a and the front end 17724a for example. In other embodiments, the hollow pocket 17742 may be formed at an inward facing surface 17734 of the side portion 17706, and in some embodiments, may overlap a portion of the head SIP device 17710a. The hollow pocket 17742 may have a non-uniform shape, such as a shape complementary to the contour of the side portion 17706 at that location. The hollow pocket 17742 defines a weakened region of the connector member 17702. As a result, the side portion 17706, 17708 of the connector member

17702 is configured to flex at the weakened region in response to an impact force of an occupant's head, thereby absorbing energy from the impact.

[0842] In other embodiments, the head SIP assembly may include both a hollow pocket 17841 formed from an area of removed material 17840 and a secondary material arranged therein. The non-limiting embodiments illustrated in FIGS. 249A-251C include a head SIP assembly 17800 having a connector member 17802 including a central body portion 17804, a first side portion 17806 extending from a first side of the central body portion 17804, and a second side portion 17808 extending from a second opposite side of the central body portion 17804. The connector member 17802 may be removably connectable or may be permanently connectable to the structural shell (not shown) of a headrest. A first head SIP device 17810a may be arranged at or adjacent to the first side portion 17806 of the connector member 17802 and a second head SIP device 17810b may be arranged at or adjacent to the second side portion 17808 of the connector member 17802. In the illustrated, non-limiting embodiment, the head SIP devices 17810a, 17810b are mounted near a rear of the head SIP assembly 17800, such as at an interface between the body portion 17804 and the respective side portions 17806, 17808 of the connector member 17802 for example.

[0843] Each head SIP device 17810a, 17810b may extend over an entire length, or over only a portion of a length of each side portion 17806, 17808. In the illustrated, non-limiting embodiment, at least one head SIP device 17810a, 17810b extends over about half of the length of a respective side portions 17806, 17808. However, embodiments where the at least one head SIP device 17810a, 17810b is longer or shorter are also contemplated herein. Similar to several embodiments previously disclosed herein, each head SIP device 17810a, 17810b includes an inwardly facing surface 17818a, 17818b having a first side impact protection area 17820a, 17820b positioned closest to the body portion 17804, as well as a second side impact protection area 17822a, 17822b extending forward, away from the first side impact protection area 17820a, 17820b. As shown, the first side impact protection areas 17820a, 17820b may be arranged at an angle to the body portion 17804 of the connector member 17802. The second side impact protection areas 17822a, 17822b may be arranged at a non-parallel angle relative to respective first side impact protection areas 17820a, 17820b.

[0844] In the illustrated, non-limiting embodiment, the first head SIP device 17810a forms a first recess 17830a within the head receiving region 17812 of the head SIP assembly 17800, and the second head SIP device 17810b forms a second recess 17830b within the head receiving region 17812. The first side impact protection areas 17820a, 17820b may abut respective second side impact protection areas 17822a, 17822b of each head SIP device

17810a, 17810b at a generally vertical line of intersection represented by L22a and L22b, respectively. The lines of intersection L22a, L22b may be disposed at the portions of the head SIP device 17810a, 17810b positioned laterally closest to a central longitudinal axis CLA of a head receiving region 17812.

[0845] The first recess 17830a is partially defined by the second side impact protection area 17822a and a plane extending laterally from an inner edge of the front ends 17824a, 17824b of the side portions 17806, 17808 of the connector member 17802. A surface of the first side portion 17806 extending between the second side impact protection area 17822a and the front end 17824a may also partly define the first recess 17830a. The recess 17830a is further defined by a plane P22a extending from the line of intersection L22a to the plane extending laterally from an inner edge of the front ends 17824a, 17824b of the side portions 17806, 17808. This plane P22a of the recess 17830a may but need not be coplanar with the first side impact protection area 17820a of the head SIP device 17810a. Similarly, the second recess 17830b is partially defined by the second side impact protection area 17822b, and in some embodiments, by a surface of the second side portion 17806 extending between the second side impact protection area 17822b and the front end 17824b.The recess 17830b further extends from the line of intersection L22b toward the plane extending laterally from an inner edge of the front ends 17824a, 17824b of the side portions 17806, 17808. The plane of the recess 17830b extending from the line of intersection L22b toward the plane extending laterally between the front ends 17824a, 17824b, represented by line P22b, may but need not be coplanar with the first side impact protection area 17820b of the head SIP device 17810b.

[0846] As shown, the connector member 17802 of the head SIP assembly 17800 may additionally include at least one area of removed material 17840 forming a hollow channel or pocket 17841, similar to 17641 and 17742 described with respect to FIG. 245A-248C. A thickness of the first side portion 17806, measured between an outer surface 17832 and an inward facing surface 17834 thereof, is reduced at the area of removed material 17840 compared to the thickness of the surrounding regions of the first side portion 17806. These pockets or areas of removed material 17841 may extend through only a small portion of the thickness of the connector member 17802, or alternatively, may extend over substantially the entire thickness of the connector member 17802 while leaving a solid opposing surface thereat.

[0847] In the illustrated, non-limiting embodiment of FIGS. 249A-249C, an area of material 17840 is removed from an outer surface 17832 of the first side portion 17806 resulting in the formation of a hollow pocket 17841 at the outer surface 17832 thereof, and in the non-limiting embodiments of FIGS. 250A-251C, area of material 17840 is removed from an inward

facing surface 17834 of the first side portion 17806, thereby forming a hollow channel or pocket 17841 at the inward facing surface 17834 of the first side portion 17806. The hollow pockets 17841 formed by areas of removed material 17840 may, but need not extend over an entire vertical height of the first side portion 17806, and may be arranged at any suitable position about the first side portion 17806.

[0848] An energy absorption assembly 17850 may be associated with the at least one pocket 17841 formed in the connector member 17802. The energy absorption assembly 17850 includes at least one energy absorption member 17852 formed from a different material than the connector member 17802. A hardness of the energy absorption member 17852 may be less than a hardness of the connector member 17802. For example, the energy absorption member 17852 may be formed from a foam material and the connector member 17802 may be formed from an expanded polypropylene. The energy absorption member 17852 may be positionable within the at least one hollow pocket or channel 17841 of the connector member 17802. In an embodiment, a shape of the energy absorption member 17852 is complementary to the shape of the corresponding hollow pocket 17841 (defined by one or more walls of the connector member 17802) within which the energy absorption member 17852 is receivable. Further, the thickness of the energy absorption member 17852 receivable within the hollow pocket 17841 in combination with the thickness of the side portion 17806 at the hollow pocket 17841 may be equal to or may be greater than the thickness of the surrounding regions of the first side portion 17806.

[0849] In the non-limiting embodiment illustrated in FIGS. 249A-250C, the hollow pocket 17841 extends from a front end 17824a of the first side portion 17806 toward a central region thereof. In such embodiments, the energy absorption member 17852 in combination with the front end 17824a of the side portion 17806 may form a front end of the head SIP assembly 17800. In other embodiments, regardless of whether the hollow pocket 17841 and energy absorption member 17852 are arranged at the inward surface 17834 or the outer surface 17832 of the side portion 17806, the hollow pocket 17841 and the energy absorption member 17852 arranged therein may be spaced away from the front end 17624a of the first side portion 17806. With reference to FIGS. 251A-251C, the hollow pocket 17841 formed in the first side portion 17806 and the energy absorption member 17852 arranged within the hollow pocket 17841 are offset from the front end 17824a of the first side portion 17806.

[0850] In instances where the hollow pocket 17841 is located at the inward facing surface 17834, the hollow pocket 17841 may be offset from the head SIP device 17810a. For example, the hollow pocket 17841 and the corresponding energy absorption member 17852

may extend to an edge of the head SIP device 17810a positioned closest to the front end 17824a. However, in other embodiments, the p hollow pocket 17841 may be located at a portion of the head SIP device 17810a, such as at a portion of the second side impact protection area 17822a for example (see FIGS. 247A-247C). In such embodiments, the hollow pocket 17841 may but need not extend to the front end 17824a of the first side portion 17806.

[0851] In an embodiment, such as shown in FIGS. 249A-250C, the side portion 17806 may form an energy absorption layer or outer stiffening layer. The continuous surface of the first portion 17806 arranged opposite the energy absorption member 17852 may form the energy absorption layer. For example, the inward facing surface 17834 of the first portion 17806 shown in FIGS. 249A-249C, and the outer surface 17832 of the first portion 17806 shown in FIGS. 250A-250C may form a respective outer stiffening layer. In an embodiment, the outer stiffening layer extends generally from the head contact location defined at the interface between the first and second side impact areas 17820a, 17822b of the head SIP device 17810a, and the front end 17824a of the side portion 17806. Embodiments where a separate sheet is positioned in overlapping arrangement with the side portion 17806 at the energy absorption member 17852 to distribute a load across the energy absorption member 17852 are also within the scope of the disclosure. Although a weakened region 17840 defined by a hollow pocket 17841 and corresponding energy absorption assembly 17850 are illustrated in the FIGS. at only the first side portion 17806 of the connector member 17802, it should be understood that in some embodiments, a similar weakened region 17840 and corresponding energy absorption assembly 17850 may be alternatively or arranged at the second side portion 17608 of the connector member 17802.

[0852] With reference now to FIGS. 252A-253B, another example of headrest 17900 including a head SIP assembly 17902 is illustrated. The head SIP assembly 17900 includes a central body portion 17904, a first side portion 17906 extending from a first side of the central body portion 17904, and a second side portion 17908 extending from a second opposite side of the central body portion 17904. The head SIP assembly 17902 may be removably connectable or may be permanently connectable to an inner surface of the structural shell 17901 of the headrest 17900. In an embodiment, the distal ends 17912a, 17912b of the side portions 17906, 17908 extend beyond the ends of the headrest shell 17901. However, embodiments where the headrest shell 17901 and the distal ends 17912a, 17912b of the side portions 17906, 17908 are generally coplanar are also contemplated herein.

[0853] In an embodiment, a first head SIP device 17910a is arranged at or adjacent to the first side portion 17906 and a second head SIP device 17910b is arranged at or adjacent to

the second side portion 17908. Although the head SIP devices 17910a, 17910b are illustrated as being mounted near a rear of the head SIP assembly 17902, such as at an interface between the body portion 17904 and the first or second side portion 17906, 17908, embodiments where the head SIP device 17910a, 17910b is arranged at another position are also contemplated herein.

[0854] Each head SIP device 17910a, 17910b may extend over an entire length, or over only a portion of a length of each side portion 17906, 17916. In the illustrated, non-limiting embodiment, at least one head SIP device 17910a, 17910b extends over about half of the length of a respective side portions 17906, 17908. However, embodiments where the at least one head SIP device 17910a, 17910b is longer or shorter are also contemplated herein. Although not described in detail, it should be appreciated that the head SIP devices 17910a, 17910b may have a configuration of any head SIP device described herein.

[0855] As shown, the first side portion 17906 of the head SIP assembly 17900 and the second side portion of the head SIP assembly 17900, respectively, may have different regions. For example, a first region 17920a, 17920b may extend from the side of the central body portion 17904 to a central region of one of the first side portion 17906 and second side portion 17908, and a second region 17922a, 17922b may extend from the front ends 17912a, 17912b of the first and side portions 17906, 17908, respectively, to the central region and may abut an end of the first region 17920a, 17920b. The different regions 17920a, 17922a, 17920b, 17922b may have different mechanical properties, such as hardness for example. For example, the first region 17920a, 17920b closest to the central body 17904 may have a first hardness and the second region proximate the distal end 17912a, 17912b of the side portions 17906, 17908 may have a second hardness, reduced relative to the first hardness. In the illustrated, non-limiting embodiment of FIGS. 252a-252b, the first and second regions 17920a, 17920b, 17922a, 17922b of each side member 17906, 17908 are formed from different materials to achieve the different properties. In an embodiment, the first region 17920a, 17920b is formed from an expanded polypropylene and the second region 17922a, 17922b is formed from a foam material, such as foam polyurethane. In embodiments where the regions are formed from different materials, the regions are typically formed as separate components positionable adjacent to and/or connectable to one another. Accordingly, in some embodiments, the head SIP assembly 17902 includes a connector member 17930 that forms the central body portion 17904 and at least a part of the first side portion 17906 and the second side portion 17908 of the head SIP assembly 17902, such as the first region 17920a, 17920b of each side portion 17906, 17908. In such embodiments, the connector member 17930 and a respective secondary

component 17932a, 17932b used to form the second region 17922a, 17922b of each side portion 17906, 17908 may be mounted separately to the headrest shell 17901.

[0856] In other embodiments, such as shown in FIGS. 253A-253B, the first and second regions 17920a, 17922a, and 17920b, 17922b having different mechanical properties at each side portion 17906, 17908 may be formed from the same material. For example, both the first region 17920a, 17920b and the second region 17922a, 17922b may be formed from expanded polypropylene; however, the density of the expanded polypropylene within the first region 17920a, 17920b may be greater than the density of the expanded polypropylene within the neighboring second region 17922a, 17922b. In embodiments where the first and second regions 17920a, 17922a, and 17920b, 17922b of each side portion 17906, 17908 are formed form the same material, the first and second regions 17920a, 17922a, and 17920b, 17922b may be integrally formed as a unitary body. In such embodiments, the connector member 17930 may forms the central body portion 17904 and the entire first and second side portions 17906, 17908 of the head SIP assembly 17900.

[0857] With continued reference to FIGS. 252A-253B and further reference again to FIG. 254, the head SIP assembly 17900 may additionally include an energy absorption layer. A respective first and second energy absorption layer or outer stiffening layer 17924a, 17924b may be arranged proximate or in overlapping arrangement with the second region 17922a, 17922b of the first and second side portions 17906, 17908. In some embodiments, the energy absorption layers 17924a, 17924b are arranged at the headrest 17900, such as in direct contact with the second region 17922a, 17922b. In the non-limiting embodiment illustrated in FIG. 252A, the outer stiffening layers 17924a, 17924b are located at the head SIP assembly 17900, and separate soft goods are positionable over the head SIP assembly 17900 including the outer stiffening layers 17924a, 17924b.

[0858] In other embodiments, as shown in FIG. 254, the outer stiffening layers 17924a, 17924b may be arranged at the soft goods 17940 positionable in overlapping arrangement with the body portion 17904 and the side portions 17906, 17908 of the head SIP assembly 17900. In an embodiment, the outer stiffening layers 17924a, 17924b are located about the soft goods 17940 such that each outer stiffening layer 17924a, 17924b is positioned in overlapping arrangement with the second region 17922a, 17922b of a respective side portion 17906, 17908. The outer stiffening layers 17924a, 17924b may overlap only a portion of a corresponding second region 17922a, 17922b, or alternatively, may overlap an entirety thereof. Further, in some embodiments, the outer stiffening layers 17924a, 17924b are positioned about the soft goods to additionally overlap a portion of the first region 17920a, 17920b.

[0859] Each outer stiffening layer 17924a, 17924b may be permanently affixed to the soft goods 17940. In such embodiments, the outer stiffening layers 17924a, 17924b may be attached to a surface of the soft goods 17940 facing the side portions 17906, 17908 via a chemical adhesive, via stitching, or in any other suitable manner. Alternatively, the outer stiffening layers 17924a, 17924b may be removably connectable to the soft goods 17940. In such embodiments a pocket 17942 may be formed at the soft goods 17940, and each outer stiffening layer 17924a, 17924b may be insertable into and removable from a respective pocket 17942. However, any other mechanism for removably mounting the outer stiffening layers 17924a, 17924b to the soft goods 17940 is also within the scope of the disclosure.

[0860] In an embodiment, a configuration of a head SIP device or a head SIP assembly may be adjusted relative to a headrest. For example, the orientation of a head SIP device or devices may be selected based on a direction in which the child seat is mounted to a vehicle seat, i.e., rearward facing or forward facing. In the non-limiting embodiment illustrated in FIGS. 24A-24D, head SIP assemblies 2302a, 2302b are mounted to an interior surface of respective headrest side members 2304, 2305 of a headrest 2301. As shown, each head SIP assembly 2302a, 2302b includes a respective first head SIP device 2306a, 2306b and a respective second head SIP device 2308a, 2308b. The first and second head SIP devices 2306a, 2306b, 2306a, 2306b may be connected to one another, such as via a connector member (not shown). The first head SIP device 2306a, 2306b has a first hardness and the second head SIP device 2308a, 2308b has a second hardness, the first hardness being greater than the second hardness.

[0861] A head SIP assembly 2302a or 2302b may be movable, for example rotatable about an axis, between a first configuration (FIG. 24A-B) associated with a forward-facing installation of the child seat system 2300 and a second configuration (FIG. 24C-D) associated with a rearward-facing installation of the child seat system 2300. It should be understood that the head SIP assembly 2302a, 2302b may be transformable between the first configuration and the second configuration when the soft goods are both positioned about the headrest and when the soft goods are removed from the headrest. In an embodiment, the head SIP device of the head SIP assembly 2302a, 2302b with the greater hardness, such as head SIP device 2306a or 2306b for example, is positioned near the rear of the headrest 2301 when the child seat is in a forward-facing configuration and the head SIP device 2306a, 2306b with the greater hardness may be positioned near a front 2314 of the headrest 2301 when the child seat is in a rearward-facing configuration.

[0862] As shown, in the first configuration the first head SIP device 2306a, 2306b may be arranged closest to a headrest support surface 2310 of the headrest 2301 and the second head SIP device 2308a, 2308b may be closest to a front 2314 of the headrest 2301. When the child seat system is installed in a rearward-facing direction and the head SIP assembly 2302a, 2302b is in the second configuration, the second head SIP device 2308a, 2308b may be arranged closest to the headrest support surface 2310 and the first head SIP device 2306a, 2306b may be closest to the front end 2314 of the headrest 2301. Such rotation of a head SIP assembly 2302a, 2302b may be driven by a dial 2320 or other control mechanism operably coupled to the head SIP assembly 2302 and arranged at an exterior of the child seat. Although the control mechanism 2320 is illustrated as being arranged at a second headrest side member 2305, in other embodiments, a control mechanism 2320 may be arranged at the first headrest side member 2304. Further, it should be appreciated that a single control mechanism 2320 may be operable to transform one of the plurality of head SIP assemblies 2302a,2302b, or alternatively, the plurality of head SIP assemblies 2302a,2302b.

[0863] In other embodiments, such as shown in FIGS. 25A-25D, an overall head accommodation space of a head SIP assembly may vary based on the direction in which the child seat system is mounted to a vehicle seat. Head SIP assemblies 2402a, 2402b may be mounted to respective headrest side members 2404, 2406 of a headrest 2401. In the illustrated, non-limiting embodiment, each head SIP assembly 2402a, 2402b includes a respective first head SIP device 2408a, 2408b and an adjacent a second head SIP device 2410a, 2410b. The hardness of the first head SIP device 2408a, 2408b may be greater than the hardness of the second head SIP device 2410a, 2410b. Each head SIP assembly 2402a, 2402b has a first configuration (FIG. 25A-B) associated with a forward-facing installation of the child seat system 2400 and a second configuration (FIG. 25C-D) associated with a rearward-facing installation of the child seat system 2400.

[0864] In the first configuration, the second head SIP device 2410 extends from the first head SIP device 2408 over a substantial portion of a length of an adjacent headrest side member 2404, 2406. In an embodiment, a length of the second head SIP device 2410 when in the first configuration may be at least double, and in some embodiments triple or quadruple for example, the length of the first head SIP device 2408. However, in the second configuration, the length of the second head SIP device 2410 is reduced relative to the length of the second head SIP device in the first configuration. As shown, the second head SIP device 2410 may extend over only a small portion of a length of a headrest side member 2404, 2406. In an

embodiment, a length of the second head SIP device 2410 when in the second configuration may be similar or equal to a length of the first head SIP device 2408.

[0865] To accommodate this transformation in length, the second head SIP device 2410 may be retractable into a corresponding cavity or may be selectively inflatable and deflatable to achieve a desired configuration. Similar to the previous embodiment, it should be understood that the head SIP assembly 2402a, 2402b may be transformable between the first configuration and the second configuration when the soft goods are both positioned about the headrest and when the soft goods are removed from the headrest. The transformation of the second head SIP device 2410a, 2410b may be controlled by a dial 2420 or other control mechanism operably coupled to the second head SIP device 2410a, 2410a and arranged at an exterior of the child seat. Although the control mechanism 2420 is illustrated as being arranged at a second headrest side member 2406, in other embodiments, a control mechanism 2420 may be arranged at the first headrest side member 2404 or another suitable location about the child seat. Further, it should be appreciated that a single control mechanism 2420 may be operable to transform a corresponding second head SIP device 2410a or 2410b, or alternatively, may be operable to transform the plurality of second head SIP devices 2410a and 2410b.

[0866] With reference now to FIGS. 26A-26F, another embodiment of at least one head SIP device transformable between a first configuration and a second configuration is illustrated. As shown, a headrest 2502 of a child seat 2500 includes a back portion 2504 having an upright support surface 2506, a first headrest side member 2508 and a second headrest side member 2510. In the illustrated, non-limiting embodiment, first head SIP devices 2512a, 2512b and second head SIP devices 2514a, 2514b are respectively mounted at each of the headrest side members 2508, 2510. At least one of the first and second head SIP devices 2512a, 2512b, 2514a, 2514b is movable relative to the headrest 2502 between a first, retracted configuration (FIGS. 26A-26C) and a second extended or deployed configuration (FIGS. 26D-26F). In such embodiments, the at least one of the first and second head SIP device 2512a, 2512b, 2514a, 2514b may be coupled to the child seat 2500 in both the retracted configuration and the extended configuration. Further, in an embodiment, the transformable first and/or second head SIP device 2512a, 2512b, 2514a, 2514b is lockable in the retracted configuration, the extended configuration, or both.

[0867] When in the retracted configuration, an outer surface 2516a, 2516b, 2518a, 2518b of at least one of the first and second head SIP devices 2512a, 2512b, 2514a, 2514b may be substantially flush with respective surfaces 2517, 2519 of the first and second head rest side members 2508, 2510. As shown, in the retracted configuration the first and second head SIP

devices 2512a, 2512b, 2514a, 2514b are retracted into a clearance 2526, 2528 defined between the headrest side member 2508, 2510 and an adjacent upright side member 2522, 2524 of a seat shell 2520 of the child seat 2500. In the extended configuration, at least one of the first and second head SIP devices 2512a, 2512b, 2514a, 2514b protrudes beyond the surfaces of the first and second headrest side members 2508, 2510 to reduce the available space within a space defined by headrest 2502 (e.g. reduce space for a child's head to move from side to side within the confines of the headrest). The first and second head SIP devices 2512a, 2512b, 2514a, 2514b may be covered by the soft goods of the headrest 2502 when in both the extended configuration and the retracted configuration. However, in other embodiments, one or more of the first and second head SIP devices 2512a, 2512b, 2514a, 2514b may protrude through the soft goods when in the extended configuration.

[0868] In the illustrated, non-limiting embodiment, the at least one first and/or second head SIP device 2512a, 2512b, 2514a, 2514b is a rigid body configured to translate along an axis between the retracted configuration and the extended configuration. However, in other embodiments, the head SIP devices 2512a, 2512b, 2514a, 2514b may be configured to rotate or move in another manner between the retracted and extended configurations. For example, in the non-limiting embodiment illustrated in FIGS. 68A-68F, first and second head SIP devices 6504a, 6504b, 6506a, 6506b arranged at a headrest 6502 of a child seat 6500 are structurally modifiable bodies, such as bladders or airbags, transformable between a first, deflated configuration (FIGS. 68A-68C) and a second inflated configuration (FIGS. 68D-68F). It should be understood that a deflated configuration may also be referred to herein as a stowed or retracted configuration and an inflated configuration may also be referred to herein as an extended or deployed configuration. A valve (not shown) may be operable to retain fluid within the bladders when inflated. At least a portion of the first and second head SIP devices 6504a, 6504b, 6506a, 6506b engageable with an occupant may be covered by the soft goods of the headrest 6502 when in both the extended configuration and the retracted configuration. However, in other embodiments, the portion of the first and second head SIP devices 6504a, 6504b, 6506a, 6506b engageable with an occupant may protrude through the soft goods when in the extended configuration.

[0869] When in a deflated configuration, a portion of the structurally modifiable bodies 6504a, 6504b, 6506a, 6506b may be arranged within a cavity formed in the headrest, or alternatively or additionally, may extend into the clearance 6524a, 6524b formed between the headrest side members 6514, 6516 and the upright side members 6510, 6512 of the seat shell 6508. Accordingly, as air or another fluid is provided to the structurally modifiable bodies

6504a, 6504b, 6506a, 6506b, the structurally modifiable bodies 6504a, 6504b, 6506a, 6506b transform and extend into the headrest cavity 6520. In other embodiments, a source 6522 arranged in fluid communication with the structurally modifiable bodies 6504a, 6504b, 6506a, 6506b may be positioned between the headrest side members 6514, 6516 and the upright side members 6510, 6512. In such embodiments, a source may be fluidly connected to one or more of a plurality of structurally modifiable bodies, such as the plurality of structurally modifiable bodies 6504a, 6504b, 6506a, 6506b associated with a given side member 6514, 6516 of the headrest 6502. For example, a first source 6520a positioned within the clearance 6524a between the headrest side member 6514 and adjacent side member 6510 may be operably coupled to both structurally modifiable bodies 6504a and 6506a. Similarly, a second source 6520b positioned within a clearance 6524b between the headrest side member 6516 and adjacent side member 6512 may be operably coupled to both structurally modifiable bodies 6504b and 6506b.

[0870] When the structurally modifiable bodies 6504a, 6504b, 6506a, 6506b are in a deflated configuration, the at least one source 6520a, 6520b arranged between the headrest 6502 and the seat shell 6508 is expanded, and when the structurally modifiable bodies 6504a, 6504b, 6506a, 6506b are inflated, the at least one source 6520, 6520b is deflated. Alternatively, an individual source may be fluidly connected to each respective structurally modifiable body 6504a, 6504b, 6506a, 6506b.

[0871] It should be appreciated that the energy absorption of a SIP device in the deployed configuration may be greater than the energy absorption of the SIP device in the stowed configuration. In an embodiment, the transformation of a head SIP device between a retracted configuration and an extended configuration may occur automatically in response to installation of the child seat upon a vehicle seat. With reference to FIGS. 27A-27B, headrest 2502 and the first and second SIP devices 2512a, 2512b, 2514a, 2514b are identical to those in FIGS. 26A-26E. When a child seat such as 2500 for example, is in a forward-facing orientation (FIG. 27A), a belt 2530 operable to couple the child seat 2500 to a vehicle seat is arranged at a first location, such as near a center of the upright portion 2532 of the child seat 2500. Similarly, when the child seat 2500 is in a rearward-facing orientation (FIG. 27B), the belt 2530 operable to couple the child seat 2500 to a vehicle seat is arranged at a second location about the child seat 2500, such as near a front 2536 of the seat portion 2534. As this belt 2530 is tensioned, it applies a force to a respective actuator 2540, 2542 associated with one of the first and second locations.

[0872] In the illustrated, non-limiting embodiment, only a portion of the plurality of head SIP devices 2512a, 2512b, 2514a, 2514b arranged at the headrest 2502 are transformed between the retracted configuration and the extended configuration in response to installation of the belt at a respective location. For example, when the child seat 2500 is installed in a forward-facing orientation, the belt 2530 engages actuator 2540 causing only the second head SIP devices 2514a, 2514b arranged near a front of the headrest 2502 to transform to the extended configuration. In this forward-facing installation orientation, the first head SIP devices 2512a, 2512b located near a rear of the headrest 2502 would remain in the retracted configuration. Similarly, when the child seat 2500 is installed in a rearward-facing orientation, the belt 2530 engages actuator 2542, causing only the first head SIP devices 2512a, 2512b arranged near a rear of the headrest 2502 to transform to the extended configuration. In this rearward-facing orientation, the second head SIP devices 2514a, 2514b located near a front of the headrest 2502 would remain in the retracted configuration.

[0873] In other embodiments, transformation of at least one head SIP device between the retracted and extended configurations may occur automatically in response to the presence of an occupant within the child seat, or in response to application of a force to the child seat, such as during a side impact event for example. Although a first and second head SIP device 2512a, 2512b, 2514a, 2514b are shown at each headrest side member 2508, 2510, it should be appreciated that embodiments having only a single head SIP device are also within the scope of the disclosure. Further, it should be appreciated that in embodiments where a plurality of head SIP devices arranged at the same portion of a headrest, such as the same headrest side member for example, are transformable, the plurality of head SIP devices may be transformable between a retracted configuration and an extended configuration simultaneously/in unison or independently.

[0874] With reference to FIGS. 82A and 82B, another embodiment of headrest 7900 having a first head SIP portion 7902a including at least one first head SIP device 7904a, and a second head SIP portion 7902b having at least one second head SIP device 7904b is illustrated. As shown, the first head SIP portion 7902a is arranged between a back portion 7906 of the headrest 7900 and a first headrest side member 7908, and the second head SIP portion 7902b is arranged between the headrest back portion 7906 and a second headrest side member 7910. Although the first and second head SIP portions 7902a, 7902b, as well as the corresponding head SIP devices 7904a, 7904b, are illustrated as separate devices not integrated into a connected SIP assembly, it should be understood that in other embodiments, such an assembly

incorporating the two SIP devices 7904a, 7904b connected together may be mounted to the inner surface of the headrest 7900.

[0875] As shown, a configuration of a side impact protection device, such as head SIP devices 7904a and 7904b for example, may vary along a longitudinal axis CLA extending between the headrest back portion 7906 and a front 7930a, 7930b of the head receiving region 7905 of a headrest 7900. For example, each of the head SIP devices 7904a, 7904b includes an inwardly facing surface 7912a, 7912b having a first side impact protection area 7914a, 7914b and a second side impact protection area 7916a, 7916b arranged at an angle relative to one another.

[0876] A portion of the headrest 7900 located between the headrest back portion 7906 and the front end 7930a, 7930b of the headrest 7900 and positioned closest to a central longitudinal axis CLA of a head receiving region 7905 of the headrest 7900 in a lateral direction is referred to herein as a "head contact location," identified at C1 and C2 in FIG. 82A. In an embodiment, the head contact location C1, C2 is the portion of the headrest configured to initially contact an occupant's head during a side impact event.

[0877] The head contact location C1, C2 is laterally offset from the inner surface of the headrest 7900 and may be arranged at an interface between the first side impact protection area 7914a, 7914b and the second side impact protection area 7916a, 7916b of an inwardly facing surface 7912a, 7912b. In such embodiments, a line of intersection as previously described herein with reference to FIGS. 2-23E may also be a head contact location. As shown, the head contact location C1, C2 may be positioned between a surface of the headrest back portion 7906 of the head receiving region 7905, such as headrest support surface 7918, and a center of gravity CoG of an occupant's head in a direction along the central longitudinal axis CLA. In an embodiment, the head contact location C1, C2 is offset from the headrest support surface 7918.

[0878] Similar to the embodiment of FIG. 14, a recess 7920a may be defined between the head contact location C1, C2 and the front 7930a of the headrest 7900. As shown, a vertical plane, represented by PT1 extending from a front end 7930a in a direction or position tangent to the head contact location C1 intersects the headrest support surface 7918 at an intersection location IT1. In an embodiment, a recess 7920a is defined between the vertical plane PT1, the second side impact protection area 1716a, and an in some embodiments, the inner surface 7932a of the headrest side member 7908 extending toward the front 7930a of the headrest from head contact location C1. However, in other embodiments, the recess 7920a, 7920b may be at least partially defined by a plane extending from the head contact location C1, C2 to a plane

extending laterally from an inner edge of the front end 7930a of the headrest and that is coplanar with the first side impact protection area 7914a.

[0879] In an embodiment, another recess or a second recess 7920b of the head receiving region 7905 may be defined between the head contact location C1, C2 and the front 7930b of the headrest 7900. As shown, a second vertical plane, identified at PT2, extends from a front end 7930b in a direction or position tangent to the head contact location C2 intersects the headrest support surface 7918 at an intersection location IT2. In an embodiment, the recess 7920b may be defined between the vertical plane PT2, the second side impact protection area 1716b, and an in some embodiments, the inner surface 7932b of the headrest side member 7910 extending toward the front 7930b of the headrest from head contact location C2. However, in other embodiments, the recess 7920b may be at least partially defined by a plane extending from the head contact location C2 to the plane extending laterally from an inner edge of the front end 7930b of the headrest and that is coplanar with the first side impact protection area 7914b.

[0880] Contact with the head contact location C1, C2, as shown in FIG, 82B, may induce a head roll during a side impact collision. For example, during a side impact collision when a child seat system is in a rear-facing position, a head SIP device 1304a, 1304b enables earlier engagement of the headrest 1301 with the head and initiates head roll. The initiation of head roll allows for energy absorption over a longer period of time and results in off-axis loading of the head. This off-axis loading of the head results in a reduction in pure lateral loading and peak head y-acceleration and increase in head x-acceleration.

[0881] With reference now to FIGS. 28A and 28B, another type of head SIP device suitable for use with a child seat system 2600 is illustrated. In the illustrated, non-limiting embodiment, at least one head SIP device 2602a, 2602b, 2602c is a friction surface 2604a, 2604b, 2604c such as formed via a friction material intended to produce friction between the material and an occupant's head to control or stop motion of the head. One or more head SIP devices 2602a, 2602b, 2602c in the form of a friction surface may be arranged at an interior surface of the headrest 2606. For example, a first friction surface 2604a may be arranged at or generally adjacent to the headrest support surface 2608. A second and/or third friction surface 264b, 2604c may be positioned near a bottom front 2610a, 2610b of a respective headrest side member 2612, 2614. The friction surfaces 2602a, 2602b, 2602c may be arranged at the headrest 2606 and covered by the soft goods positioned about the headrest, or alternatively, may be arranged at (e.g., on an exterior of) the soft goods. Forming a friction surface 2604a at the headrest support surface 2608 may be particularly beneficial when the child seat system 2600

is in a rearward-facing configuration in which an occupant's head is pushed toward the headrest support surface 2608 during a crash event. A friction surface 2604b, 2604c at the bottom front 2610 of the headrest side members 2612, 2614 may be beneficial when the child seat system 2600 is in a forward-facing configuration to prevent an occupant's head from sliding out of the headrest 2606 and striking a vehicle door panel. A friction surface 2604a, 2604b, 2604c as described herein may be formed by positioning a friction material between the headrest 2606 and the soft goods mountable about the headrest 2606, or in embodiments including another head SIP device or a head SIP assembly as previously described herein, the friction material 2604a, 2604b, 2604c may be arranged between the soft goods and a head SIP device or head SIP assembly.

[0882] Another type of head SIP device is operable to extend one or more dimensions of a headrest of the child seat system. With reference to FIGS. 29A and 29B, an illustrated head SIP assembly 2702 includes at least one extended wing 2704a, 2704b positionable at a respective headrest side member 2706, 2708. The extended wings 2704a, 2704b may be connectable to a headrest 2701, or alternatively, may integrally formed therewith. The extended wing 2704a, 2704b may be arranged at the front ends 2710a, 2710b of the headrest side members 2706, 2708 thereby increasing the distance (measured back to front) of the headrest 2701. Alternatively, or in addition, the extended wing 2704a, 2704b may be arranged at a bottom surface 2712a, 2712b of a respective headrest side member 2706, 2708. The extended wings 2704a, 2704b may extend over the entire bottom surface, as shown in FIG. 29A or alternatively, may extend over only a portion thereof (FIG. 29B) to form a notch or cutout 2714 at the bottom of the headrest 2701 for receiving an occupant's shoulder.

[0883] In an embodiment, front ends 2716a, 2716b defined by the extended wings 2704a, 2704b extend at respective non-perpendicular angles to the headrest support surface 2720. Further, the front ends 2716a, 2716b protrude beyond the adjacent edges of respective upright side members 2722, 2724 of the seat shell of the child seat 2700. In an embodiment, the front end 2716a, 2716b of the extended wing may be aligned with or protrude beyond the upright side member 2722, 2724 over its entire height.

[0884] With reference to FIGS. 30A-31B, at least one head SIP device 2804a, 2804b associated with a headrest 2802 and having another configuration is shown. In the illustrated, non-limiting embodiment, the at least one head SIP device 2804a, 2804b is transformable between a first, retracted configuration (FIGS. 30A and 30B) and a second, deployed configuration (FIGS. 31A and 31B). A respective head SIP device 2804a, 2804b may be mounted to a headrest side member 2806, 2808, such as near front ends 2810a, 2810b and/or

bottom surfaces 2812a, 2812b thereof. In the retracted configuration, the head SIP devices 2804a, 2804b may be located within the boundary defined by the headrest 2802. In the deployed or extended configuration, the head SIP devices 2804a, 2804b may protrude beyond the headrest side members 2806, 2808 in one or more directions. The first and second head SIP device 2804a, 2804b may be covered by the soft goods of the headrest 2802 when in both the extended configuration and the retracted configurations. However, in other embodiments, one or more of the first and second head SIP device 2804a, 2804b may protrude through the soft goods when in the extended configuration.

[0885] As shown, each head SIP device 2804a, 2804b may include a body 2820a, 2820b configured to protrude forward of the front end 2810a, 2810b of the headrest side member 2806, 2808 and downward beyond a bottom surface 2812a, 2812b near the front end 2810a, 2810b of the headrest side member 2806, 2808 when in the extended configuration. In an embodiment, the head SIP device 2804a, 2804b may be formed via a structurally modifiable body, such as an inflatable bladder or air bag, and as the structurally modifiable body transforms to an extended configuration, the structurally modifiable body will protrude beyond the front end 2810a, 2810b and/or bottom 2812a, 2812b of the headrest 2801. However, embodiments where the head SIP device 2804a, 2804b is a rigid body are also within the scope of the disclosure.

[0886] FIG. 83 illustrates another embodiment of a headrest 8000 having at least one head SIP device transformable between a first, retracted configuration and a second, deployed configuration. As shown, the headrest 8000 includes a first head SIP device 8002a mounted to a first headrest side member 8004 and a second head SIP device 8002b mounted to a second headrest side member 8006. The head SIP devices 8002a, 8002b may be positioned near front ends 8008a, 8008b of the headrest side members 8004, 8006. Similar to the embodiment of FIGS. 30A-31B, in the retracted configuration, the head SIP devices 8002a, 8002b may be located within a boundary defined by the headrest 8000. In the deployed or extended configuration, the head SIP devices 8002a, 8002b may protrude beyond the headrest side members 8004, 8006, in one or more directions. As shown, each head SIP device 8002a, 8002b may include a body 8010a, 8010b configured to protrude forward of the front end 8008a, 8008b of the headrest side member 8004, 8006.

[0887] FIGS. 122A-122B illustrate another embodiment of a headrest 10802 of a child seat 10800 having at least one head SIP device 10804 transformable between a first configuration (FIG. 122A) and a second configuration (FIG. 122B). The head SIP device 10804 may be removably connectable to the headrest 10802, or alternatively, may be permanently

connected thereto. In position with the seat 10800, the head SIP device 10804 is arranged adjacent to an interior surface 10806 of the headrest 10802 and extends about a substantial entirety of the interior surface 10806. The head SIP device 10804 may be movably attached to the headrest 10802, or alternatively or in addition thereto, to a portion of a harness 10808 of the child seat 10800, such as a strap or a piece of padding affixed to a strap of the harness for example. During normal use of the child seat 10800, the head SIP device 10804 remains positioned adjacent to, and in some embodiments in contact with, the interior surface 10806 of the headrest 10802, as shown in FIG. 122A. In FIG. 122B, during a crash event, the head SIP device 10804 is configured to move with the occupant. Accordingly, the head SIP device 10804 will separate from the interior surface 10806 of the headrest 10802 with the child to protect the head against contact with another surface.

[0888] With reference now to FIGS. 123A-124B, various examples of a headrest configured to deform from a first configuration to second configuration in response to a crash event are illustrated. In FIGS. 123A-12B, a head SIP device 10902 is positioned at or adjacent to an interior surface 10904 of a headrest 10900 of a child seat. As shown, the head SIP device 10902 may extend about a substantial entirety of the interior surface 10904 of the headrest 10900. The headrest 10900 may be formed from a compressible or elastic material configured to deform, for example elongate, when a compressive force is applied thereto. In the illustrated, non-limiting embodiment, when a force is applied to the head SIP device 10902, such as by an occupant's head during a crash event, the material of the head SIP device 10902 is displaced. As shown, the head SIP device 10902 is configured to absorb the energy applied thereto by expanding. In an embodiment, the head SIP device 10902 is configured to deform such that the head SIP device 10902 extends beyond a front end 10906 of the headrest 10900 for example. However, deformation in alternative or additional directions is also within the scope of the disclosure.

[0889] In the non-limiting embodiment of FIGS. 124A-124B, a head SIP device 11002 is similarly positioned at or adjacent to an interior surface 11004 of a headrest 11000 of a child seat. As shown, the head SIP device 11002 may extend about a substantial entirety of the interior surface 11004 of the headrest 11000. The headrest 11000 includes a central portion 11006, a first headrest side member 11008, and a second headrest side member 11010 extending from opposing sides of the central portion 11006. As shown, the portion of the head SIP device 11002 located adjacent to at least one of the first and second headrest side members 11008, 11010 has a double-walled configuration. In the illustrated, non-limiting embodiment, an end 11012a, 11012b of the head SIP device 11002 is folded back onto its inwardly facing

surface 11014 to form the second wall of the portion of the head SIP device 11002 located adjacent to at least one of the first and second headrest side members 11008, 11010. The head SIP device 11002 may be formed from a flexible, bendable material to allow the formation of the fold. In each of the embodiments described herein with respect to FIGS. 83 and 122A-124B, it should be understood that the disclosed head SIP devices, when in the extended configuration, may be covered by the soft goods of the headrest, or alternatively, at least a portion thereof may be external to the soft goods.

[0890] During a crash event, an occupant's head may engage and apply a force to the head SIP device 11002. In the illustrated, non-limiting embodiment, when a force is applied to a side of the head SIP device 11002, such as the double-walled section thereof, the force may cause an adjacent end 11012a, 11012b of the head SIP device 11002 of the interior wall of the head SIP device 11002 to translate. As shown, the head SIP device 11002 is configured to absorb the energy applied thereto by unfolding.

[0891] In the non-limiting embodiment of FIGS. 30A-31B, the head SIP devices 2804a, 2804b are pivotable about an axis between the retracted configuration and the deployed configuration. However, in the embodiment illustrated FIG. 83, the head SIP devices 8002a, 8002b are movable, such as translatable for example, along an axis of each respective headrest side member 8004, 8006 between the retracted and deployed configurations. The bodies 8010a, 8010b of the head SIP devices 8002a, 8002b may be rigid bodies translatable between the retracted and deployed configurations. In such embodiments, a portion of the head SIP devices 8002a, 8002b may be receivable within an interior of the headrest 8000, or alternatively, or additionally, the head SIP devices may be collapsible into themselves, such as via a telescoping configuration. In other embodiments, the head SIP devices 8002a, 8002b may be formed via a structurally modifiable body, such as an inflatable bladder or air bag. In such embodiments, as the structurally modifiable body 8010a, 8010b transforms to the deployed configuration, the structurally modifiable body will protrude forward of the front end 8008a, 8008b of the headrest 8000.

[0892] With reference now to FIGS. 32A-32C, another example of a headrest 2900 having at least one head SIP device is illustrated. As an alternative to, or in addition to the head SIP devices previously described herein, the head SIP devices (not shown) may include one or more rigid or semi-rigid bodies positioned in overlapping arrangement with the headrest side members 2906, 2908 to control a clearance between the side members 2906, 2908 within which an occupant's head is received. In an embodiment, the head SIP devices are contoured to control the clearance such that an occupant's head is spaced or offset from a headrest support

surface of a back portion 2904 of the headrest 2900 by at least a minimum distance. For example, the head SIP devices may be angled relative to one another to position an occupant's head at least about .5 inches, and in some embodiments, at least about.75 inches, about 1 inch, about 1.25 inches, and about at least 1.5 inches from the back portion 2904 of the headrest 2900. The head SIP devices may but need not span the entire headrest support surface between the adjacent headrest side members 2906, 2908.

[0893] In another embodiment, illustrated in FIG. 69A and 69B, at least one head SIP device 6602 is positioned at an exterior of the headrest 6600. In such an embodiment, the at least one head SIP device 6602 is absent coverage by soft goods. As shown, at least one SIP device 6602 may be arranged at a backside 6604 of at least a portion of the headrest 6600. For example, the head SIP device 6602 is illustrated as being positioned adjacent to a backside 6604 of a headrest side member 6606. As previously described, the head SIP device 6602 may have a rigid, semirigid, or inflatable body and may but need not have a contour complementary to the adjacent headrest side member 6606. Such a head SIP device 6602 may absorb energy during a side impact crash. In the illustrated, non-limiting embodiment, the headrest side member 6606 is shown having a lip 6608 arranged at the backside 6604 thereof and extending from a top of the headrest 6600 to a front end 6610 thereof. In an embodiment, the head SIP device 6602 is at least partially positioned underneath the lip 6608, such as within a gap formed between the lip 6608 and the exterior surface of the headrest 6600.

[0894] It should be appreciated that the head SIP devices illustrated and described herein are intended as examples only and that a head SIP device having any suitable configuration is within the scope of the disclosure. Further, although the head SIP devices arranged at opposing sides of a head SIP assembly are generally illustrated as being substantially identical, embodiments where a configuration of the head SIP devices varies from one side of the headrest to the other is also contemplated herein. As will be described in more detail below, a shoulder SIP device may be positioned adjacent to an inner surface of an upright portion of seat shell, such as at a first or second upright side member. Unless another arrangement is noted, any embodiment described herein that includes a shoulder SIP device locatable at such an inner surface region should be understood to position the shoulder SIP device generally between the seat shell of the child seat and soft goods that cover the interior surface of the seat shell. Such a shoulder SIP device may be attached to the structural body of the headrest or to the soft goods positionable thereabout. In embodiments described herein where a shoulder SIP device is associated with, and in some embodiments is movable with, a headrest of a child seat, the shoulder SIP device may, but need not be covered by soft goods.

[0895] With reference now again to FIG. 1, alternatively, or in addition to a head SIP device 70 as illustrated and described herein, the child seat system 20 may also include one or more SIP devices 72a, 72b arranged at an interior surface of the child seat 23 operable to restrict or control movement of a shoulder of an occupant of the child seat system 20. Such SIP devices 72a, 72b, also referred to herein as "shoulder SIP devices" may be arranged at areas of the child seat 23, such as the back or upright portions 28 of the child seat 23 for example, generally aligned with and configured to contact an occupant's shoulder or upper arm.

[0896] With reference now to FIGS. 33A and 33B, the illustrated, non-limiting embodiment of a child seat 3002 includes a seat shell 3003 having an upright portion 3004 including a support surface 3006, a first upright side member 3008, and a second upright side member 3010 as previously described. At least one shoulder SIP device is coupled to the child seat 3002. In the illustrated, non-limiting embodiment, a first shoulder SIP device 3012a is arranged at the first upright side member 3008 and a second shoulder SIP device 3012b is arranged at the second upright side member 3010. Although only a single shoulder SIP device 3012a, 3012b is illustrated and described as being arranged at each side of an occupant, it should be understood that embodiments including a plurality of shoulder SIP devices operable to engage the same shoulder of an occupant are within the scope of the disclosure.

[0897] The first and second shoulder SIP devices 3012a, 3012b may be permanently or removably coupled to the child seat 3002. In an embodiment, shown in FIG. 33C, the child seat 3002 includes at least one engagement feature 3014a, such as a rib for example, which protrudes from an interior surface of the seat shell 3003, such as at an upright side member 3008, 3010. The engagement feature 3014a may abut or engage a portion of a corresponding shoulder SIP device 3012a, 3012b to facilitate the proper positioning of the shoulder SIP devices 3012a, 3012b about the child seat 3000.

[0898] The first shoulder SIP device 3012a and the second shoulder SIP device 3012b are disposed at opposite sides of the child seat 3002 and may be substantially identical or may have varying configurations. Although the shoulder SIP devices 3012a, 3012b illustrated in FIGS. 33A-33C have a generally rounded shape, such as a circular or oval shape for example, embodiments where the one or more shoulder SIP devices 3012a, 3012b have another shape are also within the scope of the disclosure. As shown, the first and second shoulder SIP devices 3012a, 3012b may be aligned along a horizontal axis and protrude beyond an interior surface of the upright side members 3008, 3010 towards an interior of the child seat 3002. In an embodiment, a shoulder SIP device 3012a, 3012b is sized and positioned to allow the headrest

3020 (FIG. 33A) of the child seat 3002, including any soft goods associated therewith, to be freely raised and lowered without interference.

[0899] With reference now to FIGS. 34A and 34B, an example of a shoulder SIP device 3100, similar to shoulder SIP device 72 and 3012a, 3012b for example, is illustrated in more detail. As shown, the shoulder SIP device 3100 includes a body having a base or mounting surface 3102 mountable to a portion of a child seat, an occupant facing surface 3104 engageable by an occupant of the child seat, and a side portion 3106 extending between the base 3102 and the occupant facing surface 3104. In an embodiment, best shown in FIGS. 34A and 34B, an interface or transition between the occupant facing surface 3104 and the side portion 3106 of a shoulder SIP device 3100 is shaped or contoured, for example rounded or angled to facilitate movement of an occupant about the shoulder SIP device 3100. In other embodiments, this interface may include a sloped surface extending outwardly from the occupant facing surface toward the base. In an embodiment, this shape of this transition may facilitate forward movement of an occupant.

[0900] The shoulder SIP device 3100, such as those used in the exemplary embodiment of FIGS. 33A-33C, may have a constant thickness defined by the side portion 3106. In such embodiments, a distance between the occupant facing surface 3104 of the shoulder SIP device 3100 and the base 3102 is constant. In embodiments where an upright side member of a child seat, such as upright side members 3008, 3010 for example, extends at a non-perpendicular angle to the upright support surface, such as surface 3006, the occupant facing surface 3104 of the shoulder SIP device 3100 affixed to an upright side member 3008, 3010 may also be arranged at non-perpendicular angle to the upright support surface.

[0901] In other embodiments, such as shown in FIGS. 34A and 34B, a thickness of a side portion 3106 of a shoulder SIP device 3100 may vary, such as between a front and a back of a child seat. For example, in the non-limiting embodiment of a child seat 3200 shown in FIGS. 35A-35B, a side portion 3204 of a shoulder SIP device 3202 affixed to an upright side member 3206 of the child seat 3200 may vary such that the angle of a base 3208 of the shoulder SIP device 3202 is complementary to the angle of the upright side member 3206 relative to an upright support surface 3210. Accordingly, when the base 3208 of the shoulder SIP device 3202 is mounted to the upright side member 3206 at the proper position, an occupant facing surface 3212 of the shoulder SIP device 3202 is oriented substantially perpendicular to the upright support surface 3210. Although only a single shoulder SIP device 3202 is illustrated in the FIGS. , it should be appreciated that another shoulder SIP device 3202 may be disposed at

an opposite side of the seat, such as affixed to upright side member 3220 at a similar position for example.

[0902] With reference to FIGS. 36A-36D, a shoulder SIP device 3300 according to another embodiment is illustrated. Similar to the previously described embodiment, the shoulder SIP device 3300 includes a body having a base or mounting surface 3302 mountable to a portion of a child seat 3320, such as an upright side member 3322 for example, an occupant facing surface 3304 engageable by an occupant of the child seat, and a side portion 3306 extending between the base 3302 and the occupant facing surface 3304. An interface between the occupant facing surface 3304 and the side portion 3306 may be rounded as previously described. In the illustrated, non-limiting embodiment, the occupant facing surface 3304 of the shoulder SIP device 3300 has a non-planar configuration and includes a first portion or area 3308 arranged at a first angle relative to the base 3302, and a second portion or area 3310 arranged at a second angle relative to the base 3302. The first portion 3308 and the second portion 3310 may be separated from one another by a central portion 3312.

[0903] The thickness of the shoulder SIP device 3300 may be greatest at the central portion 3312 such that the first portion 3308 and the second portion 3310 slope downwardly away from the central portion 3312. The slope of the first and second portions 3308, 3310 may be equal or may be different. In an embodiment, the central portion 3312 has a generally rounded contour that forms a smooth transition between the first portion 3308 and the second portion 3310 of the occupant facing surface 3304. Inclusion of the curved central portion 3312 and the sloped first and second portions 3308, 3310 facilitates movement of an occupant's shoulder about the shoulder SIP device 3300 during a crash event. Although only a single shoulder SIP device 3300 is illustrated in the FIGS., it should be appreciated that another shoulder SIP device 3300 may be disposed at an opposite side of the seat, such as at a similar location affixed to upright side member 3224 at a similar position for example.

[0904] Another embodiment of a shoulder SIP device suitable for use with a child seat 3400 is illustrated in FIGS. 37A-37B. As shown, at least one shoulder SIP device 3402a, 3402b associated with the child seat 3400 has an elongated body positionable at the upright portion 3406 of a seat shell 3404 of the child seat 3400. In an embodiment, a first shoulder SIP device 3402a is positioned in overlapping arrangement with a first upright side member 3408 of the child seat 3400 and a second first shoulder SIP device 3402b is positioned in overlapping arrangement with a second upright side member 3410 of the child seat 3400. Although the child seat 3400 is illustrated and described as having two separate and distinct shoulder SIP devices

3402a, 3402b, embodiments where the two bodies are integral or are connected together as a single shoulder SIP device are also contemplated herein.

[0905] Top portions 3412a, 3412b of respective shoulder SIP devices 3402a, 3402b may be aligned with a top 3403 of the upright portion 3406 of the seat shell 3404, and the shoulder SIP devices 3402a, 3402b may extend over only a portion, or alternatively, over a substantially entire height of an upright side member 3408, 3410. Bottom or lower end portions 3414a, 3414b of the shoulder SIP device 3402a, 3402b may be aligned with or arranged near a bottom of a headrest 3416 of the child seat 3400 when the headrest 3416 is in its lowermost position relative to the seat shell 3404. Although the shoulder SIP devices 3402a, 3402b are illustrated as having an outer periphery including a contour complementary to respective upright side members 3408, 3410, embodiments where the shoulder SIP devices 3402a, 3402b have another contour are also contemplated herein. Further, respective contours of occupant facing surfaces 3420a, 3420b of the shoulder SIP device 3402a, 3402b may be configured so that the headrest 3416 is movable between a lowered position (FIG. 37A) and a raised position (FIG. 37B) without interference by the shoulder SIP devices 3402a, 3402b.

[0906] Another example of a child seat 6700 is illustrated in FIGS. 70A-70B. As shown, the child seat 6700 includes a seat shell 6702 having an upright portion 6704 and a seat portion 6706 and a headrest 6708 that is movable relative to the upright portion 6704 between a first, low position (FIG. 70A) and a second, high position (FIG. 70A). In an embodiment, at least one shoulder SIP device is coupled to and extends downwardly beyond a bottom 6710 of the headrest 6708. As shown, a first shoulder SIP device 6712a may be arranged near a first side 6714 of the headrest 6708 and a second shoulder SIP device 6712b may be arranged near a second, opposite side 6716 of the headrest 6708. The first and second shoulder SIP devices 6712a, 6712b may be any suitable size and shape. By associating the at least one shoulder SIP device 6712a, 6712b with the headrest 6708, the shoulder SIP device 6712a, 6712b is movable with the headrest 6708. Such a configuration may provide enhanced protection by adapting positions of the shoulder SIP devices 6712a, 6712b based on the height of the occupant. Further, in some embodiments, the shoulder SIP devices 6712a, 6712b may alternatively or additionally be movable relative to the headrest 6708, such as to provide improved adaptability.

[0907] With reference to FIGS. 84A-85, another example of a child seat 8100 having a headrest 8102 movable between a low position (FIG. 84A) and a high position (FIG. 84B) is illustrated. Similar to the previous embodiment, a first shoulder SIP device 8104a may be coupled to and extends downwardly beyond a bottom 8110a of a first headrest side member 8106, and a second shoulder SIP device 8104b may be coupled to and extend downwardly

beyond a bottom 8110b of a second headrest side member 8108. The shoulder SIP devices 8104a, 8104b are movable with the headrest 8102 relative to the seat body of the child seat 8100, such as between a first position and a second position.

[0908] An example of a shoulder SIP device such as the shoulder SIP device 8104a is shown in detail in FIG. 85. In the illustrated, non-limiting embodiment, the shoulder SIP device 8104a includes a body 8112 formed from a housing 8114 and at least one insert 8116. As shown, the housing 8114 may include a back wall 8124 and at least one sidewall 8126 extending at an angle from the back wall 8124. In some embodiments, the back wall 8124 of the housing 8114 has a contour generally complementary to at least one of the corresponding headrest side member 8106 and an adjacent upright side member 8122 of a seat back 8120 of the child seat 8110. However, embodiments where the back wall 8124 has a different contour are also contemplated herein. As shown, the back wall 8124 may form an end of the housing 8114 and the at least one sidewall 8126 may protrude substantially perpendicularly from of the back wall 8124. Further, the at least one sidewall 8126 may include a plurality of sidewalls or a single continuous sidewall that extends about a portion of a perimeter of the back wall 8124 to define a cavity 8128 between the at least one sidewall 8126 and the back wall 8124 within which the insert 8116 is receivable.

[0909] The at least one insert 8116 may be a single insert, or alternatively, may be a plurality of inserts having similar or different configurations. The single insert, or the plurality of inserts in combination, may have a size and/or shape complementary to the cavity 8128 of the housing 8114. The at least one insert 8116 may be permanently or removably mounted within the cavity 8128 via any suitable mounting mechanism, such as an adhesive, or one or more engagement features configured to cooperate with corresponding portions of the housing. In an embodiment, the housing 8114 is formed from a first material and the insert 8116 is formed from a second material. The hardness of the first material may be similar to, or alternatively, may be different from the hardness of the second material. In an embodiment, the first material is plastic and the second material is a foam material.

[0910] The shoulder SIP device 8104a is connectable to and movable with the headrest 8102. In an embodiment, the shoulder SIP device 8104a is mechanically coupled to the headrest 8102 via one or more fasteners, such as screws or bolts (not shown) for example. However, other suitable coupling mechanisms, such as hook and loop fasteners, magnets, or snaps for example, may be used to couple the shoulder SIP device 8104a in position. As shown, the coupling mechanism may be configured to engage a portion of the housing 8114. For example, a plurality of openings 8130 for receiving corresponding fasteners may be formed in the

housing 8114, such as at a surface thereof facing toward an interior of the cavity 8128. Embodiments including a coupling mechanism arranged at another location about the housing, or alternatively or additionally, arranged at the insert are also within the scope of the disclosure. Further, embodiments where the same coupling mechanism is used to affix the at least one insert 8116 to the housing 8114 and to affix the shoulder SIP device 8104a to the headrest 8102 are also contemplated herein. It should be appreciated that shoulder SIP device 8104b arranged at the second headrest side member 8108 may have a similar construction and coupling mechanism for connecting the shoulder SIP device 8104b to the headrest 8102.

[0911] With reference now to FIGS. 136A-141, various examples of another shoulder SIP device are illustrated. In the non-limiting embodiment of FIGS. 136A-136B, the body 12002 of the shoulder SIP device 12000 similarly includes a back wall 12004 and at least one mounting wall 12006 oriented at an angle relative to the back wall 12004. The back wall 12004 may have a contour generally complementary to a portion of a headrest. However, embodiments where the back wall 12004 has a different contour are also contemplated herein.

[0912] The shoulder SIP device 12000 may be positioned relative to a child seat such that an occupant is configured to contact a forward-facing surface 12008 of the back wall 12004. Further, the mounting wall 12006 may extend at a non-parallel angle from the back wall 12004. In an embodiment, the mounting wall 12006 extends from the forward-facing surface 12008 of the back wall 12004, such as near a first end 12010 of the back wall 12004 for example. A coupling mechanism (not shown) for connecting the shoulder SIP device 12000 to a portion of a child seat, such as to a headrest or portion of s seat shell for example, may be associated with a portion of the body 12002. Similar to the previous embodiment, the coupling mechanism may include one or more fasteners, such as screws or bolts (not shown) for example, receivable within corresponding openings 12012 formed in the mounting wall 12006.

[0913] In some embodiments, the outwardly facing surface 12014 of the back wall 12004 is a solid or substantially solid surface. However, in other embodiments, such as shown in FIG. 136B, the back wall 12004 has one or more areas of material removed from the outwardly facing surface 12014 resulting in the formation of hollow pockets 12016 at the outwardly facing surface 12014. These pockets or areas of removed material 12016 may extend through only a small portion of the thickness of the back wall 12004, or alternatively, may extend over substantially the entire thickness of the back wall 12004 while leaving a solid forward-facing surface 12008. The resulting structural ribs 12018 formed at the back wall 12004 provide the necessary structural rigidity to the shoulder SIP device 12000. Although a combination of horizontally oriented and vertically oriented structural ribs 12018 are

illustrated, it should be understood that embodiments including only horizontally oriented ribs, only vertically oriented ribs, or ribs at another orientation are also contemplated herein.

[0914] The structural ribs 12018 formed by removing areas of material may have a contour complementary to the contour of the body 12002. However, in some embodiments, such as shown in FIG. 137, the outermost edge 12020 of one or more of the structural ribs 12018, such as the edge of the horizontally oriented ribs 12018 of the shoulder SIP device 12000 for example, may have a contour different than that of the body 12002. In the illustrated, non-limiting embodiment, the edge 12020 of one or more ribs 12018 is scalloped by forming small notches therein. As a result, the edge 12020 of the at least one rib 12018 is at least partially offset, such as in an internal direction, from a periphery of the back wall 12004 at that location.

[0915] Another example of a shoulder SIP device 12100 is illustrated in FIGS. 138 and 139. Similar to the embodiment of FIGS. 136A-136B, the shoulder SIP device 12100 includes a body 12102 having a back wall 12104 and at least one mounting wall 12106 extending at an angle from a forward-facing surface 12108 of the back wall 12104. Alternatively, or in addition to removing areas of material from the outward-facing surface 12114 of the back wall 12104, in the illustrated, non-limiting embodiment, one or more areas of material may be removed from the forward-facing surface 12108 of the back wall 12104 resulting in the formation of hollow pockets 12116 in the body of the shoulder SIP device 12100 (see FIG. 138). The hollow pockets 12116 may be filled with a secondary material 12122 (see FIG. 139). In an embodiment, the hollow pockets 12116 formed in the body 12102 are filled with pieces of expanded polypropylene. However, embodiments where another suitable material is alternatively or additionally arranged within the hollow pockets 12116 are also contemplated herein.

[0916] As noted above, an occupant may directly contact a forward-facing surface 12008, 12108 of the back wall 12004, 12104, or a secondary material positioned within the pockets 12116 formed in the forward-facing surface 12008, 12108, such as secondary material 12122. However, in other some embodiments, an insert may be arranged at the forward-facing surface 12008, 12108 of the back wall 12004, 12104. With reference to FIGS. 140A-140B, an example of an insert 12250 positionable adjacent to the forward-facing surface of a back wall, such as back wall 12104 of the shoulder SIP device 12100 for example, is illustrated. As shown, the front 12252 of the insert 12250 may include a continuous or solid surface. In the illustrated, non-limiting embodiment of FIG. 140B, the rear 12254 of the insert 12250 includes one or

more contoured areas 12960. However, embodiments where the rear 12954 of the insert 12250 also has a substantially solid, smooth surface are also contemplated herein.

[0917] In an embodiment, the one or more contoured areas 12260 are complementary to the one or more hollow pockets 12216 formed at the forward-facing surface 12208 of the back wall 12204. Accordingly, each contoured area 12260 may form a tight fit with a respective pocket of the body 12202. One or more grooves or recesses 12262 may be formed in the rear surface to define the various contoured areas. These grooves 12262 may be complementary to the structural ribs 12218 defined by the hollow pockets 12216. The thickness of each contoured area may be substantially identical, as shown. However, in other embodiments, the thickness of the contoured areas 12260 may vary based on the depth of the back wall 12204 and/or the depth of a corresponding pocket 12216 at that location. The exemplary insert 12250 is formed from an expanded polypropylene material; however, and suitable material is contemplated herein.

[0918] In embodiments where an insert 12250 or secondary material 12222 is integrated into the shoulder SIP device 12200, as illustrated and described herein, the insert 12250 or secondary material 12222 may be glued or affixed to the back wall 12204 using an adhesive, such as adhesive tape for example. However, any suitable type of connection, including both permanent and removable connections, are contemplated herein.

[0919] With reference to FIG. 141, another example of a shoulder SIP device 12300 is illustrated. Similar to the previous embodiment, the shoulder SIP device 12300 includes a body 12302 having a back wall 12304 and at least one mounting wall 12306 extending at an angle from a forward-facing surface 12308 of the back wall 12304. An outward-facing surface 12310 of the back wall 12304 may be substantially solid, or alternatively, may have a plurality of pockets formed therein as previously described. In the illustrated, non-limiting embodiment, a secondary body 12320 is affixed to the outward-facing surface 12310 of the back wall 12304. The secondary body 12320 may but need not extend over an entirety of the outward-facing surface 12310. A thickness of the secondary body 12320 may be uniform over its length, or alternatively, may vary, such as based on a profile of the body 12302 for example. The secondary body 12320 may be formed from any suitable material. In an embodiment, the material of the secondary body 12320 has an increased hardness than the material of the body 12302. However, embodiments where the secondary body 12320 has the same hardness or a reduced hardness relative to the body 12302 are also contemplated herein.

[0920] With reference now to FIGS. 152A-152B, an example of a shoulder SIP device 13100 positionable adjacent to a head SIP device 13102 is illustrated. The head SIP assembly

13102 may have a configuration substantially identical to that illustrated and described with respect to FIGS. 132A-133B. As shown, the head SIP assembly 13102 includes a connector member 13104 having a central body portion 13106, a first side portion 13108 extending from a first side of the body portion 13104, and a second side portion 13110 extending from a second opposite side of the body portion 13104. A first head SIP device (not shown) may be arranged at or adjacent to the first side portion 13108 of the connector member 13104 and a second head SIP device 13112b may be arranged at or adjacent to the second side portion 13110 of the connector member 13104. In the illustrated, non-limiting embodiment, the head SIP devices 13112a, 13112b are mounted near a rear of the head SIP assembly 13102, such as at an interface between the body portion 13106 and the respective side portions 13108, 13110 of the connector member 13104 for example.

[0921] In an embodiment, a cutout or notch is formed at the bottom of the head SIP assembly 11800. As shown, a first cutout 13114a may be formed directly underneath the first head SIP device 13112a and a second cutout 13114b may be formed directly underneath the second head SIP device 13112b. The cutouts 13114a, 13114b may form part of a vehicle belt path when a child seat system associated therewith is in a forward-facing configuration, such as in a booster mode of operation. Accordingly, a bottom of the first head SIP device and the second head SIP device may define a portion of the vehicle belt path.

[0922] As shown, at least one shoulder SIP device 13100a, 13100b, similar to that described with respect to FIGS. 136A and 136B is arranged directly adjacent to the head SIP assembly 13002. However, it should be understood that the at least one shoulder SIP device may have a configuration as described with respect to the shoulder SIP devices 6712a, 6712b, 8104a, 8104b, 12000, 12100, 12200 and 12300 of the embodiments shown in FIGS. 70A-70B, 84A-85, and 136A-141. In the illustrated, non-limiting embodiment, when mounted to a child seat, such as child seat 6700 or 8100 for example, the at least one shoulder SIP device 13100a, 13100b is movable with the headrest SIP assembly 13102 and a corresponding headrest (not shown) of the child seat.

[0923] In the illustrated, non-limiting embodiments shown in FIGS. 152A-152B, a first shoulder SIP device 13100a is positioned directly underneath a corresponding opening 13114a formed at the first side portion 13108 of the head SIP assembly 13102 and a second shoulder SIP device 13100b is positioned directly underneath a corresponding opening 13114b formed at the first side portion 13110 of the head SIP assembly 13102. Accordingly, both the head SIP assembly 13102 and a corresponding shoulder SIP device 13100a, 13100b may define at least a portion or portions of the vehicle belt path of the child seat. For example, the head SIP

assembly 13102, or the head SIP devices 13112a, 13112b thereof, may define a top or upper boundary of the vehicle belt path and the shoulder SIP devices 13100a, 13100b may define a bottom or lower boundary of the vehicle belt path.

[0924] With reference now to FIGS. 257A-260B, another example of a child seat 18100 including at least one shoulder SIP device is illustrated. As shown, the child seat 18100 includes a seat shell 18102 having an upright portion 18104 and a seat portion 18106 and a headrest 18108 that is movable relative to the upright portion 18104 between a low position and a high position. In the illustrated, non-limiting embodiment, the headrest 18108 additionally includes a first head SIP device 18114a arranged at a first side 18110 of the headrest 18108, and a second head SIP device 18114b at a second, opposite side 18112 of the headrest 18108. The head SIP devices 18114a, 18114b may have a configuration as described in any of the previous embodiments. By way of non-limiting example, the head SIP devices 18114a, 18114b extend inwardly into the head receiving region 18113 of the headrest and have a configuration as described in any of the embodiments shown in FIGS. 3A-23F, 82A-82B, 132A-135C, 152A-152B, 242A-C.

[0925] As in the non-limiting embodiment previously described with reference to FIGS. 70A-70B, at least one shoulder SIP device is coupled to and extends downwardly beyond a bottom 18116 of the headrest 18108. As shown, a first shoulder SIP device 18120a may be arranged near the first side 18110 of the headrest 18108 and a second shoulder SIP device 18120b may be arranged near the second, opposite side 18112 of the headrest 18108. The first and second shoulder SIP devices 18120a, 18120b may be any suitable size and shape. By associating the at least one shoulder SIP device 18120a, 18120b with the headrest 18108, the shoulder SIP device 18120a, 18120b is movable with the headrest 18108 relative to the seat shell 18102.

[0926] In the illustrated, non-limiting embodiment, the shoulder SIP devices 18120a, 18120b are movable relative to the headrest 18108. As shown, each of the shoulder SIP devices 18120a, 18120b may be rotatable about a respective axis S1, S2 relative to the headrest 18108. A locking pin 18122a, 18122b (FIGS. 259B, 260B) may be used to mount a respective shoulder SIP device 18120a, 18120b to the headrest 18108. In such embodiments, the locking pins 18122a, 18122b may define the first and second axes S1, S2 of rotation of the shoulder SIP devices 18120a, 18120b, respectively. Although not shown, each locking pin 18122a, 18122b, or the headrest 18108 or shoulder SIP devices 18120a, 18120b proximate a locking pin 18122a, 18122b may include a locking mechanism to selectively lock the shoulder SIP devices 18120a, 18120b against rotation.

[0927] The shoulder SIP devices 18120a, 18120b are rotatable about their axes S1, S2 to adjust a width defined between the inwardly facing surfaces 18124a, 18124b of the first and second shoulder SIP devices 18120a, 18120b. The shoulder SIP devices 18120a, 18120b are rotatable between a first position (FIGS. 258A, 259A, 259B) and a second position (FIGS. 258B, 260A, 260B). In the first position, a distal end 18126a, 18126b of each of the first and second shoulder SIP devices 18120a, 18120b may be generally aligned with an edge of a corresponding head SIP device 18114a, 18114b, or an inward surface 18118a, 18118b of the side 18110, 18112 of the headrest 18108. In the second position, the distal end 18126a, 18126b of each shoulder SIP device 18120a, 18120b may be rotated out of alignment with the corresponding head SIP device 18114a, 18114b. As shown, the distal end 18126a, 18126b of each shoulder SIP device 18120a, 18120b may be arranged near an outer surface 18119a, 18119b of the first side 18110 and the second side 18112 of the headrest 18108, respectively. It should be appreciated that the shoulder SIP devices 18120a, 18120b may be arranged at one or more intermediate positions between the first and second positions described herein. This rotatability of the shoulder SIP devices 18120a, 18120b allows the positioning of the shoulder SIP devices 18120a, 18120b to be adaptable based on the size and/or height of the occupant, thereby providing enhanced protection.

[0928] Although this movability of the shoulder SIP devices 18120a, 18120b relative to the seat shell 18102 and headrest 18108 is described with respect to an embodiment where the shoulder SIP devices 18120a, 18120b are mounted to and movable with the headrest 18108, it should be appreciated that any of the shoulder SIP devices that are described herein as being mounted to the back portion of the seat shell, rather than the headrest, such as shoulder SIP devices 7102, 7202, 7404, 7504, 7702, 7804, 8104, 12000, 12100, 12250, 12300, 12402, 12508, 12620, 16726, 16942, may also configured to allow for this same rotation to adjust a position of the shoulder SIP device. Further, it should be understood that the shoulder SIP devices 18120a, 18120b are suitable for use in any of its allowable positions and that transformation between these positions occurs intentionally via a user, not in response to a side impact force.

[0929] A shoulder SIP device of any of the embodiments described herein, such as any of the shoulder SIP devices 6712a, 6712b, 8104a, 8104b, 12000, 12100, 12200, 12300, and 13100a, 13100b (and further the shoulder SIP devices 12402 and 12502 described below with respect to FIGS of FIGS. 142A-143B) may additionally include soft goods positioned in overlapping arrangement with at least a portion of the body of the shoulder SIP device, such as the front face of the body of the shoulder SIP device. In such embodiments, the soft goods

surrounding the shoulder SIP devices 6712a, 6712b, 8104a, 8104b, 12000, 12100, 12200, 12300, 13100a, 13100b, 12402 and 12502 may form or define part of the vehicle belt path.

[0930] In the illustrated, non-limiting embodiment of FIGS. 142A-142B, a child seat 12400 includes a shoulder SIP device (not shown) at least partially covered by soft goods 12402. In an embodiment, the shoulder SIP device is substantially encapsulated by the soft goods 12402. The soft goods 12402 are separate from the other soft goods of the child seat 12400, such as from the soft goods of the headrest 12404 and the soft goods 12406 of the upright portion 12408 of the child seat 12400. As shown, the soft goods 12402 cover a substantial entirety of the body of the shoulder SIP device. However, embodiments where the soft goods 12402 extend about only a portion of the body of the shoulder SIP device are also contemplated herein. The soft goods 12402 may include padding, such as a polyurethan foam for example, positionable in overlapping arrangement with or directly adjacent to a front or forward-facing surface of the body of the shoulder SIP device, such as surface 12008, 12108, 12208, 12308 for example.

[0931] In other embodiments, the soft goods of the shoulder SIP device, such as shoulder SIP device 6712a, 6712b, 8104a, 8104b, 12000, 12100, 12200 and 12300 may be integral with the soft goods of another portion of the child seat. With reference to FIGS. 143A-143B, a child seat 12500 having at least one shoulder SIP device 12502 mounted to and movable with a headrest 12504 is illustrated. It should be understood that the shoulder SIP device 12502 may have a configuration as disclosed with respect to any of 70A-70B, 84A-85, 136A-141. The child seat 12500 includes headrest soft goods 12506 positionable about the inner surface of the headrest 12504 that may be contacted by an occupant's head. In the illustrated, non-limiting embodiment, the headrest soft goods 12506 is elongated and has at least one pocket 12508a, 12508b formed therein at a position vertically beneath a bottom of the headrest 12504. The at least one shoulder SIP device 12502 is insertable into the at least one pocket 12508a, 12508b such that the soft goods of the pocket 12508a, 12508b substantially cover a forward-facing surface 12510 of the shoulder SIP device 12502. Although the soft goods 12508a, 12508b are suggested as being integral with the headrest soft goods 12506, in other embodiments soft goods corresponding to the shoulder SIP devices may be integral with the soft goods associated with the upright support portion a child seat.

[0932] With reference to FIGS. 144A-144B, in some embodiments, the body of the soft goods 12604 positionable about a headrest 12602 of a child seat 12600 may be elongated and extend about the upright or back portion 12608 of the child seat. For example, the headrest soft goods 12604 may also overlap all or at least a portion of the upright support surface (not shown)

of the child seat 12600. The headrest soft goods 12604 includes a headrest portion 12610 positionable in overlapping arrangement with the headrest 12602 and a back portion 12612 positionable in overlapping arrangement with the back portion 12608 of the child seat 12600. The headrest portion 12610 of the soft goods 12604 may be adapted to fit a headrest 12602 including an SIP device (not shown) located at the headers 12602. In some embodiments, the center panel of the headrest portion 12610 may be removed or modified to accommodate the SIP device. To allow for proper movement of one or more shoulder SIP devices 12620a, 12620b with the headrest 12602, at least one cutout, identified at 12622, may be formed at one or more areas of the headrest soft goods 12604. In the illustrated, non-limiting embodiment, the cutouts 12622 are formed proximate to an upper end 12624 of the back portion 12612 located near the headrest portion 12604. The cutouts 12622 may be sized and shaped based on the configuration of the shoulder SIP devices 12620a, 12620b mountable to the headrest 12602 so that headrest soft goods 12604 do not interfere with movement of the shoulder SIP devices 12620a, 12620b. It should be understood that these cutouts 12622 may exist regardless of whether the shoulder SIP devices are covered by soft goods and whether such soft goods are part of the headrest soft goods 12604.

[0933] With reference now to FIGS. 38A-49E, various examples of SIP devices suitable for use with a child seat to limit movement of the torso or hips of an occupant of the child seat are illustrated. Such SIP devices may be referred to herein as "torso SIP devices," with these devices typically being arranged at an occupant facing surface of a child seat at an area of the child seat (either the seat portion of the back portion) generally aligned with and configured to contact an occupant at any position between along the occupant's torso, such as between a hip and a shoulder for example. It should be understood that torso SIP devices as illustrated and described herein may be integrated into a child seat as an alternative to, or in combination with one or more of the head SIP devices and shoulder SIP devices as previously described herein. As will be described in more detail below, a torso SIP device may be positioned adjacent to an inner surface of seat shell, such as at either the upright portion or the seat portion thereof. Unless another arrangement is noted, any embodiment described herein that includes a torso SIP device locatable at such an inner surface region should be understood to position the torso SIP device generally between the seat shell of the child seat and soft goods that cover the interior surface of the seat shell. Such a torso SIP device may be attached to the seat shell or to the soft goods positionable thereabout.

[0934] With reference to FIGS. 213A-214B, a child seat system 15700 is illustrated according to an embodiment. The child seat system 15700 includes a child seat 15702

removably or permanently connected to a support base 15704. The child seat 15702 includes a seat shell 15706 that defines a seat portion 15708 and an upright portion 15710 of the child seat 15702. As shown, the upright portion 15710 includes an upright support surface 15712, a first upright side member 15714 extending from a first side of the upright support surface 15712 and a second upright side member 15716 extending from a second, opposite side of the upright support surface 15712. In the illustrated, non-limiting embodiment, a single torso SIP device 15720 is arranged about the child seat 15702 at or near the torso area of an occupant. The torso SIP device 15720 may be mounted to the upright support surface 15712. As shown, the torso SIP device 15720 is positioned such that a first end 15722 of the torso SIP device 15720 is at a central portion of the upright support surface 15712 and a second, opposite end 15724 of the torso SIP device 15720 may be adjacent to a bottom edge 15726 of the upright support surface 15712. In an embodiment, the torso SIP device 15720 is positioned so as not to interfere with a headrest 15718 of the child seat 15702 during movement along its path of travel relative to the upright portion 15710 of the child seat 15702.

[0935] The torso SIP device 15720 has an outwardly facing surface or base surface 15730 configured to contact a surface of the child seat 15702, such as the upright support surface 15712 for example. However, embodiments where the outwardly facing surface 15730 is positioned to alternatively or additionally engage a surface of at least one of the first and second upright side members 15714, 15716 are also contemplated herein. The outwardly facing surface 15730 may have a contour complementary to the adjacent portion of the child seat 15702.

[0936] Opposite the outwardly facing surface 15730 is an inwardly facing surface 15732 configured to contact an occupant of the child seat 15702. In the non-limiting embodiment, the inwardly facing surface 15732 has a plurality of different side impact protection areas arranged at different angles relative to the upright support surface 15712. As shown, a first side impact protection area 15734 extends from the upper end 15722 of the torso SIP device 15720. The first side impact protection area 15734 may be oriented at a non-parallel angle relative to the upright support surface 15712, and in some embodiments, to an adjacent surface of the occupant, such as the occupant's back. A second side impact protection area 15736 may extend from the first side impact protection area 15734 toward the lower end 15724 of the inwardly facing surface 15732. In an embodiment, the second side impact protection area 15736 is oriented parallel to, or substantially parallel (within ±10°) to, the upright support surface 15712 and/or to the occupant's back to maximize and area of contact between the second side impact protection area 15736 and an occupant.

[0937] As shown, the second side impact protection area 15736 may be arranged at a non-parallel angle relative to the first side impact protection area 15734. In an embodiment, the angle α between the first side impact protection area 15734 and the second side impact protection area 15736 is obtuse. As shown, the thickness at the second side impact protection area 15736 of the torso SIP device 15720 may gradually reduce from the interface with the first side impact protection area 15734 toward the second end 15724. Similarly, the thickness of the first side impact protection area 15734 may reduce from the interface with the second side impact protection area 15736 toward the first end 15722 of the torso SIP device 15720.

[0938] A torso SIP device 15720 as illustrated and described herein may provide lumbar support to the occupant of the child seat 15700. As shown, inclusion of the torso SIP device 15720 may cause the child seated within the child seat to be reclined relative to the upright support surface 15712. This recline causes the arms of the occupant to be pushed away from the upright support surface 15712 of the child seat 15700. In an embodiment, an angle between the occupant's upper arm and a thorax of the occupant (represented by a plane oriented tangential to the line of intersection between first side impact protection area 15734 and the second side impact protection area 15736) may be approximately 25 degrees.

[0939] In the non-limiting embodiment illustrated in FIGS. 38A-38C, a child seat 3500 includes at least one torso SIP device, and in some embodiments, a plurality of torso SIP devices. For example, a first torso SIP device 3502a and a second torso SIP device 3502b may be arranged at a child seat 3504 of the child seat 3500. As shown, the first torso SIP device 3502a may be arranged at the first upright side member 3510 of an upright portion 3508 of a seat shell 3506 of the child seat and a second torso SIP device 3502b may be arranged at a corresponding second upright side member 3512. Although only a first and second torso SIP device 3502a, 3502b are illustrated and described herein, it should be appreciated that embodiments having more than one torso SIP device associated with a same torso area of the occupant, such as at a left side or right side of the occupant for example, are also contemplated herein. In the illustrated embodiment, the first torso SIP device 3502a and the second torso SIP 3502b are substantially identical; however, embodiments where a configuration of the first and second torso SIP devices 3502a, 3502b varies are also within the scope of the disclosure.

[0940] The first and second torso SIP devices 3502a, 3502b may be positioned adjacent to a bottom 3516 of an upright support surface 3514 of the upright portion 3508, such as upwardly adjacent or proximate the interface between the upright portion 3508 and the seat portion 3509 for example. As shown, the torso SIP devices 3502a, 3502b may be located between a surface of the seat shell 3506 and the soft goods 3520 surrounding the seat shell

3506 (see FIG. 38C). In an embodiment, the first and second torso SIP devices 3502a, 3502b have a height that is restricted generally to the torso area of the occupant. For example, the torso SIP devices 3502a, 3502b may be positioned such that it does not extend beyond a hip of the occupant. Alternatively, in embodiments where the upright side members 3510, 3512 include an opening 3522 that defines a portion of a vehicle belt path when the child seat 3504 is mounted in a forward-facing configuration, the torso SIP devices 3502a, 3502b may be arranged vertically below the openings 3522.

[0941] The first and second torso SIP devices 3502a, 3502b may extend inwardly towards an occupant area from generally adjacent front edges 3524a, 3524b of a respective upright side members 3510, 3512. Further, the body of a torso SIP devices 3502a, 3502b may extend upward along at least a portion of the upright support surface 3514. The torso SIP devices 3502a, 3502b may span the entire width of the upright side member 3510, 3512, between the front edge 3524a, 3524b and the upright support surface 3514, or only a portion thereof. In some embodiments, a thickness of each torso SIP device 3502a, 3502b (measured perpendicular to the respective first and second upright side member 3510, 3512) is substantially uniform over its height. In such embodiments, an upper surface 3526 of the torso SIP device 3502a, 3502b is flat and may have a generally horizontal orientation.

[0942] With reference now to FIG. 39, another embodiment of a child seat 3600 having at least one torso SIP device, such as a first torso SIP device 3602a and a second torso SIP device 3602b, is illustrated. In the illustrated, non-limiting embodiment, the child seat 3600 is an infant car seat having a seat shell 3603 including a seat portion 3604 and a back portion 3605, and a carrying handle 3607 movably mounted to the seat shell 3603. Unlike the previous embodiments where the torso SIP devices were located at the back portion of a child seat, in the illustrated, non-limiting embodiment, at least one of the first and second torso SIP devices 3602a, 3602b are located at the seat portion 3604 of the infant car seat 3600. For example, the first and second torso SIP devices 3602a, 3602b may be arranged at the first and second seat side members 3606, 3608 of the seat portion 3604, such as proximate a rear 3612 of the seat support surface 3610. Although not shown, the first and second torso SIP devices 3602a, 3602b may have a configuration including a uniform thickness as previously described.

[0943] Alternatively, as shown in FIG. 39, a thickness of the first and second torso SIP devices 3602a, 3602b may vary over a height of the torso SIP devices 3602a, 3602b. In the illustrated, non-limiting embodiment, the thickness of the first and second torso SIP devices 3602a, 3602b gradually increases from an upper surface 3614of the torso SIP devices 3602a, 3602b toward the seat support surface 3610 such that the torso SIP devices 3602a, 3602b have

a general wedge shape. However, it should be understood that a torso SIP device torso SIP devices 3602a, 3602b having any suitable configuration is within the scope of the disclosure. Examples of other suitable configurations include but are not limited to a circular or oval torso SIP device, a rectangular torso SIP device, a curvilinear torso SIP device, and a polygonal torso SIP device.

[0944] In yet another embodiment illustrated in FIGS. 40A-40B, a child seat 3700 includes at least one torso SIP device. Similar to the previous embodiment, a first torso SIP device 3702a may be arranged at a first seat side member 3706 of a seat portion 3704 of the child seat 3700 and a second torso SIP device 3702b may be arranged at a second seat side member 3708 of the seat portion 3704. As shown, the torso SIP devices 3702a, 3702b, may be located adjacent or proximate a rear 3712 of the seat support surface 3710. However, embodiments where the torso SIP devices 3702a, 3702b are alternatively or additionally arranged at the upright portion 3714 of the child seat 3700, such as adjacent to a first upright side member 3716 and a second upright side member 3718, respectively are also contemplated herein.

[0945] In the illustrated, non-limiting embodiment, the torso SIP devices 3702a, 3702b have a generally rectangular body, with a thickness of the body being substantially less than a height of the body. When installed about the child seat 3700, a first upper end 3720a, 3720b of each torso SIP device 3702a, 3702b may be arranged at or directly adjacent the side member 3706, 3708, 3716, 3718 of the seat portion 3704 or the upright portion 3714, respectively. A second, lower end 3722 of each torso SIP device 3702a, 3702b may be spaced laterally towards the occupant from the first upper end 3720, thereby reducing the clearance between the torso SIP devices 3702a, 3702b. In such a configuration, each torso SIP device 3702a, 3702b is arranged at a non-parallel angle relative to the adjacent side member 3706, 3708, 3716, 3718. For example, the torso SIP devices 3702a, 3702b may be arranged at an angle between about 5 degrees and about 45 degrees relative to the seat support surface 3710. In the illustrated, non-limiting embodiment, a gap or clearance 3724a, 3724b may be formed between the side members 3706, 3708, 3715, or 3718 and the body of respective torso SIP devices 3702a, 3702b.

[0946] With reference now to FIGS. 215A-215B, another embodiment of an SIP device suitable for use with a child seat 15800 is illustrated. As shown, the at least one torso SIP device 15820a, 15820b associated with the upright portion 15804 of the child seat 15800 has an elongated body 15822a, 15822b positionable at the upright portion 15804 of a seat shell 15802 of the child seat 15800. In an embodiment, the first torso SIP device 15820a is positioned in overlapping arrangement with a first upright side member 15806 of the child seat 15800 and a

second torso SIP device 15820b is positioned in overlapping arrangement with a second upright side member 15808 of the child seat 15800. Although the child seat 15800 is illustrated and described as having two separate and distinct torso SIP devices 15820a, 15820b, embodiments where the two bodies 15822a, 15822b are integral or are connected together as a single torso SIP device are also contemplated herein.

[0947] A first end 15824a, 15824b of the respective torso SIP devices 15820a, 15820b may be aligned with or proximate the bottom of the upright portion 15804 of the seat shell 15802, and the torso SIP devices 15820a, 15820b may extend over only a portion, or alternatively, over a substantially entire height of an upright side member 15806, 15808. In the illustrated, non-limiting embodiment, the second end 15826a, 15826b of the torso SIP device 3402a, 3402b may be aligned with or arranged near the top surface 15810 of the upright portion 15804. In such embodiments, the torso SIP devices 15820a, 15820b may be operable not only as torso SIP devices, but also as shoulder SIP devices.

[0948] Although the torso SIP devices 15820a, 15820b are illustrated as having an outer periphery including a contour complementary to respective upright side members 15806, 15808, embodiments where the torso SIP devices 15820a, 15820b have another contour are also contemplated herein. The occupant facing surfaces 15828a, 15828b of the torso SIP devices 15820a, 15820b may be configured so that a headrest 15812 of the child seat 15802 is movable between a lowered position and a raised position without interference by the shoulder SIP devices 15820a, 15820b. In an embodiment, the bodies 15822a, 15822b of the torso SIP devices 15820a, 15820b are formed from foam or another suitable material, such as having a hardness less than a hardness of the shell. As shown, a backside of each of the torso SIP devices 15820a, 15820b may have one or more features 15830 formed thereon, such as grooves or ridges for example. These features 15830 may cooperate with complementary features 15832 on the seat shell 15802 to properly position the torso SIP devices 15820a, 15820b about the upright portion 15804 of the child seat 15800. In an embodiment, the torso SIP devices 15820a, 15820b described herein may be permanently connected to the child seat 15802 and in some embodiments, may be covered by soft goods. However, embodiments where the torso SIP devices 15820a, 15820b are removable from the child seat 15802 are also contemplated herein.

[0949] Another embodiment of a child seat 15900 having at least one torso SIP device, such as a first torso SIP device 15920a and a second torso SIP device 15920b, is illustrated in FIGS. 216A-216D. As in the previously described embodiments, the child seat 15900 may include a seat shell 15902 that defines a seat portion 15904 and an upright portion 15906 of the child seat 15900. As shown, the upright portion 15906 includes an upright support surface

15908, a first upright side member 15910 extending from a first side of the upright support surface 15908 and a second upright side member 15912 extending from a second, opposite side of the upright support surface 15908.

[0950] The first torso SIP device 15920a may be arranged at the first upright side member 15910 and the second torso SIP device 15920b may be arranged at the second upright side member 15912. In the illustrated, non-limiting embodiment, the torso SIP devices 15920a, 15920b are also arranged in contact with the upright support surface 15908. Accordingly, an outwardly facing surface 15922a, 15922b of the torso SIP devices 15920a, 15920b may have a contour complementary to at least one of the upright side members 15910, 15912 and the upright support surface 15908. The torso SIP devices 15920a, 15920b may be integrally formed with the seat shell 15902, integrally formed with the soft goods (not shown) positionable about the seat shell 15902 or may be removably connectable to one or both of the seat shell 15902 and the soft goods surrounding the seat shell 15902.

[0951] The first and second torso SIP devices 15920a, 15920b may be spaced from a bottom 15914 of the upright support surface 15908. As shown, the torso SIP devices 15920a, 15920b may be positioned vertically above a plane where a seat side member 15916, 15918 of the seat portion 15904 meets a corresponding upright side member 15910, 15912 of the upright portion 15906 of the child seat 15900. The torso SIP devices 15920a, 15920b may be positioned and/or configured so as not to interfere with a headrest 15909 of the child seat 15900 during movement along its path of travel relative to the upright portion 15906 of the child seat 15900.

[0952] An inwardly facing surface 15924a, 15924b of each torso SIP device 15920a, 15920b has at least one side impact protection area arranged at a non-parallel angle relative to the upright support surface 15908. As shown, the inwardly facing surface 15924a, 15924b may be contoured such that a thickness of the torso SIP device 15920a, 15920b gradually reduces from a first end 15926a, 15926b near a respective upright side member 15910, 15912 to a distal end 1598a, 15928b of the torso SIP device 15920a, 15920b. Accordingly, in an embodiment, the torso SIP device 15920a, 15920b is thinnest near a center of the upright support surface 15908. To achieve this configuration, the inwardly facing surface 15924a, 15924b may have a planar configuration, or alternatively, may have a curved configuration, such as a concave curvature for example. It should be understood that although the torso SIP devices 15920a, 15920b are illustrated and described as having a general wedge-shape, the angles and lengths of the torso SIP devices 15920a, 15920b may be adjusted based on a specific application.

[0953] In the non-limiting embodiment of FIGS. 216A-217B, the first and second torso SIP devices 15920a, 15920b are elongated in height. As shown, the first and second torso SIP

devices 15920a, 15920b may extend from at or above a hip of an occupant of the child seat 15900 to a shoulder of the occupant of the child seat 15900. With reference now to FIGS. 218A-218C, another embodiment of a torso SIP device is illustrated, and reference numerals similar to those of FIGS. 217A-217B are used to represent similar portions. However, in this embodiment, the torso SIP device 15920a, 15920b, has a reduced height suitable to engage only a portion of an occupant's body extending between a hip and a shoulder. In this shortened configuration, the torso SIP device 15920a, 15920b may be located directly underneath the occupant's shoulder, such as near an upper rib cage of the occupant.

[0954] In the illustrated non-limiting embodiment of FIGS. 38A-40B, the disclosed first and second torso SIP devices are separate devices mounted individually about a child seat. However, in other embodiments, the first and second torso SIP devices located at opposite sides of the child seat may be integrally formed as a unitary body. For example, in the non-limiting embodiment illustrated in FIG. 41A-41C, a torso SIP assembly 3802 including one or more torso SIP devices may be mountable to a child seat 3800. As shown, the torso SIP assembly 3802 includes a first torso SIP device 3804a positionable near a torso of an occupant within the child seat, a second torso SIP device 3804b positionable at the same height or at a different height near a torso of an occupant within the child seat 3800, and a connector body 3806 coupling the first torso SIP device 3804a and the second torso SIP device 3804b. In such embodiments, the torso SIP devices 3804a, 3804b may be formed from a first material, and the connector body 3806 may be formed from a second, different material. However, embodiments where the SIP devices 3804a, 3804b and the connector body 3806 are formed from the same material are also within the scope of the disclosure. As shown, the torso SIP assembly 3802 may be an insert removably connected to the child seat 3800, or alternatively, may be permanently connected to the child seat 3800. In embodiments where the torso SIP assembly 3802 is separable from the child seat 3800, the torso SIP assembly 3802 may function as an insert intended for use with an occupant of a desired size, such as less than 40 pounds for example. Accordingly, the torso SIP assembly 3802 may be removable as necessary to make room a larger occupant.

[0955] With reference to FIGS. 41A-41C, in the illustrated, non-limiting embodiment, the first and second torso SIP devices 3804a, 3804b have generally vertically oriented occupant facing surfaces 3810a, 3810b configured to contact an occupant. Further, the torso SIP devices 3804a, 3804b may have an outwardly facing surface or base 3812a, 3812b complementary to the curvature of the adjacent portion of the child seat 3800, such as a portion of the upright side members 3820, 3822 for example. As shown, the connector body 3806 extends between and

couples the first torso SIP device 3804a and the second torso SIP device 3804b. Further, a portion of the connector body 3806 may be arranged between the first and second torso SIP devices 3804a, 3804b and a surface of the child seat, such as the upright side members 3820, 3822. In such embodiments, an occupant facing surface 3814 of the connector body 3806 may be complementary to the contour of an adjacent portion of the child seat, such as the upright side members 3820, 3822, the upright support surface 3824 of the upright portion 3825 of the child seat 3800, and/or the seat side members 3826, 3828, and/or the seat support surface 3830 of the seat portion 3832 of the child seat 3800. The first and second torso SIP devices 3804a, 3804b may be arranged within respective pockets formed in the connector body 3806. In an embodiment, the first and second torso SIP devices 3804a, 3804b are encapsulated by the connector body 3806.

[0956] Another embodiment of a torso SIP assembly 3902 suitable for use with a child seat 3900 is illustrated in FIGS. 42A-42C. As shown, the torso SIP assembly 3902 may be substantially similar to that of the previous embodiment. The torso SIP assembly 3902 includes a plurality of first torso SIP devices arranged at opposite sides of a connector body 3906. As shown, a connector body 3906 may include a back portion 3908 and a first side portion 3910 and a second side portion 3912 extending from opposite sides of the back portion 3908. In the illustrated, non-limiting embodiment, a first torso SIP device 3904a is arranged adjacent to the first side portion 3910 and another first torso SIP device 3904b arranged adjacent to the second side portion 3912 of the connector body 3906. The first torso SIP devices 3904a, 3904b may be substantially identical.

[0957] Further, the torso SIP assembly 3902 may include at least one second torso SIP device and in some embodiments, a plurality of second torso SIP devices. In the illustrated, non-limiting embodiment, a second torso SIP device 3914a is arranged adjacent to the first side portion 3910 and another second torso SIP device 3914b arranged adjacent to the second side portion 3912 of the connector body 3906. The second torso SIP device 3914a, 3914b may be positionable within an upper torso region of the child seat 3900, such as associated with a chest of an occupant, such as between a hip and a shoulder for example. In the non-limiting embodiment, a second torso SIP device 3914a, 3914b is positioned directly adjacent to and in vertical overlapping arrangement with a corresponding first torso SIP device 3904a, 3904b. However, embodiments where a second torso SIP device 3914a, 3914b may be offset (laterally and/or vertically) from the first torso SIP devices 3904a, 3904b are also contemplated herein.

[0958] The second torso SIP devices 3914a, 3914b may be formed from a material selected to absorb crash energy. In some embodiments, a hardness of the second torso SIP

devices 3914a, 3914b may be different than the hardness of the first torso SIP devices 3904a, 3904b. For example, the second torso SIP devices 3914a, 3914b may be softer or have a reduced hardness compared to the first torso SIP devices 3904a, 3904b. In other embodiments, the second torso SIP devices 3914a, 3914b may be harder than the first torso SIP device 3904a, 3904b or may have the substantially same hardness as the first torso SIP device 3904a, 3904b.

[0959] As shown, an outwardly facing surface of a second torso SIP device 3914a, 3914b and/or the connector body 3906 is complementary to a contour of the child seat 3900, such as at the upright portion 3916 of the child seat 3900. For example, the first side portion 3910 is positionable adjacent to a first upright side member 3918 and the second side portion 3912 of the connector body 3906 is positionable adjacent to a second upright side member 3920. In some embodiments, as shown in FIG. 42A, respective heights of the second torso SIP devices 3914a, 3914b, measured parallel to the side portions 3910, 3912 of the connector body 3906 for example, may vary over a height of the second torso SIP devices 3914a, 3914b. In the illustrated, non-limiting embodiment, front or forward-facing surface 3922a, 3922b of the second torso SIP devices 3914a, 3914b may be sloped between an upper end and a central portion of a second torso SIP devices 3914a, 3914b. For example, a distance between an upright support surface 3924 of the back portion 3917 of the seat shell 3916 and the forward-facing surface 3922a, 3922b at a central portion of the second torso SIP device 3914a, 3914b is greater than the distance between the upright support surface 3924 of the back portion 3917 and the forward-facing surface 3922a, 3922b at a top of the second torso SIP device 3914a, 3914b. The angled portion of the front surface 3922 of the second torso SIP devices 3914a, 3914b may position the occupant's arms towards a front of the child seat, such as forward of the occupant's chest. Such a positioning may improve crash performance by preventing the occupant's arm from being compressed between the upright side member and the occupant's torso.

[0960] With reference now to FIG. 43A-43B, another embodiment of a child seat 4000 of a child seat system including at least one torso SIP device is illustrated. In an embodiment, torso SIP devices 4002a, 4002b are arranged at occupant facing surfaces of each upright side member 4006, 4008 of an upright portion 4004 of a seat shell 4005 of the child seat 4000. As shown, the torso SIP devices 4002a, 4002b generally have planar upper surfaces 4010a, 4010b positioned to form an armrest for an occupant of the child seat 4000. The torso SIP device 4002a, 4002b may be integrally formed with the seat shell 4005. As shown, soft goods 4012 may be positioned in overlapping arrangement with an interior facing surface of at least a portion of the torso SIP devices 4002a and 4002b.

[0961] With reference now to FIGS. 151A-151B, the illustrated child seat system 13000 includes a support base 13002 and a child seat 13004 receivable on the support base 13002. The child seat 13004 includes a seat shell 13006 that defines a seat portion 13008 and an upright portion 13010 of the child seat 13000. As shown, the upright portion 13010 includes an upright support surface 13012, a first upright side member 13014 extending from a first side of the upright support surface 13010 and a second upright side member 13016 extending from a second, opposite side of the upright support surface 13010. The seat portion 13008 may similarly include a seat support surface 13020 facing generally upwardly, a first seat side member 13022 may be arranged at a first side of the seat support surface 13020 and a second seat side member 13024 may be arranged at a second, opposite side of the seat support surface 13020.

[0962] In the illustrated, non-limiting embodiment, each seat side member 13022, 13024 has a slot 13026 formed therein configured to function as a lap belt guide during at least one mode of use of the child seat 13000. In some modes of operation of the child seat 13004, the slot 13026 may be configured to receive and position a lap belt portion of a vehicle restraint or a separate restraint belt to secure a child within the child seat 13004.

[0963] The seat portion 13008 may be removably connectable to both the support base 13002 and the back portion 13010. When separated from the remainder of the child seat system 13000, the seat portion 13008 may be configured as a booster seat positionable in direct contact with a vehicle seat and configured to support a child thereon.

[0964] A portion of the first side member 13022 arranged between the slot 13026 and part of the back portion 13008, such as the first upright support member 13014 for example, may be contoured to form an armrest when the seat portion 13008 is separated from the child seat 13004. Similarly, a portion of the second side member 13022 arranged between the slot 13026 and part of the back portion 13008, such as the second upright support member 13016 for example, may be contoured to form an armrest when the seat portion 13008 is separated from the child seat 13004. These armrest portions are identified at 13028a, 13028b, respectively.

[0965] In the illustrated, non-limiting embodiment, a first torso SIP device 13030a is permanently or removably coupled to the first armrest portion 13028a and a second torso SIP device 13030b is permanently or removably coupled to the second armrest portion 13028b. The torso SIP devices 13030a, 13030b may include one or more pieces of padding or foam and may be connected to the child seat 13004 using a chemical adhesive or via a mechanical connection, including but not limited to a snap connection, magnets, rivets, or hook and loops

fasteners for example. Because the torso SIP devices 13030a, 13030b are arranged at a portion of the seat side members 13022, 13024 directly adjacent to slot 13026 formed therein, the torso SIP devices 13030a, 13030b may be considered to define a portion of the vehicle belt path extending through the seat portion 13008 of the child seat 13004.

[0966] The torso SIP devices 13030a, 13030b are illustrated as being positioned at an inward facing surface of one of the first and second armrest portion 13028a, 13028b such that the torso SIP devices 13030a, 13030b may be directly adjacent to and configured to contact a hip of the occupant. However, embodiments where the torso SIP devices 13030a, 13030b are alternatively or additionally arranged at another surface of the armrest portions 13028a, 13028b are also contemplated herein. In an embodiment, as shown in FIG. 151B, the soft goods 13032 associated with the upright portion 13010 of the child seat 13000 may be configured to at least partially overlap the torso SIP device 13030a, 13030b when the seat portion 13008 is connected to the child seat 13004.

[0967] With reference now to FIGS. 186A-187C, in some embodiments, the soft goods 14402 of a child seat 14400 positionable about an SIP device, such as the torso SIP device 14404 (see FIG. 186B) for example, include a stiffener 14406. The stiffener 14406 may be arranged within the soft goods 14402, such as at a side of the soft goods facing towards the seat shell of the child seat 14400, at a position located in horizontal alignment with or above a corresponding SIP device, such as the torso SIP device 14404 within a hip region. The stiffener 14406 may provide additional stiffness. During a crash event, the stiffener 14406 may aid in distributing a load across the SIP device 14404 as the SIP device 14404 is compacted or crushed. The stiffener 14406 may be formed from any suitable material, including polyethylene (PE). The stiffener 14406 may have any suitable thickness. In an embodiment, the thickness of the stiffener 14406 is between 1.0 mm and 3.0 mm, such as 2.0 mm for example. The stiffener 14406 may be attached to the soft goods 14402 by, for example, glueing, sewing, or another form of attachment. In the illustrated, non-limiting embodiment shown in FIGS. 187A-187C, the stiffener 14406 is positioned within a pocket 14408 formed in the soft goods 14402. In such embodiments, the stiffener 14406 may be stitched into the pocket 14408 such that the stiffener 14406 is fully encapsulated within the soft goods 14402 and is not separable therefrom. However, embodiments where the stiffener 14406 is removably mounted within the pocket 14408 are also contemplated herein.

[0968] With reference now to FIGS. 188A-191B, in other embodiments an SIP device, such as a torso SIP device for example, may be connected to soft goods, and the soft goods including the torso SIP device may be positioned about the child seat. In the non-limiting

embodiment illustrated in FIGS. 188A-188B, the soft goods 14500 are sized and/or shaped to receive a first torso SIP device 14502a and a second torso SIP device 14502b. Each torso SIP device 14502a, 14502b may be retained in position relative to the soft goods 14500 in any suitable manner. For example, the soft goods 14500 may include a pocket within which the torso SIP device 14502a, 14502b is received. In other embodiments, such as shown in the FIG 188A., the soft goods 14500 may include one or more snaps or other first connectors 14504 that are connectable to a corresponding connector (not shown) located at the body of a respective the torso SIP device 14502a, 14502b. A surface of the soft goods 14500, such as an exterior surface of a flap 14506 in overlapping arrangement with a portion of a torso SIP device 14502a, 14502b, may have at least one second connector 14508 mounted thereto. The second connector 14508 may be couplable to one or more respective connectors 14510 (see FIG. 188B) located about a seat shell 14520 of a child seat, such as at the armrest 14522 for example. Although the one or more second connectors 14508 are illustrated as snaps and the corresponding connectors 14510 located at the seat shell 14520 are holes, any suitable type of connectors are within the scope of the disclosure.

[0969] In the non-limiting embodiment illustrated in FIGS. 189A-189B, one or more connectors 14604 may be located at a surface 14602 of the SIP device 14600, such as a torso SIP device. The connectors 14604 may be permanently affixed to, or in some embodiments may be integrally formed with the SIP device 14600 and are connectable to corresponding connectors 14612, such as formed at the seat shell 14614 of the child seat. When the torso SIP device 14600 is installed relative to corresponding soft goods 14606, such as within a pocket 14608 formed in the soft goods 14606 for example, the connectors 14604 of the SIP device 14600 may be accessible from an exterior of the soft goods 14606. In embodiments where the connectors 14604 of the torso SIP device 14600 protrude from the surface 14602 of the torso SIP device 14600, the connectors 14604 may further extend through aligned holes 14610 formed in the soft goods 14606. In embodiments where the connectors 14604 are openings formed in the torso SIP device 14600, corresponding holes 14610 may be formed in the soft goods 14606 at a position aligned with the openings 14604 of the torso SIP device 14600, for receipt of a corresponding connector therethrough.

[0970] In another embodiment, shown in FIGS. 190A-190B, one or more connectors 14704 associated with a torso SIP device may be movably positioned relative to the torso SIP device. A torso SIP assembly may include a torso SIP device (not shown) partially covered by or fully enclosed within a body of soft goods 14700. In the illustrated, non-limiting embodiment, the connector 14704 is part of a connection assembly 14702 affixed to a surface

of the soft goods 14700. The connection assembly 14702 includes a tether 14706 and the connector 14704 is mounted to a movable portion of the tether 14706, such as a distal end 14708 thereof. Although the tether 14706 is illustrated as being stitched to the soft goods 14700 and the connector 14704 is illustrated as being stitched to the tether 14706, embodiments where the tether 14706 is connected to the soft goods 14700 and/or the connector 14704 in another suitable manner are contemplated herein. The connector 14704 is couplable to a corresponding connector 14710, such as arranged at a surface 14712 of a seat shell 14714 of a child seat for example, to attach the SIP device and soft goods 14700 to the child seat at a desired position.

[0971] In other embodiments, such as shown in FIGS. 191A-191B, a connector 14806 associated with the SIP device may be connectable to another piece of the soft goods, instead of to the seat shell 14802 of a child seat 14800, to affix the SIP device at a desired position relative to the child seat. In the illustrated, non-limiting embodiment, a torso SIP assembly includes a torso SIP device (not shown) partially covered by or fully enclosed within a body of soft goods 14804. A connection assembly including one or more connectors 14806, such as snaps for example, may be arranged at an exterior surface of the soft goods. In some embodiments, the soft goods 14804 include a flap 14808 movable relative to the SIP device, and the connector 14806 is arranged at the flap 14808. Another piece of soft goods, such as a soft goods panel 14810 for example, may be arranged about the child seat 14800, separate from the soft goods 14804 of the torso SIP device. The soft goods panel 14810 may be restricted from movement relative to the child seat 14800. For example, the soft goods panel 14810 may extend through a pocket or slot 14812 formed in another component of the child seat 14800. In an embodiment, the soft goods panel 14810 has one or more connectors 14814, such as formed at an underside thereof. The connectors 14814 of the soft goods panel 14810 may be configured to couple to a corresponding connector 14806 of the soft goods 14804 surrounding a torso SIP device to affix the torso SIP device in position about the child seat 14800.

[0972] Additional examples of a torso SIP device mountable at an interior of a seat shell are illustrated in more detail in FIGS. 171A-174. In the illustrated, non-limiting embodiment of FIGS. 171A-171B, a torso SIP device 13700 has a body 13702 including a front surface 13704 and a back surface 13706. In the illustrated, non-limiting embodiment, the body 13802 of the torso SIP device 13700 is solid body and both the front surface 13704 and the back surface 13706 are solid surfaces. The front surface 13704 may be configured to engage a child's hip. Accordingly, the front surface 13704 may be generally smooth. The back surface 13706 is positionable closest to a sidewall of the seat shell. The body 13702 is illustrated as being rectangular in shape, though it should be understood that embodiments having another

shape, such as a shape corresponding to an adjacent part of the seat shell for example, are also within the scope of the disclosure. Both the front surface 13704 and the back surface 13706 are illustrated as having a generally planar configuration with the front surface 13704 oriented parallel to the back surface 13706. However, embodiments where one or more of the front surface 13704 and the back surface 13706 has a non-planar contour, such as where the back surface 13706 has a contour complementary to a mounting surface of the seat shell for example, and/or embodiments where the front surface 13704 is arranged at a non-parallel angle relative to the back surface 13706 are also contemplated herein.

[0973] A connector assembly for connecting the torso SIP device 13700 to a portion of a child seat may be associated with a portion of the body 13702. The connector assembly may include one or more connectors, such as screws, bolts, or snaps (not shown) for example, receivable within corresponding openings 13708 formed about the body 13702 of the torso SIP device 13700. In such embodiments, if the portion of the torso SIP device 13700 including the connector assembly is covered by soft goods, one or more openings are formed in the soft goods to enable access to the connector assembly. In other embodiments, one or more snaps, fasteners or other suitable connectors may be arranged at the body of the torso SIP device and may be connectable to a corresponding opening arranged at a seat shell of a child seat. In some embodiments, the back surface 13706 is a solid or substantially solid surface. In such embodiments, the openings 13708 associated with the coupling mechanism may be formed at the back surface 13706. In other embodiments, the back surface 13706 may have a different configuration and as a result, an interface of the torso SIP device with a coupling mechanism may not be located at the back surface 13706.

[0974] In the non-limiting embodiment of a torso SIP device 13800 shown in FIGS. 172A and 172B, a body 13802 of the torso SIP device 13800 has a front surface 13804 and a back surface 13806. Similar to the previous embodiment, the front surface 13804 is configured to engage a child's hip and may be generally smooth and the back surface 13806 is positionable adjacent to a surface of the seat shell. As shown, the back surface 13806 may have one or more areas of material removed therefrom resulting in the formation of hollow pockets 13810 at the back surface 13806. These pockets or areas of removed material 13810 may extend through only a small portion of the thickness of the body 13802, or alternatively, may extend over substantially the entire thickness of the body 13802 while leaving a continuous front surface 13804. The resulting structural ribs 13812 formed in the body 13802 provide the necessary structural rigidity to the torso SIP device 13800. Although a combination of horizontally oriented and vertically oriented structural ribs 13812 are illustrated, it should be understood

that embodiments including only horizontally oriented ribs, only vertically oriented ribs, or ribs at another orientation are also contemplated herein.

[0975] Yet another example of a torso SIP device 13900 is illustrated in FIGS. 173A-173B. The torso SIP device 13900 has a body 13902 including a front surface 13904 and a back surface 13906. In the illustrated, non-limiting embodiment, both the front surface 13904 configured to abut a child and the back surface 13906 positionable adjacent to a seat shell of a child seat are continuous surfaces having a smooth, generally planar contour. However, the body 13902 of the torso SIP device 13900 need not be solid or have continuous surfaces. As shown, one or more areas of material have been removed from an interior of the torso SIP device 13900 resulting in the formation of hollow pockets 13910. In the illustrated, non-limiting embodiment, the pockets 13910 extend through a perimeter surface of the torso SIP device 13900, such as a bottom surface 13914 of the body 13902 for example. While these pockets 13910 are not illustrated as extending through an opposite upper surface 13916 of the body 13902, embodiments where the pockets 13910 alternatively or additionally extend through the upper surface 13916 are also contemplated herein. In other embodiments, the pockets 13910 may extend through one or more lateral sides 13918, 13920 of the body 13902 defined between the front surface 13904 and the back surface 13906. These pockets or areas of removed material 13810 may extend through only a small portion of the thickness of the body 13902, or alternatively, may extend over substantially the entire thickness of the body 13902 while leaving a solid front surface 13904 and solid back surface 13906. The resulting structural ribs 13912 formed in the body 13902 provide the necessary structural rigidity to the torso SIP device 13900. Although vertically oriented structural ribs 13812 are illustrated, it should be understood that embodiments including only horizontally oriented ribs are also contemplated herein.

[0976] A torso SIP device 14000 a multi-piece construction is shown in FIG. 174. The torso SIP device 14000 may include a first or front housing 14002 and a second or back housing 14004 connectable to one another. The front housing 14002 may define a front surface 14006 of the torso SIP device 14000 and the back housing 14004 may define a back surface 14008 of the torso SIP device 14000. In the illustrated, non-limiting embodiment, both the front surface 14006 configured to abut a child and the back surface 14008 positionable adjacent to a seat shell of a child seat (not shown) are solid surfaces having a smooth, generally planar contour. One or both of the front housing 14002 and the back housing 14004 may have a generally hollow interior. In the illustrated, non-limiting embodiment, the front housing 14002 has a generally hollow interior. Alternatively, or in addition, one or both of the front housing 14002

and the back housing 14004 may have areas of material removed therefrom. For example, as shown in FIG. 174, areas of material have been removed from a portion of the back housing 14004 positionable directly adjacent to the front housing 14002 such that a plurality of pockets 14010 are formed at a front of the back housing 14004. Accordingly, the back housing 14004 may include a plurality of structural ribs 14010 as a result of the pockets. In an embodiment, material may be removed from the body of the back housing 14004 such that the ribs 14040 protrude beyond a plane containing an end of the back housing 14004 configured to engage the front housing 14002. With such a configuration, the ribs 14010 may be received within the hollow interior of the front housing 14002. In some embodiments, the structural ribs 14010 are arranged in contact with an inner surface of the front housing 14002, thereby providing structural rigidity to the front housing 14002.

[0977] With continued reference to FIG. 174, in the illustrated, non-limiting embodiment, a connection assembly 14020 may protrude outwardly from the torso SIP device 14000. As shown, the connection assembly 14020 may include a tether 14022. A portion of the tether 14022, such as a first end thereof, may be attached to the torso SIP device 14000. For example, the tether 14022 may be mechanically fastened, or chemically adhered to a portion of the body of the torso SIP device 14000, such as to an interior of the front housing 14002 and/or the back housing 14004. In embodiments where the torso SIP device 14000 is formed by joining together a front and back housing 14002, 14004, the tether may be clamped at an interface between the front and back housing 14002, 14004. A connector 14024, such as a snap, rivet, or hook and loop fastener for example, may be arranged at a portion of the tether 14022 that is external to the torso SIP device 14000. The connector 14024 is permanently or removably connectable to a complementary connection mechanism, such as arranged at a seat shell of a child seat to couple the torso SIP device to the child seat at a desired position. For example, as shown in FIG. 175, a seat shell 14052 of a child seat 14050, such as a portion of an upright sidewall 14054 forming an armrest for example, may include one or more connection mechanisms 14056 connectable to the connector 14024 of the torso SIP device 14000.

[0978] Although the connection assembly 14020 is illustrated and described with respect to a torso SIP device having a two-part construction, it should be understood that any torso device described herein, including but not limited to torso SIP devices 13700, 13800, 13900, 14000, may be affixed to a child seat via a connection assembly 14020. For example, as shown in FIG. 173C, the body 13902 of the torso SIP device 13900 may include a slot 13922, such as arranged at a lateral side 13918 or 13920 thereof, through which the tether of such a

connection assembly may extend. It should further be understood that any type of SIP device, including but not limited to a shoulder SIP device, external SIP device, head SIP device may also include a connection assembly as described herein.

[0979] With continued reference to FIG. 174, and further reference to FIGS. 176A and 176B, in some embodiments the torso SIP device may be surrounded or enclosed within soft goods 14030. In the illustrated, non-limiting embodiment, soft goods 14030 are sewn to form a pocket sized and shaped to receive an SIP device, such as a torso SIP device 13700, 13800, 13900, 14000 for example, therein. In such embodiments, a hole or opening 14032 may be formed in the soft goods 14030, such as at a portion of the soft goods adjacent to the connection assembly 14020. When the torso SIP device 14000 is arranged within the interior of the pocket, as shown in FIG. 175B, the tether 14022 of the connection assembly 14020 is extendable through the hole 14032 such that the connector 14024 mounted to the tether 14022 is arranged at an exterior of the pocket.

[0980] An example of a connection assembly 14102 associated with an SIP device, such as a torso SIP device 14100 is illustrated in more detail in FIGS. 177 and 178A-178C. The connection assembly 14102 includes a tether 14104 and a connector 14106 arranged at a first surface 14108 of the tether 14104, such as near a first distal end 14110 thereof, as previously described. In some embodiments, the at least one fold is formed in the tether 14104. In the illustrated, non-limiting embodiment, the tether has two folds F1, F2 formed therein. The first fold F1 may be oriented such that the folded portion of the tether 14104 is positioned directly adjacent to and in overlapping arrangement with the second surface 14112 of the tether 14104. The second fold F2 may be positioned such that the portion of the tether 14104 extending between the second fold F2 and a second end 14114 of the tether 14104 is positioned directly adjacent to and in overlapping arrangement with the portion of the tether 14104 extending between the first fold F1 and the second fold F2. One or more stitches, identified at 14116, may extend through the three layers of tether 14104 arranged axially between the first fold F1 and the second fold F2. In an embodiment, a portion of the tether 14104 extending between the seam formed by the one or more stitches 14116 located between the first fold F1and the second fold F2 and the end 14114 of the tether 14104 may be bent relative to the portion of the tether 14104 including the connector 14106. When arranged at an angle to the connector 14106, this stitched end 14114 of the tether 14104 may be larger than an opening or slot formed in a corresponding SIP device, such as slot 13922 for example. Accordingly, this stitched end 14114 of the tether 14104 may be used to retain the tether 14104 in position relative to a torso SIP device, such as torso SIP devices 13700, 13800, 13900, 14000, 14100.

[0981] With reference to FIGS. 179A-180E, in some embodiments, at least one torso SIP device is integrated into a car seat insert 14220 removably positionable within a child receiving region 14202 of a child seat 14200. In the illustrated, non-limiting embodiment, the car seat insert 14220 includes a first torso SIP device (see 14221 in FIG. 179C) arranged within a first pocket 14223 (FIG. 179C) formed from soft goods and a second torso SIP device (not shown) arranged within a second pocket (not shown) formed from soft goods. The soft goods forming a pocket and a corresponding torso SIP device arranged therein may be identified in the FIGS. collectively at 14222a, 14222b. As shown, a central member 14224 coupled to and arranged centrally between both the first pocket 14222a and the second pocket 14222b. The torso SIP devices surrounded by soft goods 14222a, 14222b may be movable, for example foldable relative to the central member 14224 to position the car seat insert 14220 within a car seat.

[0982] In some embodiments, such as shown in FIGS. 180A-180B, the torso SIP devices surrounded by soft goods 14222a, 14222b may be freely movable relative to the central member 14224 and/or a portion of the child seat. However, in the illustrated, non-limiting embodiment shown in FIGS. 180C-180E, each torso SIP device has a connector assembly 14223a, 14223b protruding outwardly from the pocket and connectable to a corresponding connector (not shown) formed at the child seat 14200. As shown, the central member 14224 may be formed from soft goods and is configured to overlap a seat support surface 14204 of the child seat 14200, an upright support surface 14206 of the child seat 14200, or both. In embodiments where the central member 14224 is configured to overlap both surfaces 14204, 14206, a seam may be formed in the connector member 14224, thereby defining a seat portion 14226 and a back portion 14228. Accordingly, the central member 14224 may extend beyond the first and second pockets 14222a, 14222b in one or two directions. In the illustrated, non-limiting embodiment, the soft goods forming the first pocket 14222a and the soft goods forming the second pocket 14222b are stitched to the central member 14224.

[0983] The car seat insert 14220 including the at least one torso SIP device may be adapted for use with a harness 14208 of the child seat 14200. For example, in embodiments where the central member 14224 overlaps the seat support surface 14204, one or more slits 14230 may be formed in the central member 14224 to receive a crotch strap 14210 of the harness 14208. The lower webbing 14212 of the harness 14208 may extend between a respective pocket 14222a, 14222b containing a torso SIP device and the central member 14224. Accordingly, the length of the seam formed at the interface between the first pocket 14222a and the central member 14224 and/or the second pocket 14222b and the connector member

14224 may be controlled to minimize interference between the car seat insert 14220 and the harness webbing 14212.

[0984] In some embodiments, an infant insert 14250 is usable in combination with the car seat insert 14220 to properly position a child within the child seat 14200. With reference to FIGS. 180A and 180E, an example of an infant insert 14250 is illustrated in more detail. As shown, the infant insert 14250 includes a central body 14252 positionable in overlapping arrangement with an upper surface of the central member 14224 of the car seat insert 14220. In the illustrated, non-limiting embodiment, the central body 14252 includes a seam that defines a respective seat portion 14254 and a back portion 14256 of the central body 14252. The central body 14252 of the infant insert 14520, such as the seat portion 14254 for example, may similarly include an opening or slit 14258 to receive a crotch strap 14210 of the harness 14208. In the non-limiting embodiment illustrated in FIG. 180F, the infant insert 14250 additionally includes a pair of shoulder flaps 14260a, 14260b may be attached to and extend outwardly from the lateral sides 1of the central body 14252, such as a near a distal end 14368 of the back portion 14256. It should be understood that in some embodiments, the shoulder flaps 14260a, 14260b are operable as SIP devices.

[0985] Each insert 14220, 14250, or the combination thereof is configured to occupy extra space within the area of the child seat 14200 configured to receive the child to adapt the size of the area to that of the child. The insert 14220, 14250 may be configurable for operation in a plurality of different stages, such as based on the size and/or weight of the child receivable within the area of the child seat. In an embodiment, the different stages may be adapted for use with a child ranging from a newborn up to about 40 pounds. The inserts 14220, 14250may be used in combination or independently based on a desired stage of operation. When configured for use in a first stage, the car seat insert 14220 and the infant insert 14250 are both installed about the child seat 14200. In the first stage, the inserts 14220, 14250 may be intended for use with a child up to 11 pounds. The inserts 14220, 14250 may also be configured for use in a second stage in which one of the insert portions has been removed. For example, in some embodiments, only the car seat insert 14220 may be installed about the child seat 14200 in the second stage. Alternatively, only the infant insert 14250 may be installed about the child seat 14200 in the second stage. When either the car seat insert 14220 or the infant insert 14250 (but not both) is installed, the insert may be intended for use with a child having a weight between about 11 pounds and about 40 pounds. In an embodiment, both the car seat insert 14220 and the infant insert 14250 are removed from the child seat 14200 when the child seat is being used by a child exceeding 40 pounds.

[0986] Another example of a car seat insert 14320 including a first torso SIP device and a second torso SIP device is illustrated in FIGS. 181A-182C. Similar to the previous embodiment, both the first torso SIP device (not shown) and the second SIP device (not shown) may be enclosed within soft goods. The pockets containing a respective torso SIP device are identified collectively at 14322a and 14322b. A connector member 14324, also formed from soft goods may couple the pockets 14322a, 14322b containing the first and second torso SIP devices. In the illustrated, non-limiting embodiment, the connector member 14324 is configured to overlap both a seat support surface 14304 of a child seat and an upright support surface 14306 of a child seat. In such embodiments, a seam may be formed in the connector member 14324, thereby defining a seat portion 14326 and a back portion 14328. Unlike the previous embodiment, the torso SIP devices of the insert do not have a connection assembly including a tether that protrudes beyond the soft goods. Rather, in the illustrated, non-limiting embodiment, at least one connector 14323a, 14323b, such as a snap for example, may be affixed to an exterior surface of the soft goods surrounding each torso SIP device, such as at a back end of the torso SIP devices.

[0987] The back portion 14328 of the connector member 14324 may include a respective connection assembly 14330a, 14330b associated with each torso SIP device. As shown, a first connection assembly 14330a may be arranged at a first side 14332 of the back portion 14328, near the pocket 14322a containing the first torso SIP device, and a second connection assembly 14330b may be arranged at a second side 14334 of the back portion 14328, near the pocket 14322b containing the second torso SIP device. In the illustrated, non-limiting embodiment, each connection assembly 14330a, 14330b includes a tether 14336a, 14336b affixed to the back portion 14328 of the connector member 14324 such that the tether 14336a, 14336b extends outwardly beyond an edge 14332, 14334 of the connector member 14324. Further a connector 14338a, 14338b, such as complementary to the connector 14323a, 14323b arranged at the torso SIP devices may be mounted at or proximate to the distal end of each tether 14336a, 14336b. For example, a socket of a snap may be arranged at the torso SIP device, and a stud of a snap may be arranged at the connection assembly. Accordingly, the connector 14338a, 14338b of the connection assembly 14330a, 14330b is couplable to the connector 14323a, 14323b of a torso SIP device.

[0988] When the car seat insert 14320 is installed about a child seat 14300 (see FIGS. 182A-182C) , the crotch strap 14310 of a harness 14308 of the child seat 14300 is similarly extendable through one or more openings 14340 formed in the connector member 14324. Further, the lower webbing 14312 of the harness 14308 may be routed between the back portion

14328 of the connector member 14324 and a pocket 14322a, 14322b containing the torso SIP device. Once the harness webbing 14312 is properly positioned, the connector 14338a, 14338b of the connection assembly 14330a, 14330b may be affixed to the connector 14323a, 14323b of the pocket 14322a, 14322b containing the torso SIP device to restrict movement of the car seat insert 14320 relative to the child seat 14300.

[0989] In some embodiments, an infant insert 14350 is usable in combination with the car seat insert 14320 to properly position a child within the child seat 14300. With reference to FIGS. 183A-185B, an example of an infant insert 14350 is illustrated in more detail. As shown, the infant insert 14350 includes a central body 14352 positionable in overlapping arrangement with at least one of the seat support surface 14304 and the upright support surface 14306 of a child seat 14300. In the illustrated, non-limiting embodiment, the central body 14352 is configured to overlap both the seat support surface 14304 and the upright support surface 14306. In such embodiments, a seam may be formed in the central body 14352 to define a respective seat portion 14354 and a back portion 14356. A pair of hip flaps 14358a, 14358b may be attached to and extend outwardly from the lateral sides 14360, 14362 of the central body 14352, such as a near a distal end 14364 of the seat portion 14354. Alternatively, or in addition, a pair of shoulder flaps 14366a, 14366b may be attached to and extend outwardly from the lateral sides 14360, 14362 of the central body 14352, such as a near a distal end 14368 of the back portion 14356. It should be understood that in some embodiments, the hip flaps 14358a, 14358b and/or shoulder flaps 14366a, 14366b are operable as SIP devices. In some embodiments, the infant insert 14350 includes a head attachment 14370. The head attachment 14370 may be permanently attached to the central body 14352, or in some embodiments, such as shown in the FIGS. 184A and 184B, may be removably connectable thereto. In the illustrated, non-limiting embodiment, an extension 14372 arranged at the bottom of the head attachment 14370 is positionable in overlapping arrangement with a back surface 14374 of a portion of the central body 14352, such as the back portion 14356 for example. The extension 14372 may have one or more connectors 14376 couplable to one or more corresponding connectors 14378 located at the back surface 14374.

[0990] In the illustrated, non-limiting embodiment, the infant insert 14350 is positionable in overlapping arrangement with the car seat insert 14320. For example, the central body 14352 is located directly on top of the connector member 13324 of the car seat insert 14320. Accordingly, the central body 14352 may include one or more slots 14380 through which a crotch strap of a harness is extendable. The hip flaps 14358a, 14358b may be foldable relative to the central body 14352 such that the hips flaps 14358a, 14358b are positionable

directly in front of the pockets 14322a, 14322b containing torso SIP devices of the car seat insert 14320. Similarly, the shoulder flaps 14366a, 14366b may be foldable relative to the central body 14352 such that the shoulder flaps 14366a, 14366b are positionable directly in front of a portion of pockets 14322a, 14322b containing the torso SIP devices. Alternatively, or in addition, the shoulder flaps 14366a, 14366b may be arranged directly adjacent to one or more shoulder SIP devices 14314a, 14314b positioned about the child seat 14300.

[0991] With reference now to FIGS. 228A-229B, another example of a torso SIP device is illustrated. As in previous embodiments, the illustrated child seat system 16600 includes a child seat 16602 mounted to a support base 16604. The child seat 16602 includes a seat shell 16606 having an upright or seat back portion 16608 and seat pan portion 16610. In the illustrated, non-limiting embodiment, at least one torso SIP device is arranged at an interior of the seat shell 16606 at or proximate to the seat pan portion 16610 of the seat shell 16606. In some embodiments, the at least one torso SIP device may be slightly offset from the occupant's hip, such as in a direction away from the upright portion 16608 of the seat shell 16606.

[0992] As shown, the child seat system 16600 includes a harness assembly 16611 operable to secure a child within the child seat 16602. The harness assembly 16611 includes at least one waist strap, such as a first waist strap 16612a and a second waist strap 16612b, each including a piece of webbing 16613a, 16613b, and being connectable to at least one crotch strap 16614. The crotch strap 16614 is positionable between an occupant's legs and has a piece of webbing 16616 and a buckle 16618 at a first end thereof. A latch 16620a, 11620b associated with the waist straps 16612a, 16612b is configured to releasably fasten to the buckle 16618 to secure a child in the child seat 16602. A first end 11622a, 11622b of the piece of webbing 16613a, 16613b of each waist strap 16612a, 16612b may be anchored to the child seat 16602. In the illustrated, non-limiting embodiment, the waist straps 16612a, 16612b include a secondary piece of webbing 16624a, 16624b affixed, such as stitched at an end thereof for example, to a respective piece of webbing of one of the waist straps 16612a, 16612b near the first end 16622a, 16622b. The distal end 16626a, 16626b of each secondary piece of webbing 16624a, 16624b may also be anchored to the child seat 16602. As shown, the first end 16622a, 16622b and a corresponding distal end 16626a, 16626b of each waist strap mounted to the child seat 16602 with a gap or clearance formed between each pair of ends 16622a, 16626a and 16622b, 16626b. These two anchor points of a waist strap 16612a, 16612b of the harness assembly 16611 and the resulting clearance formed therebetween may form an SIP device, generally identified at 16630a, 16630b, located between an occupant's leg or hip and an adjacent sidewall of the seat shell.

[0993] In such a configuration, when a side impact is applied to a side of the child seat 16602 in a first direction, a child seated within the child set will begin to shift in the same first direction, toward an opposite side of the seat shell from where the side impact was applied. This movement will apply a tension to each SIP device 16630a, 16630b, such as to a portion of each waist strap 16612a, 16612b. For example, in the illustrated, non-limiting embodiment, the side impact and resulting movement of the occupant causes the first end 16622a of the first piece of webbing 16613a of the first waist strap 16612a to be fully tensioned and the end 16626a of the secondary piece of webbing 16624a to be minimally tensioned. Similarly, the end 16626b of the secondary piece of webbing 16624b may be fully tensioned and the first end 16622c of the first piece of webbing 16613b of the second waist strap 16612b may be minimally tensioned. Accordingly, when a side impact is applied to the left side of the set shell, the left anchor point of both waist straps 16612a, 16612b may be fully tensioned and the right anchor point of both waist straps 16612a, 16612b may be minimally tensioned. When a side impact is applied to a right side of the seat shell, the left anchor point of both waist straps 16612a, 16612b may be minimally tensioned and the right anchor point of both waist straps 16612a, 16612b may be fully tensioned. Tensioning the waist straps 16612a, 16612b in such a manner limits the lateral translation of a child within the child seat 16602 during a crash event.

[0994] In some embodiments, a torso SIP device is transformable between a first configuration and a second configuration. For example, a torso SIP device may be movable relative to the seat shell of a child seat between a retracted configuration and an extended configuration. In such embodiments, the torso SIP device may be coupled to the child seat in both the retracted configuration and the extended configuration. Further, in an embodiment, the torso SIP device is lockable in the retracted configuration, the extended configuration, or both. It should be understood that the torso SIP device is generally positioned between the child seat and the soft goods when in the retracted configuration and may also be arranged between the child seat and the soft goods when in the extended configuration. However, embodiments where the torso SIP device is configured to protrude through or beyond the soft goods overlapping the child seat when in the extended configuration are also contemplated herein. Further, the torso SIP device is transformable between the extended and retracted configurations not only when the soft goods are removed from the child seat, but also when the soft goods are positioned about the child seat.

[0995] With reference to a child seat 4100 illustrated in FIGS. 44A- 44D, a first torso SIP device 4102a may be associated with a first portion of the seat shell 4104 of the child seat 4100, such as the first upright side member 4106, and a second torso SIP device 4102b may be

associated with a second portion of the seat shell 4104, such as a second upright side member 4108. In an embodiment, each of the first and second upright side members 4106, 4108 has a cavity 4110a, 4110b (see FIGS. 44C & 44D) formed therein. The first and second SIP devices 4102a, 4102b are positioned within respective cavities 4110 of the first and second upright side members 4106, 4108 when in a retracted configuration. As shown, when in the retracted configuration, occupant facing surfaces 4112a, 4112b of the torso SIP devices 4102a, 4102b may be substantially flush with an adjacent interior surface of the first and second upright side members 4106, 4108 or another adjacent portion of the seat shell 4104. In the extended configuration, the first and second torso SIP devices 4102a, 4102b are removed from their cavities 4110a, 4110b and are positioned adjacent to the occupant surface of the seat shell 4104.

[0996] A torso SIP device 4102a, 4102b may be rotated about an axis between the retracted configuration and the extended configuration. In the illustrated, non-limiting embodiment, the first and second torso SIP devices 4102a, 4102b are configured to rotate about a generally horizontally oriented axis at a bottom of the cavity 4110a, 4110b. Accordingly, the first torso SIP device 4102a may be positioned directly beneath the cavity 4110a formed in the first upright side member 4106 when in the extended configuration. Similarly, the second torso SIP device 4102b may be positioned directly beneath the cavity 4110b formed in the second upright side member 4108 when in the extended configuration. In the extended configuration, the occupant facing surface 4112a, 4112b of each respective torso SIP device 4102a, 4102b may be located adjacent to, and in some embodiments in direct contact with an adjacent surface of the seat shell 4104. However, it should be understood that embodiments where the torso SIP devices 4102a, 4102b are rotatable an axis having a different orientation, such as a vertically oriented axis for example, between a retracted and extended configuration are also within the scope of the disclosure. In an embodiment, a portion of a torso SIP device 4102a, 4102b may be affixed to the child seat 4101 to limit the allowable movement of the torso SIP device 4102a, 4102b to transformation between the retracted and extended configurations.

[0997] Another embodiment of a child seat 4200 having at least one torso SIP device transformable between a retracted configuration and an extended configuration is illustrated in FIGS. 45A-45D. Similar to the previously described embodiment, a first torso SIP device 4202a may be associated with a first portion of the seat shell 4204, such as a first upright side member 4208 of an upright portion 4206 of the seat shell 4204, and a second torso SIP device 4204b may be associated with a second portion of the seat shell, such as a second upright side member 4210 of the upright portion 4206. In an embodiment, each of the first and second upright side members 4208, 4210 has a recess or cavity formed therein (not shown). At least a

portion of the first and second torso SIP devices 4202a, 4202b are received within the respective cavities of the first and second upright side members 4208, 4210 in a retracted configuration (FIGS. 45A and 45B). As shown, when in the retracted configuration, an occupant facing surface 4212a, 4212b of the torso SIP devices 4202a, 4202b may be substantially flush with an adjacent interior surface of the seat shell 4204, such as an occupant facing surface of the seat side members 4220, 4222 of a seat portion 4224 of the seat shell 4104 for example. In the extended configuration, the first and second torso SIP devices 4202a, 4202b protrude from their cavities to reduce the available space within the interior of the seat shell 4204.

[0998] In an embodiment, the torso SIP devices 4202a, 4202b are translatable along an axis, such as a horizontally oriented axis for example, between the retracted configuration (FIGS 45A and 45B) and the extended configuration (FIGS. 45C and 45D. Further, in the illustrated, non-limiting embodiment, respective upper surfaces 4230a, 4230b of the first and second torso SIP devices 4202a, 4202b are configured to form an armrest for an occupant of the child seat 4200. The torso SIP devices 4202a, 4202b may form an armrest when a torso SIP device 4202a, 4202b is in at least one, and in some embodiments in both, the retracted configuration, and the extended configuration.

[0999] In other embodiments, a similarly retractable torso SIP device may have another configuration including size and shape. For example, in the non-limiting embodiment of FIG. 46, a retractable torso SIP device 4302 of a child seat 4300 has a circular or oval configuration.

[1000] Another child seat 4400 having at least one torso SIP device transformable between a retracted configuration and an extended configuration is illustrated in FIGS. 47A-47D. Similar to the previous embodiments, a first torso SIP device 4402a may be associated with a first portion of a seat shell 4404 of the child seat 4400, such as a first upright side member 4408 of an upright portion 4406 of the seat shell 4404. Alternatively, or in addition, a second torso SIP device 4402b may be associated with a second portion of the seat shell, such as a second upright side member 4410 of the upright portion 4406. In the illustrated, non-limiting embodiment, the first and second torso SIP devices 4402a, 4402b are connected to the back 4412 of the seat shell 4104, at a location near the first upright side member 4408 and the second upright side member 4410, respectively.

[1001] Each of the first and second torso SIP devices 4402a, 4402b may be receivable within a corresponding cavity (not shown) formed in the seat shell 4104 via an opening 4414 in the upright support surface 4416 of the back 4412 (proximate a junction between the seat back 4412 and a seat support surface 4418). When in the retracted configuration and arranged

within a cavity, the torso SIP devices 4402a, 4402b may be flush with, the adjacent upright support surface 4416, or alternatively, an adjacent seat support surface 4418. When in the extended configuration, as shown in FIGS. 47C and 47D, the first and second torso SIP devices 4402a, 4402b protrude from their cavities to reduce the available space within the interior of the seat shell 4404. The torso SIP devices 4402a, 4402b in the extended configuration are disposed between an occupant's torso and/or leg and the adjacent upright side member 4408, 4410 and/or seat side member 4420, 4422. The torso SIP devices 4402a, 4402b may be translatable, rotatable, or some combination of translatable and rotatable between the retracted configuration and the extended configuration.

[1002] A child seat 4500 having at least one similar torso SIP according to another embodiment is illustrated in FIGS. 48A-48D. Similar to the previous embodiment, a first torso SIP device 4502a may be associated with a first portion of the seat shell 4504 and a second torso SIP device 4502b may be associated with a second portion of the seat shell 4504. In the illustrated, non-limiting embodiment, the first and second torso SIP devices 4502a, 4502b are connected to a seat portion 4506 of the seat shell 4504, such as at a location near a first upright side member 4508 and a second upright side member 4510 of an upright portion 4512 of the seat shell 4504, respectively. The first and second torso SIP devices 4502a, 4502b are movable relative to openings 4514a, 4514b formed in the seat support surface 4516 between a retracted configuration and an extended configuration. In the retracted configuration (FIGS 48A and 48B), the torso SIP devices 4502a, 4502b are fully arranged within a corresponding cavity (not shown), such as located beneath the seat support surface 4516. In the extended configuration (FIGS. 48C and 48D), the first and second torso SIP devices 4502a, 4502b protrude generally vertically upwardly through the openings 4514 formed in seat support surface 4516 to reduce the available space within the interior of the seat shell 4504. The torso SIP devices 4502a, 4502b may be translatable, rotatable, or some combination thereof between the retracted configuration and the extended configuration.

[1003] With reference now to FIGS. 86A-86F, another embodiment of a child seat 8200 including a torso SIP device 8202 transformable between a plurality of configurations is illustrated. In each of the plurality of configurations, at least a portion of the torso SIP device 8202 remains at a fixed location relative to the child seat 8200 as will be described in more detail below. As shown, the torso SIP device 8202 includes a plurality of sections 8204a, 8204b, 8204c, 8204d connected together via one or more connector members 8206. Although four sections 8204a, 8204b, 8204c, 8204d are illustrated in the FIGS., it should be understood that embodiments having any number of sections, such as two sections, three sections, or more

than four sections are also within the scope of the disclosure. Each of the plurality of sections 8204a, 8204b, 8204c, 8204d of the torso SIP device 8202 may be substantially identical; however, embodiments where one or more of the sections 8204a, 8204b, 8204c, 8204d has a different configuration are also contemplated herein. Further, in the illustrated, non-limiting embodiment, a single connector member 8206 is coupled to each of the plurality of sections 8204a, 8204b, 8204c, 8204d. For example, a connector member 8206 may be coupled to a surface of each of the plurality of sections 8204a, 8204b, 8204c, 8204d facing an adjacent side member 8208 of the child seat 8200. In other embodiments, a connector member 8206 may be coupled to only a portion of the plurality of sections 8204a, 8204b, 8204c, 8204d, such as to two adjacent sections of the plurality of sections for example.

[1004] When coupled by the at least one connector member 8206, the plurality of sections 8204a, 8204b, 8204c, 8204d are movable relative to one another to control a configuration of the torso SIP device 8202. The sections 8204a, 8204b, 8204c, 8204d may be movable to control a width and a height of the torso SIP device 8202. At least one of the plurality of sections 8204a, 8204b, 8204c, 8204d of the torso SIP device is mounted at a position in alignment with a hip of an occupant. The total number of the plurality of sections 8204a, 8204b, 8204c, 8204d arranged at this position is adjustable to control a width of the torso SIP device 8202. In a first or minimum thickness mode (FIG. 86A), only a single section 8204a is arranged at the position in alignment with an occupant's hip. However, in a second mode, more than one section, such as a first and second section 8204a, 8204b (FIG. 86B), may be arranged at this position. To transform between modes, one or more adjacent sections of the plurality of sections 8204a, 8204b, 8204c, 8204d may be folded, translated, or otherwise manipulated into overlapping arrangement with the first section 8204a along an axis extending between the opposing sides of the child seat 8200 at the position in alignment with an occupant's hip. In further modes, additional sections may be arranged in overlapping arrangement and alignment with the other sections and the hip of an occupant. For example, a mode including three stacked sections 8204a, 8204b, 8204c is shown in FIG. 86C and a mode including four stacked sections 8204a, 8204b, 8204c, 8204d is shown in FIG. 86D. Stacking respective sections 8204a, 8204b, 8204c, 8204d of the torso SIP device 8202 allows a user to adjust the width of the torso SIP device 8202 based on the size of the occupant within the child seat 8200. Although the torso SIP device 8202 is illustrated as being arranged at a first side member 8208 of the child seat 8200, it should be appreciated that in other embodiments, the torso SIP device 8202 may alternatively or additionally be arranged at the opposite side member (not shown) of the child seat 8200.

[1005] With reference now to FIGS. 219A-219D, a torso SIP assembly 16020 similar to that of FIGS. 42A-42C is illustrated. The illustrated torso SIP assembly 16020 includes a plurality of first torso SIP devices 16022a, 16022b and a plurality of second torso SIP devices 16024a, 16024b arranged at opposite sides of a connector member 16026. The second torso SIP devices 16024a, 16024b may be positionable within an upper torso region of a child seat 16000 and the first torso SIP devices 16022a, 16022b may be positioned within a lower torso region of the child seat 16000.

[1006] In the illustrated, non-limiting embodiment, the SIP assembly 16020 includes at least one third torso SIP device 16028a, 16028b transformable between a retracted or stowed configuration (FIGS. 219A-219B) and an extended or deployed configuration (FIGS. 219C-219D). Each third torso SIP device 16028a, 16028b may be associated with another one of the first and second SIP devices 16022a, 16022b, 16024a, 16024b. For example, a third torso SIP device 16028a, 16028b may be removably or permanently mounted to a second SIP device 16024a, 16024b of the SIP assembly 16020, and in some embodiments may be removably or permanently mounted to each respective second torso SIP device 16024a, 16024b.

[1007] The third torso SIP devices 16028a, 16028b may be formed from or contain a material selected to absorb crash energy. In some embodiments, a hardness of the third torso SIP devices 16028a, 16028b is different than the hardness of the second torso SIP devices 16024a, 16024b and/or the hardness of the first torso SIP devices 16022a, 16022b. For example, the third torso SIP devices 16028a, 16028b may be softer or have a reduced hardness compared to the second torso SIP devices 16024a, 16024b. However, in other embodiments, the second torso SIP devices 16024a, 16024b may be harder than the third torso SIP devices 16028a, 16028b or may have the substantially same hardness as the third torso SIP devices 16028a, 16028b.

[1008] The third torso SIP device 16028a, 16028b may be operable to engage and apply a force to a portion of an occupant's arm, such as between the elbow and shoulder for example, to prevent the arm from being compressed against an occupant during a crash event. In the illustrated, non-limiting embodiment, the third torso SIP device 16028a, 16028b is arranged at a portion of a forward-facing surface 16030a, 16030b of each second torso SIP device 16024a, 16024b. However, in other embodiments, the third torso SIP device 16028a, 16028b may be arranged at another surface of the second torso SIP device 16024a, 16024b, such as an inwardly facing surface thereof for example. Each of the second torso SIP devices 16024a, 16024b may have a recess or cavity (not shown) formed therein and at least a portion of the third torso SIP devices 16028a, 16028b is receivable within the respective cavities when in the retracted or

stowed configuration. In an embodiment, the outer surface of each third torso SIP device 16028a, 16028b may be substantially flush with an adjacent surface of a second torso SIP device 16024a, 16024b, or may be arranged within the interior of the cavity when in the retracted configuration. In the extended configuration, at least a portion of the body 16032a, 16032b of the third torso SIP devices 16028a, 16028b protrudes outwardly beyond the forward-facing surface 16030a, 16030b of the second torso SIP devices 16024a, 16024b.

[1009] The bodies 16032a, 16032b of the third torso SIP devices 16028a, 16028b may be formed from a rigid or semi-rigid material. In other embodiments, the third torso SIP devices 16028a, 16028b may have structurally modifiable bodies 16032a, 16032b, such as formed by inflatable bladders or air bags. In a retracted configuration, the structurally modifiable bodies 16032a, 16032b may be deflated and in a deployed configuration, the structurally modifiable bodies 16032a, 16032b may be filled with a fluid, such as air for example. When filled, the structurally modifiable bodies 16032a, 16032b of the third torso SIP devices 16028a, 16028b may be elastically deformable to absorb energy applied thereto during a crash event.

[1010] With reference now to FIGS. 224A-224C, another example of a SIP device 16300 operable to move a portion of an occupant's arm forward to prevent the arm from being compressed against an occupant during a crash event is illustrated. As shown, the SIP device 16300 may be formed from a structurally modifiable body, such as an airbag for example, and is positionable adjacent to a side of the occupant's torso and behind an arm. In the illustrated, non-limiting embodiment, the SIP device 16300 is sized to extend from a location proximate to the occupant's hip toward the occupant's upper body, such as to a location proximate to the occupant's shoulder for example. In such embodiments, the SIP device 16300 may be operable as a torso SIP device and/or a shoulder SIP device. A front surface 16306 of the SIP device 16300 may have an angled or sloped configuration such that at least a portion of the arm of the occupant seated adjacent to the SIP device 16300 is located forward of the occupant's chest. In the illustrated, non-limiting embodiment, the front surface 16306 is sloped downwardly such that a depth of the SIP device 16300 defined between the front surface 16306 and a back surface 16308 of the SIP device 16300 increases from the top of the SIP device 16300 toward the bottom thereof. Although the entirety of the front surface 16306 is illustrated as having a generally uniform slope, embodiments where the slope varies, or where only a portion of the front surface 16306 is sloped are also contemplated herein.

[1011] In some embodiments, the SIP device 16300 is transformable between a stowed or retracted configuration, as shown in FIGS. 224A and 224B, and a deployed or extended configuration (FIG. 224C). In the deployed configuration, an extending portion 16302 extends

from the structurally modifiable body, such as from a side 16304 of the SIP device 16300 arranged adjacent to and/or facing toward a corresponding sidewall of a child seat (not shown), from the front surface 16306, or from an interface between the side 16304 and the front surface 16306. In some embodiments, the deployed extending portion 16302 may additionally form a bulge at the front surface 16306 of the SIP device 16300. Accordingly, the deployed extending portion 16302 may extend forward from the front 13606, and alternatively or additionally, from the side 13604, beyond the remainder of the front surface 16306. In such embodiments, the extending portion 16302, when deployed, may be aligned with an upper portion of the occupant's arm, such as upwardly adjacent to the occupant's elbow, and may exert an upward force on the nearby portion of the occupant's arm. When the SIP device 16300 is in the stowed configuration, the extending portion 16302 is deflated and the material of the SIP device 16300 that defines the extending portion 16302 may be folded onto itself. In the illustrated, non-limiting embodiment, the portion of the body defining the extending portion 16302 may be tucked into the interior of the SIP device 16300. In such a stowed configuration, the portion of the body defining the extending portion 16302 may form a pocket at an interior of the SIP device 16300.

[1012] With reference to FIGS. 225A-225C, another SIP device 16400 similar to the SIP device 16300 of FIGS. 224A-224C is illustrated. As in the previous embodiment, the SIP device 16400 may be formed from a structurally modifiable body and may extend from a location proximate to the occupant's hip toward the occupant's shoulder. The SIP device 16400 is transformable between a stowed or retracted configuration, as shown in FIGS. 225A and 225B, and a deployed or extended configuration (FIG. 225C). Unlike the embodiment of FIGS. 224A-224C in which an extending portion 16302 extends from a side, front surface or junction therebetween of the structurally modifiable body, in the non-limiting embodiment of FIGS. 225A-225C, an extending portion 16402 extends forward from a relative middle of the front surface 16406 of the body of the SIP device 16400 when in the deployed configuration. As in the previous embodiment, when the SIP device 16400 is in the deployed configuration, the extending portion 16402 engages and applies a force to a portion of the occupant's arm, thereby moving the occupant's arm forward away from the occupant's body to prevent the arm from being compressed against the occupant during a crash event. When the SIP device 16400 is in the stowed configuration, the extending portion 16402 is deflated and the material of the SIP device 16400 that defines the extending portion 16402 may be folded. In the illustrated, non-limiting embodiment, the portion of the body defining the extending portion 16402 forms a

pocket at an interior of the SIP device 16400. As shown, the pocket may be arranged at a center of the front surface 16406 of the SIP device 16400.

[1013] With continued reference to the SIP device 16300, 16400, of FIGS. 224A-225C, a fluid source may be operably coupled to the interior of the structurally modifiable body of the SIP device 16300, 16400. In such embodiments, fluid may be provided to the interior of the SIP device 16300, 16400 in response to a crash event. As the fluid fills the interior, the extending portion 16302, 16402 moves outwardly, away from the remainder of the SIP device 16300, 16400. In other embodiments, the SIP device 16300, 16400 may maintain a constant fluid level within its interior while transforming between a stowed configuration and a deployed configuration. In such embodiments, during a crash event, movement of the occupant may apply a force to part of the SIP device 16300, 16400, such as the lower part near the occupant's hip for example. This force displaces fluid from the bottom interior of the SIP device 16300, 16400 toward the folded portion, causing the extending portion 16302, 16402 to fill and unfold until the extending portion16302, 16402 extends outwardly from the remainder of the SIP device 16300, 16400.

[1014] With reference now to FIGS. 220A-220B, a child seat 16100 having at least one SIP assembly (not shown) associated with an occupant's arm, such as an elbow for example, to prevent the arm from being compressed against an occupant during a crash event. The SIP assembly, such as in combination with the structure of the child seat, may define a space for receiving a portion of the occupant's arm to minimize chest compression during a crash event. As shown, the occupant's lower arm and/or elbow may move outwardly into the predefined space proximate to the upright side member 16104, 16106 of the seat shell 16102 (see FIG. 220B) during a crash event.

[1015] An example of the child seat 16100 of FIGS. 220A-220B is illustrated in more detail, for example under the soft goods, in FIGS. 221A-221B. In the illustrated, non-limiting embodiment, the SIP assembly 16107 includes a cutout or recess 16110 formed at an interior surface of the upright side members 16104, 16106 of the rigid or hard seat shell 16102. As shown, a thickness of the upright side member 16104, 16106 at a location adjacent to a seat portion 16108 (see FIGS. 220A-220B) of the seat shell 11602 is greater than a thickness of the upright side member 16104, 16106 at the recess 16110. The recess 16110 may extend over only a portion of the height of the upright side members 16104, 16106, or alternatively, over a substantial entirety thereof.

[1016] As shown, the SIP assembly 16107 may additionally include an SIP device 16120 arranged within a portion of the recess 16110. The SIP device 16120 may have a shape

complementary to at least a portion of the recess 16110. In an embodiment, the SIP device 16120 is configured such that an inwardly facing surface 16122 of the torso SIP device 16120 is flush or substantially aligned with an inner seat surface defined by the interior surface of the upright side member 16104, 16106 and/or the surface of the adjacent seat portion 16108 of the seat shell 16102. The SIP device 16120 may extend over only a portion of a height of the recess 16110. For example, in the illustrated, non-limiting embodiment, the SIP device 16120 is arranged at an upper portion of the recess 16110 generally aligned with a shoulder of an occupant of the child seat 16100. The remaining portion of the recess 16110 forms a pocket 16124 horizontally aligned with a lower portion of an occupant's arm. In such embodiments, both the SIP device 16120 and the adjacent pocket 16124 may be covered by soft goods, as shown in FIGS. 220A-220B, such that the pocket 16124 is not visible at the interior of the child seat 16100.

[1017] The seat shell 16102 may be formed from a first material and the SIP device 16120 may be formed from a second material, different from the first material. In an embodiment, the second material of the SIP device 16120 has a reduced hardness compared to the first material of the seat shell 16102. The SIP device 16120 may be formed from any suitable material, such as a rigid or semi-rigid foam material for example, configured to absorb energy.

[1018] In some embodiments, such as shown in FIG. 222, the SIP assembly 16107 includes both a first SIP device 16120 and a second SIP device 16130 arranged within the recess 16110 formed in an upright side member 16104, 16106 of the seat shell 16102. Specifically, the second SIP device 16130 may be positioned within the pocket 16124 formed in combination, by the first SIP device 16120 and the recess 16110. In such embodiments, the second SIP device 16130 has a reduced hardness compared to the first SIP device 16120. As a result, during a crash event, the second SIP device 16130 is configured to compress, when a force is applied thereto, such as by the occupant's lower arm.

[1019] In yet another embodiment, illustrated in FIGS. 223A-223B, the child seat 16200 similarly includes a seat shell 16202 having a first upright side member 16204 and a second upright side member 16206. The child seat 16200 may include at least one SIP assembly 16207. In some embodiments, a recess 16210 may be formed at an interior surface of the upright side members 16204, 16206 of the rigid or hard seat shell 16202. As shown, a thickness of the upright side member 16204, 16206 at a location adjacent to a seat portion 16208 of the seat shell 16202 may be greater than a thickness of the upright side member 16204, 16206 at

the recess 16210. The recess 16210 may extend over only a portion of the height of the upright side members 16204, 16206, or alternatively, over a substantial entirety thereof.

[1020] In the illustrated, non-limiting embodiment, the SIP assembly 16207 includes an SIP device 16220 positionable in overlapping arrangement with the interior surface of the upright side member 16204, 16206. As shown, the SIP device 16220 may extend over a substantial entirety of the upright side member 16204, 16206. In embodiments where a recess 16210 is formed in the upright side member 16204, 16206, the SIP device 16220 may extend over a substantial entirety of the recess 16210. The front of the SIP device may be flush with an inwardly facing surface of a portion of the upright side member 16204, 16206 remote from the recess 16210.

[1021] As shown, the surface of the SIP device facing the child receiving region of the child seat 16200 may be substantially continuous and/or smooth. In the illustrated, non-limiting embodiment, material is removed from a backside of the SIP device 16220, facing an upright side member 16204, 16206, to form a recess 16222 at the back of the SIP device 16220. Accordingly, a thickness of the SIP device 16220 at the recess 16222 is less than a thickness of the SIP device 16220 at a location of the SIP device remote from the recess 16222. The portion of the SIP device 16220 having a reduced thickness due to the recess 16222 may also be referred to herein as a weakened region and may be horizontally aligned with a lower portion of an occupant's arm. Accordingly, a hollow pocket may be formed between the recess 16222 of the SIP device 16220 and the recess 16110 of an adjacent upright side member 16204, 16206. During a crash event, the occupant's arm may apply a force to the portion of the weakened region of the SIP device 16220. As a result, the occupant's arm may push through the weakened region of the SIP device 16220 into the pocket formed between the back of the SIP device 16220 and the upright side member 16204, 16206 of the child seat 16200.

[1022] With reference now to FIGS. 87A-87E, another embodiment of a child seat 8300 having at least one torso SIP device is shown. In the illustrated, non-limiting embodiment, a torso SIP assembly 8302 including one or more torso SIP devices 8304a, 8304b mounted to a child seat 8300. As shown, the torso SIP assembly 8302 includes a first torso SIP device 8304a positionable near a torso of a child seated within the child seat 8300 and a second torso SIP device 8304b positionable at the same height or at a different height near a torso of the occupant of the child seat 8300. A connector body 3806 is connected to both the first torso SIP device 8304a and the second torso SIP device 8304b to form a single unit. As shown, the torso SIP assembly 8302 may be an insert removably connectable to the child seat 8300. Although the torso SIP devices 8304a, 8304b are illustrated and described as being part of a torso SIP

assembly 8302, in other embodiments, the torso SIP devices 8304a, 8304b may be directly connectable to the child seat 8300.

[1023] In embodiments where the torso SIP assembly 8302 and/or the torso SIP devices 8304a, 8304b are separable from the child seat 8300, the child seat 8300 may include a connection assembly 8310 engageable with a portion of at least one torso SIP devices 8304a, 8304b or alternatively, with the connector 8306 of the torso SIP assembly 8302 to retain the torso SIP devices 8304a, 8304b in position about the child seat 8300. In an embodiment, the connection assembly 8310 may be operably to loosely retain the torso SIP assembly 8302 or torso SIP devices 8304a, 8304b in position about the child seat 8300. The phrase "loosely retain" as used herein is intended to include embodiments where the torso SIP assembly 8302 or torso SIP devices 8304a, 8304b are attached to the child seat 8300, however, the torso SIP assembly 8302 or torso SIP devices 8304a, 8304b have some degree of movement while attached thereto. In the illustrated, non-limiting embodiment, the connection assembly 8310 includes a tether 8314 mounted to the child seat 8300 via a pin 8312. As shown, the pin 8312 is arranged at an upright surface 8322 of the back portion 8320 of the child seat 8300. However, embodiments where the pin 8312 is arranged at another suitable location that does not affect the occupant of the child seat are also contemplated herein. Rotation of the pin 8312 may lock the pin 8312 into engagement with the child seat 8300, thereby restricting separation of the tether 8314 coupled to the pin 8312 from the child seat 8300.

[1024] In other embodiments, such as shown in FIGS. 88A-88D, the connection assembly 8310 may rigidly mount the torso SIP assembly 8302 or torso SIP devices 8304a, 8304b to the child seat 8300. In such embodiments, the connection assembly 8310 may include a pin 8330 movable between a first position and a second position. The pin 8330 may include a feature or alternatively, may be operably coupled to another component, represented at 8332, that is movable into engagement with a torso SIP device 8304a, 8304b or the connector 8306 to restrict separation and/or movement thereof relative to the child seat 8300. For example, the feature or component 8332 may be receivable within or configured to engage a corresponding groove or recess 8334 formed in a torso SIP device 8304a, 8304b or the connector 8306. When the pin 8330 is in a first position, as shown in FIG. 88A and 88C, the feature or component 8332 is separated or disengaged from a torso SIP device 8304a, 8304b or the connector 8306, and when the pin 8330 is in the second position, as shown in FIG. 88B and 88D, the feature or component 8332 may be coupled to the torso SIP device 8304a, 8304b or the connector 8306. In the non-limiting embodiment of FIGS. 88A and 88B, the pin 8330 is illustrated as rotating about an axis between the first position and the second position. In another embodiment, as

shown in FIGS. 88C and 88D, the pin 8330 may be configured to translate within a slot between the first position and the second position. Although the various connection mechanisms 8310 are illustrated and described herein with respect to a torso SIP device 8304a, 8304b, it should be understood that such a connection assembly 8310 may be applied to any SIP device disclosed herein, such as a head SIP device, a shoulder SIP device, and/or an external SIP device (to be described in more detail below) formed from a structurally modifiable body.

[1025] The transformable torso SIP devices illustrated and described in FIGS. 38A-48D are illustrated and described herein as rigid or semi-rigid bodies. However, in other embodiments, a transformable torso SIP device may be formed from a structurally modifiable body. With reference now to FIGS. 49A-49E, a child seat 4600 having at least one configurable or transformable torso SIP device formed from a flexible body is illustrated. As shown, a first torso SIP device 4602a may be associated with a first portion of a seat shell 4604 of the child seat 4600 and a second torso SIP device 4602b may be associated with a second portion of the seat shell 4604. In the illustrated, non-limiting embodiment, the first and second torso SIP devices 4602a, 4602b are connected to a first upright side member 4608 and a second upright side member 4610, respectively, of an upright portion 4606 of the seat shell 4604. The first and second torso devices 4602a, 4602b may be positioned proximate to an interface with an adjacent first side seat member 4614 and second side seat member 4616 of a seat portion 4612 of the seat shell 4604. A portion of the first and second torso SIP devices 4602a, 4602b may but need not be receivable within a cavity formed in a corresponding portion of the seat shell 4604.

[1026] In the illustrated, non-limiting embodiment, the first and second torso SIP devices 4602a, 4602b are formed from structurally modifiable bodies, such as inflatable bladders or air bags. In a retracted configuration, the structurally modifiable bodies may be deflated, and therefore are generally flush with the interior of the seat shell 4604, such as shown in FIGS. 49A and 49B. In a deployed configuration, the structurally modifiable bodies 4602a, 4602b may be filled with a fluid, such as air for example. As shown in FIGS. 49C-49E, the filled structurally modifiable bodies 4602a, 4602b protrude inwardly from the interior surface of the first and second upright side members 4608, 4610, respectively. Further, when filled, the structurally modifiable bodies 4602a, 4602b may be elastically deformable to absorb energy applied thereto during a crash event.

[1027] With reference to FIGS. 89A-89D, another embodiment of a child seat 8400 having a first and second torso SIP device 8402a, 8402b formed from structurally modifiable bodies, such as inflatable bladders or air bags is illustrated. Similar to the previous

embodiments, the structurally modifiable bodies 8402a, 8402b may be filled with a fluid, such as air for example, to transform between a retracted and a deployed configuration. As shown, a control 8404a, 8404b, such as a valve for example, operable to control a flow of air into and/or out of a structurally modifiable body may be associated with at least one of the torso SIP devices 8402a, 8402b. Although separate valves 8404a, 8404b are illustrated as being associated with each respective torso SIP device 8402a, 8402b in the FIGS., embodiments where a single valve is operable to control a fluid flow into a plurality of SIP devices 8402a, 8402b are also contemplated herein. The valves 8404a, 8404b may be adjusted, for example rotated in a first direction to provide a flow of air into a corresponding torso SIP device 8402a, 8402b, and the valves 8404a, 8404b may be further adjusted, such as rotated in a second direction to remove air from a corresponding torso SIP device 8402a, 8402b.

[1028] The valves 8404a, 8404b may be arranged at respective surfaces 8406a, 8406b of the torso SIP devices 8402a, 8402b that are not intended to contact an occupant of the child seat 8400. In the illustrated, non-limiting embodiment, the valves 8404a, 8404b are arranged at a forward-facing surfaces 8406a, 8406b of the torso SIP devices 8402a, 8402b. However, embodiments where a valves 8404a, 8404b is at another suitable location accessible by an operator are also contemplated herein. Further, because the valves 8404a, 8404b are arranged at the body of each respective torso SIP device 8402a, 8402b, the valves 8404a, 8404b are movable with the torso SIP devices 8402a, 8402b between the retracted and deployed positions. Although a control 8404a, 8404b in the form of a valve is illustrated and described herein with respect to torso SIP devices 8402a, 8402b, it should be understood that such a control may be applied to any SIP device disclosed herein, such as a head SIP device, a shoulder SIP device, and/or an external SIP device (to be described in more detail below) formed from a structurally modifiable body.

[1029] With reference now again to FIG. 1, alternatively, or in addition to a head SIP device 70, shoulder SIP device 72a, 72b, and/or torso SIP device, as illustrated and described herein, the child seat system 20 may also include one or more SIP devices 74 arranged at a lateral side of the back or upright portion 28, such as near a center thereof, and may protrude outwardly therefrom. Such an SIP device, also be referred to herein as an “external SIP device” may be arranged at a child seat, a support base, or both. Further, it should be understood that an external SIP device as illustrated and described herein may be integrated into a child seat as an alternative to, or in combination with one or more of a head SIP device, a shoulder SIP device, and a torso SIP device as previously described herein. An external SIP device may be

operable to limit or control an interaction between an exterior of the child seat system and an adjacent part of a vehicle, such as a vehicle door for example.

[1030] With reference now to FIGS. 50A-52B, various examples of an external SIP device associated with a child seat system. The at least one external SIP device may be permanently or removably connected to a corresponding portion of the child seat system via any suitable connection mechanism. For example, an external SIP device may be chemically adhered to, fastened via one or more fasteners, or integrally formed with a portion of the child seat system. Accordingly, an external SIP device may be a single unitary body or may be formed via a plurality of components connectable to one another to form the external SIP device.

[1031] With reference to FIGS. 50A and 50B, an example of a child seat system 4700 including an external SIP device 4702 is illustrated. As shown, the child seat system includes a child seat 4704 positionable about a support base 4706. The child seat 4704 includes a seat shell 4708 having an upright portion 4710 and a seat portion 4712. The external SIP device 4702, such as a bumper for example, may be arranged at the support base 4706. In the illustrated, non-limiting embodiment, the support base 4706 includes a base seat portion 4714 positioned generally adjacent to the seat portion 4712 of the child seat 4704 and a base back portion 4716 positioned generally adjacent to the upright portion 4710 of the child seat 4704. As shown, the external SIP device may be arranged at a lateral side 4720 of the base back portion 4716, such as near a center thereof, and may protrude outwardly therefrom, as shown in FIG. 50A. However, in other embodiments, such as shown in FIGS. 51A-51B, an external SIP device may alternatively or additionally be located at another portion of the support base.

[1032] The example of a child seat system 4800 illustrated in FIGS. 51A-51B is similar to that of FIGS. 50A-50B. However, in the illustrated, non-limiting embodiment, the external SIP device 4802 is located at a base seat portion 4810 of the support base 4806, adjacent to a seat portion 4808 of the child seat 4804. As shown, the external SIP device 4802 may be arranged at a lateral side 4812 of the base seat portion 4810 and may protrude outwardly therefrom, as shown in FIG. 51A. Although the external SIP device 4802 is illustrated as being arranged near an interface with the base back portion 4814, in other embodiments, the external SIP device 4802 may be arranged near a front 4811 of the base seat portion 4810.

[1033] Regardless of a position of an external SIP device 4702, 4802 about the support base 4706, 4806, a contour of the external SIP device 4702, 4802 may be generally complementary to the adjacent surface of the support base 4706, 4806 at that location.

However, embodiments where the external SIP device 4702, 4802 has a different contour are also contemplated herein.

[1034] In the illustrated, non-limiting embodiments shown in FIGS. 50A-51B, the external SIP devices 4702 and 4802, may be pods or bumpers fixed in position about the support base and formed from a material having a desired hardness. With reference now to FIGS. 99 and 100, in other embodiments, an external SIP device mounted to the support base is formed from a substantially rigid member. FIG. 99 illustrates a child seat system including a child seat 8900 positionable about a support base 8902. The child seat 8900 includes a seat shell 8904 having an upright portion 8906 and a seat portion 8908. The support base 8902 includes a base seat portion 8910 positioned generally adjacent to the seat portion 8908 of the child seat 8900 and a base back portion 8912 positioned generally adjacent to the upright portion 8906 of the child seat 8900. An external SIP device 8920 in the form of a bar is mounted to the support base 8902, such as at a lateral side of the support base 8902 for example. In the illustrated, non-limiting embodiment, a first end 8922 of the external SIP device 8920 is connected to the base seat portion 8910 and a second opposite end 8924 of the external SIP device 8920 is connected to the base back portion 8912. The external SIP device 8920 may have a generally linear contour, or in some embodiments may have an arcuate contour, such as a convex contour extending away from the support base 8902 for example.

[1035] The example of a child seat system illustrated in FIG. 100 is similar to that of FIG. 99. However, in the illustrated, non-limiting embodiment of FIG. 100, both ends 9004, 9006 of an external SIP device 9002 are connected to the same portion of the support base 9000. For example, both the first end 9004 and the second end 9006 of the external SIP device 9002 may be arranged at a base seat portion 9010 of the support base 9000. Alternatively, the first end 9004 and the second end 9006 of the external SIP device 9002 may be arranged at a base back portion 9012 of the support base 9000.

[1036] The external SIP devices 8920, 9002 described herein may protrude generally perpendicularly from the lateral side of the support base 8902, 9000. In other embodiments, the external SIP devices 8920, 9002 may extend generally vertically from the support base 8902, 9000. In such embodiments, as shown in FIG. 100, the external SIP device 9002 overlaps a portion of the child seat 9020 positioned vertically above the interface between the ends 9004, 9006 of the external SIP device 9002 and the support base 9000.

[1037] Further, the external SIP devices 8920, 9002 may be permanently or removable coupled to the support base 8902, 9000. In embodiments where the external SIP device 8920, 9002 is removable, the external SIP device 8920, 9002 may be connectable to the support base

8902, 9000 via any suitable coupling mechanism (not shown). In the illustrated, non-limiting embodiments, the external SIP devices 8920, 9002 are detachably connectable to the support base 8902, 9000, at both a first lateral side and a second, opposite lateral side thereof. In such embodiments, the position of the external SIP devices 8920, 9002 relative to the support base 8902, 9000 may be selected based on the orientation and/or location of the child seat system 20 relative to a vehicle door. Further, the external SIP devices 8920, 9002 may be attached to the support base 8902, 9000, with a tether (not shown) even when the external SIP devices 8920, 9002 are not affixed at the first side or second side of the support base 8902, 9000. It should be appreciated that any of the SIP devices disclosed herein, including head SIP devices, shoulder SIP devices, and torso SIP devices may be tethered to a portion of a corresponding child seat, such as a child seat or a support base, when the SIP device is removably connectable to the child seat system.

[1038] Another example of an external SIP device is illustrated in FIG. 101. Similar to the embodiment shown in FIG. 99, the support base 9100 includes a base seat portion 9104 and a base back portion 9106 and in the illustrated, non-limiting embodiment the external SIP devices 9102a, 9102b disposed at opposite sides of the support base 9100 are rigid bars having both respective first ends 9110a, 9110b and second ends 9112a, 9112b connected to the support base 9100. Although the first ends 9110 are illustrated as being connected to the base seat portion 9104 and the second ends 9112 are illustrated as being connected to the base back portion 9106, embodiments where both ends 9110, 9112 are connected at the base seat portion 9104 or the base back portion 9106 are also contemplated herein. The external SIP devices 9102a, 9102b may have any suitable contour, and in an embodiment, include a contour complementary to the lateral side of the support base 9100. In an embodiment, the external SIP devices 9102a, 9102b each include respective clips 9114 for securing the vehicle belt relative to the support base 9100. Although a support base 9100 having two similar external SIP devices 9102a, 9102b is illustrated, it should be appreciated that in other embodiments, the support base 9100 may have a single external SIP device movable between opposing lateral sides of the support base 9100 based on the orientation and location of the support base 9100.

[1039] In an embodiment, the external SIP devices 9102a, 9102b are movably mounted to the support base 9100 of a child seat system. The external SIP devices 9102a, 9102b may be transformable between respective stowed or retracted configurations, and respective deployed or extended configurations. The external SIP devices 9102a, 9102b may be positioned to absorb energy applied to the child seat during a side impact crash event when in the deployed configurations and may not be positioned to absorb energy when in the stowed configurations.

In FIG. 101, the external SIP device 9102a is illustrated in the stowed configuration and the external SIP device 9102b is illustrated in the extended configuration.

[1040] When in the stowed configuration, a substantial entirety of the body of the stowed external SIP device 9102a, and/or 9102b may be arranged directly adjacent to the side of the support base 9100 (see external SIP device 9102a in FIG. 101). In an embodiment, the external SIP devices 9102a, 9102b are arranged within a corresponding recess (not shown) formed at the lateral side of the support base 9100 when in the stowed configuration. In respective extended configurations, the body of the external SIP devices 9102a, 9102b are generally offset from the surface of the support base 9100. As shown in FIG. 101, in the extended configuration the external SIP device 9102b protrudes laterally outwardly from the support base 9100 to form a brace. The external SIP devices 9102a, 9102b may be rotatable between the stowed and extended configurations. In an embodiment, the external SIP devices 9102a, 9102b remain coupled to the support base 9100 as the external SIP devices 9102a, 9102b are transformed between the stowed and extended configurations. However, embodiments where the external SIP devices 9102a, 9102b are separated from the support base 9100 during this transformation are also contemplated herein.

[1041] Another example of an external SIP device transformable between a stowed configuration and an extended configuration is illustrated in FIGS. 102A and 102B. The illustrated child seat system includes a support base 9200 configured to receive a child seat (not shown). The support base 9200 includes a base seat portion 9202 and a base back portion 9204. An external SIP device 9210 may be movably mounted to the support base 9200, such as adjacent to the base back portion 9204 thereof. In an embodiment, the external SIP device 9210 is arranged at a forward-facing surface 9206 of the base back portion 9204 rather than a lateral side thereof. The external SIP device 9210 may include a rigid member, such as bar formed into a U-shape for example. In an embodiment, the external SIP device 9210 is pivotable about an axis relative to the support base 9200 between the stowed configuration (FIG. 102A) and the extended configuration (FIG. 102B). In the stowed configuration, the external SIP device 9210 may be positioned adjacent to the forward-facing surface 9206 of the base back portion 9204, and in some embodiments, may be receivable within a groove 9212 formed therein. In the extended configuration, a portion of the external SIP device 9210 extends beyond a lateral side of the support base 9200. In FIG. 102B, the external SIP device 9210 is illustrated in a rotated position arranged at the right of the support base 9200. However, it should be understood that in other embodiments, the external SIP device 9210 may alternatively or additionally be rotatable about an axis such that a portion of the external SIP device 9210

extends beyond the left lateral side of the support base 9200. Further, in other embodiments, the external SIP device 9210 may be separable from the support base 9200 and reconnectable thereto in the desired position.

[1042] In a similar embodiment, illustrated in FIGS. 106A-106B, a support base 9600 configured to receive a child seat (not shown) includes a base seat portion 9602 and a base back portion 9604, and a belt lock-off mechanism 9606 operable to secure a vehicle belt 9601 to the support base 9600. In an embodiment, the belt lock-off mechanism 9606 has a base 9608 and a plurality of arms 9610a, 9610b extending outwardly from the distal end of the base 9608 to form a general T-shape. The belt lock-off mechanism 9606 including these arms 9610a, 9610b may act as an external SIP device. The belt lock-off mechanism 9606 is movably mounted to the support base 9600, such as adjacent to the base back portion 9604 thereof. In an embodiment, the belt lock-off mechanism 9606 is arranged at a forward-facing surface 9612 of the base back portion 9604 rather than a lateral side thereof.

[1043] The belt lock off mechanism 9606 is rotatable about an axis between a first, open position (FIG. 106A) in which a gap 9614 for receiving the vehicle belt 9601 is formed between the forward-facing surface 9612 and the belt lock off mechanism 9606 and a second, closed position (FIG. 106B) in which the belt lock-off mechanism 9606 is positioned adjacent to the forward-facing surface 9612 and applies a tension to the vehicle belt 9601. With the belt lock-off mechanism 9606 in the closed position, the end of a respective arm 9610a, 9610b may be positioned adjacent to a vehicle door such that in the event of a side impact crash, the door will contact the arm 9610a, 9610b before contacting the remainder of the child seat system.

[1044] In the non-limiting embodiments illustrated in FIGS. 103-105, and FIGS. 168A -168C, an external SIP device is arranged at a lateral side of a support base and is movable relative thereto between the stowed and extended configurations. With reference to the support base 9300 of FIG. 103, the external SIP device 9302 includes a rigid member 9304. The distal end 9306 of the rigid member 9304 positioned closest to a vehicle door may include a planar surface to maximize engagement with the vehicle door and absorption of energy therefrom in the event of a side impact crash. The body 9304 of the external SIP device 9302 may be receivable within an opening 9308 formed at a bottom or an interior of the support base 9300 such that a portion of the body 9304 protrudes from a side of the support base 9300 in both the stowed and deployed configurations. In an embodiment, the portion of the external SIP device 9302 extending from the side of the support base 9300 has a generally curved contour. However, embodiments with a different contour are also contemplated herein. The external SIP device 9302 may be configured to slide or translate within the opening between the stowed and

deployed configurations. Accordingly, the amount of the body 9304 arranged of the external SIP device 9302 at a respective side of the support base 9300 when in the deployed configuration is greater than the amount of the body 9304 arranged at the respective side of the support base 9300 when in the stowed configuration.

[1045] In the non-limiting embodiment illustrated in FIG. 103, the external SIP device 9302 is movable to a deployed configuration at only one side of the support base 9300. In such embodiments, a second external SIP device (not shown) may be positioned for deployment adjacent to an opposite side of the support base 9300. However, in other embodiments, the external SIP device 9300 may be movable between a stowed configuration, a first deployed configuration, and a second deployed configuration. In such embodiments, the same external SIP device 9300 may be used regardless of which side the support base 9300 is positioned adjacent to a vehicle door. Further, in such embodiments, opposing sides of the body 9304 may have similar configurations and each end may have a planar surface, like surface 9306 described above, for contacting a vehicle door during a crash event.

[1046] The support base 9400 of FIG. 104 is similar to the support base of FIG. 103. As shown, an external SIP device 9402a, 9402b associated therewith includes a rigid member 9404 having a distal end 9406 including a planar surface to maximize engagement with the vehicle door. Each external SIP device 9402a, 9402b may be pivotally mounted to the support base 9400 and configured to rotate about an axis between the stowed configuration (9402b) and deployed configurations (9402a). In an embodiment, the respective axes of the external SIP devices 9402a, 9402b are oriented generally parallel to a longitudinal axis of the support base 9400. As shown by external SIP device 9402a, when in the deployed configuration, the external SIP devices 9402a, 9402b protrude in one or more directions from a lateral side of the support base 9400. In an embodiment, when in the stowed configuration, as shown by external SIP device 9402b, the external SIP devices 9402a, 9402b are each receivable within a corresponding groove or recess 9408a, 9408b formed in the support base 9400. In the illustrated, non-limiting embodiment, the external SIP devices 9402a, 9402b are arranged at the base seat portion 9410 thereof and the groove 9408a, 9408b are formed at an upper surface 9412 of the base seat portion 9410. However, it should be understood that embodiments where the external SIP devices 9402a, 9402b are arranged at another location about the support base 9400, such as at the base back portion 9414 for example, are also contemplated herein. When the external SIP device 9402a, 9402b is in the stowed configuration, the entirety of the external SIP device 9402a, 9402b may be arranged within the corresponding recess 9408a, 9408b, or alternatively, only a portion of the external SIP device 9402a, 9402b may be receivable therein.

[1047] In yet another embodiment illustrated in FIG. 105, at least one external SIP device 9502 mounted to a support base 9500 is translatable between a stowed configuration and a deployed configuration. As shown, the external SIP device 9502 may be arranged at a lateral side of the support base 9500. Although the external SIP device 9502 is illustrated as being positioned at the base back portion 9504, embodiments where the at least one external SIP device 9502 is alternatively or additionally mounted at the base seat portion 9506 are also contemplated herein. The external SIP device 9502 includes a plurality of body members 9508a, 9508b coupled together in an axially telescoping or translating manner. Accordingly, one or more of the plurality of body members 9508a, 9508b may be nested when the external SIP device 9502 is in a stowed configuration and the plurality of body members 9508a, 9508b may be coupled to and protrude one from another when the external SIP device 9502 is in the deployed configuration. In the deployed configuration, a distal end of the external SIP device 9502 may be positioned to contact the vehicle door.

[1048] In an embodiment, the external SIP device 9502 may be removably connectable to the support base 9500. In the illustrated, non-limiting embodiment, the support base 9500 includes a plurality of reliefs or mounting grooves for mounting the external SIP device 9502. While the external SIP device is illustrated as being mounted to a relief (not shown) formed at a right lateral side of the support base 9500, the external SIP device may alternatively be mounted to the relief arranged at the left lateral side of the support base 9500 based on an orientation of the support base 9500 and its position relative to a vehicle door. Accordingly, in an embodiment, a position go the external SIP device is selected based on an orientation of the support base 9500 relative to a vehicle door.

[1049] Another example of an external SIP device mounted to a support base is shown in FIG. 192A-192D. In the illustrated, non-limiting embodiment, at least one external SIP device 14904a, 14904b is mounted to an underside of the support base 14902 (see FIG. 192D) of a child seat 14900. By way of example, the at least one external SIP device may include a plurality of SIP devices 14094a, 14904b. However, embodiments including only a single external SIP device are also within the scope of the disclosure. As shown, the external SIP devices 14904a, 14904b may be transformable, for example rotatable, between a plurality of configurations relative to the support base 14902. These configurations include a stowed configuration, and at least one deployed configuration. An external SIP device 14904a, 14904b, when in the stowed configuration, may be positioned behind the base seat back 14906 of the support base 14902 and/or the seat back 14910 of a child seat 14900 connectable to the support base 14902. When an external SIP device 14904a, 14904b is in the deployed configuration, the

external SIP device 14904a, 14904b is arranged at or proximate to a lateral side 14912, 14914 of the support base 14902, such as at a position between the support base 14902 and a corresponding vehicle door 14920.

[1050] In an embodiment, each external SIP device 14904a, 14904b is movable between a first deployed configuration arranged at or proximate to a first lateral side 14912 of the support base 14902 and a second deployed configuration arranged at or proximate to a second lateral side 14914 of the support base 14902. In some embodiments, an external SIP device 14904a, 14904b is movable between a plurality of deployed configurations associated a first lateral side 14912 of the support base 14902 and is movable between a plurality of deployed configurations associated with a second lateral side 14914 of the support base 14902.

[1051] In embodiments where multiple deployed positions are associated with each lateral side 14912, 14914 of the support base 14902, each external SIP device 14904a, 14904b may be movable between the plurality of deployed configurations associated with one lateral side 14912, 14914 of the support base 14902 and the stowed configuration. Further, in embodiments where multiple deployed positions are associated with each lateral side 14912, 14914 of the support base 14902, one of the deployed positions at a lateral side 14912, 14914 may be associated with operation of the child seat 14900 in a forward facing orientation, and another of the deployed positions at the same lateral side 14912, 14914 may be associated with operation of the child seat 14900 in a rearward facing orientation.

[1052] The external SIP devices 14904a, 14904b may be movable in a first manner between a plurality of deployed configurations. In an embodiment, the external SIP devices 14904a, 14904b are further movable at each of the plurality of positions in a second manner, such as to selectively lock or unlock the external SIP device 14904a, 14904b relative to that position. For example, the external SIP devices 14904a, 14904b may be translatable to lock or unlock the external SIP devices 14904a, 14904b. Once the external SIP devices 14904a, 14904b have been moved to a desired rotational position of the plurality of discrete positions, such as associated with the stowed configuration or a deployed configuration for example, the external SIP devices 14904a, 14904b can then translate radially inwardly, thereby reducing the clearance between the external SIP devices 14904a, 14904b and an adjacent surface of the support base 14902. This inward translation of the external SIP devices 14904a, 14904b may lock the external SIP devices 14904a, 14904b against rotation about the axis.

[1053] A locking mechanism, such as a locking post 14926 for example, may be arranged at a surface of one or more of the external SIP devices 14904a, 14904b, such as facing toward the support base 14902. The locking post 14926 may be configured as a shock absorber.

In embodiments where the engagement portion 14924 of the external SIP device 14904a, 14904b is configured to flex about a pivot and includes a locking post 14926, the combination of this flexure and the shock absorption is configured to absorb energy when a force of a crash event is applied to the external SIP device 14904a, 14904b.

[1054] In an embodiment, one or more openings 14930 are formed at the support base 14902, such as at a position associated with one or more of the stowed configuration and the at least one deployed configuration. In an embodiment, as the external SIP devices 14904a,14904b translate radially inwardly, at least a portion of the locking post 14926 is received within the opening 14930, thereby locking the external SIP devices 14904a,14904b at the rotational position associated with the stowed configuration. To unlock the external SIP devices 14904a,14904b, the external SIP devices 14904a,14904b are translated outwardly, away from the support base 14902, thereby separating the locking post 14926 from the opening 14930. Once unlocked, the external SIP devices 14904 are free to rotate about its axis to another of the plurality of rotational positions associated with the stowed configuration and the at least one deployed configuration. Although the external SIP device 14904a, 14904b is illustrated and described herein as being lockable in each of the plurality of configurations, embodiments where the external SIP device 14904a, 14904b is only lockable in a portion of the configurations, such as only in the stowed configuration for example, are also within eh scope of the disclosure.

[1055] In the illustrated, non-limiting embodiment, the support base 14902 includes a first external SIP device 14904a and a second external SIP device 14904b. Each external SIP device 14904a, 14904b may include a base 14922a, 14922b and an engagement portion 14924a, 14924b connected to the base 14922a, 14922b. As shown, the external SIP device 14904a, 14904b is arranged at an angle greater than 90 degrees to the base 14922a, 14922b. In some embodiments, the engagement portion 14924a, 14924b is configured to flex about a pivot defined at the interface formed between the engagement portion 14924a, 14924b and the base 14922a, 14922b of the external SIP device 14904a, 14904b. Further, the engagement portion 14924a, 12924b may be arranged at a non-parallel angle relative to an adjacent surface of the support base 14902, such as lateral surfaces 14912, 14914. In embodiments including at least one locking post 14926, the locking post may be arranged at a surface of an engagement portion 14924a, 14924b.

[1056] In the illustrated, non-limiting embodiment, the base 14922b of the second external SIP device 14904b may be integrally formed with or coupled to a portion of the first external SIP device 14904a, such as the base 14922a thereof. In such embodiments, the first

and second external SIP devices 14904a, 14904b are configured to rotate about the axis in unison and translate relative to the support base 14902 between a locked and unlocked position in unison.

[1057] With reference to FIGS. 168A-169B, another example of an external SIP device transformable between a stowed configuration and an extended configuration is illustrated. The illustrated child seat system 13600 includes a support base 13602 having a child seat 13604 removably or permanently mounted thereto. As shown, an external SIP device 13610 may be movably mounted to the support base 13602, such as at a lateral side 13606, 13608 of the support base 13602. Although the external SIP device 13610 is illustrated and described herein as being mounted to the support base 13602, it should be understood that in other embodiments, the external SIP device 13610 may alternatively be mounted to the child seat 13604. The external SIP device 13610 may include a rigid member, such as bar 13620 formed into a U-shape for example. In an embodiment, the external SIP device 13610 is pivotable about at least one axis relative to the support base 13602 between the stowed configuration (FIG. 168A) and the extended configuration (FIG. 168B).

[1058] The external SIP device 13610 may also be stoppable and/or lockable at one or more positions along the path of movement between the stowed configuration and the extended configuration. In the illustrated, non-limiting embodiment of FIG. 168C, the external SIP device 13610 is arrangeable at an intermediate position between the stowed configuration and the extended configuration along the path of movement of the external SIP device 13610. At this intermediate position, the external SIP device 13610 may be considered in an "intermediate configuration." When the external SIP device 13610 is in the intermediate configuration, the external SIP device 13610 is arranged at a non-parallel angle relative to the lateral side 13606, 13608 of the support base 13602. However, the angle of the external SIP device 13610 relative to the support base 13602, when in the intermediate configuration is less than the angle of the external SIP device 13610 relative to the support base 13602 when in the extended configuration. Accordingly, in the intermediate configuration, a connecting portion 13622 of the bar 13620 forming the bottom of the U-shape, may be vertically offset from the bottom of the support base 13602, such as at a vertical position located between the support base 13602 and a seat support surface 13612 of the child seat 13604.

[1059] When the SIP device 13610 is in the extended configuration, the bar 13620 is oriented generally horizontally and the connecting portion 13622 of the bar 13620 is positioned directly adjacent to a surface of a vehicle door. In such a configuration, the bar 13620 is configured to absorb energy during a crash impact. It should be understood that when the SIP

device is at another position along the path of movement in which the connecting portion 13622 protrudes outwardly from the support base 13602, such as at the intermediate configuration for example, the external SIP device 13610 is still operable to absorb energy during a crash impact. As a result of the change in angle relative to the vehicle door, the ability of the of the external SIP device 13610 in the intermediate configuration to absorb energy may be reduced compared to that of the external SIP device 1610 in the extended configuration.

[1060] In some embodiments, a child may use the external SIP device 13610 at one or more positions along its path of movement as a step to assist with entering and exiting the child seat 13604. For example, the child may use the connecting portion 13622 of the U-shape bar 13620 to assist with stepping into and out of the child seat 13604. The external SIP device 13610 may be used as a step when the external SIP device 13610 is in any configuration where the bar 13620 protrudes outwardly, away from the support base 13602. Accordingly, the external SIP device 13620 in the intermediate configuration and in the extended position may be used as a step. However, it should be understood that the ease of use of the external SIP device 13610 as a step may vary based on the angle of the bar 13620 relative to the support base 13602. For instance, the external SIP device 13610 may be more conveniently located and used as a step in the intermediate configuration than in the extended configuration. It is also possible that the connecting portion 13622 of the bar 13620 may be used as a step to assist a child with stepping into and out of the child seat 13604 when the external SIP device 13610 is in the stowed configuration.

[1061] With reference to FIGS. 169A-169B, an example of the movement of the external SIP device 13610 relative to the support base 13602 is illustrated in more detail. As shown, the external SIP device 13610 may include a main bar or step/SIP bar 13620 pivotally coupled, such as at an end 13624 thereof, to the support base 13602. A portion of the step/SIP bar 13620, such as connecting portion 13622 located at the opposite end, may engage a surface of a vehicle door to function as an SIP device, or alternatively, may support the weight of a child therein when used as a step. A secondary bar 13626 mounted to the support base 13602 may also be operably coupled to the step/SIP bar 13620. In the illustrated, non-limiting embodiment, the secondary bar 13626 is movably coupled to the support base 13602. For example, the secondary bar 13626 may be configured to pivot relative to the support base 13602 about an axis, and alternatively or additionally, may be configured to translate relative to the support base 13602. As shown, a pin 13628 affixed to the secondary bar 13626 may be receivable within a slot 13630 formed in the support base. In the illustrated, non-limiting embodiment, the step/SIP bar 13620 is pivotally coupled to the secondary bar 13626 such that

the step/SIP bar 13620 is rotatable relative to the secondary bar 13626 about an axis. In some embodiments, the axis of rotation about which the step/SIP bar 13620 rotates relative to the secondary bar 13626 may be parallel to the axis of rotation about which the step/SIP bar 13620 is rotatably coupled to the support base 13602.

[1062] When the SIP device 13610 is in the stowed configuration (not shown), the secondary bar 13626 may be at the lowest translational position along the path of translation defined by the slot 13630. The secondary bar 13626 and the step/SIP bar 13620 may be arranged in a generally coplanar orientation or overlapping arrangement, and in some embodiments, may have a generally vertical orientation. In this stowed configuration, the step/SIP bar 13620 may be generally flush with an adjacent surface of the support base 13602. To transform the SIP device 13610 to the intermediate configuration (FIG. 169A), the step/SIP bar 13620 may be rotated away from the secondary bar 13626 and the support base 13602. In the illustrated, non-limiting embodiment, the intermediate configuration may be defined as the maximum allowable rotation of the step/SIP bar 13620 relative to the secondary bar 13626 while the secondary bar 13626 remains translationally fixed. As shown, the secondary bar 13626 does not translate relative to the support base 13602 as the SIP device 13610 transforms from the stowed configuration to the intermediate configuration.

[1063] To transform the SIP device 13610 to the extended configuration from the intermediate configuration, the secondary bar 13626 is translated within the slot 13630 relative to the support base 13602, such as to an uppermost translational position. As shown, the secondary bar 13626 may translate to a second, opposite end of the slot 13630 when in the extended configuration. This translation applies a force to the step/SIP bar 13620, thereby causing the step/SIP bar 13620 to rotate relative to the secondary bar 13626 and the support base 13602. In the illustrated, non-limiting embodiment, translation of the secondary bar 13626 drives rotation of the step/SIP bar 13620 to a generally horizontal orientation.

[1064] A locking mechanism 13640 may be operably coupled to the SIP device 13610 to lock the SIP device 13610 at one or more of the stowed configuration, the extended configuration, and the intermediate configuration. In an embodiment, the locking mechanism 13640 is arranged at an interface between the step/SIP bar 13620 and the support base 13602. With reference to FIGS. 170A-170B, an example of a locking mechanism 13640 is illustrated in more detail. As shown, the locking mechanism 13640 includes a first housing 13642, such as embedded within the support base 13602. The first housing 13642 may include a cavity 13644 within which a locking gear 13646 is receivable. In an embodiment, a first plurality of grooves 13648 are plurality at an inner periphery of the cavity 13644, and the plurality of teeth

13650 of the locking gear 13646 are selectively receivable within the first plurality of grooves 13648 of the first housing 13642.

[1065] A second housing 13652 is rotatably connectable to the first housing 13642. The second housing 13652 may be arranged at the end 13622 of the step/SIP bar 13620 and is positionable in axial alignment with the first housing 13642. The second housing 13652 includes a first cavity 13656 facing towards and configured to cooperate with the cavity 13644 of the first housing 13642 to contain the locking gear 13646. In the illustrated, non-limiting embodiment, a second plurality of grooves 13658 are arranged about an inner periphery of the cavity 13656, and the teeth 13650 of the locking gear 13646 are selectively receivable within the second plurality of grooves 13658 of the second housing 13652.

[1066] A biasing mechanism 13660 may extend between the first housing 13642 and an adjacent surface of the locking gear 13646. In the illustrated, non-limiting embodiment, the biasing force of the biasing mechanism 13660 is operable to bias the locking gear 13646 toward the second housing 13652 and into engagement with the second plurality of grooves 13658 formed therein. In an embodiment, the cavity 13656 of the second housing 13652 includes one or more ledges 13662 that limit a position of the locking gear 13646 of the cavity 13656 the biased locking gear 13646 can extend. In this biased position, the teeth 13650 of the locking gear 13646 is engaged with the grooves 13648, 13658 of both the first housing 13642 and the second housing 13652, thereby restricting movement of the second housing 13652 relative to the first housing 13642. Accordingly, in the biased position, the second housing 13652 is locked at its current rotational position relative to the first housing 13642.

[1067] An actuator 13664 may be operably coupled to the locking gear to oppose the biasing force of the biasing mechanism 13660. As shown, an actuator 13664 is movably mounted to the second housing 13652.In the illustrated, non-limiting embodiment, the actuator 13664 may be arranged at the second housing 13652, such as within a second cavity 13666 formed opposite the first cavity 13656. The actuator 13664 may be a button with one or more engagement features 13668, such as tabs for example, that extend through at least one corresponding hole 13670 in the second housing 13652, into the first cavity 13656. When a force is applied to the button 13664, in the direction of the second housing 13652, the button 13664 translates within the second cavity 13666, causing the engagement features 13668 to extend further into the first cavity 13656. As the engagement features 13668 extend further, they contact and transmit the force to the locking gear 13646. This force opposes the bias of the biasing mechanism 13660 and causes the locking gear 13646 to translate toward the first housing 13642. Once the teeth 13650 of the locking gear 13646 have moved out of engagement

with the grooves 13658 of the second housing 13652, the second housing 13652 is free to rotate about an axis relative to the first housing 13642 to a desired position. This rotation may cause translation of the secondary bar 13626 relative to the support base 13602 as previously described. Upon release of the actuator 13664, the biasing force of the biasing mechanism 13660 will return the locking gear 13646 into engagement with the grooves 13658 of the second housing 13652, thereby locking rotation of the second housing 13652 relative to the first housing 13642.

[1068] With reference to FIGS. 131A-131C, another embodiment of an external SIP device movable between a plurality of positions is illustrated. A child seat system 11700 including a support base 11702 and a child seat 11704 connectable to the support base 11072 in a plurality of positions is illustrated. As shown, an external SIP device 11706 may form a foot arranged at the support base 11702. The foot may extend laterally beyond the lateral sides of the support base 11702 such that when the support base is installed on a vehicle seat, an end of the foot may abut or engage a vehicle door. In an embodiment, the external SIP device 11076 is movable between a first configuration (FIG. 131B), associated with a forward-facing installation of the child seat system 11700 and a second configuration (FIG. 131C) associated with a rearward-facing installation of the child seat system 11700. In the first configuration, the external SIP device 11706 may be arranged at a rear of the support base 11702, such as near an interface between a seat portion 11708 and an upright portion 11710 of the support base 11702. In the second configuration, the external SIP device 11706 may be arranged at a front 11712 of the support base 11702, such as near an opposite end of the seat portion 11708 thereof. One or more notches may be formed at the support base 11702, such as at the front 11712 or the back thereof, to properly position the foot 11706 at the respective forward and rearward positions. The external SIP device 11706 may be pivotally coupled to the support base 11702 for rotation between the first and second configurations. The configuration of the external SIP device 11706 may be adjusted manually, or alternatively, the external SIP device 11706 may transform automatically, such as with rotation of the child seat 11704 relative to the support base 11702 for example.

[1069] The child seat system may have a maximum width at a location of at least one side impact protection (SIP) device arranged at an exterior thereof. With reference to FIGS. 50A-51B, FIGS. 98A -106B and further reference to FIGS. 126A and 126C discussed below, in an embodiment, the child seat system has a maximum width at a location of at least one SIP device mounted to an exterior surface of a support base. The at least one SIP device may be located at the base seat portion of the support base, at the base back portion of the support base,

or alternatively, at both the base seat portion and the base back portion. In such embodiments, a width of the child seat at the at least one SIP device is less than the width defined by the at least one SIP device. In embodiments where the at least one SIP device is transformable between a first position and a second position, the maximum width may be defined by the at least one SIP device when in the first, deployed position. However, in some embodiments, the width at the at least one SIP device when in a second, stowed position may still be greater than a width of the child seat at the at least one SIP device.

[1070] In other embodiments, an external SIP device may alternatively or additionally be mounted at one or more locations about an exterior of the child seat of the child seat system. With reference now to FIGS. 52A-56B, various embodiments including at least one external SIP device affixable to a child seat at or near a location of the child seat associated with a vehicle belt path are illustrated.

[1071] The non-limiting embodiment of FIGS. 52A and 52B includes child seat system 4900 including an external SIP device 4902 device. As shown, the child seat system includes a child seat 4904 positionable about a support base 4906. The child seat 4904 includes a seat shell 4908 having an upright portion 4910 and a seat portion 4912. The upright portion 4910 includes a back portion 4914, and a first upright side member 4916 and a second upright side member 4918 extending from opposing sides of the back portion 4914. In the non-limiting embodiment, an external SIP device 4902 is arranged at an exterior surface of the at least one of the first and second upright side members 4916, 4918. As shown, the external SIP device may be positioned near the bottom of the upright portion 4910, such as adjacent to an interface with the seat portion 4912 for example. The external SIP device 4902 may but need not have a contour complementary to the corresponding portion of the upright side member 4916, 4918. Further, the external SIP device 4902 may protrude outwardly beyond the surface of the adjacent surface of upright side member 4916, 4918. In the illustrated, non-limiting embodiment of FIGS, the child seat 4904 does not include openings that define part of a vehicle belt path.

[1072] In FIGS. 53A-53B, another embodiment of a child seat system 5000 having a child seat 5002 positionable about a support base 5004 is shown. Similar to the previous embodiments, the child seat 5002 includes a seat shell 5006 having an upright portion 5008 and a seat portion 5010. The seat portion 5010 includes a first seat side member 5012 and a second seat side member (not shown) extending from opposing sides of a seat support surface (not shown). An external SIP device 5020 is arranged at an exterior surface of at least one of the first and second seat side members 5012. In the illustrated, non-limiting embodiment, the

external SIP device 5020 is arranged near an interface with the upright portion 5008 and adjacent to, for example behind, a slot 5014 formed in a seat side member 5012 for receiving a lap portion of a vehicle belt. As shown, a body of the external SIP device 5020 protrudes laterally or outwardly from the seat side member 5012 such as in a direction oriented substantially perpendicular to the seat side member 5012. Although an external SIP device 5020 having a generally rectangular configuration is shown, it should be understood that other suitable configurations are also within the scope of the disclosure.

[1073] With reference now to FIG. 112, the illustrated, non-limiting child seat system 10000 includes a child seat 10002 positionable about a support base 10004. Similar to the previous embodiments, the child seat 10002 includes a seat shell 10006 having an upright portion 10008 and a seat portion 10010. The seat portion 10010 includes a first seat side member (not shown) and a second seat side member 10012 extending from opposing sides of a seat support surface (not shown). In the illustrated, non-limiting embodiment, a cupholder 10014 is arranged at each seat side member 10012, such as near a front 10016 of the child seat 10002 for example. As shown, the cupholder 10014 may be movable between an extended configuration (in which a cup is received therein) and a retracted configuration (shown); however, in other embodiments, the cupholder 10014 may be fixedly mounted to the child seat 10002.

[1074] At least one external SIP device is arranged at an exterior surface of at least one of the first and second seat side members 10012. In an embodiment, an external SIP device 10020 is arranged at each respective seat side member 10012, at a location forward of the cupholder 10014. Alternatively, or in addition, an external SIP device may be vertically aligned with the cupholder 10014. For example, an external SIP device 10022 may be positioned above the cupholder 10014, such as between the cupholder 10014 and an upper edge 10024 of the seat side member 10012 and/or an external SIP device 10026 may be positioned beneath the cupholder 10014, such as between the cupholder 10014 and a bottom 10029 of the seat portion 10010 for example. In the illustrated, non-limiting embodiment, the child seat 10002 additionally includes an external SIP device 10028 arranged near an interface between the upright portion 10008 and a seat portion 10010. As shown, the external SIP device 10028 may be positioned adjacent to, for example beneath, an opening 10030 that defines a portion of a vehicle belt path, such as formed in an adjacent upright side member 10032 of the upright portion 10008.

[1075] Each of the illustrated external SIP devices 10020, 10022, 10026, 10028 may protrude laterally or outwardly from the first or second seat side member 10012 in a direction

oriented substantially orthogonal to the respective seat side member 10012. Although an external SIP devices 10020, 10022, 10026, 10028 having generally rectangular configurations are shown, it should be understood that other suitable configurations, such as configurations complementary to the contour of the child seat 10002 at a respective location for example, are also within the scope of the disclosure.

[1076] In some embodiments, an external SIP device is located near or directly adjacent to an opening that forms part of a vehicle belt path when the child seat system is mounted in a forward-facing configuration. With reference to FIGS. 54A-54B, another embodiment of a child seat system 5100 is illustrated. As shown, the child seat system 5100 includes a child seat 5102 positionable about a support base 5104. A seat shell 5106 of the child seat 5102 includes an upright portion 5108 and a seat portion 5110. The upright portion 5108 includes a back portion 5112, and a first upright side member 5114 and a second upright side member (not shown) extending from opposing sides of the back portion 5112. Each upright side member 5114 includes an opening 5116 formed therein that may form part of a belt path for receiving a vehicle belt about the child seat 5102.

[1077] Similar to the previous embodiments, an external SIP device 5120 is arranged at an exterior surface of at least one of the first and second upright side members 5114. In the illustrated, non-limiting embodiment, the external SIP device 5120 is arranged vertically above the opening 5116. The external SIP device 5120 may protrude from and be oriented generally parallel to the adjacent upright side member 5114. As shown, the external SIP device 5120 may extend from near a front edge 5118 of the upright side member 5114 toward the back portion 5112. In such embodiments, the external SIP device 5120 may extend over the entire length of the upright side member 5114, or alternatively, over only a portion thereof. However, in other embodiments, the external SIP device 5120 may be arranged locally above the opening 5116.

[1078] Another embodiment of a child seat system 5200 including a child seat 5202 and a support base 5204 is illustrated in FIGS. 55A-55E. Similar to the previous embodiment, a seat shell 5206 of the child seat 5202 includes an upright portion 5208 and a seat portion 5210. The upright portion 5208 includes a back portion 5212, and a first upright side member 5214 and a second upright side member 5216 extending from opposing sides of the back portion 5212. Each upright side member 5214, 5126 includes an opening 5218 formed therein that may form part of a belt path for receiving a vehicle belt about the child seat 5202.

[1079] At least one external SIP device is affixed to an exterior surface of the upright portion. In the illustrated, non-limiting embodiment, a first external SIP device 5220a is positioned at an exterior surface of the first upright side member 5214 and a second external

SIP device 5220b is positioned at an exterior surface of the second upright side member 5216. As shown, the first and second external SIP devices 5220a, 5220b are located directly behind the opening 5218, such as between the opening 5218 and the back portion 5212 of the child seat 5202. The first and second external SIP devices 5220a, 5220b may but need not extend above the opening 5218. Although the external SIP devices 5220a, 5220b are illustrated as being positioned solely at the upright side members 5214, 5216, with a back surface 5222 substantially flush with a back edge 5224 of the upright side member 5216 (see FIG. 55E), embodiments where the external SIP devices 5220a, 5220b additionally extend about the back portion 5212 are also within the scope of the disclosure. At such a position, the external SIP devices 5220a, 5220b may be remote from the vehicle belt path, such as from both the lap portion and the shoulder portion of a vehicle belt for example. The external SIP devices 5220a, 5220b protrude laterally or outwardly from the upright side member 5214, 5216 such as in a direction oriented substantially perpendicular to the upright side member 5214, 5216. The external SIP device 5220a, 5220b may extend laterally beyond the outermost surface of the upright side member 5214, 5216.

[1080] In the illustrated, non-limiting embodiments, the external SIP devices 5220a, 5220b positioned near the opening 5218 are illustrated as having a generally rectangular or polygonal shape. As shown, the shape may vary over a cross-section of the external SIP device 5220a, 5220b taken in one or more planes, such as a vertical plane and/or a horizontal plane. However, the illustrated embodiments are intended as an example only and an external SIP device 5220a, 5220b having a uniform shape or any other suitable shape that does not extend interfere with the vehicle belt path opening 5218 is contemplated herein. For example, in the non-limiting embodiment of a child seat system 5300 illustrated in FIGS. 56A and 56B, a child seat 5302 having an external SIP device 5320 mounted to the upright portion 5308 of a seat shell 5306 adjacent to an opening 5318 that forms part of a vehicle belt path is illustrated. However, as shown, a surface 5322 of an external SIP device 5320a, 5320b positioned closest to the opening 5318 may be curved. Such curvature of the surface 5322 may be sized and positioned to allow a user's hand to reach through the adjacent opening 5318 during installation of the vehicle belt; additionally, or alternatively, the curvature may be sized and positioned to avoid contacting a vehicle belt. Although the curvature of the surface 5322 is illustrated as being complementary to the contour of the adjacent opening 5318, such as a convex curvature for example, in other embodiments, the external SIP device 5320 may have a curvature that is different than the adjacent opening 5318, such as a convex curvature for example.

[1081] Although not shown, it should be appreciated that one or more additional external SIP devices may be arranged at the child seat and/or support base of the child safety system disclosed in each of the embodiments of FIGS. 50A-56B. In some embodiments, each child seat and/or support base includes another external SIP device disposed at an opposite side of the child safety system and having a configuration substantially identical to the external SIP devices illustrated and described herein.

[1082] An external SIP device, such as device 4902, 5020, 5120, 5220, 5320, located at an exterior surface of a child seat may assist with absorbing impact between a child seat and a vehicle door during a side impact crash event. In an embodiment, such an external SIP device may be operable to transfer a load applied thereto, such as during a crash event for example, into the structure of the child seat, such as the back portion of the seat shell for example. This transferal of load may induce rotation of the child seat. Rotation of the child seat may better distribute the load applied to the occupant, thereby reducing the likelihood of a head injury. An external SIP device may also reduce the chest deflection of an occupant of the child seat system during a crash event.

[1083] In embodiments where an external SIP device is arranged near an opening in the back portion that forms part of a vehicle belt path when the child seat system is in a forward-facing configuration, such as shown in FIGS. 55A-56B for example, the external SIP device 5220a, 5220b, 5320 may be operable to engage or retain a portion of the vehicle belt, such as the shoulder portion for example, at a desired position relative to the child seat. With reference to FIG. 57, an exemplary embodiment of an external SIP device 5402 arranged adjacent to an opening 5404 formed in an upright support member 5406 of a child seat 5400 is illustrated. In an embodiment, the external SIP device 5402 includes a guide portion 5408 in the form of a slot. As shown, the slot 5408 may extend inwardly from an outermost end 5410 of the external SIP device 5402. A width of the slot 5408 may be equal to or greater than a width of a corresponding portion of the vehicle belt 5412, such as a shoulder portion 5414 of the vehicle belt 5412. The slot 5408 may be formed at a non-parallel angle to a back surface 5416 of the external SIP device 5402. As shown, the slot 5408 may slope vertically downwardly toward a front of the external SIP device 5402. However, a slot having any configuration suitable to properly position a portion of a vehicle belt 5412 receivable therein is contemplated herein. The slot 5408 may be arranged to direct the vehicle belt toward the opening, and therefore may be considered to form a portion of the belt path.

[1084] In an embodiment, the slot 5408 is configured to apply a clamping force to the vehicle belt to hold the vehicle belt in a desired position. For example, a width of the slot 5408,

measured between a back and front of the external SIP device, may vary over the length of the slot 5408, whereby a portion of the slot proximate the back of the slot 5408 may be lesser in width so as to hold the vehicle belt in position. FIG. 58 illustrates an external SIP device 5502 according to another embodiment. Similar to the previous embodiment, the external SIP device 5502 is arranged adjacent to an opening 5504 formed in an upright support member 5506 of a child seat 5500. A guide portion 5509 of the external SIP device 5502 includes a guide member 5510 affixed to a portion of the external SIP device 5502, such as an upper surface 5508 thereof for example. In an embodiment, the guide member 5510 is a resilient clip biased into engagement with the adjacent surface 5508 of the external SIP device 5502. A clearance may be defined between a surface of the guide member 5510 and the adjacent surface 5508 of the external SIP device 5502 and a portion of a vehicle belt 5512, such as a shoulder portion 5514 for example may be receivable therein. The bias of the guide member 5510 towards the surface 5508 may restrict unintended movement of the vehicle belt 5512 relative to the external SIP device 5502 in at least one direction.

[1085] In other embodiments, such as shown in FIG. 59, an external SIP device 5602 includes a guide portion 5609 in the form of a guide member 5610, such as similar to guide member 5510. The guide member 5610 may be rotatable relative to an external SIP device 5602 to selectively restrict movement of a vehicle belt 5612 relative to the external SIP device 5602. For example, the guide member 5610 may be rotatable between a first, unlocked position and a second, locked position. In the first, unlocked position, the vehicle belt 12 is free to move relative to the guide member 5610, and in the second, locked position, the vehicle belt 12 is locked within by the guide member 5610 relative to the guide portion 5609 and the external SIP device 5602.

[1086] As shown, the clip 5610 may be mounted to an upper surface 5608 of the external SIP device 5602. However, embodiment where such a clip 5610 is movably mounted at an adjacent portion of the seat shell of the child seat 5600, such as at the upright support member 5606 near the opening 5604 for receiving the vehicle belt 5612 for example, are also contemplated herein.

[1087] With reference now to FIG. 60, another embodiment of a child seat 5700 having an external SIP device 5702 arranged adjacent to an opening 5704 formed in an upright support member 5706 of the child seat 5700 is illustrated. As shown, the external SIP device 5702 may be movably mounted to the child seat 5700, such as to the upright support member 5706. In the illustrated, non-limiting embodiment, the external SIP device 5702 is rotatable about an axis relative to the child seat 5700 to selectively engage and restrict movement of a portion of the

vehicle belt 5712, such as a shoulder portion 5714 for example, relative thereto. In an embodiment, the external SIP device may include a camming surface such that as the external SIP device 5702 rotates in a first direction, a force applied to the vehicle belt 5712 by the external SIP device 5702 increases. It should be appreciated that each of the external SIP devices 5402, 5502, 5602, 5702 described in FIGS. 57-60 engageable with a vehicle belt is similarly operable to transfer a load applied thereto, such as via engagement with a vehicle door during a crash event, into the structure of the child seat, and in some embodiments, to cause rotation of the child seat relative to a vehicle seat.

[1088] With reference now to FIGS. 145A-145E, an example of a child seat system 12700 including a plurality of external SIP devices according to another embodiment is illustrated. The child seat system 12700 includes a support base 12701 and a child seat mountable to the support base 12701. In the illustrated, non-limiting embodiment, the child seat is movable, for example rotatable, relative to the support base 12701 when connected thereto. The child seat 12702 may be rotatable relative to the support base 12701 between a plurality of configurations. For example, the child seat 12702 may be rotatable between a first rotational configuration (FIGS. 145A-145C), such as a configuration in which the child seat 12702 is in a facing-forward position, and a second rotational configuration (FIG. 145D), such as a configuration in which the child seat 12702 is in a rearward-facing position. However, it should be appreciated that embodiments where the child seat 12702 is positionable in one or more additional configurations, such as at third configuration (FIG. 145E) between the first rotational configuration and a second rotational configuration are also within the scope of the disclosure.

[1089] As shown, the child seat 12702 has a seat shell 12704 defining a seat portion 12706 and an upright portion 12708 of the child seat. The upright portion 12708 includes an upright support surface 12710, a first upright support member 12712 arranged at a first side of the upright support surface 12710 and a second upright support member 12714 arranged at a second opposite side of the upright support surface 12710. A belt path opening 12716a, 12716b may be formed in each upright support member 12712, 12714 that defines a portion of a vehicle belt path relative to the child seat 12702. The belt path openings 12716a, 12716b may be configured to receive a vehicle seatbelt (not shown) to secure the child seat 12702 to a vehicle seat, such as when the child seat 12702 is in a forward-facing high-back configuration.

[1090] As shown, a first external SIP device 12720a is mountable to the first upright support member 12712 near the belt path opening 12716a formed therein, and a second external SIP device 12720b is mountable to the second upright support member 12714, such as near the

belt path opening 12716b formed therein. Various views of an exemplary first external SIP device 12720a are illustrated in more detail in FIGS. 146A-146C. It should be understood that the second external SIP device 12720b may be substantially identical to, but a mirror image of the first external SIP device 12720a. As shown, the external SIP device 12720a includes a substantially hollow body 12722 having a front wall 12724 and a rear wall 12726. In the illustrated, non-limiting embodiment, the rear wall 12726 is connected to the front wall 12724 at a first end 12728 of the body 12722. The rear wall 12726 may have an arcuate contour such that a distance between the front wall and the rear wall 12726 gradually increases from the first end of the body 12722 towards a second, opposite end of the body 12730. In an embodiment, the front wall 12724 is contoured such that the distance between front wall 12724 and the rear wall 12726 varies over a height of the external SIP device 12720a. In the illustrated, non-limiting embodiment, the front wall has an arcuate configuration, such as a convex curvature. Accordingly, the distance between the front and rear walls 12724, 12726 as shown in FIG. 146C may be at a maximum near a top 12729 of the external SIP device 12720a and may be at a minimum near a bottom of the external SIP device 12720a. In the illustrated, non-limiting embodiment, the front wall 12724 is connected to the rear wall 12728 at the bottom 12731 of the external SIP device 12720a.

[1091] A sidewall 12732 may extend between and connect the front wall 12724 and the rear wall 12726 between the first end 12728 and the second end 12730 of the body 12722, such as near the top 12729 of the external SIP device 12720a. However, in some embodiments, the at least one sidewall 12732 is integrally formed with the front wall 12724. The external SIP device 12720a may have a unitary body such that the plurality of walls 12724, 12728, 12732 of the body 12722 are integrally formed. It should be understood that the shape of the external SIP device 12720a illustrated and described herein is intended as an example only.

[1092] When the external SIP device 12720a is mounted to the child seat 12702, the first end 12728 of the body 12722 is spaced from the child seat 12702 and the second end 12730 is arranged in direct contact therewith. When mounted, the rear wall 12726 may be substantially flush with an exterior surface of the upright portion 12708 such that the rear wall of the external SIP device extends continuously therefrom. For example, as shown in FIG. 145A and 145C, the second end 12730 of the body 12722 is affixed to a side of the back 12713 of the upright portion 12708 such that the rear wall 12726 is flush with the back 12713 and extends continuously outward therefrom. Further, the contour of the rear wall 12726 over its height may mirror the corresponding contour of the back 12713 of the child seat 12702 directly adjacent to its mounting location. Forming the external SIP devices 12720a, 12720b with such

a contoured back wall 12726 may prevent interference with the support base 12701 or with a vehicle seat as the child seat 12702 is rotated relative to the support base 12701.

[1093] In some embodiments, the contour of the rear wall 12726 corresponds to or is complementary to a contour of an adjacent surface, such as a forward-facing surface for example, of an industry standard vehicle seat. This contour may be complementary to the vehicle seat in a horizontal direction and/or a vertical direction. In embodiments where the vehicle seat is a free-standing seat, such as a captain's chair, the rear walls 12726 of the external SIP devices 12720a, 12720b may be complementary to the forward-facing surface of the vehicle seat near the two opposing edges thereof. In embodiments where the vehicle seat is a bench seat, the rear wall 12726 of at least one of the external SIP devices 12720a, 12720b, may be complementary to the forward-facing surface of the vehicle seat near an edge thereof positioned closest to a vehicle door.

[1094] Further, due to the positioning of the external SIP device 12720a about the child seat 12702, such as at an interface between an upright support member 12712 and a back 12713 of the upright portion 12708 and adjacent to a corresponding belt path opening 12716a for example, an axial length of at least a portion of the front wall 12724 (measured between the first end 12728 and second end 12730 of the body 12722) may vary over the height of the body 12722. This variation in length of the front wall 12724 may match a contour of the exterior of the upright support member 12712 at a location adjacent to the belt path opening 12716a. When an external SIP device 12720a, 12720b is positioned about the child seat 12702, as shown in FIG. 145B and FIG, 153 part of the front surface formed by the front wall 12724, such as the lower portion thereof, is curved or sloped away from the belt path opening 12716a, 12716b. This contour creates an enlarged area for a user to access the belt path opening 12716a, 12716b.

[1095] In an embodiment, a top portion of the front wall 12724, or the top portion of the front wall 12724 in combination with the sidewall 12732 may also be contoured, for example rounded or sloped. This contour and/or the position of the external SIP device 12720a, 12720b relative to the belt path opening 12716a, 12716b may facilitate proper positioning of the vehicle belt relative to the belt path opening 12716a, 12716b.

[1096] As shown, the exemplary external SIP device 12720a may include one or more mounting members for connecting the external SIP device 12720a to the child seat 12702. In the illustrated, non-limiting embodiment, the one or more mounting members may include at least one tuck tab 12740. As shown, the at least one tuck tab 12740 is an elongated rib 12742 that protrudes beyond the second end 12730 of the body 12722. The at least one tuck tab 12740 may additionally include a protrusion 12744 arranged at a distal end of the elongated rib 12742

engageable with a corresponding feature, such as a groove for example, formed in the child seat 12702. In the illustrated, non-limiting embodiment, the external SIP device 12720a, 12720b includes a two tuck tabs 12740, each being receivable within a corresponding opening (not shown) formed in the child seat 12702. Although the tuck tabs 12740 are both illustrated as extending from the rear wall 12726, embodiments where one or more tuck tabs 12740 are arranged at another location about the body 12722 are also contemplated herein. Further, although the tuck tabs are illustrated as being substantially identical, embodiments where tuck tabs 12740 have different dimensions to prevent installation of the external SIP device 12720a, 12720b in an improper orientation are also contemplated herein. When the external SIP device 12720a, 12720b is positioned about the child seat 12720 and the tuck tabs 12740 are arranged within a corresponding opening or recess, one or more fasteners 12748 may additionally be used to couple the external SIP device to the child seat 12702. The fasteners 12748 may be engageable with the body 12722 near a tuck tab or remotely therefrom.

[1097] Various views of an exemplary first external SIP device 12800 suitable for use as an external SIP device 12720a, 12720b of FIGS. 146A-146E according to another embodiment are illustrated in FIGS. 148A-148C. The external SIP device 12800 has a substantially hollow body 12802 including a front wall 12804 and an arcuate rear wall 12806. The body 12802 may have a configuration substantially identical to that described in the previous embodiment. However, the one or more mounting members of the external SIP device 12720a of FIGS. 148A-148C vary from that of the previous embodiment. As shown, the one or more mounting members of the external SIP device 12800 may include at least one tuck tab 12810. In the illustrated, non-limiting embodiment, the tuck tab 12810 extends from the front wall 12804. Similar to the previous embodiment, the tuck tab 12810 includes a protrusion 12812 engageable with a corresponding portion of the child seat 12702.

[1098] With reference to FIGS. 149A-149B, an example of a bracket 12820 positioned about the periphery of a belt path opening 12716a, 12716b formed in an upright support member 12712, 12714 of the child seat 12702 is illustrated. As shown, the bracket 12820 may include an engagement rib 12822 configured to engage the at least one tuck tab 12810 of the external SIP device 12800. In the illustrated, non-limiting embodiment, the rib 12822 is arranged at an inner surface 12824 of the bracket 12820 and extends into the belt path opening 12716a, 12716b. As shown in FIGS. 149B, when the external SIP device 12800 is mounted to the child seat 12702, the tuck tab 12810 may extend through a gap 12826 created between the rib 12822 and the adjacent inner surface 12824 of the bracket 12820 and the protrusion 12812

may engage a side surface of the rib 12822, thereby restricting translation of the external SIP device 12800 away from the bracket 12820.

[1099] The one or more mounting features may alternatively or additionally include at least one positioning feature 12840a, 12840b including an elongated body 12842 that protrudes beyond a second end 12808 of the body 12802 and that is receivable within at least one corresponding opening formed in the child seat 12702. In the illustrated, non-limiting embodiment, the external SIP device includes a first positioning feature 12840a and a second positioning feature 12840b. The first positioning feature 12840a and the second positioning feature 12840b may have different dimensions to prevent installation of the external SIP device 12800 in an improper orientation.

[1100] Alternatively, or in addition to the tuck tab 12810 and/or the positioning features 12840a, 12840b, the one or more mounting members of the external SIP device 12800 may alternatively or additionally include at least one connector 12850 receivable within an opening formed in the child seat 12702. An end of the connector 12850 extends from the body 12802 and has an opening 12852 formed therein. When the external SIP device 12800 is positioned adjacent to a child seat such as child seat 12702 for example, a fastener (not shown) may be receivable within the opening 12852 to mount the external SIP device 12800 to the child seat.

[1101] With reference to FIG. 150, yet another embodiment of an external SIP device having one or more mounting members is illustrated. Exclusive of the mounting members, the external SIP device 12900 may be substantially identical to the body of the external SIP devices 12720a, 12720b and 12800. In the illustrated, non-limiting embodiment, the external SIP device 12900 includes a plurality of connectors 12902, each having a body with an opening 12904 formed therein for receiving a fastener. In an embodiment, a fastener 12906 may alternatively or additionally be receivable within an opening formed at or proximate to a front wall of the external SIP device 12900. The fastener 12906 may be extendable through a bracket 12910 arranged about a periphery of a belt path opening 12912 formed in an upright side member 12914 of a child seat 12901.

[1102] Another embodiment of an external SIP device 8602 mounted to a child seat 8600 is illustrated in FIGS. 96A-96B. As shown, the external SIP device 8602 may be mounted to the child seat 8600 at a location near an opening 8604 formed in an upright support member 8606 of the child seat 8600. However, embodiments where the external SIP device 8602 is mounted to another location about the child seat 8600 or even the support base are also contemplated herein. The opening 8604 formed in the upright support member 8606 may be part of the vehicle belt path and is configured to receive a vehicle seatbelt (not shown) to secure

the child seat 8600 to a vehicle seat, such as when the child seat is in a forward-facing high-back configuration. In an embodiment, the size of the body 8610 of the external SIP device 8602 is larger than the opening 8604 formed in the upright support member 8606. As shown, the body 8610 may have a generally trapezoidal shape such that a width of the body 8610 is smallest near a location, such as an end 8612 where the body 8610 is coupled to the child seat 8600 and increases in a direction away from the coupling with the child seat 8600, such as toward a distal end 8614 for example. However, any suitable shape is contemplated herein.

[1103] The external SIP device 8602 may be movable relative to the child seat 8600 to selectively access the opening 8604 associated with the vehicle belt path. As shown, the external SIP device 8602 is rotatable between a first position in which the external SIP device 8602 is aligned with and configured to overlap at least a portion of the opening 8604 (see FIG. 96A) and a second position, where the external SIP device 8602 is spaced from the opening 8604. In the illustrated, non-limiting embodiment, the external SIP device 8602 covers the entire opening 8604 when in the first position such that the opening 8604 and the vehicle belt path is inaccessible, and the external SIP device 8602 is spaced from the opening 8604 such that the substantially entire opening 8604 is exposed and the vehicle belt path is accessible when in the second position. Because the opening 8604 may be used when the child seat 8600 is in a forward-facing configuration, the external SIP device 860 may be arranged in the first position when the child seat 8600 is in a rearward-facing configuration and may be arranged in the second position when the child seat 8600 is in the forward-facing configuration. Although only a single external SIP device 8602 is illustrated in FIGS. 96A-96B, it should be appreciated that an identical external SIP device may be arranged at the opposite side of the child seat 8600.

[1104] With reference to FIGS. 90-95, another embodiment of a child seat 8500 having a movable external SIP device 8502 is illustrated. Similar to the previous embodiment, the external SIP device 8502 is positioned generally adjacent to an opening 8504 formed in an upright support member 8506 of the child seat 8500. However, embodiments where the external SIP device 8502 is arranged at another position about a side of the child seat 8500 are also contemplated herein. The external SIP device 8502 is movable between a first position and a second position, the second position being spaced from the first position. Further, it should be appreciated that the external SIP device 8502 may be arranged at one or more intermediate positions along the path of movement defined between the first position and the second position. In such embodiments, a position of the external SIP device 8502 may be adjusted by a user to align the external SIP device 8502 with a vehicle door or to locate the external SIP device 8502 at a position closest to the vehicle door.

[1105] In the illustrated, non-limiting embodiment, the child seat 8500 includes a key plate 8510 having an elongated slot 8512 formed therein. As shown, the elongated slot 8512 extends longitudinally relative to the key plate 8510 and has a length less than the length of the key plate 8510. Although a substantially linear elongated slot is illustrated in FIGS. 92A-92B, embodiments where the elongated slot has another configuration, such as a curvilinear configuration for example, are also within the scope of the disclosure. As will be described in more detail below, the elongated slot 8512 defines the path of movement of the external SIP device relative to the child seat 8500. Although the key plate 8510 is shown as a separate component secured to either an interior or an exterior of the child seat 8500, it should be understood that in other embodiments, the key plate 8510 may be integrally formed with a portion of the child seat 8500, such as the upright support member 8506 of the child seat 8500 for example. The external SIP device 8502 is positioned adjacent to a first side 8514 of the key plate 8510, such as at the exterior of the child seat 8500 for example. Further, the external SIP device 8502 is movably coupled to the key plate 8510. In an embodiment, the external SIP device 8502 includes a keying member 8520 that extends through the elongated slot 8512. As shown, a locking nut 8522 may be arranged at an end of the keying member 8520 adjacent to the second, opposite side 8516 of the key plate 8510. The locking nut 8522 has one or more dimensions larger than the elongated slot 8512 to prevent movement of the external SIP device 8502 out of the plane defined by the first side 8514 of the key plate 8510. Accordingly, the interface between the locking nut 8522 and the elongated slot 8512 restricts separation of the external SIP device 8502 from the key plate 8510.

[1106] In an embodiment, the key plate 8510 includes at least one lock recess, and in some embodiments, a plurality of lock recesses 8524 formed at different locations at the second side 8516 of the key plate 8510. The lock recesses 8524 may be counterbores that extend through only a portion of a thickness of the key plate 8510. Although the illustrated key plate 8510 includes four lock recesses 8524 spaced over a length of the elongated slot 8512, embodiments having a single lock recess, two lock recesses, three lock recesses, or more than four lock recesses are also within the scope of the disclosure. In an embodiment, the plurality of lock recesses 8524 are substantially identical. Each of the plurality of lock recesses 8524 may have a contour complementary to the locking nut 8522. For example, the lock recess 8524 may be substantially identical in size and/or shape to the locking nut 8522 such that the locking nut 8522 is receivable within any of the plurality of lock recesses 8524. When arranged within a lock recess 8524, the locking nut 8522, and therefore the external SIP device 8502 coupled

to the keying member 8520, is restricted from travel along the path of movement defined by the elongated slot 8512.

[1107] The external SIP device 8502 is movable, for example translatable or slidable, between a first position adjacent to a first end 8526 of the slot 8512, as shown in FIG. 92A and 92B, and a second position where the external SIP device 8502 is arranged adjacent the second, opposite end of the slot (FIG. 90). In the illustrated, non-limiting embodiment, the external SIP device 8502 is arranged at an exterior of the child seat 8500 as the external SIP device 8502 travels along the path of movement of the elongated slot 8512. With reference to FIG. 92B, in the first position, the locking nut 8522 is arranged within a first lock recess 8524a, and in the second position, the locking nut 8522 is arranged within a fourth lock recess 8524d. Further, in the illustrated, non-limiting embodiment, the external SIP device 8502 is positionable at a third position in which the locking nut 8522 is arranged within a second lock recess 8524b, and a fourth position in which the locking nut 8522 is positioned within a third lock recess 8524c. The second lock recess 8524b may be positioned adjacent to the first lock recess 8524a, and the third lock recess 8524c may be located between the second lock recess 8524b and the fourth lock recess 8524d.

[1108] An actuator 8530 may be operably coupled to the keying member 8520. In the illustrated, non-limiting embodiment, the actuator 8530 is threadably connected to the keying member 8520; however, any suitable direct or indirect connection is within the scope of the disclosure. The actuator 8530 includes a button 8532 exposed at a surface of the external SIP device 8502. The actuator 8530 is receivable within a corresponding slot 8534 (FIG. 95) of the external SIP device 8502 such that the button 8532 may be selectively depressed. In an embodiment, a biasing mechanism 8536 is arranged between a portion of the external SIP device 8502 and the actuator 8530, or between a surface of the child seat 8500, such as the upright support member 8506, and the actuator 8530. The biasing force of the biasing mechanism 8536 is operable to bias the actuator 8530 to a default or unactuated position. In the unactuated position, the button 8532 of the actuator 8530 may be flush with the adjacent surface of the external SIP device 8502, or alternatively, may be sunken relative to the surface of the external SIP device 8502.

[1109] When the actuator 8530 is operated, such as by applying a force to the button 8532 for example, the keying member 8520 is moved in a direction away from the key plate 8510 and the external SIP device 8502. Accordingly, the actuator 8530 is operable to separate the lock nut 8522 from a respective lock recess 8524. While the lock nut 8522 is disengaged from the plurality of lock recesses 8524, the external SIP device 8502 is freely movable along

the path of movement defined by the elongated slot 8512. Upon reaching a desired position, the force is removed from the button 8532 and the actuator 8530 is biased by the biasing mechanism 8536 back to its unactuated position. This movement of the actuator 8530 in response to the biasing force of the biasing mechanism 8536 causes a similar movement of the keying member 8520, causing the locking nut 8522 to reengage with a corresponding lock recess 8523 of the key plate 8510. In an embodiment, at least one of the locking nut 8522, the keying member 8520, the key plate 8510, and the external SIP device 8502 includes a feature, such as a contour for example, which prevents unintended rotation of the external SIP device 8502 when the locking nut 8522 is disengaged from the lock recesses 8524. It should be appreciated that the movable connection between the external SIP device 8502 and the child seat 8500 as described herein is intended as an example only.

[1110] With reference now to FIGS 193A-195D, another embodiment of a child seat 15000 having a movable external SIP device 15002 similar to the movable external SIP device 8502 is illustrated. The external SIP device 15002 may be positioned generally adjacent to an opening 15004 formed in an upright support member 15006 of the child seat 15000 and is movable, for example translatable, between a first position (FIG. 193A, 195A, 195C) and a second position (FIGS. 193B, 195B, and 195D). The mechanism for moving the external SIP device 15002 may be the same as described above with respect to FIGS. 90-95. It should be understood that in some embodiments, one of the first, raised position, and the second lowered position may be considered a stowed position, and the other of the first, raised position, and the second, lowered position may be considered a deployed position. Further, it should be appreciated that the external SIP device 15002 may be arranged at one or more intermediate positions along the path of movement defined between the first position and the second position. Accordingly, a user may adjust the external SIP device 15002 to a desired position, such as a position closest to the vehicle door. The external SIP device 15002 may similarly have an actuator 15008 used to selectively unlock the external SIP device 15002, as described above.

[1111] In the non-limiting embodiment, the external SIP device 15002 includes a belt guide or belt lock 15010 arranged proximate to an exterior surface of the body 15003 of the external SIP device 15002. The belt lock 15010 may include an axially aligned first arm 15012 and second arm 15014 and a receiving channel 15016 may be formed between the exterior surface of the body 15003 of the external SIP device 15002 and an adjacent surface of the first and second arm 15012, 15014. The distal end 15018 of the first arm 15012 is positioned closest to the distal end 15020 of the second arm 15014; however, the distal ends 15018, 15020 of the

first and second arm 15012, 15014 are offset from one another to define a slot 15022 for accessing the receiving channel 15016. During installation of the child seat 15000 in a vehicle, a portion of the vehicle belt 15030, such as a shoulder portion identified at 15032 for example, is engaged with the belt lock 15010. The portion 15032 of the vehicle belt 15030 is inserted through the slot 15022 into the receiving channel 15016. Once arranged within the receiving channel 15016, the vehicle belt 15030 is contained therein by the first and second arms 15012, 15014. Accordingly, the vehicle belt 15030 will remain contained within the receiving channel 15016 as the external SIP device 15002 is moved between a plurality of positions, such as between a raised position and a lowered position for example, relative to the child seat 15000. Further, movement of the external SIP device 15002 may be used to apply tension to the vehicle belt 15030 via the belt lock 15010. For example, when the vehicle belt 15030 is secured to the SIP device 15002 via the belt guide 15010, in the first position, the SIP device 15002 applies a first force to the vehicle belt 15030 and in a second position, the SIP device 15002 applies a second force to the vehicle belt 15030. The second force may be greater than the first force.

[1112] With reference now to FIGS. 196A-197D, another embodiment of a child seat 15100 having a movable external SIP device 15102 similar to the movable external SIP device 15002 is illustrated. The external SIP device 15102 may be positioned generally adjacent to an opening 15104 formed in an upright support member 15106 of the child seat 15100 and is movable, for example translatable, between a first position (FIG. 196A, 197A, 197C) and a second position (FIGS. 196B, 197B, and 197D). The mechanism for moving the external SIP device 15002 may be the same as described above with respect to FIGS. 90-95.

[1113] In the illustrated, non-limiting embodiment, the external SIP device 15102 includes a belt guide or belt lock 15110 having a different configuration from the previous embodiment. As shown, the belt lock 15110 includes a retaining member 15112 and a post 15114 connected to and extending at an angle from the retaining member 15112, such as near a first end 15116 thereof. In the illustrated, non-limiting embodiment, the post 15114 is receivable within a corresponding opening (not shown) formed in the external SIP device 15102 such that the retaining member 15112 is located directly adjacent to an exterior surface 15118 of the external SIP device 15102. The belt lock 15110 is fixedly attached to the external SIP device 15102 or may be removably connectable thereto. Further, when the belt lock 15110 is attached to the external SIP device 15102, the belt lock 15110 is fixed in position relative to the external SIP device 15102. In some embodiments, at least a portion of a bottom surface 15120 of the retaining member 15112 may be arranged in contact with the exterior surface 15118 of the external SIP device 15102. As shown, a groove or recess 15122 may be formed

at a central portion of the retaining member, such as in the bottom surface thereof. When the belt lock 15110 is installed about the external SIP device 15102, the recess 15122 forms a receiving channel 15124 bounded by the ends 15116, 15126 of the retaining member 15112 and the exterior surface 15118 of the body of the external SIP device 15102.

[1114] Similar to the previous embodiment, during installation of the child seat in a vehicle, a portion 15132 of the vehicle belt 15130, such as a shoulder portion for example, is engaged with the belt lock 15110. The portion 15132 of the vehicle belt 15130 may be slid between the distal or second end 15126 of the retaining member 15112 into the receiving channel 15124. In some embodiments, an upward force may be applied to the distal end 15126 of the retaining member 15112 to create a clearance sufficient to thread the vehicle belt 15130 between the retaining member 15112 and the exterior surface 15118 of the external SIP device 15102. Once arranged within the receiving channel 15124, the vehicle belt 15130 is contained therein by the retaining member 15112. Accordingly, the vehicle belt 15130 will remain contained within the receiving channel 15124 as the external SIP device 15102 is moved between a plurality of positions, such as between a first raised position and a second lowered position for example, relative to the child seat. In addition, movement of the external SIP device 15102 may be used to apply tension to the vehicle belt 15130 via the belt lock 15110. For example, when the vehicle belt 15130 is secured to the SIP device 15102 via the belt guide 15110, in the first position, the SIP device 15102 applies a first force to the vehicle belt 15130 and in a second position, the SIP device 15102 applies a second force to the vehicle belt 15130. The second force may be greater than the first force.

[1115] Yet another example of an SIP device 15152 is illustrated in the non-limiting embodiment of FIGS. 198A-198B. The body 15153 of the SIP device 15152 may have a similar shape to those shown in FIGS. 193A-197D. However, the SIP device 15152 does not include a belt guide or belt lock operable to engage and retain a vehicle belt 15160 in position relative thereto. Rather, a portion of the vehicle belt 15160, such as a shoulder portion 15162 for example, may be positionable underneath a bottom of the body 15153 of the external SIP device 1512. In such a configuration, a user may adjust a position of the external SIP device 1512 to control a tension applied to the vehicle belt 15160. As shown, downward movement of the external SIP device 15152 into engagement with the shoulder portion 1515 may increase the tension acting thereon.

[1116] In embodiments where the child seat of the child seat system is configured as an infant car seat, one or more SIP devices may be mounted at an exterior of the child seat. With reference now to FIG. 61A-61C and FIG. 166, the illustrated child seat 5800 is an infant

car seat including a handle 5802 rotatably affixed to a seat shell 5804 via one or more handle hubs 5806. In the non-limiting embodiment of FIG. 61A, an external SIP device 5808 is affixed to and protrudes outwardly from an exterior surface of at least one handle hub 5806. The external SIP device 5808 may be rotatable with the handle hub 5806 about an axis relative to the seat shell 5804 of the child seat 5800. Alternatively, or in addition, as shown in FIG. 166, an external SIP device 5808 may be fixed to the carrying handle 5802 of an infant car seat 5800 at a location offset from the handle hubs 5806. In the illustrated, non-limiting embodiment, the external SIP device 5808 is arranged at an inwardly facing surface 5809 of the handle 5802. The external SIP device 5808 may be positioned to be alignable with, and in some embodiments configured to contact, the adjacent sidewall of the back portion 5805 of the seat shell 5804 when the handle 5802 is arranged at a stored position extending behind the back portion 5805 of the seat shell 5804. In such an aligned or contacting position, the external SIP device 5808 may be in continuous lateral contact with both the carrying handle 5802 and the seat shell 5804. Further, when the handle 5802 is in a use position, such as a when the handle is oriented within a vertical plane, the external SIP device 5808 may be positioned out of alignment with a sidewall of the back portion 5805 of the seat shell 5804. Rather, the external SIP device 5808 may be vertically offset from the seat shell 5804. Although only a single side of the carrying handle 5802 and the seat shell 5804 of the infant car seat 5800 are illustrated in FIG. 166, it should be appreciated such that another external SIP device 5808, having a substantially identical or a different configuration, may be arranged at an inwardly facing surface of the carrying handle 5802 at the opposite side of the seat shell 5804.

[1117] Alternatively, or in addition, as shown in FIGS. 61B and 61C, an external SIP device 5810 may be arranged at an exterior of the child seat 5800, such as near a front end 5812 of a seat portion 5814 of the child seat 5800. As shown, the external SIP device 5810 may have a contour generally complementary to the adjacent portion of the child seat 5800 and protrudes outwardly, for example perpendicularly, away from the child seat 5800. At such a position, the external SIP device 5810 may be positioned between the seat shell 5804 and soft goods 5816 (see FIG. 61A) overlapping the seat shell 5804. In such embodiments, the external SIP device 5810 is sized and shaped so as not to interfere with rotation of the handle 5802 to a forward position adjacent to the front 5812 of the child seat 5800. An external SIP device 5808 and/or 5810 mounted at an exterior of an infant car seat, may be operable to increase the stiffness of the child seat and distribute a load applied to the child seat across the length of the child seat, away from the occupant.

[1118] In another embodiment, an infant car seat 10400 including a handle 10402 rotatably affixed to a seat shell 10404 via one or more handle hubs 10406a, 10406b is illustrated in FIGS. 116A-116D. As shown, at least one external SIP device 10408a, 10408b may be arranged at an exterior surface of the seat shell 10404, such as near a handle hub 10406a, 10406b for example. In the illustrated, non-limiting embodiment, the first external SIP device 10408a is positioned behind a first handle hub 10406a, such as between the handle hub 10406a and a rear 10410 of the child seat 10400 for example, and the second external SIP device 10408b is positioned at a similar location behind a second handle hub 10406b, between the handle hub 10406b and a rear 10410 of the child seat 10400. In an embodiment, the at least one external SIP device 10408a, 10408b is contoured to prevent interference with the handle 10402 as it rotates about an axis relative to the seat shell 10404 between a front position (not shown) and a rear position (shown in FIGS. 116C-116D). Although a notch or cutout 10412 is illustrated in FIGS. 116C-116D, it should be understood that any suitable configuration to prevent interference with the handle 10402 is contemplated herein.

[1119] In some embodiments, the seat body of a child seat may be adapted to minimize injury to a child during a frontal impact of a vehicle. With reference to FIG. 155, an exemplary infant car seat 13200 is illustrated. As shown, the infant car seat 13200 has a rigid seat shell 13202 including a seat portion 13204 and a seat back or upright portion 13206 arranged at an angle relative to the seat portion 13204. In the illustrated, non-limiting embodiment, the seat portion 13204 and the seat back portion 13206 are integrally formed as a single unitary body. As shown, the seat portion 13204 of the child seat 13200 includes a seat support surface 13208 and the seat back portion 13206 of the child seat 13200 includes an upright support surface 13210 upon which an infant is positionable. The seat back portion 13206 may include a first upright side member 13212 arranged at a first side 13214 of the upright support surface 13210 and a second upright side member 13216 may be arranged at a second, opposite side (not shown) of the upright support surface 13210. The first and second upright side members 13212, 13216 therefore form the left side and the right side of the seat back portion 13206, respectively. As shown, the first and second upright side members 13212, 13216 extend forward and/or upward from the upright support surface 13210. The first and second upright side members 13212, 13216 may extend generally orthogonally to the upright support surface 13210 or alternatively, may extend therefrom at another angle. Accordingly, the upright support surface 13210 and the first and second upright side members 13212, 13216 define a backrest region or upright support cavity within which an upper body of a child is received.

[1120] The seat portion 13204 may similarly include a first seat side member 13220 arranged at a first side 13222 of the seat support surface 13208, and a second seat side member 13224 arranged at a second, opposite side (not shown) of the seat support surface 13208. The first seat side member 13220 and the second seat side member 13224 extend upwardly and form the left side and the right side of the seat portion 13204. The seat support surface 13208 and the first and second seat side members 13220, 13224 in combination define a region within which at least part of a lower body of a child may be received.

[1121] When the child seat 13200 is an infant car seat, the child seat 13200 may include a carrying handle 13226. In the illustrated, non-limiting embodiment, the carrying handle 13226 has a generally arcuate shape and the two opposite ends 13228, 13230 thereof are respectively connected with a left and right side of the seat shell 13202. In some embodiments, the carrying handle 13226 is movably connected with the seat shell 13202. The carrying handle 13226 may be transformable, for example rotatable, between a plurality of positions or angles relative to the seat shell 13202, such as to more easily access the child positioned within the child seat 13200 or for storage purposes for example

[1122] With continued reference to FIG. 155 and further reference to FIGS. 156A and 156B, a dimension of one or more areas of the seat back portion 13206 may be increased or extended to restrict movement of an occupant's head into contact with a vehicle door during a crash event. For example, at least one of the upright side members 13212, 13216 may be sized to minimize head contact with a vehicle door during a vehicle side impact when a child is positioned in the child seat 13200. In an embodiment, a height, measured perpendicular to the upright support surface 13210, of at least a portion of the upright side members 13212, 13216 is increased compared to an existing child seat to increase head protection of an occupant of the child seat 13200 during a frontal impact of the vehicle. This portion of the upright side members 13212, 1326 where the height has been increased may be referred to herein as the "extended region" and is identified at 13232a, 13232b in FIGS. 155-156B, and may be arranged at an area generally aligned with an occupant's head. A canopy (not shown) may be movably mounted to the first and second upright side members 13212, 13216 via at least one canopy mount, such as a first canopy mount 13234 and a second canopy mount 13236. As shown, the first and second canopy mounts 13234, 13236 are arranged at the seat shell at a position between the ends 13228, 13230 of the carrying handle 13226 and the top 13211 of the upright side members 13212, 13216. In an embodiment, the extended regions 13232a, 13232b are arranged between a respective canopy mounts 13234, 13236 and the top 13211 of the seat shell 13202.

[1123] The increase in height at an extended regions 13232a, 13232b may be constant over a respective length of each of the extended regions 13232a, 13232b. In other embodiments, the increase in height may vary over these respective lengths of the extended regions 13232a, 13232b. In an embodiment, the increase in height at the extended regions 13232a, 13232b is gradually reduced near one or both ends of the extended regions 13232a, 13232b, such as near canopy mounts 13234, 13236, and/or near the top 13211 of the seat shell 13202. This allows the extended regions 13232a, 13232b to blend or form a smooth contour with an adjacent portion of the upright side members 13212, 13216. For example, the variation of the respective increases in height at the extended regions 13232a, 13232b may be selected such that each extended region 13232a, 13232b reaches a maximum increased height within a distance of about 40mm from the canopy mount, and in some embodiments, at a distance about 25mm from a canopy mount 13234, 13236. Once reaching the maximum increased height, such as an increase of about 8mm for example over standard seats, the increased height may remain constant over a substantial length of the extended region 13232a, 13232b. In an embodiment, at least one extended region 13232a, 13232b maintains a constant increased height over a length between about 150mm and 200mm, such as about 185mm for example, before being reduced near the top 13211 of the seat shell 13202.

[1124] Alternatively, or in addition, the overall length of the upright support surface 13210, measured between an end located adjacent to the seat support surface 13208 and an opposite end thereof, such as at the top 13211 of the seat shell 13202, may be increased or extended compared to existing child seats. This extended portion of the upright support surface 13210 increases head protection of an occupant of the child seat 13200 during a frontal impact of the vehicle. In an embodiment, this extended portion of the upright support surface 13210 has a length of between 10mm and 20mm, such as about 15mm for example. Further, a thickness of this additional length of the upright support surface 13210 may be about 10mm.

[1125] With continued reference to FIG. 155, in an embodiment, a cushion 13240 is positionable in overlapping arrangement with the upright support surface 13210. The cushion 13240 be separate from the soft goods associated with the child seat 13200, or alternatively, may be integrated into the soft goods configured to overlap the seat support surface 13208 and the upright support surface 13210 of the seat shell 13202. The cushion 13240 may be configured to overlap a substantial entirety of the upright support surface 13210, or alternatively, only a portion thereof. The cushion 13240 is designed to overlap the extended portion of the upright support surface 13210. In an embodiment, a top edge 13242 of the cushion 13240 is generally aligned with the top 13211 of the upright support surface 13210. In

an embodiment, the cushion 13240 has a thickness of at least 10mm, such as about 13mm for example. However, embodiments having another suitable thickness are also contemplated herein. Further, embodiments where the cushion 13240 has non-uniform thickness intended to cooperate with the variation in contour and thickness of the upright support surface 13210 are also contemplated herein. The cushion 13240 may be made of any suitable material including but not limited to memory foam or polyfoam for example. Inclusion of the cushion 13240 may facilitate proper positioning of an occupant's head adjacent to the at least one extended region 13232a, 13232b.

[1126] In other embodiments, as shown in FIGS. 240A-240C, an SIP device may be arranged at an interior surface of an infant car seat 17200. As previously described with respect to FIG. 155, the infant car seat 17200 may have a rigid seat shell 17202 including an upright portion 17204. The upright portion includes an upright support surface 17206, a first upright side member 17208 arranged at a first side of the upright support surface 17206 and a second upright side member 17210 arranged at a second, opposite side of the upright support surface 17206. The first and second upright side members 17208, 17210 therefore form the left side and the right side of the upright portion 17204, respectively. Accordingly, the upright support surface 17206 and the first and second upright side members 17208, 17210 define a backrest region or upright support cavity within which an upper body of a child is received.

[1127] The infant car seat 17200 may include a carrying handle 17212, such as having a generally arcuate shape, and affixed at two opposite ends 17214, 17216 to a left and right side of the seat shell 17202. In some embodiments, the carrying handle 13226 is movably connected with the seat shell 13202. The carrying handle 17212 may be transformable, for example rotatable, between a plurality of positions or angles relative to the seat shell 17202, such as to more easily access the child positioned within the infant car seat 17200 or for storage purposes for example.

[1128] In an embodiment, at least one SIP device 17220 is arranged at an area of the seat shell 17202 to minimize head contact with a vehicle door during a vehicle side impact when a child is positioned in the infant car seat 17200. The at least one SIP device 17220 may be generally aligned with an occupant's head. As shown, the SIP device 17220 may be arranged at or near a top edge 17218 of the upright side member 17208, and in some embodiments, has a contour complementary to the top edge 17218. Further, a thickness of the body of the SIP device 17220 may be substantially uniform, or alternatively, may vary across the body of the SIP device 17220. The SIP device 17220 may be formed from any suitable material. Examples of suitable materials include but are not limited to foam padding such as expanded

polypropylene or memory foam. Memory foam may be particularly beneficial in that its compression rate varies based on the force applied thereto. For example, a perceived hardness of memory foam may increase as the speed of the impact applied thereto increases, thereby providing a quicker deceleration.

[1129] In the illustrated, non-limiting embodiment shown in FIGS. 240B-240C, the at least one SIP device 17220 is positioned adjacent to, such as in direct contact with, an interior surface 17219 of an upright side member 17208. A further SIP device (not shown) like SIP device 17220 may additionally or alternatively be positioned on an interior surface of upright side member as discussed above and below 17210. The upright side member 17208 may include a structural shell and a first padded portion positioned in overlapping arrangement with the structural shell. In such embodiments, the SIP device may be positioned directly adjacent to the inwardly facing surface of the first padded portion. Accordingly, the first padded portion of the upright side member may be considered a proximal material of the upright side member 17208, and the SIP device 17220 may be considered a second padded portion or a distal material of the upright side member 17208. In an embodiment, the material of the second padded portion has an increased resiliency comparted to the material of the first padded portion. A thickness, measured along an axis extending horizontally between the first and second upright side members 17208, of an upright side member 17208at the SIP device 17220 is increased compared to a thickness of an adjacent portion of the upright side member 17208 to increase head protection of an occupant of the infant car seat 17200 during a crash event. In an embodiment, a thickness of the upright side member 17208 at an area including both the proximal and distal materials is greater than a thickness of the upright side member 17208 having only the proximal material. As is alluded to above, the upright side member 17210 may alternatively or additionally include the same thickness profile as upright side member 17208.

[1130] In other embodiments, such as shown in FIG. 240A, a groove or recess (not shown) may be formed at the interior surface 17219 of the upright side member 17208 and the SIP device 17220 may be arranged within the recess. In such embodiments, an inwardly facing surface 17222 of the SIP device 17220 may be substantially flush with an adjacent surface of the upright side member 17208, or the inwardly facing surface 17222 may protrude inwardly beyond the adjacent surface. This groove or recess may alternatively or additionally be included in the upright side member 17210.

[1131] Although the SIP device is illustrated and described herein as a separate body affixed to a side member of the child seat, in other embodiments, such as shown in FIG. 241, the SIP device may be integrally formed with the material of the upright side member.

Accordingly, a thickness of a desired portion of the upright side member near an occupant's head may here again be increased.

[1132] Another embodiment of an infant car seat 18000 is illustrated in FIG. 255A-256. As in the embodiment previously described above with respect to FIGS. 240A-240C, the infant car seat 18000 includes a seat body 18002 having an upright portion 18004. The upright portion includes an upright support surface 18006, a first upright side member 18008 arranged at a first side of the upright support surface 18006 and a second upright side member 18010 arranged at a second, opposite side of the upright support surface 18006. The first and second upright side members 18008, 18010 therefore form the left side and the right side of the upright portion 18004, and the upright support surface 18006 in combination with the first and second upright side members 18008, 18010 defines a backrest region or upright support cavity within which an upper body of a child is received.

[1133] The infant car seat 18000 may include a carrying handle 18012 affixed at two opposite ends 18014, 18016 to a left and right side of the seat body 18002. In some embodiments, the carrying handle 18012 is movably connected with the seat body 18002. The carrying handle 18012 may be transformable, for example rotatable, between a plurality of positions or angles relative to the seat body 18002, such as to more easily access the child positioned within the infant car seat 18000 or for storage purposes for example. The upright portion 18004 of the seat body 18002, including the first and second upright side members 18008, 18010 may be formed by a structural shell 18020 (FIGS. 255A and 255B) and a padded body 18022 (FIG. 256) arranged at an inward facing surface of the structural shell 18020. The padded body 18022 may be formed from any suitable material, such as but not limited to expanded polypropylene. Further, as shown in FIG. 256, soft goods 18024 may be positionable in overlapping arrangement with an inward facing surface 18026 of the padded body 18022. In some embodiments, the soft goods 18024 wrap around and/or cover the distal or upper end 18030 of the padded body 18022 at both the first upright side member 18008 and the second upright side member 18010.

[1134] In the illustrated, non-limiting embodiment, a thickness at the top or distal end of the first upright side member 18008 is increased relative to the thickness of the remainder of the first upright side member 18008. The area of increased thickness arranged at the first upright side member 18008 may form a ridge 18032 at the distal end 18030 of the first upright side member 18008. The ridge 18032 may act as an SIP device by minimizing head contact with a vehicle door during a vehicle side impact when a child is positioned in the infant car seat 18000.

[1135] The ridge 18032 may be formed via a body separate from the padded body 18022. In such embodiments, the body may be an SIP device mounted to the padded body 18022 of the first upright side member 18008 at or near the distal end 18030 of the first upright side member 18008. In other embodiments, the ridge 18032 may be defined by the padded body 18022 itself. As shown, the thickness of the padded body 18022 proximate the distal end 18030 of the first upright side member 18008 is increased compared to the thickness of the padded body 18022 at the portion of the first upright side member 18008 proximate the upright support surface 18006. As shown, the ridge 18032 may extend from the portion of the first upright side member 18008 located adjacent to the back 18040 of the upright portion 18004 of the infant car seat 18000 to a portion of the first upright side member 18008 proximate a respective end 18014 of the carrying handle 18012. However, in other embodiments, the ridge 18032 may extend over only a portion of the region extending between the back 18040 and the end 18014 of the carrying handle 18012. The inward facing surface 18026 of the padded body 18022 may taper outwardly toward the ridge 18032.

[1136] The edges of the ridge 18032 may be smoothed or curved to maximize comfort when contacted by an occupant's head. Further, in the illustrated, non-limiting embodiment, a vertical height of the ridge 18032 at the first upright side member 18008 is constant over its length, such as between the back 18040 and the end 18014 of the carrying handle 18012. As shown, a height of the ridge 18032, measured perpendicular to the upright support surface 18006, may be less than ¼ of the height of the upright side member 18008, and in some embodiments may be less than 1/5 of the height of the upright support member 18008.

[1137] It should be appreciated that the second upright side member 18010 may similarly be formed by a structural shell and a padded body. The structural shell and padded body of the second upright side member 18010 may be distinct from the structural shell 18020 and padded body 18022 of the first upright side member 18008 or may be integrally formed therewith. Further, another ridge, like ridge 18032, may additionally or alternatively be positioned at the distal end of the second upright side member 18010.

[1138] Although not shown, a second SIP device, similar to SIP device 17220, may be arranged at the first upright side member 18008, such as between the ridge 18032 and the upright support surface 18006. In such embodiments, the second SIP device may be formed from a different material than the padding 18022. For example, the second SIP device may be formed from a softer material than the padding 18022, such as a foam material for example. Again, it should be appreciated that in some embodiments, a second SIP device may alternatively or additionally be arranged at the second upright side member 18010.

[1139] With reference now to FIGS. 199A-199B, in an embodiment, an SIP device in the form of a cushion 15210 is positionable in overlapping arrangement with a seat support surface 15204 of a seat shell 15202 of a child seat 15200. The cushion 15210 may be separate from the soft goods (not shown) associated with the child seat 15200, or alternatively, may be integrated into the soft goods configured to overlap the seat support surface 15204 of the seat shell 15202. The cushion 15210 may be made of any suitable material including but not limited to memory foam or polyfoam for example. As shown, the cushion 15210 may overlap a substantial entirety of the seat support surface 15204, or alternatively, only a portion thereof. In some embodiments, the cushion 15210 has a slot or opening 15212 formed therein, such as configured to receive a portion of a harness (not shown) of the child seat 15200. The cushion 15210 may be used to properly position a child within the child seat 15200, such as by aligning the child with one or more SIP devices of the child seat. For example, the cushion 5210 may be used to increase a height of the seat portion of the child seat by at least 120mm or greater. In an embodiment, the cushion 15210 is formed via a plurality of individual layers that are removably connected to one another. With such a configuration, layers may be gradually removed from the cushion 15210 as the child grows. For example, the cushion 15210 shown in FIGS. 198A may have a plurality of layers and the cushion 15210 shown in FIGS. 198B has a single layer or fewer layers than the cushion shown in FIG. 198A.

[1140] With reference now to FIGS. 157-163, in an embodiment, a support base 13302 may be engageable with a portion of a child car seat (such as an infant car seat 13300) to transmit a force applied to a side of the infant car seat 13300 about a periphery of the infant car seat 13300 and/or support base 13302. In the illustrated, non-limiting embodiment of FIGS. 158A-159B, an infant car seat 13300 has a rigid body or seat shell 13304 defining a seat pan portion 13306 and a seat back portion 13308. A handle 13310 is rotatably affixed to opposite sides of the seat shell 13304, such as at a location near an interface between the seat pan portion 13306 and the seat back portion 13308.

[1141] The support base 13302, which is configured to receive and couple the seat shell 13304 to a vehicle seat, includes a body having a first end 13320 and a second, opposite end 13322. The body includes a left side 13321 and a right side 13323, respectively, extending between the first end 13320 and the second end 13322. An upper surface 13324 extends between the top of the each first end 13320, second end 13322, left side 13321, and right side 13323, and is configured to contact the seat shell 13304. When the infant car seat 13300 is coupled to the support base 13302, the seat pan portion 13306 is arranged near the first end 13320 of the support base 13302 and the seat back portion 13308 is arranged near the second

end 13322 of the support base 13302. When the support base 13302 is installed about a vehicle seat, the first end 13320 is positionable near a seat back of the vehicle seat, and the second end 13322 is positionable near a front of the vehicle seat.

[1142] In an embodiment, the support base 13302 includes at least one SIP device 13326a, 13326b positionable in contact with a portion of the infant car seat 13300. When the infant car seat 13300 is mounted to the support base 13302, the handle 13310 is rotatable relative to the seat shell 13304 into engagement with the at least one SIP device 13326a, 13326b of the support base 13302. In an embodiment, the at least one SIP device 13326a, 13326b is configured to interlock with the handle 13310 of the infant car set 13300.

[1143] As shown, the at least one SIP device 13326a, 13326b may be arranged near the second end 13322 of the body, such as at a position horizontally aligned with a head receiving area of the seat back portion 13308 of the infant car seat 13300. For example, a first SIP device 13326a may be located adjacent to the first side 13321 of the body of the support base 13302, near the second end 13322, and a second SIP device 13326b may be positioned adjacent to a second, opposite side 13323 of the body of the support base 13302, near the second end 13322. Embodiments where the at least one SIP device 13326a, 13326b additionally extends along the second end 13322 of the support base 13302, between the first side 13321 of the body and the second side 13323 of the body are also contemplated herein. In such embodiments, the first SIP device 13326a and the second SIP device 13326b may be integrally formed.

[1144] The at least one SIP device 13326a, 13326b may be a protrusion and may extend upwardly, and in some embodiments, outwardly, from the body of the support base 13302, such as from the upper surface 13324. In an embodiment, the height of the support base 13302 at or proximate to the second end 13322 of the support base 13302, such as defined by the at least one SIP device 13326a, 13326b for example, may be equal to or greater than a height of the upper surface 13324 at the first end 13320 of the support base 13302. In the illustrated, non-limiting embodiment, a maximum height of the at least one SIP device 13326a, 13326b is at least coplanar with the axis of rotation of the handle 13310, and in some embodiments, extends vertically beyond the plane containing the axis of rotation of the handle 13110. Accordingly, when the handle 13310 is rotated to a storage position behind the seat back portion 13308, as shown in FIGS. 158A and 158B, the sides 13328a, 13328b of the handle 13310 positioned adjacent to the sides 13312, 13314 of the seat back portion 13308 of the seat shell 13304 are horizontally aligned with the at least one SIP device 13326a, 13326b.

[1145] As shown in FIGS. 159A-159B, the position of the at least one SIP device 13326a, 13326b relative to the support base 13302 defines respective recesses 13332a, 13332b

within which the sides 13328a, 13328b of the handle 13310 are receivable when the handle 13310 is rotated to a position behind the seat back portion 13308 of the seat shell 13304. The first and second SIP devices 13326a, 13326b are laterally offset from an exterior surface of the sides 13321, 13323 of the support base 13302. In the illustrated, non-limiting embodiment, the SIP devices 13326a, 13326b are aligned with a respective clearance formed between the inward facing surfaces 13311a, 13311b of the sides 13328a, 13328b of the handle 13310 and the sides 13312, 13314 of the seat back portion 13308. In such embodiments, the recesses 13332a, 13332b are arranged between an outward facing surface 13334a, 13334b of the SIP devices 13326a, 13326b and an exterior surface of the sides 13321, 13323 of the support base 13302. The outward facing surfaces 13334a, 13334b of the SIP devices 13326a, 13326b may be complementary to the inward facing surfaces 13311a, 13311b of the sides 13328a, 13328b of the handle 13310 to maximize the surface area of engagement therebetween.

[1146] With reference now to FIGS. 160A-162, another example of an infant car seat 13400 engageable with a support base 13402 to transmit a force applied to a side of the infant car seat 13400 about a periphery of the infant car seat 13400 and/or support base 13402 is illustrated. The infant car seat 13400 and the support base 13402 may be similar to the infant car seat 13300 and the support base 13302 described in the previous embodiments. For example, an infant car seat 13400 has a rigid body or seat shell 13404 defining a seat pan portion 13406 and a seat back portion 13408 and a handle 13410 is rotatably affixed to opposite sides of the seat shell 13404. The support base 13402 includes a body having a first end 13420 and a second, opposite end 13422 and an upper surface 13424 of the body is configured to contact the seat shell 13404. When the infant car seat 13400 is coupled to the support base 13402, the seat pan portion 13406 is arranged near the first end 13420 of the support base 13402 and the seat back portion 13408 is arranged near the second end 13422 of the support base 13402.

[1147] Similar to the previous embodiment, at least one SIP device 13426a, 13426b may be arranged near the second end 13422 of the body of the support base 13402. However, as shown in FIGS. 160A-161, the at least one SIP device 13426a, 13426b is horizontally aligned with and positioned adjacent to an outward facing surface 13436a, 13436b of the sides 13428a, 13428b of the handle 13410, rather than an inward facing surface of the handle 13410 (see FIGS. 158A-159B). This engagement of at least one SIP device 13426a, 13426b with an outward facing surface or exterior surface 13436a, 13436b of the sides 13428a, 13428b of the handle 13410 is operable to secure the handle 13410 relative to the support base 13402 such that a force may be transmitted between the handle 13410 and the support base 13402.

[1148] The position of the at least one SIP device 13426a, 13426b relative to the support base 13402 may define a recess 13432a, 13432b within which the sides 13428a, 13428b of the handle 13410 are receivable when the handle 13410 is rotated to a position behind the seat back portion 13408 of the seat shell 13404. In an embodiment, the at least one SIP device 13426a, 13426b is a protrusion arranged at or near an exterior surface of the sides 13421, 13423 of the support base 13402. In such embodiments, the recesses 13432a, 13432b are arranged adjacent to an inward facing surface 13438a, 13438b of each SIP device 13426a, 13426b. The inward facing surfaces 13438a, 13438b of the SIP devices 13426a, 13426b may be contoured to maximize an engagement surface with a corresponding exterior surface 13436a, 13436b of the handle 13410.

[1149] In yet another embodiment, the at least one SIP device may be arranged to engage both an interior and an exterior surface of a side of the handle. With reference to FIG. 163, each SIP device 13426a, 13426b of the support base 13402 includes a first protrusion 13440a, 13440b laterally spaced from a second protrusion 13442a, 13442b. Similar to the SIP devices 13326a, 13326b described with respect to FIGS. 158-159B, the first protrusions 13440a, 13440b may be aligned with a respective clearance or gap formed between the inward facing surfaces 13411a, 13411b of the handle 13410 and the adjacent sides 13412, 13414 of the seat back portion 13408. The second protrusions 13442a, 13442b may be positioned adjacent to, and in some embodiments is aligned with the exterior of the sides of the support base 13402, similar to the SIP devices 13426a, 13426b of FIGS. 160A-162. In such embodiments, a recess 13432a, 13432b within which a side 13428a, 13428b of the handle 13410 is receivable is defined within the gap between the first protrusion 13440a, 13440b and the second protrusion 13442a, 13442b of an SIP device 13426a, 13426b.

[1150] With continued reference to FIGS. 157-163, and further reference to FIGS. 164 and 165, in an embodiment, the infant car seat 13300, 13400 may be rotatable about an axis while the infant car seat 13300, 13400 is affixed to the support base 13302, 13402. For example, the infant car seat 13300, 13400 may be rotatable about a vertically oriented axis V1 (see FIGS. 164 and 165) relative to the support base 13302, 13402 while remaining coupled thereto. In an embodiment, the infant car seat 13300, 13400 is rotatable between a first position, such as a rearward-facing position for example, and a second position, such as a loading position for example. A loading position may be oriented approximately 90 degrees relative to the rearward-facing position. In the loading position, a front of the infant car seat 13300, 13400, such as defined by the seat pan portion 13306, 13406 for example, may face the vehicle door located closest to the infant car seat 13300, 13400. In embodiments where the infant car seat

13300, 13400 is rotatable relative to the support base 13302, 13402, the support base 13302, 13402 may include a stationary first portion, and a rotatable second portion. For example, in the non-limiting embodiment shown in FIGS. 164 and 165, the stationary first portion 13450 of the support base 13402 may include the bottom of the support base 13402 positionable in contact with the vehicle seat, and at least a portion of the upper surface 13424 (not shown in FIG. 164) of the support base 13402 may be part of the second portion 13452. The infant car seat 13300, 13400 may be couplable to the rotatable second portion 13452.

[1151] Further, in some embodiments, the at least one SIP device 13326a, 13326b, 13426a, 13426b may be transformable between an extended first configuration in which the at least one SIP device 13326a, 13326b, 13426a, 13426b is aligned with a side 13328a, 13328b, 13428a, 13428b of the handle 13310, 13410 as shown in FIGS. 157-162, and a retracted second configuration (see FIG. 161B) in which the at least one SIP device 13326a, 13326b, 13426a, 13426b does not protrude beyond the upper surface 13324, 13424 of the support base 13302, 13402, or protrudes a reduced amount beyond the upper surface 13324, 13424 of the support base 13302, 13402.

[1152] With reference to FIG. 164, in some embodiments, the at least one SIP device 13426a, 13426b is part of the fixed or stationary first portion 13450 of the support base 13402. In such embodiments, the at least one SIP device 13426a, 13426b, is selectively operable to restrict rotation of the infant car seat 13400 about the axis V1. For example, when the at least one SIP device 13426a, 13426b is in the extended position, as shown, the at least one SIP device 13426a, 13426b is arranged within the path of rotation of the infant car seat 13400 and/or the second portion 13452 of the support base 13402 relative to the stationary first portion 13450 of the support base 13402. Accordingly, transformation of the at least one SIP device 13426a, 13426b to the stowed configuration enables rotation of the of the infant car seat 13400 relative to the support base 13402. In the illustrated, non-limiting embodiment, the at least one SIP device 13426a, 13426b is rotatable about a hinge axis H1 relative to the support base 13402 between the extended configuration and the stowed configuration. However, embodiments where the at least one SIP device 13426a, 13426b is configured to transform between the extended configuration and the stowed configuration in another manner are also contemplated herein. For example, in some embodiments the at least one SIP device 13426a, 13426b may be translatable relative to the stationary portion 13450 of the support base 13402 to a position out of the path of rotation of the child seat 13400. The at least one SIP device 13426a, 13426b may, for example, be nested/stored within a cavity (not shown) of the stationary portion 13450.

[1153] In other embodiments, the second rotatable portion 13452 of the support base 13402 includes the at least one SIP device 13426a, 13426b such that the at least one SIP device 13426a, 13426b is rotatable with the child seat 13400 about the axis V1 relative to the support base 13402. In the non-limiting embodiment illustrated in FIG. 165, the rotatable portion 13452 of the support base 13402 may be operably coupled to the stationary portion 13450 of the support base 13402 via a rotational ring 13454. However, any suitable interface between the first and second portions 13450, 13452 of the support base that allows relative rotation therebetween is contemplated herein.

[1154] In embodiments where the at least one SIP device 13426a, 13426b is rotatable with the child seat 13400 about the axis V1, transformation of the at least one SIP device 13426a, 13426b between the extended configuration and the stowed configuration may occur automatically in response to rotation of the infant car seat 13300, 13400, and therefore the second portion 13452 of the support base 13402 relative to the stationary first portion of the support base 13402. The stationary first portion of the support base 13302, 13402 may be operably coupled to the at least one SIP device 13326a, 13326b, 13426a, 13426b, such as via a movable engagement member (not shown) for example. Rotation of the infant car seat 13300, 13400 may cause the engagement member to move relative to the support base 13302, 13402, and the movement of the engagement member may cause the at least one SIP device 13326a, 13326b, 13426a, 13426b to transform between the first configuration and the second configuration. Examples of suitable mechanisms for transforming at least one SIP device, such as SIP devices 13426a, 13426b, between a plurality of configurations will be described in more detail below. Although transformation of the at least one SIP device 13426a, 13426 is illustrated and described in FIGS. 164 and 165 with reference to a support base 13402 having at least one SIP device 13426a, 13426 arranged at an exterior of a handle 13410 of the infant car seat 13400, it should be understood that such movement of at least one SIP device 13326a, 13326b arranged adjacent to an interior surface of a handle 13410 of the infant car seat 13400, as shown in FIGS. 158A-159B, is also contemplated herein.

[1155] With reference now to FIGS. 62A-64C, in some embodiments, an external SIP device may be transformable between a stowed or retracted configuration and a deployed or extended configuration. The non-limiting embodiment of a child seat system 5900 illustrated in FIGS. 64A-64B includes a child seat 5902 that may be mountable to a support base 5904. The child seat 5902 includes a seat shell 5906 having an upright portion 5908 and a seat portion 5910 as previously described herein. The upright portion 5908 may include a back 5912 and a first and second upright side member 5914, 5916 extending from the back 5912. At least one

external SIP device is mounted to an exterior surface of the child seat 5902, such as at the upright portion 5908. In the illustrated, non-limiting embodiment, a first external SIP device 5920a is mounted near a first side 5922 of the back 5912 of the child seat 5902 and a second external SIP 5920b is mounted near a second, opposite side 5924 of the back 5912 of the child seat 5902. Although the external SIP devices 5920a, 5920b are shown as being mounted to the back 5912, in other embodiments, at least one of the external SIP device 5920a, 5920b may be mounted to a respective upright side member 5914, 5916.

[1156] The external SIP devices 5920a, 5920b may each be a bumper or other suitable member. In the illustrated, non-limiting embodiment, the external SIP devices 5920a, 5920b are movable, for example rotatable, between a stowed or retracted configuration and an extended or deployed configuration. In the retracted configuration, the external SIP devices 5920a, 5920b are arranged within corresponding cavities 5930a, 5930b formed in the seat shell 5906. In a retracted configuration (FIG. 62A), the external SIP devices 5920a, 5920b may be flush with an adjacent surface 5932 of the seat shell 5906. In the extended configuration (FIG. 62B), the external SIP devices 5920a, 5920b protrude outwardly from the seat shell 5906, such as beyond a most lateral surface of an adjacent upright side member 5914, 5916. The extended configuration may be substantially perpendicular to the retracted configuration. Although the external SIP devices 5920a, 5920b are illustrated as having a generally vertical orientation in the stowed configuration and generally horizontal orientation in the extended configuration, it should be understood that such an external SIP device 5920a, 5920b arranged at another orientation or movable in another manner, such as about an axis extending across a width of the child seat 5902 is also contemplated herein.

[1157] A child seat system 6000 illustrated in FIGS. 63A-63C is similar to that of FIGS. 62A-62B. The child seat system 6000 includes a child seat 6002 mountable to a support base 6004. The child seat 6002 includes a seat shell 6006 having an upright portion 6008 and a seat portion 6010 as previously described herein. The upright portion 6008 may include a back 6012 and a first and second upright side member 6014, 6016 extending from the back 6012, respectively. At least one external SIP device 6020 is mounted to an exterior surface of the child seat 6002, such as at the upright portion 6008 for example.

[1158] In the illustrated, non-limiting embodiment, the child seat 6002 includes a single external SIP device 6020. As shown, the external SIP device includes a structural member 6022 mounted within a cavity 6024 formed at the back 6012 of the child seat 6002. Similar to the previous embodiment, the external SIP device 6020 is movable between a stowed or retracted configuration and at least one extended or deployed configuration. In the retracted

configuration (FIG. 63A), the structural member 6022 of the external SIP device is wholly arranged within the cavity 6024. In such a configuration, the structural member 6022 may be flush with an adjacent surface 6032 of the child seat 6002. In an extended configuration, the structural member 6022 protrudes beyond a side 6026 or 6028 of the back 6012 of the child seat 6002.

[1159] In an embodiment, the external SIP device 6020 is movable between a first extended configuration (FIG. 63B) in which the structural member 6022 extends beyond a first side 6026 of the back 6012, and a second extended configuration (FIG. 63C) in which the structural member 6022 extends beyond a second, opposite side 6028 of the back 6012 (potentially depending on what side of the vehicle the child seat system 6000 is positioned). The structural member 6022 may be translatable between the retracted configuration and the extended configurations. In the extended configuration, the projection of the structural member 6022 extending beyond the side of the child seat 6002 is operable to absorb crash energy. Although an external SIP device 6020 having a single translatable element is illustrated and described herein, it should be appreciated that embodiments having a plurality of separate external SIP devices 6020, associated with a respective side of the child seat and translatable to a single extended configuration are also contemplated herein.

[1160] With reference to FIGS. 64A-64C, another child seat system 6100 is illustrated having a child seat 6102 mountable to a support base 6104. The child seat 6102 includes a seat shell 6106 having an upright portion 6108 and a seat portion 6110 as previously described herein. The upright portion 6108 may include a back 6112 and a first and second upright support member 6114, 6116 extending from the back 6112, respectively.

[1161] At least one external SIP device 6120 is mounted to an exterior surface of the child seat 6102, such as at the upright portion 6108. In the illustrated, non-limiting embodiment, the external SIP device 6120 is mounted to the back 6112 of the upright portion 6108, such as near a center thereof for example. Similar to the previous embodiment, the external SIP device 6020 includes a structural member 6122 movable between a stowed or retracted configuration and at least one extended or deployed configuration. In the illustrated non-limiting embodiment, the structural member 6122 is rotatable between the retracted configuration and an extended configuration. In the retracted configuration (FIG. 64A), the structural member 6122 is positioned in substantially overlapping arrangement with the back 6112 of the child seat 6102 and in some embodiments may have a generally vertical orientation. In an extended configuration (see FIGS. 64B and 64C), the structural member 6122 protrudes beyond one or both sides 6124, 6126 of the back 6112 of the child seat 6102 to absorb crash energy.

[1162] In an embodiment, the external SIP device 6120 is rotatable between a first extended configuration (FIG. 64B) in which the structural member 6122 extends beyond a first side 6124 of the back 6012, and a second extended configuration (FIG. 64C) in which the structural member 6122 extends beyond a second, opposite side 6126 of the back 6112 (potentially depending on what side of the vehicle the child seat system 6100 is positioned). Although an external SIP device 6120 having a single structural member 6122 movable between a plurality of extended configurations is illustrated and described herein, it should be appreciated that embodiments having a plurality of separate external SIP devices 6120, each being movable relative to an extended configuration adjacent to a respective side 6124, 6126 of the back 6112 of the child seat 6102 is also contemplated herein.

[1163] Another example of an external SIP device is illustrated in FIGS. 200A-202B. The illustrated child seat system 15300 includes a child seat 15302 mountable to a support base 15304. The child seat 15302 includes a seat shell 15306 having an upright portion 15308 and a seat portion 15310 as previously described herein. The upright portion 15308 may include a back 15312 and a first and second upright side member 15314, 15316 extending from the back 15312, respectively. At least one external SIP device 15320 is mounted to an exterior surface 15322 of the child seat 15302, such as at the upright portion 15308.

[1164] As shown, the external SIP device 15320 includes a structural body or pod 15324 movable relative to the child seat 15302 between a stowed or retracted configuration and at least one extended or deployed configuration. In the illustrated non-limiting embodiment, the SIP pod 15324 is rotatable between the retracted configuration (FIGS. 200A, 201A-201B) and an extended configuration (FIGS. 200B, 202A-202B). In the retracted configuration, a distal end of the SIP pod 15324 is positioned directly adjacent to an upright support member 15314, 15316 of the child seat 15302. In an extended or deployed configuration, the distal end of the SIP pod 15324 is separated from the upright support member 15314, 15316 of the child seat 15302 by a clearance. In the deployed configuration, the structural body 15324 is configured to rotate about its axis to absorb crash energy. Although not shown, it should be understood that external SIP devices may be arranged at opposite sides of the upright portion 13508, such as at the first and second upright support members 15314, 15316, respectively. Further, when the SIP pods 15324 of the SIP devices 15320 are deployed, the SIP pods 15324, may define a maximum width of the child seat 15302. However, in other embodiments, a portion of the child seat 15302, such as the seat shell for example, may extend outwardly beyond the distal end of a corresponding SIP pod 15324 to form a maximum width of the child seat 15302.

[1165] The at least one external SIP device 15320 is illustrated in more detail in FIGS. 201A-202B. As shown, the external SIP device 15320 includes a hinge block 15330 affixed to the child seat 15302, such as within a groove formed at a surface of an upright side member 15314, 15316 via a hinge pin 15332. The SIP pod 15324 may be rotatably coupled to the hinge block 15330 via a rotation pin 15334. As shown, the SIP pod 15324 may include a first arm 15336, a second arm 15338, and a connecting member 15340 extending between and connecting the first and second arms 15336, 15338 such that the SIP pod 15324 has a general U-shape. In such embodiments, the distal ends of the first and second arms 15336, 15338 may be arranged at an upper and lower end of the hinge block 15330, respectively.

[1166] In the illustrated, non-limiting embodiment, the rotation pin 15334 extends between the first arm 15336 and the second arm 15338 of the SIP pod 15324 and is arranged within a slot 15342 formed in the hinge block 15330. The slot 15342 defines the path of movement of the structural body 15324 relative to the hinge pin 15332 between the stowed configuration and the deployed configuration. In some embodiments, the SIP pod 15324 may include a locking mechanism operable to lock the SIP pod 15324 in the stowed configuration and/or the deployed configuration relative to the hinge block 15330. As shown, the locking mechanism of the SIP pod 15324 may include at least one locking pin, such as a first locking pin 15346 arranged at the first arm 15336 and a second locking pin 15348 arranged at the second arm 15338. In an embodiment, the at least one locking pin 15346, 15348 is movably coupled to the structural body 15324 and is receivable within one or more openings formed in the hinge block 15330 based on a position of the SIP pod 15324.

[1167] An actuator plate 15350 may be movably coupled to the SIP pod 15324. The actuator plate 15350 may have a shape, such as a U-shape for example, complementary to the shape of the SIP pod 15324. In the illustrated, non-limiting embodiment, the actuator plate 15350 includes at least one slot, such as a first slot 15352 aligned with the first arm 15336 of the SIP pod 15324 and a second slot 15354 aligned with the second arm 15338 of the SIP pod 15324. A catch pin 15356 coupled to each locking pin 15346, 15348 is receivable within a corresponding pin slot 15352, 15354. In the illustrated, non-limiting embodiment, the at least one pin slot 15352, 15354 is arranged at an angle to a vertical axis such that lateral movement of the actuator plate 15350 causes a vertical movement of the catch pins 15356 and therefore the locking pins 15346, 15348.

[1168] A portion of the actuator plate 15350 is arranged at an exterior of the structural body 15324. For example, a portion of the actuator plate 15350 may protrude beyond the structural body 15324, such as into the clearance defined between the first arm 15336 and the

second arm 15338 of the structural body 15324. This portion may form a release button 15360 engageable by a user to selectively move the locking pins 15346, 15348 out of engagement with the hinge block 15330. When the locking pins 15346, 15348 are separated from the hinge block 15330, the SIP pod 15324 is unlocked and free to move relative to the hinge block 15330 between the stowed configuration and the deployed configuration. A biasing mechanism 15358 may be operably coupled to the actuator plate 15350. For example, in the illustrated, non-limiting embodiment, a biasing mechanism 15358 is positioned between the actuator plate 15350 and an interior surface of the SIP pod 15324. The biasing mechanism 15358 is operable to bias the actuator plate 15350 toward an unactuated position, which drives movement of the locking pins 15346, 15348, via the pin slots 15352, 15354, into a locked position.

[1169] Another example of an external SIP device 15402 positionable about a child seat 15400 and transformable between a stowed configuration and an extended configuration is illustrated in FIGS. 203A-207. As shown, the external SIP device 15402 includes an exterior panel 15404 pivotably coupled to the child seat 15400 at a first end 15406 thereof. In an embodiment, the external SIP device 15402 is pivotably mounted at an upright side member 15401 of the child seat 15400. At least one secondary panel is operably coupled to the exterior panel 15404. In an embodiment, the secondary panel includes a front panel 15408 that extends between a second end 15410 of the exterior panel 15404 and the child seat 15400. In an embodiment, a hinge axis H2 is formed at a center of the front panel 15408 such that the front panel 15408 has a first front segment 15408a arranged at a first side of the hinge axis H2 and a second front segment 15408b arranged at the second, opposite side of the hinge axis H2. As the external SIP device 15402 transforms between a stowed configuration and a deployed configuration, the first front segment 15408a is rotatable relative to the second front segment 15408b about the hinge axis H2. In the deployed configuration, the first front segment 15408a and the second front segment 15408b may be coplanar. In the stowed configuration, the first front segment 15408a and the second front segment 15408b may be generally parallel to one another and stacked in overlapping arrangement.

[1170] The at least one secondary panel, such as front panel 15408 for example, may similarly be hingedly connected to the child seat 15400 and to the exterior panel 15404 to allow the first front segment 15408a and the second front segment 15408b to collapse on top of one another. Accordingly, the front panel 15408 is arranged at a first angle relative to the exterior panel 15404 when the SIP device is in the stowed configuration, and the front panel 15408 is arranged at a second angle, different from the first angle, relative to the exterior panel 15404 when the SIP device is in the deployed configuration. In the illustrated, non-limiting

embodiment, the front panel 15408 is illustrated as pivoting inwardly to a collapsed position aligned with the exterior panel 15404. In such a configuration, the exterior panel 15404 is stacked in overlapping arrangement with the first front segment 15408a and the second front segment 15408b in the stowed configuration. However, embodiments where the first and second front segments 15408a, 15408b pivot outwardly to a collapsed position offset from the exterior panel 15404 are also contemplated herein.

[1171] Alternatively, or in addition, the at least one secondary panel includes at least one side panel 15412, 15414 extending between the exterior panel 15404 and the child seat 15400. For example, a first side panel 15412 may extend between a first side 15416 of the exterior panel 15404 and the child seat 15400 and a second side panel 15414 may extend between a second side 15418 of the exterior panel 15404 and the child seat 15400. Similar to the front panel 15408, in an embodiment, each side panel 15412, 15414 may include a corresponding hinge axis H3, H4 forming a first side segment 15412a, 15414a and a second side segment 15412b, 15414b at opposing sides of the hinge axis H3, H4. In such embodiments, the at least one side panel 15412, 15414 may be pivotably coupled to the child seat 15400 and to the exterior panel 15404. When the external SIP device is in the deployed configuration, each respective first side segment 15412a, 15414a and second side segment 15412b, 15414b may be coplanar and positioned between the child seat 15400 and the exterior panel 15404. In the stowed configuration, the first side segment 15412a, 15414a and the second side segment 15412b, 15414b may be generally parallel to one another and stacked in overlapping arrangement. The side panels 15412, 15414 may be configured to pivot inwardly to a position underneath the exterior panel 15404 or may be configured to pivot outwardly to a positioned offset from the exterior panel 15404 as shown. When in the deployed configuration, the external SIP device 15402 is configured to dissipate a side impact force from the exterior panel 15404 to the seat shell. This dissipation may be caused by the collapsing or deformation of the at least one secondary panel of the SIP device 15402.

[1172] Although now shown, a locking device may be used to retain the SIP device 15402 in the deployed configuration. For example, a locking device may contact one or more of the secondary panels to restrict rotation of the plurality of segments of a panel about a respective hinge axis. In some embodiments, this locking device may also restrict rotation of one or more of the segments about a respective hinge axis beyond the deployed configuration. An actuator 15420 may be arranged at a portion of the external SIP device 15402, such as at the exterior panel 15404 for example. The actuator 15420 may be operably coupled to the locking device, or alternatively or additionally, to one or more secondary panels 15408, 15412,

15414 of the SIP device 15402. In an embodiment, application of a force to the actuator 15420 by a user may cause the front panel 15408 and/or the at least one side panel 15412, 15414 to collapse about a respective hinge axis H2, H3, H4. The collapse of one of the front panel 15408 and the at least one side panel 15412, 15414 may cause the other of the front panel 15408 and the at least one side panel 15412, 15414 to collapse, thereby transforming the external SIP device 15404 from the deployed configuration to the stowed configuration.

[1173] With reference to FIGS. 208A-210, another embodiment of an external SIP device 15502 similar to external SIP device 15402 is illustrated. As shown, the external SIP device 15502 includes an exterior panel 15504 pivotably coupled to a child seat (illustrated generally at 15500) at a first end 15506 thereof. At least one side panel 15512, 15514 extends between and is pivotably connected to both the exterior panel 15504 and the child seat. For example, a first side panel 15512 may extend between a first side 15516 of the exterior panel 15504 and the child seat and a second side panel 15514 may extend between a second side 15518 of the exterior panel 15504 and the child seat. Each side panel 15512, 15514 may include a corresponding hinge axis H5, H6 forming a respective first side segment 15512a, 15514a and a second side segment 15512b, 15514b at opposing sides of the hinge axis H5, H6. Accordingly, the first and second side segments 15512a, 15512b, 15514a, 15514b are rotatable relative to the one another, while remaining coupled.

[1174] The external SIP device 15502 is transformable between a stowed configuration and a deployed configuration. When the external SIP device 15502 is in the deployed configuration, the first side segment 15512a, 15514a and the second side segment 15512b, 15514b of a respective side panel 15512, 15514 may be coplanar and positioned between the child seat 15500 and the exterior panel 15504. In the stowed configuration, the first side segment 15512a, 15514a and the second side segment 15512b, 15514b may be generally parallel to one another and stacked in an overlapping arrangement. The side panels 15512, 15514 may be configured to pivot inwardly to a position underneath the exterior panel 15504 or may be configured to pivot outwardly to a positioned offset from the exterior panel 15504.

[1175] As shown, a locking panel 15508 may extend between the second end 15510 of the exterior panel 15504 and the child seat 15500. The locking panel 15508 may be pivotably coupled to the second end 15510 of the exterior panel. When the external SIP device 15502 is in a stowed configuration, the locking panel 15508 is rotated relative to the exterior panel 15504 to a position substantially parallel with the exterior panel 15504. In the illustrated, non-limiting embodiment, the locking panel 15508 may be configured to pivot inwardly such that the locking panel 15508 is positioned underneath the exterior panel 15504; however, embodiments

where the locking panel 15508 is configured to pivot outwardly, away from the exterior panel 15504 are also contemplated herein. When the external SIP device 15502 is in the deployed configuration, the locking panel 15508 is arranged at an angle to both the child seat 15500 and the exterior panel 15504. The orientation of the locking panel 15508 in the deployed configuration and the corresponding positioning of the second end 15510 of the exterior panel 15504 may be sufficient to retain the first and second side segments 15512a, 15512b, 15514a, 15514b of the side panels 15512, 15514 in a coplanar configuration.

[1176] An actuator 15520 may be arranged at a portion of the external SIP device 15502, such as at the locking panel 15508 for example. In the illustrated, non-limiting embodiment, the actuator 15520 is a tab that protrudes from the locking panel 15508 and that is accessible by an operator. Application of a force to the actuator 15520 by a user may cause the locking panel 15508 to pivot about an axis relative to the exterior panel 15504. Once the distal end 15522 of the locking panel 15508 is pivoted out of engagement with a surface of the child seat 15500, the side segments 15512a, 15512b, 15514a, 15514b of the at least one side panel 15512, 15514 are able to collapse about a respective hinge axis H5, H6.

[1177] In yet another embodiment, shown in FIGS. 211A-212B, an external SIP device 15602 similar to external SIP device 15402 is illustrated. The external SIP device 15602 may have a top or exterior panel 15604, for example oriented generally parallel to an adjacent surface of a child seat 15600. A front panel 15608 may extend between and couple a first end 15606 of the exterior panel 15604 to the child seat 15600, and/or a back panel 15610 may extend between and couple a second end 15612 of the exterior panel 15604 to the child seat 15600. In an embodiment, the front panel 15608 and the back panel 15610 are pivotably connected to both the child seat 15600 and the exterior panel 15604. In embodiments including a front panel 15608 and a back panel 15610, a respective hinge axis (only H7 shown) is formed at a center of the front panel 15608 and the back panel 15610. Accordingly, the front panel 15608 has a first front segment 15608a and a second front segment 15608b arranged at opposite side of the hinge axis H7. Similarly, the back panel 15610 may include a first back segment (not shown) and a second back segment (not shown) arranged at opposite sides of the hinge axis. In the illustrated, non-limiting embodiment, at least one side panel 15614, 15616 extends between and is pivotably connected to both the exterior panel 15604 and the child seat 15600. For example, a first side panel 15614 may extend between a first side 15615 of the exterior panel 15604 and the child seat 15600 and a second side panel 15616 may extend between a second side 15617 of the exterior panel 15604 and the child seat 15600. Each side panel 15614, 15616 may include a corresponding hinge axis H9, H10 forming a first side segment 15614a,

15616a and a second side segment 15614b, 15616b at opposing sides of the hinge axis H9, H10. Accordingly, the first and second side segments 15614a, 15614b, 15616a, 15616b are rotatable relative to the one another, while remaining coupled

[1178] As the external SIP device 15602 transforms between a stowed configuration and a deployed configuration, the first front segment 15608a is rotatable relative to the second front segment 15608b about the hinge axis H7, the first back segment is rotatable relative to the second back segment about a respective hinge axis, and the first side segments 15614a, 15616a are rotatable relative to the second side segments 15614b, 15616b about their respective axes H9, H10. In the deployed configuration, the first front segment 15608a and the second front segment 15608b may be coplanar, the first back segment and the second back segment may be coplanar and the first side segment 15614a, 15616a and the second side segment 15614b, 15616b may be coplanar. In the stowed configuration, the first and second segments of each of the front panel 15608, back panel 15610, and at least one side panel 15614, 15616, respectively, may be generally parallel to one another and stacked in overlapping arrangement. The first and second segments of each panel 15608, 15610, 15614, 15616 may be configured to collapse on top of one another. Each of the front panel 15608, back panel 15610, and at least one side panel 15614, 15616 may be configured to collapse inwardly to a position underneath the exterior panel 15604, or alternatively, may be configured to collapse outwardly to a position offset from the exterior panel 15604.

[1179] With reference now to FIGS. 113A-113C, another example of an external SIP device 10102 movable between a stowed or retracted position and an extended position is illustrated. As shown, the external SIP device 10102 is a cupholder movable relative to a child seat 10100 between an extended position (FIG. 113A) and a retracted position (FIG. 113B). In the illustrated, non-limiting embodiment, the cupholder 10102 is pivotable about an axis, such as a vertically oriented axis for example, between the extended and retracted positions. However, in other embodiments, the cupholder 10102 may be pivotable about an axis having another orientation, such as a horizontally oriented axis for example.

[1180] A locking member 10104 may be associated with the cupholder 10102 and may be operable to selectively lock the cupholder 10102 in the extended position. The locking member 10104 may be transformable between a locked configuration and an unlocked configuration. In the unlocked configuration, the locking member 10104 is slidable within an interior of the child seat 10100 and in the locked configuration, the locking member 10104 is locked in position relative to the child seat 10100.

[1181] In an embodiment, an impact member 10106 is operably coupled to the cupholder 10102. Although the impact member 10106 is illustrated and described herein as a biasing mechanism such as a coil spring, it should be understood that in other embodiments, the impact member may be a cushion member, shock absorber, or other suitable mechanism configured to absorb energy applied thereto. As shown, the biasing mechanism 10106 is affixed to the locking member 10104 and may bias the locking member 10104 into engagement with the cupholder 10102. The locking member 10104 may be arranged at a position generally aligned with a movable portion of the cupholder 10102. Accordingly, the biasing mechanism 10106 may bias the cupholder 10102 toward the extended configuration. If the locking member 10104 is unlocked as the cupholder 10102 is rotated inwardly, the unlocked locking member 10104 will slide out of the path of rotation of the cupholder 10102 (see FIG. 113B). However, when the locking member 10104 is locked, the locking member 10104 remains fixed within the path of rotation of the cupholder 10102.

[1182] With reference to FIG. 113C, during a side impact event, a force may be applied to the cupholder 10102 causing the cupholder 10102 to pivot toward the retracted position. As the cupholder 10102 pivots, it engages the locking member 10104. Because the locking member 10104 is locked in position, the locking member 10104 will not translate laterally out of the path of rotation of the cupholder 10102. Rather, the force applied to the locking member 10104 compresses the biasing mechanism 10106. Once the force is removed, the biasing mechanism 10106 applies a reactionary force to the cupholder 10102. Accordingly, the cupholder 10102 and biasing mechanism 10106 absorb energy from the side impact event.

[1183] In another embodiment shown in FIG. 114A-114C, another example of a cupholder 10202 configured as an external SIP device movable between a stowed or retracted position and an extended position relative to a child seat 10200 is illustrated. In the illustrated, non-limiting embodiment, the cupholder 10202 is translatable along an axis between the extended and retracted positions. Similar to the previous embodiment, at least one locking member 10204 is associated with the cupholder 10202. In the illustrated, non-limiting embodiment, a first locking member 10204a is aligned with a first side of the cupholder 10202 and a second locking member 10204b is aligned with a second side of the cupholder 10202. The at least one locking member 10204a, 10204b is transformable between a locked configuration and an unlocked configuration. In the unlocked configuration, each locking member 10204a, 10204b is slidable within an interior of the child seat 10200 and in the locked configuration, the locking member 10204a, 10204b is locked in position relative to the child seat 10200.

[1184] A biasing mechanism 10206a, 10206b is operably coupled to the cupholder 10202. As shown, a biasing mechanism 10206a, 10206b is affixed to each locking member 10204a, 10204b and is operable to bias the locking member 10204a, 10204b into engagement with the cupholder 10202. Each locking member 10204a, 10204b may be arranged at a position generally aligned with a movable portion of the cupholder 10202. Accordingly, a biasing mechanism 10206a, 10206b may bias the cupholder 10202 toward the extended configuration via the at least one locking member 10204a, 10204b. If the locking member 10204a, 10204b is unlocked as the cupholder 10202is translated inwardly, the unlocked locking members 10204a, 10204b will slide outwardly (see FIG. 114B), out of the path of movement of the cupholder 10202. Accordingly, the biasing mechanisms 10206a, 10206b may not compress when the cupholder 10202 translates inwardly and the locking members 10204a, 10204b are unlocked. However, when a locking member 10204a, 10204b is locked, the locking member 10204a, 10204b will remain fixed within the path of the cupholder 10202.

[1185] During a side impact event, a force applied to the cupholder 10202 causes the cupholder 10202to translate toward the retracted position. As the cupholder 10202 moves, it engages the locking members 10204a, 10204b. With the locking members 10204a, 10204b locked in position, the locking members 10204a, 10204b will not translate laterally out of the path of the cupholder 10202. Rather, the force applied to the locking members 10204a, 10204b compresses the respective biasing mechanisms 10206a, 10206b. Once the force is removed, the biasing mechanisms 10206a, 10206b apply a reactionary force to the cupholder 10202. Accordingly, the cupholder 10202 and biasing mechanisms 10206a, 10206b absorb energy from the side impact event.

[1186] In other embodiments, such as shown in FIG. 115, a sidewall of the child seat 10300 including a cupholder 10302, such as a seat side member 10306 of a seat portion 10304 of the child seat 10300 for example, may have an increased thickness. This increased thickness may be formed by increasing the thickness of the seat shell 10308 at the seat side member 10306, by increasing the thickness of the soft goods 10310 located adjacent to the seat side member 10306, or alternatively, by adding additional material or padding (not shown) at either the exterior of the seat side member 10306, or at an interior of the seat side member 10306, such as between the seat side member 10306 and the soft goods 10310 connected thereto.

[1187] In each of the embodiments of FIGS. 113A-114C, the external SIP device 10102, 10202, in the extended position, is movable or deformable to absorb energy during a crash event. Additional examples of SIP devices movable or deformable to absorb energy

during a crash event, such as a side impact event for example are illustrated in FIGS. 125A-129.

[1188] In the illustrated, non-limiting embodiment shown in FIGS. 125A-125C, an SIP device 11102 is arranged at a portion of the child seat system, illustrated at 11100, such as a headrest, upright side member, seat side member, or the support base. Although the SIP device 11102 is illustrated as being mounted adjacent to an exterior surface 11104 of the portion 11100 of the child seat, embodiments where the SIP device 11102 is arranged at another position are also contemplated herein. As shown, the SIP device 11102 includes a rigid body 11106 movable between a first position (FIG. 125A, 125B) and a second position (FIG. 125C). The body 11106 includes a plurality of pins 11108 positioned to interact with a reaction member 11110. As shown, at least one pin 11108 is disposed on each side of the reaction member 11110 and the pins are arranged such that portion of the reaction member 11110 engaged with the pins 11108 has a curvature formed therein. This curvature restricts movement of the SIP device 11102 from the first position if a force applied thereto is less than a threshold. During a crash event, a force is exerted on the SIP device 11102, such as by the vehicle door for example. If the force exceeds the threshold associated with the reaction member 11110, the SIP device 11102 will move relative to portion 11100 of the child seat system and the reaction member 11110. Because the curvature of the reaction member 11110 is arranged at the pins 11108 of the SIP device 11102, as the SIP device 11102 and therefore the pins 11108 translate relative to the reaction member 11110, the reaction member 11110 is bent to move the curvature of the reaction member 11110 with the pins 11108. In the illustrated, non-limiting embodiment, when the SIP device 11102 is in the first position, the curvature is formed near a first end of the reaction member 11110 and when the SIP device is in the second position, the curvature is formed near a second, opposite end of the reaction member 11110. This straightening and bending of different sections of the reaction member 11110 generates a constant reaction force as the SIP device 11102 moves, thereby absorbing energy.

[1189] With reference to FIGS. 126A-126C, the exemplary child seat system 11200 includes a support base 11202 and a child seat 11204 mounted to the support base 11202. An SIP device 11206 may be mounted at one or more locations about the support base 11202 and/or the child seat 11204. As shown, the support base 11202 may include a base seat portion 11208 and a base upright portion 11210, and at least one SIP device 11206 may be arranged at the base seat portion 11208, the base upright portion 11210, or both. Similarly, the child seat 11204 may include a seat portion 11212 and an upright portion 11214, and at least one SIP device 11206 may be arranged at the seat portion 11212, the upright portion 11214, or both. In

each of the illustrated, non-limiting embodiments, the one or more SIP devices 11206 are protrusions extending laterally from the child seat system. Further, the SIP devices 11206 are sacrificial and configured to deform or break off when a force is applied thereto, such as during a crash event. In an embodiment, protrusions may include one or more weakened regions to direct the transfer of force therethrough.

[1190] With reference to FIGS. 127A-127C and FIGS. 154A-154B, an example of a sacrificial SIP device 11304 configured to deform or break off when a force is applied thereto is illustrated in more detail. In the illustrated, non-limiting embodiment, the exemplary SIP device 11304 is arranged at an exterior of the upright portion 11302 of a child seat 11300, such as at one of the upright side members 11301, 11303 thereof. The SIP device 11304 may be permanently or removably connectable to the child seat 11300, such as an exterior of the seat shell for example. In embodiments where the SIP device 11304 is permanently connected to the child seat 11300, the SIP device 11304 is fixed or locked to the child seat 11300 and therefore is not removable therefrom even after the occurrence of a crash event and deformation of the SIP device 11304. However, in embodiments where the SIP device 11304 is attached to the child seat 11300 via a removable connection, the sacrificial SIP device 11304 may be removed and replaced with a new SIP device as needed, such as after the occurrence of a crash event. In some embodiments, such as shown in FIGS. 154A-154B, the SIP device 11304 is tethered to the child seat 11300 via a cable or other connection member 11305. In such embodiments, the SIP device 11304 may be considered to have two connections to the child seat 11300: 1) a connection formed via the tether 11305 and 2) a removable connection selectively formed direction between the body of the SIP device 11304 and the child seat 11300.

[1191] As shown, the SIP device 11304 may include a generally cylindrically shaped body affixed at a first end to the child seat 11300. The body may be solid, or alternatively, may be at least partially hollow depending on the material of the body. In an embodiment, one or more weakened regions 11306 are formed in the body of the SIP device 11304. The weakened regions 11306 may be formed as groves, slots, or any other suitable feature and may extend through only a portion or the entire thickness of the body. In an embodiment, the weakened regions are formed from a material having a reduced strength compared to the strength of the child seat. Alternatively, or in addition, the weakened regions may be formed by coupling two discrete components to one another .As shown, the weakened regions 11306 may be spaced about a periphery of the SIP device 11304 and adjacent weakened regions 11306 may be staggered relative to one another and relative to the distal end of the body. The weakened

regions 11306 may facilitate the structural collapse of the SIP device 11304 when an impact force is applied to the distal end thereof. The body of the SIP device 11304 may be configured to bend and deform at each weakened region 11306. A distance between a surface of the child seat and the distal end of the SIP device 11304 after collapse is less than the distance between the child seat and the distal end of the SIP device 11304 before an impact force is applied thereto. The collapse of the SIP device 11304 absorbs energy from the impact applied thereto, thereby limiting the force transmitted to the child seat.

[1192] Another example of a sacrificial SIP device configured to deform or break off when a force is applied thereto is illustrated in more detail in FIG. 128A-128B. In the illustrated, non-limiting embodiment, an exemplary SIP device 11402 is arranged at an exterior of the child seat 11400. The SIP device 11402 may include a rigid body 11404 and at least one crushable structure 11406 mounted between the rigid body 11404 and the child seat 11400. The crushable structure 11406 may but need not be generally conical in shape. Further, the crushable structure 11406 may be formed from a material configured to depress, collapse, or crush when a force is applied thereto such that the crushable structure 11406 absorbs energy as it deforms. Although the crushable structures 11406 shown in FIG. 128B are formed from a bendable wire coiled into a conical shape, it should be understood that a crushable structure 11406 formed from any suitable material and having any shape is within the scope of the disclosure. The one or more crushable structures 11406 may be designed such that the displacement or deformation thereof plateaus beneath the threshold associated with injury of a child positioned within the child seat 11400.

[1193] In an embodiment, an SIP device, such as any of sacrificial SIP devices 11304, 11404 for example, may be provided in a first state, separated from the remainder of the child seat system, such as from the child seat or support base thereof. The SIP device 11304, 11404 may be transformed from the first state to a second state in which the SIP device 11304, 11404 is affixed to the child seat system. Such a transformation of an SIP device from a first separated state to a second, affixed state may be performed by the manufacturer prior to sale, or alternatively, by a user after purchase of the child seat system. For example, the SIP device may be an accessory sold separately and/or shipped in a separated state (e.g., the first separated state) from the child seat system. In embodiments where the SIP device is shipped in the separated state from the child seat system, the SIP device may be contained in the same or a different package than the child seat system.

[1194] In embodiments where the SIP device is transformable to the affixed state, the SIP device may be repeatedly transformable between a first, separated state and a second,

affixed state. In such embodiments, the SIP device may be considered removably connected to the child seat system when in the affixed state. Connection via threaded or other fasteners may be considered removable for purposes of this description.

[1195] In other embodiments, the SIP device may not be separable from the child seat system once affixed thereto. In such embodiments, separation of the SIP device from the child seat system may cause damage to one or both of the SIP device and the child seat system. In an example of such a connection, the SIP device may have one or more tabs rotatably insertable into corresponding openings formed in the child seat system. These tabs may be locked into engagement with a cam or ratchet wheel rotatable about an axis in only one direction. In such an embodiment, rotation of the tabs of the SIP device to a locked position drive rotation of the ratchet wheel in the first direction. However, because the ratchet wheel is locked against rotation of the ratchet wheel in the second direction, the SIP device cannot be rotated in a second, opposite direction to unlock the SIP device or disengage the tabs from the child seat system. It should be understood that the described mechanism is intended as an example only and any interface that restricts separation of the SIP device from the child seat one connected thereto is within the scope of the disclosure.

[1196] FIG. 129 illustrates a plurality of head SIP devices 11502a, 11502b movable relative to the child seat 11500 to absorb energy during a crash event. As shown, one or more ramped surfaces 11504a, 11504b may be arranged at a first portion of the child seat 11500, such as at an interior surface 11506a, 11506b of one or more upright side members 1508, 11510 of the child seat 11500. In the illustrated, non-limiting embodiment, each head SIP device 11502a, 11502b includes one or more complementary ramped surfaces 11520a, 11520b arranged at an exterior surface of a headrest 11512 of the child seat 11500 adjacent to the interior surface 11506a, 11506b of the upright side members 11508, 11510. However, embodiments where the first portion of the child seat includes the soft goods of the headrest are also within the scope of the disclosure. During normal use of the child seat 11500, the ramped surfaces 11520a, 11520b of a respective head SIP device 11502a, 11502b are not aligned with the adjacent ramped surfaces 11504a, 11504b of the upright side members 11508, 11510. However, when an impact force is applied to an upright side member 11508, 11510 of the child seat 11500, the ramped surfaces 11504a, 11504b thereof align with and engage the ramped surfaces 11520a, 11520b of the headrest 11512. As a result of the orientation of the ramped surfaces 11504a, 11504b, 11520a, 11520b, this engagement causes the upright side member 11508, 11510 to translate in a relative to the headrest 11512. In the illustrated, non-limiting embodiment, engagement between the ramped surfaces 11504a, 11504b, 11520a,

11520b is configured to drive the upright side member 11508, 11510 in a direction perpendicular to the direction of the impact force, thereby absorbing energy from the impact. Although the head SIP device 11502a, 11502b is illustrated and described relative to a headrest of the child seat, it should be understood that a similar SIP device may be arranged at another suitable location about the child seat.

[1197] In an embodiment, an SIP device may be mounted at a portion of the vehicle as an alternative to, or in addition to an SIP device mounted to the child seat system. With reference to FIG. 130, a child seat system 11600 is illustrated positioned on a vehicle seat of a vehicle 11601. As shown, an SIP device 11602 may be connectable to an interior surface of the vehicle adjacent to the child seat system 11600, such as to the vehicle door 11604 configured to contact or abut the child seat system 11600. The SIP device 11602 may be an airbag or a pod formed from any suitable energy absorbing materials or mechanisms, such as one or more padded materials, coils, or at least one shearing mechanism for example. In an embodiment, the SIP device 11602 includes one or more components for mounting to any suitable portion of the vehicle 11601 including but not limited to a vehicle door 11604, a vehicle window 11608, a pillar 11614, the floor 11610, a door jamb, or the roof 11612. In the illustrated non-limiting embodiment, the SIP device 11602 is directly attached to the vehicle door 11604 and is removably mountable thereto. However, embodiments where the SIP device is permanently affixed to the vehicle door 11604 are also contemplated herein. In an embodiment, the SIP device 11602 is tethered to the child seat system 11600 via a cable or other connection member 11620 such that the SIP device 11602 cannot be detached therefrom without breaking the connection member 11620. It should be understood that the SIP device 11602 may be arranged adjacent to and configured to contact any suitable portion of the child seat system 11600 and may have a contour as described in any of the other embodiments disclosed herein.

[1198] In another embodiment, illustrated in FIGS. 167A and 167B, an SIP device may be located at the vehicle seat, as an alternative to, or in addition to an SIP device mounted to and movable with the child seat system. As shown, a child seat system 13500 is illustrated positioned on a vehicle seat 13502 of a vehicle (not shown). As shown, an SIP device 13504 may be arranged at an interface between the vehicle seat 13502 and the child seat system 13500. The child seat system 13500 may include a support base 13510 and a child seat 13512 permanently or removably mounted to the support base 13510 and when the child seat system 13500 is installed in a vehicle, the support base 13510 is positioned on top of a vehicle seat pan 13506 of the vehicle seat 13502.

[1199] The SIP device 13504 may include a body, such as formed from a flat or planar sheet of material having a thickness less than an inch (about 25 mm), and in some embodiments having a thickness less than about 20 mm, less than about 18 mm, less than about 15 mm, less than about 12 mm, or less than about 10 mm. The material of the SIP device 13504 may be a rigid or semi-rigid material having a low coefficient of friction. Examples of suitable materials include but are not limited to plastics, such as polypropylene. The material of the SIP device 13504 may have a low coefficient of friction such that sliding movement of the child seat system 13500, such as the support base 13510 for example, relative to an upper surface 13508 of the SIP device 13504 is induced in response to a crash impact. In other embodiments, the upper surface 13508 of the flat sheet 13504 may be coated with a material, polished, or include another modification suitable to create a low friction upper surface 13508. Because of the low coefficient of friction of the surface, when a force is applied to the child seat system 13500, such as in response to a crash event, engagement with the surface will not restrict movement of the child seat system 13500 relative thereto. Rather, the low coefficient of friction at the SIP device facilitates movement of the child seat system 13500 relative to the SIP device 13504 in response to a crash. This movement may help absorb some of the energy resulting from the crash event, rather than transmitting it through the child seat system 13500 to the occupant.

[1200] Although only a portion of the various SIP devices illustrated and described herein are explicitly described as being transformable or configurable between a first configuration and a second configuration or a first position and a second position, it should be understood that any SIP device disclosed herein may be movable in such a manner. In an embodiment, one or more of the head SIP devices, shoulder SIP devices, torso SIP devices, and/or external SIP devices are transformable manually. For example, a user may apply a force to the SIP device, such as external SIP devices 5920a, 5920b, 6020, and 6120, to physically move the external SIP device to a desired position or configuration. This manual transformation may be performed either prior to or after installing an occupant within the child seat.

[1201] In other embodiments, transformation of one or more of the head SIP devices, shoulder SIP devices, torso SIP devices, and/or external SIP devices may occur automatically prior to or upon positioning of an occupant within a child seat. In such embodiments the child seat may include one or more sensors or mechanisms operable to detect the presence of a child and adjust or transform the SIP devices accordingly.

[1202] For example, with reference to FIGS. 97A-98B, a child seat may include an actuation mechanism operable to transform one or more SIP devices from a first configuration to a second configuration based on a configuration of the child seat. In the non-limiting

embodiment of FIG. 97, an actuation mechanism 8702 is operable to transform an SIP device, such as an external SIP device 8704 for example, between a first configuration and a second configuration based on the direction in which the child seat 8700 is mounted, such a relative to a support base 8706. For example, when the child seat 8700 is in a first, rearward-facing position (see FIG. 97B), the external SIP device 8704 may be in the first configuration. In the first configuration, the external SIP device 8704 may be retracted, or alternatively, may be at a first position along a path of movement of the external SIP device 8704. The first position along the path of movement may block or interfere with an opening (not shown) formed in the seat shell 8708 of the child seat 8700 associated with a vehicle belt path. When the child seat 8700 is in a second, forward-facing position, as shown in the FIG. 97A, the external SIP device 8704 may be in the second configuration. In the second configuration, the external SIP device 8704 may be extended, or alternatively, may be arranged at a second position along a path of movement of the external SIP device 8704. In the second position along the path of movement, the external SIP device 8704 may be spaced from the opening so as not to interfere with a vehicle belt path of the child seat 8700. It should be understood that embodiments where the external SIP device 8704 is extended when the child seat 8700 is in a rearward-facing configuration and stowed when the child seat is in the forward-facing configuration are also contemplated herein.

[1203] In the illustrated, non-limiting embodiment, the child seat 8700 and/or the support base 8706 includes an engagement member 8710 that is movable up and down as the child seat 8700 rotates relative to the support base 8706. This engagement member 8710 may be operably coupled to the external SIP device 8704 such that movement of the engagement member 8710 causes the external SIP device 8704 to transform between the first configuration and the second configuration. Although the external SIP device 8704 is illustrated and described herein as being arranged at the child seat 8700, embodiments where an external SIP device arranged at the support base 8706 is movable between a retracted and a deployed configuration in response to rotation of the child seat 8700 are also contemplated herein.

[1204] With reference to FIGS. 98A-98B, an actuation mechanism (not shown) is configured to operate different SIP devices based on the configuration of the child seat 8800 relative to a support base 8802. In the non-limiting embodiment, the support base 8802 includes a first external SIP device 8804 arranged at a first position and a second external SIP device 8806 arranged at a second position. For example, the first external SIP device 8804 may be arranged at a seat portion 8808 of the support base 8802 and the second external SIP device 8806 may be arranged at the back portion 8810 of the support base 8802. The first external SIP

device 8804 and the second external SIP device 8806 may have similar configurations, or alternatively, may have different configurations. As shown, the first external SIP device 8804 may be extended and the second external SIP device 8806 may be retracted when the child seat 8800 is in the first rearward-facing configuration. Similarly, when the child seat 8800 is in the second, forward-facing configuration, the first external SIP device 8804 may be retracted and the second external SIP device 8806 may be extended.

[1205] In an embodiment, the actuation mechanism includes at least one an engagement member arranged at the child seat 8800 and associable with at least one external SIP device 8804, 8806. Different engagement members may be associated with respective external SIP devices 8804, 8806, or the same engagement member may be associated with multiple SIP devices 8804, 8806. The engagement between an engagement member and an external SIP device 8804, 8806 may cause the external SIP device 8804, 8806 to transform to the extended or deployed configuration. In other embodiments, an external SIP device 8804, 8806 may be biased to the extended configuration, such as by a biasing mechanism for example. In such embodiments, the engagement between the engagement member and an external SIP device 8804, 8806 may oppose the biasing force acting on the external SIP device 8804, 8806, thereby transforming the external SIP device 8804, 8806 to a retracted configuration.

[1206] In some embodiments, an SIP device, such as an external SIP device for example, is transformable between an extended position and a retracted position to provide clearance during rotation of the child seat between a forward-facing and a rearward-facing configuration. In the illustrated, non-limiting embodiment of a child seat system 9700 shown in FIGS. 107A-107B, a child seat 9702 is rotatably mounted to a support base 9704. As shown, the child seat 9702 includes a first external SIP device 9706a arranged at a first side of an upright portion 9708 of the child seat 9702 and a second external SIP device 9706b arranged at a second, opposite side of the upright portion 9708. As shown, the external SIP devices 9706a, 9706b are extended when the child seat 9702 is in both the forward-facing configuration (FIG. 107A) and the rearward-facing configuration (FIG. 107B). However, the external SIP devices 9706a, 9706b are movable to a retracted position to avoid interference during rotation of the child seat 9702 between the forward-facing and rearward-facing configurations.

[1207] Movement of the external SIP devices 9706a, 9706b to the retracted position may occur automatically by an actuation mechanism 9710 in response to rotation of the child seat 9702. The actuation mechanism 9710 includes at least one engagement link 9712 connected at a first end to a corresponding external SIP device 9706a, 9706b. An opposite end

of the at least one engagement link 9712 may be movably coupled to a stationary cam ring 9714. The cam ring 9714 may have one or more raised areas 9716 and the engagement link 9712 may be located at the raised areas when the child seat 9702 is in at least one of the forward-facing and rearward-facing configurations. The raised areas 9716 drive vertical movement of the engagement link 9712, thereby causing the external SIP devices 9706a, 9706b operably coupled to the at least one engagement link 9712 to transform from a retracted position to a deployed position. Once the engagement links 9712are rotated away from the raised areas 9716, the downward movement of the engagement links 9712causes the external SIP devices 9706a, 9706b to transform to the retracted configuration. It should be appreciated that the actuation mechanism 9710 illustrated and described herein is intended as an example only and that an actuation mechanism 9710 having any suitable configuration to selectively retract an SIP device 9706a, 9706b during rotation of the child seat 9702 is contemplated herein. Further, although two external SIP devices 9706a, 9706b are illustrated, it should be appreciated that such an actuation mechanism may be used with a plurality of SIP devices arranged at different positions about the child seat 9702.

[1208] In yet another embodiment, illustrated in FIG. 108, an external SIP device 9802 mounted at an exterior of a child seat 9800 may be moved from an extended position to a retracted position automatically via engagement with a support base 9804 on which the child seat 9800 is mounted. As shown, the external SIP device is pivotally mounted within and protrudes from a cavity 9806 formed at a side of the child seat 9800. As the child seat 9800 rotates relative to the support base 9804, the support base 9804 will engage and apply a force to the external SIP device 9802 causing the external SIP device 9802 to rotate about its pivot axis in a first direction. This rotation opposes a biasing force of a biasing mechanism 9808 operably coupled to the external SIP device 9802. The external SIP device 9802 remains retracted within the cavity 9806 9806 while the external SIP device 9802 is located adjacent to the support base 9804.

[1209] Once the portion of the child seat 9800 including the external SIP device 9802 is rotated away from the support base 9804, the force opposing the biasing mechanism 9808 is removed. As a result, the biasing mechanism 9808 biases the external SIP device 9802 back to the extended position. In an embodiment, the external SIP device 9802 is positionable in both a first retracted position and a second retracted position depending on the direction of rotation of the child seat 9800 relative to the support base 9804. In such embodiments, the cavity 9806 may be configured to receive the external SIP device 9802 when rotated in not only a first direction, but also in a second opposite direction. In such embodiments, a second biasing

mechanism 9810 may be operably coupled to the external SIP device 9802 to bias the external SIP device 9802 back to the extended position from rotation in the second direction.

[1210] When a child seat system is mounted on a vehicle seat, it may be desirable to engage or extend only the portion of the SIP devices positioned adjacent to the vehicle door, and not the SIP devices located at an opposite side of the child seat system. With reference now to FIGS. 109A-111, a child seat system 9900 including a system for controlling a configuration of the SIP devices based on a position of the child seat system is illustrated. As shown, the child seat system 9900 includes a child seat 9902 rotatably mounted to a support base 9904. At least one SIP device 9906a is associated with the child seat 9902 in a forward-facing configuration and at least one SIP device 9906b is associated with the child seat 9902 in a rearward-facing configuration. The child seat 9902 additionally includes a first engagement member 9908 and a second engagement member 9909 operably coupled to the at least one SIP device 9906a associated with the child seat 9902 in a forward-facing configuration and a third engagement member 9910 and a fourth engagement member 9911, distinct from the first and second engagement members 9908, 9909, and operably coupled to the at least one SIP device 9906b associated with the child seat 9902 in a rearward-facing configuration. The first and second engagement members 9908, 9909 may be arranged at the same surface of the child seat 9902, such as a rear of the child seat 9902 for example, and are separated from one another by a distance. Similarly, the third and fourth engagement members 9910, 9911 may be arranged at the same surface of the child seat 9902, such as a front of the child seat 9902 for example, and are separated from one another by a distance.

[1211] The support base 9904 of the child seat system 9900 includes an actuator 9912 engageable with one of the first engagement member 9908, the second engagement member 9909, the third engagement member 9910, and the fourth engagement member 9911 to selectively extend the corresponding SIP devices 9906a, 9906b. As shown, the actuator 9912 of the support base 9904 may be arranged at a forward-facing surface 9916 of an upright portion 9914 of the support base 9904, and the engagement members 9908, 9909, 9910, and 9911 are located at a rear and front of the child seat 9902, respectively, at a surface positionable adjacent to the forward-facing surface 9916.

[1212] In an embodiment, the plurality of SIP devices 9906a, 9906b mounted to the child seat 9902 are biased into a retracted or stowed position. When the actuator 9912 engages either the first engagement member 9908 or the second engagement member 9909, a force is applied to the at least one SIP device 9906a associated with the child seat 9902 in the forward-facing configuration. This force opposes the bias acting thereon causing the at least one SIP

device 9906a associated with the child seat 9902 in the forward-facing configuration to deploy. Similarly, when the actuator 9912 is engaged with the third engagement member 9910 or the fourth engagement member 9911, a force is applied to the at least one SIP device 9906b associated with the child seat 9902 in the rearward-facing configuration. This force opposes the bias acting thereon causing the at least one SIP device 9906b associated with the child seat 9902 in the rearward-facing configuration to deploy. When none of the engagement members 9908, 9909, 9910, and 9911 are arranged in contact with the actuator 9912, such as when the child seat 9902 is rotating between the rearward-facing configuration and the forward-facing configuration for example (see FIGS. 110A-110B), the plurality of SIP devices 9906a, 9906b associated with each of the engagement members 9908, 9910 may be stowed.

[1213] The actuator 9912 may be arranged at different positions relative to the support base 9904 based on the location of the child seat system 9900 about a vehicle seat. For example, when the child seat 9902 is mounted to a vehicle seat at the driver side of the vehicle, the actuator 9912 may be in a first position, and when the child seat 9902 is mounted to a vehicle seat at the passenger side of the vehicle, the actuator 9912 may be in a second position. In the first position, the actuator 9912 may be engageable with the first engagement member 9908 and the third engagement member 9910, and in the second position, the actuator 9912 may be engageable with the second engagement member 9909 and the fourth engagement member 9911. Accordingly, the first engagement member 9908 and the third engagement member 9911 may be associated with operation of the SIP devices 9906a, 9906b when the child seat system 9900 is mounted at a driver side of a vehicle seat and the second engagement member 9909 and the fourth engagement member 9911 may be associated with operation of the SIP devices 9906a, 9906b when the child seat system 9900 is mounted at a passenger side of a vehicle seat. In some embodiments, the actuator 9912 may be positionable at a third position associated with the child seat 9902 being mounted to a vehicle seat centrally between the driver side and the passenger side of the vehicle.

[1214] In the illustrated, non-limiting embodiment, the actuator 9912 is movably mounted within a slot 9920 formed at the support base 9904, and the first position and the second position are disposed at opposite ends of the slot 9920 with the third position being arranged centrally between the first position and the second position. As shown in FIG. 111, a control feature 9922, such as a lever or dial for example, operably coupled to the actuator 9912 may also be arranged at the support base 9904. In the illustrated, non-limiting embodiment, the control feature 9922 is arranged at a different surface of the support base 9904 than the surface 9916 where the actuator 9912 is located. The control feature 9922 is movable to select a

corresponding position of the actuator 9912 relative to the slot 9920 based on the position of the support base 9904 on a vehicle seat.

[1215] During installation of the support base 9904 upon a vehicle seat, the operator will select a corresponding position of the actuator 9912 using the control feature 9922. This selection will position the actuator for engagement with either the engagement members 9908, 9910 associated with the driver side or the engagement members 9909, 9911 associated with the passenger side of a vehicle seat. The operator will then rotate the child seat 9902 into a desired position relative to the support base 9904, such as based on the age and/or size of the child being received within the child seat 9902. This rotation of the child seat 9902 will move one of the plurality of engagement members 9908, 9909, 9910, 9911 into contact with the actuator 9912 causing the corresponding SIP devices 9906a, 9906b associated with the respective engagement member 9908, 9909, 9910, 9911 and positioned closest to the vehicle door to deploy. Although the engagement members 9908, 9909, 9910, 9911 are illustrated and described with respect to external SIP devices, it should be understood that multiple SIP devices arranged at any suitable location about the child seat 9902 may be associated with a respective engagement member.

[1216] In other embodiments, transformation of one or more of the head SIP devices, shoulder SIP devices, torso SIP devices, and/or external SIP devices may occur automatically in response to application of an external force to the child seat. Such a force may be applied by deployment of external airbags, such as airbags of a vehicle within which the child seat system is mounted. Alternatively, such a force may be applied via contact between a portion of the child seat system and an adjacent surface, such as a vehicle door for example.

[1217] With reference to FIGS. 117A – 118B, an example of a child seat system 10500 including an SIP device that is transformable in response to application of an external force is illustrated. The child seat system 10500 includes a child seat 10502 positioned about a support base 10504. The child seat 10502 includes a seat portion 10506 and an upright portion 10508, and at least one SIP device 10510 is illustrated protruding from an exterior surface of the upright portion 10508 of the child seat 10502. As shown, the SIP device 10510 may extend through an opening (not shown) formed in a seat shell 10512 of the child seat 10502 such that the SIP device 10510 is also arranged at an interior of the child seat 10502.

[1218] In the illustrated, non-limiting embodiment, the SIP device 10510 is movably mounted to the child seat 10502 via a linkage assembly 10520. As shown the linkage assembly 10520 includes a first link 10522 having a first end pivotally mounted to the child seat 10502 and a second link 10524 having a first end pivotally mounted to the child seat 10502. The

second, opposite ends of the first link 10522 and second link 10524 are pivotally coupled to one another, and the SIP device 10510 may be attached to the linkage assembly 10520, such as at the pivotal connection between the first and second links 10522, 10524 for example. When a force is applied to an exterior of the SIP device 10510, such as resulting from a side impact event, the SIP device translates inwardly with the movement being controlled by the corresponding pivotal movement of the first and second links 10522, 10524 of the linkage assembly 10520. It should be understood that any type of mechanism for controlling movement of the SIP device 10510 is contemplated herein, and that although the SIP device 10510 is arranged generally adjacent to a torso area of an occupant seated within the child seat 10502, such a linkage assembly 10520 may be implemented at any SIP device arranged at any suitable location about the child seat 1502.

[1219] With reference now to FIGS. 65A-67H, various embodiments of an actuation mechanism for transforming a SIP device are illustrated. Although the actuation mechanisms are illustrated and described herein as being operably coupled to at least one torso SIP device and/or at least one shoulder SIP device, it should be appreciated that an actuation mechanism may be suitable for use with any type of SIP device of the child seat system, at any position thereon. It should be appreciated that in any of the embodiments, one or more SIP devices may be at another location about the child seat, such as an opposite side of the child seat for example. Further, the same actuation mechanism, or alternatively, another actuation mechanism may be associated with the one or more SIP devices at the opposite side of the child seat.

[1220] In the non-limiting embodiment of a child seat 6200 as shown in FIGS. 65A-65D, a first torso SIP device 6202a is arranged adjacent to a first portion of the seat shell 6204, such as the first upright side member 6208 of an upright portion 6206 of the seat shell 6204, and a second torso SIP device 6202b is arranged adjacent to a second portion of the seat shell, such as a second upright side member 6210 of the upright portion 6206. However, embodiments where one or more of the torso SIP devices 6202a, 6202b are positioned adjacent a seat side member 6212, 6214 of a seat portion 6216 of the seat shell 6204 are also contemplated herein. Further, in the illustrated, non-limiting embodiment, a first shoulder SIP device 6220a is arranged adjacent to a portion of the seat shell 6204, such as the first upright side member 6208, and a second shoulder SIP device 6220b is arranged adjacent to another portion of the seat shell 6204, such as the second upright side member 6210.

[1221] At least one actuation mechanism 6230 associated with torso SIP device 6202a, 6202b and/or shoulder SIP devices 6220a, 6220b is operable to drive transformation of the at least one SIP device from a first configuration to a second configuration. As shown, the

actuation mechanism 6230 includes an actuator or button 6232. In an embodiment, the actuator 6232 is arranged at an exterior surface 6234 of the child seat 6200. The actuator 6232 need not be located directly adjacent to or in alignment with a SIP device operably coupled thereto, such as torso SIP device 6202a, 6202b or shoulder SIP device 6220a, 6220b. The actuator 6232 is operatively coupled to one or more SIP devices 6202a, 6202b, 6220a, 6220b via a linkage such as linkage 6236. Various linkages are illustrated in the FIGS. and may be suitable for use with the actuator 6232. In an embodiment, the linkage 6236a connecting the actuator 6232 to a torso SIP device 6202a is a rigid linkage. Another linkage 6236b illustrated as extending between the actuator 6232 and a shoulder SIP device 6220a is a flexible linkage, such as a cable or other tension member for example. In embodiments where an actuator 6232 is operably coupled to a plurality of SIP devices 6202a, 6202b, 6220a, 6220b, a separate linkage may be used to couple the actuator 6232 to each SIP device. In such embodiments, the plurality of linkages 6236a, 6236b associated with an actuator 6232 may be the same type of linkage or may be different (as shown).

[1222] An actuation mechanism 6230 as described herein is operable to selectively deploy or transform at least one SIP device, such as one or more head, shoulder, torso, or external SIP devices from a retracted configuration to an extended configuration in response to application of a force to the actuator 6232. For example, a force may be applied to the actuator 6232 during a crash event. This force is transmitted from the actuator 6232 to the torso SIP device 6202a via a corresponding linkage 6236a. Simultaneously, the force may be transmitted from the actuator 6232 to another SIP device, such as a shoulder SIP device 6220a via a corresponding linkage 6236b. Accordingly, such an actuation mechanism 6230 is operable to instantaneously transform one or more SIP devices associated with a child seat system to an extended configuration during a side impact collision.

[1223] The actuation mechanism 6230 may include a biasing mechanism (not shown) arranged between the actuator 6232 and the seat shell 6204. A biasing force of the biasing mechanism may be operable to bias the actuation mechanism 6230, via the actuator 6332, to a non-actuated configuration. In such embodiments, upon removal of the force from the actuator 6332, the biasing force of the biasing mechanism will bias the actuator 6332 back to a non-actuated position. This movement of the actuator 6232 may similarly transmit a force to an operatively coupled SIP device via the linkage 6236a, 6236b causing the SIP device to return to the retracted configuration.

[1224] With reference now to FIGS. 66A-66H, the illustrated child seat of FIGS 66A-66B may be substantially identical to the child seat previously described in FIGS. 65A-65D.

As shown, a first torso SIP device 6302a is arranged adjacent to the first upright side member 6308 of an upright portion 6306 of the seat shell 6304, and a second torso SIP device 6302b may be arranged adjacent to a second portion of the seat shell 6304, such as a second upright side member 6310 of the upright portion 6306. Further, in the illustrated, non-limiting embodiment, a first shoulder SIP device 6320a is arranged adjacent to a portion of the seat shell 6304, such as the first upright side member 6308, and a second shoulder SIP device 6320b is arranged adjacent to another portion of the seat shell 6304, such as the second upright side member 6310.

[1225] Another embodiment of an actuation mechanism for transforming a SIP device from a retracted configuration to an extended configuration is illustrated in these FIGS. 66A-66H. As shown, an actuation mechanism 6330 associated with the child seat 6300 includes an actuator 6332 operably coupled to at least one of the plurality of SIP devices of the child seat 6300, such as SIP devices 6302a, 6302b, 6320a, 6320b. In an embodiment, a biasing mechanism, such as a coil spring for example, may be operably coupled to one or more SIP device. For example, as shown, a first biasing mechanism 6334a is associated with a first torso SIP device 6302a and a second biasing mechanism 6334b may be associated with a first shoulder SIP device 6320a. Such biasing mechanisms 6334a and 6334b may be arranged between a body of the corresponding SIP device, such as torso SIP device 6302a and/or shoulder SIP device 6320a for example, and an adjacent surface of the child seat, such as the seat shell 6304. A biasing force of the biasing mechanism 6334a, 6334b is operable to bias a respective SIP device 6302a, 6320a into an extended configuration such that the SIP device 6302a, 6320a protrudes towards an occupant in the child seat 6300.

[1226] One or more catches 6336 may be used to retain each SIP device in a retracted configuration, against the biasing force of the biasing mechanism 6334. The actuator 6332 is operably coupled to the catch 6336 opposing the biasing mechanism 6334. In an embodiment, the actuator 6332 is operable to directly engage the catch, or a portion of the SIP device. However, in other embodiments, the actuator 6332 may be operably coupled to the catch 6336 via a linkage, such as a rigid linkage or a flexible linkage as previously described. In response to a crash, such as a side impact event, a force is applied to the actuator 6332. The resulting movement of the actuator 6332 transmits a force to the one or more catches 6336 opposing the biasing force of the biasing mechanism 6334 to hold a corresponding SIP device in the retracted configuration. This force causes the catch 6336 to disengage from the biasing mechanism 6334. Once the catch 6336 is released, the biasing force of the biasing mechanism 6334 biases the SIP device, such as 6302a, or 6320a for example, to the extended configuration. Accordingly,

in the illustrated, non-limiting embodiment, transformation of an SIP device to an extended configuration is driven directly by a biasing mechanism 6334 and indirectly by the actuator 6332.

[1227] With reference to FIGS. 67A-67H, another embodiment of an actuation mechanism operable to selectively transform a SIP device from a first, retracted configuration to a second, extended configuration is illustrated. The child seat 6400 illustrated may be similar to the previous embodiments. A SIP device, such as a torso SIP device 6402 for example, may be arranged adjacent to the first upright side member 6408 of an upright portion 6406 of the seat shell 6404. Further, in the illustrated, non-limiting embodiment, a second SIP device, such as a shoulder SIP device 6410 is arranged adjacent to a portion of the seat shell 6404, such as the first upright side member 6408.

[1228] An actuation mechanism 6430 associated with at least one SIP device, such as a torso SIP device 6402 or shoulder SIP device 6410 is operable to drive transformation of the SIP device from a first configuration to a second configuration. The actuation mechanism 6430 may include an actuator 6432 and a connection mechanism 6434 extending between the actuator 6432 and a corresponding SIP device 6402, 6410. In the illustrated, non-limiting embodiment, a headrest 6412 of the child seat 6400 is configured as the actuator 6432. As will be described in more detail below, movement of the headrest 6412 relative to the seat shell 6404 may be operable to extend or retract a corresponding SIP device 6402, 6410 of the child seat 6400.

[1229] An example of a connection mechanism 6434 is illustrated in more detail in FIGS. 67C, 67D, 67G, 67H. As shown, a track 6436 may be formed in the headrest 6412, and a lever 6438 associated with the seat shell 6404 may be operably coupled to the track 6436. Further, the lever 6438 may be operably coupled to an SIP device, such as the shoulder SIP device 6410 for example, via a flexible or rigid linkage 6440a. The lever 6438 may be operably coupled to the torso SIP device 6402 via another linkage 6440b. In the illustrated, non-limiting embodiment, the lever 6438 is pivotally mounted to the seat shell 6404 and a pin 6442 protruding from the lever 6438 is slidably receivable within the track 6436. When at least one SIP device, such as the shoulder SIP device 6410 and/or the torso SIP device 6402 for example, is in a retracted configured, the lever 6438 may be in a first position (see FIGS. 67C and 67D).

[1230] As the headrest 6412 is moved, for example translated relative to the seat shell 6404, the pin 6442 of the lever 6438 moves within the track 6436 of the headrest 6412. As shown, the track 6436 has a non-linear configuration such that as headrest 6412 moves, engagement of the pin 6442 with a bend or angle formed in the track 6436 causes the lever

6438 to rotate about its axis to a second position (see FIGS. 67G and 67H). As the lever 6438 rotates to this second position, a force is transmitted to the shoulder SIP device 6410 via the linkage 6440a and to the torso SIP device 6402 via linkage 6440b, thereby causing the shoulder SIP device 6410 and the torso SIP device 6402 to transform from a retracted configuration to an extended configuration. In the illustrated, non-limiting embodiment, movement of the headrest 6412 in a downward direction, toward the seat portion of the seat shell 6404 transforms a corresponding SIP device 6402, 6410 to the extended configuration. However, embodiments where movement of the headrest 6412 in another direction, such as away from the seat portion of the seat shell 6404 for example is operable to transform a corresponding SIP device 6402, 6410 to the extended configuration is also contemplated herein. It should be appreciated that the connection mechanism 6434 illustrated and described herein is intended as an example only and that any suitable device operable to convert motion of the headrest into a corresponding movement of a SIP device coupled thereto is within the scope of the disclosure.

[1231] Although not shown in FIGS. 67A-67H, it should be appreciated that the child seat 6400 may include one or more additional devices, such as another torso SIP device and shoulder SIP device for example. In some embodiments, the child seat 6400 includes another torso SIP device and another shoulder SIP device disposed at an opposite side of the child safety system and having a configuration substantially identical to the torso and shoulder SIP devices 6402, 6410 illustrated and described herein.

[1232] In another embodiment, illustrated in FIGS. 118A-118B, another embodiment of an actuation mechanism operable to deploy an SIP device is illustrated. In the illustrated, non-limiting embodiment, the child seat 10600 has a seat portion 10602 and an upright portion 10604. The upright portion 10604 includes an upright support surface 10606 and a first and second upright side member 10608, 10610 extending from opposing sides of the upright support surface 10606. As shown, a first torso SIP device 10612a may be pivotally mounted near a center of the upright support surface 10606 and extend toward the first upright side member 10608, and a second torso SIP device 10612b may be pivotally mounted proximate a center of the upright support surface 10606 and extend toward the second upright side member 10610. Although the first and second torso SIP devices 10612a, 10612b are illustrated as being coaxial, embodiments where the first and second torso SIP device 10612a, 10612b are rotatable about different axes are also contemplated herein. A surface of the first and second torso SIP device 10612a, 10612b may define a seat back arranged at an interior of the upright portion 10604 of the child seat 10600.

[1233] At least one actuation mechanism 10620 associated with one or more of the torso SIP devices 10612a, 10612b is operable to drive transformation of the at least one torso SIP device 10612a, 10612b from a first configuration (FIGS. 119A-119B) to a second configuration (FIGS. 120A-120B). In the illustrated, non-limiting embodiment, the child seat 10600 includes a first actuation mechanism 10620a associated with the first torso SIP device 10612a and a second actuation mechanism 10620b associated with the second torso SIP device 10612b. Each actuation mechanism 10620a, 10620b includes an actuator or button 10622a, 10622b operably coupled to a respective torso SIP device 10612a, 10612b. However, embodiments where a single actuation mechanism is operably coupled to the plurality of torso SIP devices 10612a, 10612b are also contemplated herein. In an embodiment, each actuator 10622a, 10622b is arranged at an exterior surface of the child seat 10600. The actuators 10622a, 10622b may but need not be located directly adjacent to or in alignment with the torso SIP device 10612a, 10612b operably coupled thereto.

[1234] As shown, each actuator 10622a, 10622b may be slidably connected to the child seat 10600 adjacent to a respective torso SIP device 10612a, 10612b. Accordingly, when a force is applied to the actuator, such as during a side impact event for example, the actuator 10622a, 10622b may translate inwardly from an unactuated position to an actuated position. Further, each actuator 10622a, 10622b may include an angled engagement surface 10624a, 10624b configured to contact a portion of the respective torso SIP device 10612a, 10612b. The slope of this surface 10624a, 10624b as the actuator 10622a, 10622b translates inwardly is configured to drive rotation of the torso SIP device 10612a, 10612b about its pivot axis into the interior of the child seat 10600, from a stowed position to a deployed position. Accordingly, the seat back of the child seat 10600, such as defined by the torso SIP devices 10612a, 10612b, may be movable in response application of a crash impact to the child seat 10600. This rotation of the torso SIP device 10612a, 10612b may rotate the occupant of the child seat 10600. In an embodiment, a biasing mechanism (not shown) may be operably coupled to each actuator 10622a, 10622b to bias the actuator 10622a, 10622b toward the unactuated position. Alternatively, or in addition, a biasing mechanism (not shown) may be operably coupled to each torso SIP device 10612a, 10612b to bias the torso SIP device 10612a, 10612b to the stowed position.

[1235] In another embodiment illustrated in FIG. 121A and 121B, an illustrated torso SIP device 10702 is a soft goods panel arranged at an interior of the child seat 10700, such as in contact with an occupant thereof. Although only a single torso SIP device 10702 is illustrated, it should be appreciated that embodiments including additional SIP devices are also

within the scope of the disclosure. An actuation mechanism 10704 is associated with the torso SIP device 10702 and is operable to drive transformation of the torso SIP device 10702 from a first configuration (FIGS. 121A to a second configuration (FIGS. 121B). In the first configuration, the soft goods panel may not have a linear configuration and/or a tension may not be applied to thereto. Similar to the previous embodiment, the actuation mechanism 10704 includes an actuator 10706 operably coupled to the torso SIP device 10702. In the illustrated, non-limiting embodiment, a portion of the torso SIP device 10702 is connected to the actuator 10706. The torso SIP device 10702 may be fixedly connected, or in some embodiments, may be pivotally connected to the actuator 10706.

[1236] The actuator 10706 may be slidably connected to the child seat 10700 adjacent to the torso SIP device 10702. When a force is applied to the actuator 10706, such as during a side impact event for example, the actuator 10706 is configured to translate relative to the child seat 10700. This movement of the actuator 10706 applies a tension to the torso SIP device 10702, pulling the soft goods panel taut. This transformation of the torso SIP device 10702 may rotate the occupant of the child seat 10700.

[1237] With reference now to FIGS. 226-227B, in an embodiment, at least one SIP device may be arranged at an interior of the child seat system 16500, such as at a rotational interface between a child seat 16504 and a support base 16502. The child seat system 16500 includes a support base 16502 and a child seat 16504 rotatably coupled to the support base 16502. A portion of the child seat 16504 has been removed for ease of visibility. In such embodiments, the child seat system 16500 includes a spin lock 16506 operable to lock the child seat 16504 in a desired rotational position relative to the support base 16502. In the illustrated, non-limiting embodiment, the spin lock 16506 includes at least one locking member 16508 extendable from the child seat 16504 into a corresponding opening 16510 formed in the support base 16502; however, it should be understood that a spin lock 16506 having any suitable configuration is within the scope of the disclosure.

[1238] At least one SIP device 16512a, 16512b may be arranged at the interior of the support base 16502. In the illustrated, non-limiting embodiment, the at least one SIP device includes a first SIP device 16512a arranged at a first side of an opening 16510 formed in the support base 16502 and a second SIP device 16512b arranged at a second, opposite side of the opening 16510 formed in the support base 16502. The first and second SIP devices 16512a, 16512b may protrude from a sidewall 16514 of the support base 16502 such that the first and second SIP devices 16512a, 16512b are arranged within the path of rotation of the at least one locking member 16508. However, in the exemplary embodiment shown in FIGS. 227A and

227B, the first and second SIP devices 16512a, 16512b are not arranged within the path of rotation of the structural bottom of the seat 16504 to avoid interference with normal rotation of the child seat 16504 (such as while the locking member 16508 is retracted) relative to the support base 16502. At least one of the first and second SIP devices 16512a, 16512b may be formed from a deformable material, for example compressible material. The material may be configured to permanently deform, or alternatively, may be a resilient material operable to return to its normal state when the force is removed therefrom.

[1239] An impact force applied to the child seat 16504 during a crash event may cause the child seat 16504 to rotate relative to the support base 16502. In some embodiments, the impact force may cause the locking member 16508 to disengage a corresponding opening 16510 formed in the support base 16502. Rotation of the child seat 16504 in a first direction will cause the child seat 16504 to engage the first SIP device 16512a and rotation of the child seat 16504 in a second direction will engage the second SIP device 16512b. Engagement with and the resulting deformation of an SIP device 16512a, 16512b reduces the energy acting on the child seat 16504 and transferred to a child seated therein. Although only a single locking member is illustrated in the FIGS., it should be understood that in some embodiments, the spin lock 16506 may include one or more additional locking members 16508, such as disposed opposite the illustrated locking member, and one or more corresponding openings 16510 for receiving the locking member 16508. In such embodiments, additional SIP devices (not shown) may be positioned about the child seat system 16500 to simultaneously cooperate with the additional locking member 16508. In embodiments including a plurality of openings 16510 associated with multiple rotational positions of the child seat, SIP devices may be arranged adjacent to each, or only some of the openings 16510.

[1240] With reference now to FIGS. 230A-233B, another example of a child seat system 16700 including at least one SIP device is illustrated. The child seat system 16700 includes a child seat 16702 connectable to a support base (not shown). The child seat 16702 includes a seat shell 16704 having a seat portion 16706 and a back or upright portion 16708 extending at an angle from the seat portion 16706. As shown and previously described herein, the upright portion 16708 may include an upright support surface 16710 and at least one upright side member, such as a first upright side member 16712 and a second upright side member 16714 disposed at opposite sides of the upright support surface 16710. The seat portion 16706 may include a seat support surface 16716 and at least one seat side member, such as a first seat side member 16718 and a second seat side member 16720 disposed at opposite sides of the seat

support surface 16716. A headrest 16722 may be movably connected to the upright portion 16708 of the seat shell.

[1241] As shown, the child seat 16702 may include at least one SIP device. For example, a first external SIP device 16724a may be arranged at an exterior of the first upright side member 16712, and a second external SIP device 16724b may be arranged at an exterior of the second upright side member 16714. The first and second external SIP devices 16724a, 16724b may be located near a bottom of the first and second first upright side members 16712, 16714, respectively. Alternatively, or in addition, the child seat 16702 may include a first shoulder SIP device 16726a arranged adjacent to an interior of the first upright side member 16712 and a second shoulder SIP device 16726b arranged adjacent to an interior of the second upright side member 16714. The at least one torso SIP device may be arranged proximate to the interior of the seat portion 16706 of the seat shell 16704. For example, a first torso SIP device 16728a may be arranged adjacent to the first seat side member 16718, and a second torso SIP device 16728b may be arranged at or adjacent to the second seat side member 16720.

[1242] The upright portion 16708 of the seat shell 16704 of the child seat 16702 may include a frame 16730, and/or the seat portion 16706 of the seat shell 16704 may include a base frame 16732. The frame 16730 and base frame 16732 may but need not be integrally formed. At least a portion of the frame 16730 and base frame 16732 may be embedded within the seat shell 16704. In an embodiment, one or both of the frame 16730 and the base frame 16732 are formed from a material having a greater strength and/or rigidity than the material of the seat shell 16704. For example, the frame 16730 and base frame 16732 may be formed from material and the seat shell 17606 may be formed from a plastic material. One or more SIP devices of the child seat 16702 may be connectable to the frame 16730. It should be understood that any of the external SIP devices 16724a, 16724b, shoulder SIP devices 16726a, 16726b, and/or torso SIP devices 16728a, 16728b may be directly or indirectly connected to the frame 16730 (see FIG. 231). Alternatively, or in addition, one or more SIP devices of the child seat 16702 are connectable to the base frame 16732. It should be understood that any of the external SIP devices 16724a, 16724b, shoulder SIP devices 16726a, 16726b, and/or torso SIP devices 16728a, 16728b may be directly or indirectly connected to the base frame 16732. The SIP devices may be mechanically or chemically connected to the frame 16730 and/or base frame 16732 in any suitable manner, such as via one or more fasteners for example.

[1243] A connection bar 16734 may also extend about a portion of the seat shell 16704 of the child seat 16702, such as between the first external SIP device 16724a and the second external SIP device 16724b. In an embodiment, the connection bar 16734 is positioned at or is

configured to wrap around an exterior surface at least one upright side member 16712, 16714 and a back 16713 of the back portion 16708 of the seat shell 16704. However, embodiments where the connection bar 16734 has another configuration are also contemplated herein. For example, as shown in FIG. 232, the connection bar 16734 may have an angular configuration, and an interface between a first arm 16736 and a second arm 16738 of the connection bar 16734 defining the angle therebetween may be arranged at or adjacent to the back 16713 of the back portion 16708 of the seat shell 16704.

[1244] The connection bar 16734 may be formed from any suitable material. In an embodiment, the connection bar 16734 is formed from a material having a greater strength and/or rigidity than the material of the seat shell 16704. In such embodiments, the connection bar 16734 may enhance the stability of the child seat 16702 during a crash event. The connection bar 16734 may be affixed to a portion of the child seat at one or more connection points 16735. The connection bar 16734 may alternatively or additionally be coupled to the first and second external SIP devices 16724a, 16724b. In an embodiment, the connection bar 16734 couples at least one of the first and second external SIP devices 16724a, 16724b to the child seat 16702, such as to the frame 16730 and/or base frame 16732. The connection bar 16734 may be permanently or removably connected to any of the child seat 16702, the first external SIP device 16724a, and the second external SIP device 16724b in any suitable manner. IN an embodiment, the connection bar 16734 is connectable to at least one of the child seat 16702, the first external SIP device 16724a, and the second external SIP device 16724b via one or more fasteners.

[1245] In an embodiment, shown in FIGS. 233A-233B, one or more rigid members, such as reinforcement bar 16740, may be mounted to the frame 16730 and/or the base frame 16732 of the child seat 16702. For example, reinforcement bar 16740 may be arranged at an upright side member 16712, 16714 of the seat shell 16704, such as in a generally vertical orientation. The reinforcement bar 16740 may be offset from an exterior surface of the seat shell 16704. Accordingly, the reinforcement bar 16740 need not be positioned in contact with or adjacent to the connection bar 16734. However, embodiments where a reinforcement bar 16740 is attached to the child seat 16702 via the connection bar 16734 are also within the scope of the disclosure.

[1246] A reinforcement bar 16740 may extend over a substantially entire length of the upright side member 16712. However, in other embodiments, the reinforcement bar 16740 may extend over only a portion of the height of the upright side member 16712, such as less than 75% of the length of the upright side member 16712. In embodiments where the length of the

reinforcement bar 16740 is less than a length of the upright side member 16712, the reinforcement bar 16740 is positioned such that the reinforcement bar 16740 extends to or past an adjacent external SIP device 16724a. In the illustrated, non-limiting embodiment, an SIP device, such as one of the first external SIP device 16724a is permanently or removably connectable to the reinforcement bar 16740. Further, the SIP device 16724a may be directly or indirectly connected via any suitable connection mechanism, such as a fastener for example, to the reinforcement bar 16740. Although not shown, it should be understood that a further reinforcement bar (not shown) like reinforcement bar 16740 may additionally or alternatively be positioned at the upright side member 16714, and that the SIP device 16724b may be connected to such a reinforcement bar.

[1247] With reference now to FIGS. 234A-234C, another example of a child seat system 16800 is illustrated. Similar to the previous embodiment, the child seat system 16800 includes a child seat 16802 connectable to a support base 16804. The child seat 16802 includes a seat shell 16806 having a seat portion 16808 and a back or upright portion 16810 extending at an angle from the seat portion 16808. As shown and previously described herein, the upright portion 16810 may include an upright support surface 16812 and at least one upright side member, such as a first upright side member 16814 and a second upright side member 16816 disposed at opposite sides of the upright support surface 16812. The seat portion 16808 may include a seat support surface 16818 and at least one seat side member, such as a first seat side member 16820 and a second seat side member 16822 disposed at opposite sides of the seat support surface 16818. In the illustrated, non-limiting embodiment, the seat portion 16808 of the seat shell 16806 is removably connectable to the remainder of the seat shell 16806 in the form of a booster. A headrest 16824 may be movably connected to the upright portion 16810 of the seat shell 16806.

[1248] The child seat system 16800 includes at least one SIP device. For example, in the illustrated, non-limiting embodiment, a first external SIP device 16826a is arranged at an exterior of the first upright side member 16814, and a second external SIP device 16826b is arranged at an exterior of the second upright side member 16816. The child seat 16802 may alternatively or additionally include at least one shoulder SIP device, such as a first shoulder SIP device 16828a and a second shoulder SIP device 16828b, and/or at least one head SIP device, such as a first head SIP device 16830a and a second head SIP device 16830b. As shown, the first and second upright side members 16814, 16816 of the upright portion 16810 may be contoured such that a recess 16832a, 16832b is formed between the upright side members 16814, 16816 and the lateral sides of the back 16815. In the illustrated, non-limiting

embodiment, the first external SIP device 16826a and the second external SIP device 16826b are positioned directly adjacent to the lateral sides of the back 16815 of the upright portion 16810, within a respective recess 16832a, 16832b. The overall size and contour of the first and second external SIP devices 16826a, 16826b may be selected such that the first and second external SIP devices 16826a, 16826b do not protrude laterally outwardly beyond the upright side members 16814, 16816.

[1249] An example of a child seat system 16900 having a child seat 16902 movable, for example rotatable, relative to the support base 16904 is illustrated in FIGS. 235A-236B. The child seat 16902 includes a seat shell 16906 having a seat portion 16908 and a back or upright portion 16910 extending at an angle from the seat portion 16908. The upright portion 16910 includes an upright support surface 16912 and at least one upright side member, such as a first upright side member 16914 and a second upright side member 16916 disposed at opposite sides of the upright support surface 16912. The seat portion 16908 may include a seat support surface 16918 and at least one seat side member, such as a first seat side member 16920 and a second seat side member 16922 disposed at opposite sides of the seat support surface 16918. A headrest 16924 may be movably connected to the upright portion 16910 of the seat shell 16906. The support base 16904 may include a body having a base seat portion 16930 and a base back portion 16932 extending at an angle relative to the base seat portion 16930. In the illustrated, non-limiting embodiment, the base back portion 16932 extends over a majority of the height of the upright portion 16910 of the seat shell 16906. However, embodiments where the base back portion 16932 extends over less than 75%, or even less than 50%, of a height of the upright portion 16910 of the child seat 16902 are also contemplated herein.

[1250] The child seat system 16900 includes at least one SIP device. For example, in the illustrated, non-limiting embodiment, a first external SIP device 16940a is arranged at an exterior of the first upright side member 16914, and a second external SIP device 16940b is arranged at an exterior of the second upright side member 16916. The child seat 16902 may alternatively or additionally include at least one shoulder SIP device, such as a first shoulder SIP device 16942a and a second shoulder SIP device 16942b, and/or at least one head SIP device, such as a first head SIP device 16944a and a second head SIP device 16944b. In an embodiment, the child seat 16902 includes at least one torso SIP device, such as a first torso SIP device 16946a located near the first seat side member 16920 and a second head SIP device 16946b located near the second seat side member 16922. In an embodiment, the at least one torso SIP device 16946a, 16946b is formed from the same material as the seat shell 16906. In

such embodiments, the torso SIP devices 16946a, 16946b may be separate pieces connectable to the seat shell 16906, or alternatively, may be integrally formed with the seat shell 16906.

[1251] In an embodiment, the external SIP devices 16940a, 16940b are sized and/or shaped to allow rotation of the child seat 16902 relative to the support base 16904. As the child seat 16902 moved along its path of rotation relative to the support base 16904, the external SIP devices 16940a, 16940b may pass a surface of the base back portion 16934 and the child seat 16902. Accordingly, the external SIP devices 16940a, 16940b may be sized and shaped to fit within the clearance, identified at 16936, defined between the surface of the base back portion 16934 and an exterior surface of the child seat 16902.

[1252] In addition or alternatively to the above, in the illustrated, non-limiting embodiment shown in FIGS. 236A-236B, the external SIP devices 16940a, 16940b may be removably connectable to the seat shell 16906. The external SIP device 16940a, 16940b may have one or more features and at least one slot 16949 may be formed in the exterior of the seat shell 16906 configured to engage or mater with a corresponding feature of the external SIP device 16940a, 16940b to couple the SIP device to the seat shell 16906.

[1253] Examples of an external SIP device connectable to the seat shell 16906, such as external SIP devices 16940a, 16940b, are illustrated in more detail in FGS. 237A-237D. Similar to the SIP devices in FIGS. 146A-148C, each of the illustrated external SIP devices 16940 includes a substantially hollow body 16942 having a front wall 16944 and a rear wall 16946. The front wall 16944 may have an arcuate contour such that a distance between the front wall 16944 and the rear wall 16946 varies over a height of the external SIP device. In an embodiment, the distance between the front wall 16944 and the rear wall 16946 gradually increases between a first end 16948 of the body 16942 and a second, opposite end 16950 of the body 16942. A sidewall 16952 extends between and connects an end of the front wall 16944 and the rear wall 16946. However, in some embodiments, the at least one sidewall 16952 is integrally formed with the front wall 16944and/or the rear wall 16946. The external SIP device 16940 may have a unitary body such that the plurality of walls 16944, 16946, 16952 are integrally formed. It should be understood that the shape of the external SIP device 16940 illustrated and described herein is intended as an example only.

[1254] The various exemplary external SIP devices 16940 shown may include one or more mounting members 16954 for connecting the external SIP device 16940 to the child seat 16902. In the illustrated, non-limiting embodiment, the one or more mounting members 16954 be receivable within the corresponding slots formed at the surface of the child seat 16902 and/or support base 16904. In an embodiment, an energy absorbing structure may be arranged at an

interior of the body 16942 of the SIP device 16940. As shown, the energy absorbing structure 16956 may be a crushable structure including one or more ribs or other members 16958, such as extending between and connecting adjacent mounting members 16954. The crushable structure 16956 may be formed from a material configured to depress, collapse, or crush when a force is applied thereto such that the crushable structure 16956 absorbs energy as it deforms. The crushable structure 16956 may be designed such that the displacement or deformation thereof plateaus beneath the threshold associated with injury of a child positioned within the child seat 16902.

[1255] With reference now to FIGS. 265A-268B, another example of a child seat 18500 includes a seat portion or seat base 18502 and a seat back or back portion 18504 extending at an angle from the seat portion 18502. The seat portion 18502 may be separable from the back portion 185402, such as for use as a booster seat. As shown, the back portion 18504 includes an upright support surface 18510 and at least one upright side member, such as a first upright side member 18512 and a second upright side member 18514 disposed at opposite sides of the upright support surface 18510. The seat portion 18502 may include a seat support surface 18520 and at least one seat side member, such as a first seat side member 18522 and a second seat side member 18524 disposed at opposite sides of the seat support surface 18520. A headrest 18530 may be movably connected to the back portion 18504 of the child seat 18500.

[1256] The child seat 18500 includes at least one SIP device. For example, in the illustrated, non-limiting embodiment, a first external SIP device 18540 is arranged at an exterior of the first upright side member 18512, and a second external SIP device (not shown) is arranged at an exterior of the second upright side member 18514. The child seat 18500 may alternatively or additionally include at least one shoulder SIP device, such as a first shoulder SIP device 18542a and a second shoulder SIP device 18542b, at least one head SIP device, such as a first head SIP device 18544a and a second head SIP device 18544b, and/or at least one torso SIP device, such as a first torso SIP device 18546a and a second torso SIP device 18546b.

[1257] An example of an external SIP device, such as the first external SIP device 18540 is illustrated in more detail in FIGS. 266-268B. As shown, the external SIP device 18540 has a substantially hollow body 18550 having a front wall 18552 and a rear wall 18554. The front wall 18552 may have an arcuate contour such that a distance between the front wall 18552 and the rear wall 18554 varies over a height of the external SIP device 18540. In an embodiment, the distance between the front wall 18552 and the rear wall 18554 gradually increases from a first end 18556 of the body 18550 toward a second, opposite end 18558 of the

body 18550. A sidewall 18560 extends between and connects an edge of the front wall 18552 and the rear wall 18554. However, in some embodiments, the at least one sidewall 18560 is integrally formed with the front wall 18552 and/or the rear wall 18554. The external SIP device 18540 may have a unitary body such that the plurality of walls 18552, 18554, 18560 are integrally formed. It should be understood that the shape of the external SIP device 185400 illustrated and described herein is intended as an example only.

[1258] The external SIP device 18540 may include a plurality of mounting members 18562 operable to connect the external SIP device 18540 to the child seat 18500. In the illustrated, non-limiting embodiment, the plurality of mounting members 18562 of the external SIP device 18540 permanently couple the external SIP device 18540 to the child seat 18500, such as to the back portion 18504 of the child seat 18500. A distal end 18564 of each of the plurality of mounting members 18562 may include a locking element 18566. In the illustrated, non-limiting embodiment, a diameter of the locking element 18566 varies over the its axial length. For example, the diameter of the locking element 18566 may gradually increase from the distal end 18564 of the mounting member 18562 toward the body 18550 of the external SIP device 18540, such as to form a tapered surface. The diameter may remain constant over a small axial length and may then abruptly reduce to a minimum diameter thereby forming a step between the minimum and maximum diameters of the locking element 18566. Accordingly, the portion of the locking element having the minimum diameter may be considered a neck and the portion of the locking element extending from the maximum diameter adjacent to the neck, to an end of the locking element may be considered a head of the locking element. It should be appreciated that the configuration of the locking element 18566 illustrated and described herein is intended as an example only and that any suitable configuration is within the scope of the disclosure.

[1259] The mounting members 18562 are receivable within corresponding slots 18570 (see FIG. 268B) formed at a surface of the child seat 18500, such as formed at an upright side member 18512, near the rear of the back portion 18504. Each slot 18570 may be configured to allow movement of the locking element 18566 therethrough in a first direction, but not in a second, opposite direction. For example, the slots 18570 may include one or more directional control members 18572, such as resilient teeth for example, that define an opening 18574 in which a corresponding locking element 18566 is insertable. The opening 18574 may be sized based on the minimum diameter or neck of the locking element 18566. The one or more teeth 18572 may be configured to flex in a first direction to accommodate the increased diameter of the locking element 18566 during installation of the locking element 18566; however, the one

or more teeth 18572 may be restricted from flexing in the opposite, second direction, such as if a pulling force were applied to the external SIP device 18540 in a direction away from the child seat 18500 for example. Although the use of one or more resilient teeth 18752 are described herein to permanently couple the mounting members 18562 of the external SIP device 18540 to the child seat 18500, it should be appreciated that any suitable directional control member associated with a slot 18570 and operable to restrict separation of a mounting member 18562 therefrom is contemplated herein.

[1260] Similar to the embodiment illustrated in FIG. 237C, the external SIP device 18540 may include an energy absorbing structure 18576 may be arranged at an interior of the body 18550 of the external SIP device 18540. As shown, the energy absorbing structure 18576 may be a crushable structure formed from a material configured to depress, collapse, or crush when a force is applied thereto such that the crushable structure absorbs energy as it deforms.

[1261] In an embodiment, an external SIP device arranged about the child seat may be located at a position offset from the base back portion of the support base of the child seat. With reference to FIGS. 238A-238D, another example of a child seat system 17000 having a child seat 17002 movable, for example rotatable, relative to the support base 17004 is illustrated. The child seat 17002 includes a seat shell 17006 having a seat portion 17008 and a back or upright portion 17010 extending at an angle from the seat portion 17008. The upright portion 17010 includes an upright support surface 17012 and at least one upright side member, such as a first upright side member 17014 and a second upright side member 17016 disposed at opposite sides of the upright support surface 17012. The seat portion 17008 may include a seat support surface 17018 and at least one seat side member, such as a first seat side member 17020 and a second seat side member 17022 disposed at opposite sides of the seat support surface 17018. A headrest 17024 may be movably connected to the upright portion 17010 of the seat shell 17006. The support base 17004 may include a body having a base seat portion 17030 and a base back portion 17032 extending at an angle relative to the base seat portion 17030. In the illustrated, non-limiting embodiment, the base back portion 17032 extends over a majority of the height of the upright portion 17010 of the seat shell 17006.

[1262] The child seat system 17000 includes at least one SIP device. For example, in the illustrated, non-limiting embodiment, a first external SIP device 17040a is arranged at an exterior of the first upright side member 17014, and a second external SIP device 17040b is arranged at an exterior of the second upright side member 17016. Unlike the previous embodiments where the external SIP devices were arranged near an interface between the seat portion 17008 and a back portion 17010 of the seat shell 17006, in this embodiment the external

SIP devices 17040a, 17040b are arranged proximate or near the top of the child seat 17002. In an embodiment, the external SIP devices 17040a, 17040b are located at a height arranged vertically above a plane containing the uppermost surface the base back portion 17032 of the support base 17004. By arranging the external SIP devices 17040a, 17040b vertically above the support base 17004, the external SIP devices 17040a, 17040b do not need to pass through the clearance defined between the support base 17004 and the child seat 17002 as the child seat 17002 rotates relative to the support base 17004. This allows for greater flexibility in the design of the external SIP devices 17040a, 17040b, and rotation of the child seat 17002.

[1263] In the illustrated, non-limiting embodiment shown in FIGS. 238A-238D, the external SIP devices 17040a, 17040b have a generally planar configuration arranged within a horizontal plane. However, in the embodiment illustrated in FIGS. 239A-239B, the external SIP devices 17140a, 17140b arranged at an exterior of a child seat 17102 of a child seat system 17100 may have a different configuration. As shown, the external SIP devices 17140a, 17140b are located near the top of a back portion 17110 of a seat shell 17106 of the child seat 17102, at a location vertically offset from the base back portion 17132 of a support base 17104 connectable to the child seat 17102. The external SIP devices 17140a, 17140b have a generally curved contour that is complementary to the design of the child seat.

[1264] In some embodiments, a child seat having one or more SIP devices associated therewith may be a booster seat. In such embodiments, the child seat is positionable about a vehicle seat without the use of a support base. With reference now to FIGS. 261A-264B, various embodiments of booster seats are illustrated in more detail. In the non-limiting embodiment of a child seat 18200 illustrated in FIGS. 261A-261E, the child seat 18200 includes a seat body having a bottom or seat portion 18202 and an upright or back portion 18204 extending generally at a non-parallel angle relative to the seat portion 18202. The seat portion 18202 and the back portion 18204 may be detachably coupled. In an embodiment, the child seat 18200 is transformable between a first booster mode (shown), in which the back portion 18204 is connected to the seat portion 18202, and a second mode in which the back portion 18204 is removed from the seat portion 18202.

[1265] The back portion 18204 of the child seat 18200 may include an upright support surface 18210 generally facing forward and that extends from a first end or top 18212 to a second, opposite end or bottom 18214 of the back portion 18204. A first upright side member 18216 may be arranged at a first side 18218 of the upright support surface 18210 and a second upright side member 18220 may be arranged at a second, opposite side 18212 of the upright support surface 18210. The first and second upright side members 18216, 18220 may therefore

form the left side and the right side of the back portion 18204, respectively. As shown, the first and second upright side members 18216, 18220 extend forward from the upright support surface 18210. The first and second upright side members 18216, 18220 may extend generally orthogonally to the upright support surface 18210, or alternatively, may extend therefrom at another angle, such as an angle greater than 90° for example (the respective angles therefore being at least 90° for example). Accordingly, the upright support surface 18210 and the first and second upright side members 18216, 18220 define a backrest region or upright support cavity within which an upper body of a child is received.

[1266] The upright side members 18216, 18220 may be configured to facilitate the correct positioning of a vehicle belt when the child seat 18200 is installed in a vehicle. In an embodiment, each upright side member 18216, 18220 has a respective opening 18224a, 18224b formed therein. The opening 18224a, 18224b may be configured to receive a vehicle seatbelt (not shown) to secure the child seat 18200 to a vehicle seat in a forward-facing high-back configuration. With reference to FIG. 261D, in some embodiments, a thickness of the upright side member 18216, 18220 at a location adjacent to each respective opening 18224a, 18224b may be increased. This increased thickness may form a ridge, identified generally by 18226, surrounding a periphery of each opening 18224a, 18224.

[1267] In the illustrated, non-limiting embodiment, the back portion 18204 of the child seat 18200 includes a headrest 18230. The headrest 18230 is attached to or integral with the back portion 18204. The headrest 18230 may be stationary or in some embodiments, may be configured to move relative to the upright support surface 18210. For example, the headrest 18230 may be configured to translate relative to the upright support surface 18210 between a vertically retracted position and a vertically extended position, allowing for adjustment based on the size of the child positioned within the child seat 18200.

[1268] The seat portion 18202 includes a seat support surface 18240 facing generally upwardly and that extends from a first end or front 18242 to a second end or back 18244 of the seat portion 18202. A first seat side member 18246 may be arranged at a first side 18248 of the seat support surface 18240 and a second seat side member 18250 may be arranged at a second, opposite side 18252 of the seat support surface 18240. The first seat side member 18246 and the second seat side member 18250 extend upwardly and form the left side and the right side of the seat portion 18202. The seat support surface 18240 and the first and second seat side member 18246, 18250 in combination define a region within which at least part of a lower body of a child may be received.

[1269] As shown, the seat side members 18246, 18250 extend at an angle from the seat support surface 18240. The angle of the first seat side member 18246 relative to the seat support surface 18240 may but need not be the same as the angle of the first upright side member 18216 relative to the upright support surface 18210. Similarly, the angle of the second seat side member 18250 relative to the seat support surface 18240 may but need not be the same as the angle of the second upright side member 18220 relative to the upright support surface 18210.

[1270] In the illustrated, non-limiting embodiment, each seat side member 18246, 18250 has a slot 18254a, 18254b formed therein configured to function as a lap belt guide during at least one mode of use of the child seat 18200. The slot 18254a, 18254b may be configured to receive and position a lap belt portion of a vehicle restraint or a separate restraint belt to attach the child seat 18200 to a vehicle seat when the child seat 18200 is in a forward-facing high-back configuration as illustrated in the FIGS.

[1271] As shown, one or more SIP devices may be mounted to the child seat 18200. In an embodiment, the headrest 18230 includes at least one head SIP device. As shown, the headrest 18230 may be formed by a headrest shell 18232 and an inner member 18233 mounted to the headrest shell 18232. The headrest 18230 includes a back portion 18234, a first side member 18236 extending from a first side of the back portion 18234 and a second side member 18238 extending from a second, opposite side of the back portion 18234. An inwardly facing surface 18235 of the inner member 18233 at the back portion 18234, first side member 18236 and second side member 18238 defines a head receiving region 18239.

[1272] A first head SIP device 18260a may be arranged at or adjacent to the first side member 18236 of the headrest 18230 and a second head SIP device 18620b may be arranged at or adjacent to the second side member 18238 of the headrest 18230. In the illustrated, non-limiting embodiment, each of the first and second head SIP devices 18260a, 18260b extends an entire length of a respective side member 18236, 18238. However, embodiments where the at least one head SIP device 18260a, 18260b is longer or shorter that a corresponding side member 18236, 18238of the headrest 18230 are also contemplated herein. Each head SIP device 18260a, 18260b includes an inwardly facing surface 18262a, 18262b having a first side impact protection area 18264a, 18264b positioned closest to the back portion 18234, as well as a second side impact protection area 18266a, 18266b extending forward, away from the first side impact protection area 18264a, 18264b. As shown, the first side impact protection areas 18264a, 18264b may be arranged at an angle to the back portion 18234 of the inner member 18233. The second side impact protection areas 18266a, 18266b may be arranged at a non-parallel angle relative to respective first side impact protection areas 18264a, 18264b.

[1273] In the illustrated, non-limiting embodiment, the first head SIP device 18260a forms a first recess 18270a (see FIG. 261E) within the head receiving region 18239 of the inner member 18233, and the second head SIP device 18260b forms a second recess 18270b within the head receiving region 18239 of the inner member 18233. The first side impact protection areas 18264a, 18264b may abut respective second side impact protection areas 18266a, 18266b of each head SIP device 18260a, 18260b at a generally vertical line of intersection represented by L23a and L23b, respectively. The lines of intersection L23a, L23b may be disposed at the portions of the head SIP device 18260a, 18260b positioned laterally closest to a central longitudinal axis CLA of a head receiving region.

[1274] The first recess 18270a is partially defined by the second side impact protection area 18266a and a plane extending laterally from an inner edge of the front ends 18241a, 18241b of the side members 18236, 18238 of the inner member 18233. As shown, the recess 18270a is further defined by a plane P23a extending from the line of intersection L23a to the plane extending laterally from an inner edge of the front ends 18241a, 18241b of the side members 18236, 18238. This plane P23a of the recess 18270a may but need not be coplanar with the first side impact protection area 18264a of the head SIP device 18260a. Similarly, the second recess 18270b is at least partially defined by the second side impact protection area 18266b, by the plane extending laterally from an inner edge of the front ends 18241a, 18241b of the side members 18236, 18238, and by a plane P23b extending from the line of intersection L23b to the plane extending laterally from an inner edge of the front ends 18241a, 18241b of the side members 18236, 18238. The plane represented by P23b may but need not be coplanar with the first side impact protection area 18264b of the head SIP device 18260b.

[1275] In the illustrated, non-limiting embodiment, the child seat 18200 additionally includes at least one torso SIP device. As shown, a torso SIP device 18280a may be arranged adjacent to the first seat side member 18246, such as near the first upright side member 18216 and a second, substantially identical torso SIP device 18280b may be arranged adjacent to the second seat side member 18250, such as near the second upright side member 18220 for example. The torso SIP devices 18280a, 18280b may be mounted to the adjacent first seat side member 18246 and second seat side member 18250. Each of the first and second torso SIP devices 18280a, 18280b has a body including an outer surface 18282a, 18282b positioned closest to the seat side member 18246, 18250, and an opposite front surface 18284a, 18284b facing an interior of the seat portion 18202. Although the bodies of the torso SIP devices 18280a, 18280b are illustrated as being generally rectangular in shape, it should be understood that torso SIP devices 18280a, 18280b having another shape are also contemplated herein.

[1276] In an embodiment, each of the first and second torso SIP devices 18280a, 18280b is removably connectable to at least a portion of the child seat 18200. In an embodiment, the first and second torso SIP devices 18280a, 18280b are removably connectable to the seat portion. The first and second torso SIP devices 18280a, 18280b may be connected thereto, such as via connector assembly described above with respect to FIGS. 171A-171B. Examples of suitable connectors include but are not limited to snaps, hook and loop, fasteners or other suitable connectors. In other embodiments, the first and second torso SIP devices 18280a, 18280b may be permanently connected to the seat portion 18202 of the child seat 18200. A permanent connection between the first and second torso SIP devices 18280a, 18280b and the seat portion 18202 ensures the presence of the first and second torso SIP devices 18280a, 18280b, regardless of whether or not the back portion 18204 is attached to the seat portion 18202. Alternatively, or in addition, the first and second torso SIP devices 18280a, 18280b may be removably connectable to the back portion 18204 of the child seat 18200. Allowing the torso SIP devices 18280a, 18280b to separate from the back portion 18204 enhances the likelihood of use of the torso SIP devices when the child seat is in the second mode and includes only the seat portion 18202. Further, in embodiments where the torso SIP devices 18280a, 18280b are connected or connectable to the seat portion 18202 and are connectable to the back portion 18204, the torso SIP devices 18280a, 18280b are operable to couple the seat portion 18202 and back portion 18204.

[1277] With reference now to FIGS. 262A-262D, another embodiment of a child seat 18300 configured as a booster seat having one or more SIP devices associated therewith is illustrated. Similar to the previously described embodiment, the child seat 18300 includes a seat body having a seat portion 18302 and a back portion 18304 extending at a non-parallel angle relative to the seat portion 18302. The back portion 18304 may be removably connectable to the seat portion 18302. In an embodiment, the child seat 18300 is transformable between a first booster mode (shown), in which the back portion 18304 is connected to the seat portion 18302, and a second mode in which the back portion 18304 is separated from the seat portion 18302. In the second mode, only the seat portion 18302 is positionable on a vehicle seat.

[1278] The back portion 18304 of the child seat 18300 may include an upright support surface 18310 generally facing forward and that extends from a first end or top 18312 to a second, opposite end or bottom 18314 of the back portion 18304. A first upright side member 18316 may be arranged at a first side 18318 of the upright support surface 18310 and a second upright side member 18320 may be arranged at a second, opposite side (not shown) of the upright support surface 18310. The first and second upright side members 18316, 18320 may

therefore form the left side and the right side of the back portion 18304, respectively. As shown, the first and second upright side members 18316, 18320 extend forward from the upright support surface 18310. The first and second upright side members 18316, 18320 may extend generally orthogonally to the upright support surface 18310, or alternatively, may extend therefrom at another angle, such as an angle greater than 90° for example (the respective angles therefore being at least 90° for example). Accordingly, the upright support surface 18310 and the first and second upright side members 18316, 18320 define a backrest region or upright support cavity within which an upper body of a child is received. In an embodiment, each upright side member 18316, 18320 has a respective opening 18324a, 18324b formed therein configured to receive a vehicle seatbelt (not shown) to secure the child seat 18300 to a vehicle seat in a forward-facing high-back configuration.

[1279] In the illustrated, non-limiting embodiment, the back portion 18304 of the child seat 18300 includes a headrest 18330. The headrest 18330 is attached to or integral with the back portion 18304. The headrest 18330 may be stationary or in some embodiments, may be configured to move relative to the upright support surface 18310. For example, the headrest 18330 may be configured to translate relative to the upright support surface 18310 between a vertically retracted position and a vertically extended position, allowing for adjustment based on the size of the child positioned within the child seat 18300.

[1280] As shown, the back portion 18304 of the child seat 18300 may include a headrest 18330. The headrest 18330 is attached to or integral with the back portion 18304. The headrest 18330 may be stationary or in some embodiments, may be configured to move relative to the upright support surface 18310. For example, the headrest 18330 may be configured to translate relative to the upright support surface 18310 between a vertically retracted position and a vertically extended position, allowing for adjustment based on the size of the child positioned within the child seat 18300.

[1281] The seat portion 18302 includes a seat support surface 18340 facing generally upwardly and that extends from a first end or front 18342 to a second end or back 18344 of the seat portion 18302. A first seat side member 18346 may be arranged at a first side 18348 of the seat support surface 18340 and a second seat side member 18250 may be arranged at a second, opposite side 18352 of the seat support surface 18340. The first seat side member 18346 and the second seat side member 18350 extend upwardly and form the left side and the right side of the seat portion 18302. The seat support surface 18340 and the first and second seat side member 18346, 18350 in combination define a region within which at least part of a lower body of a child may be received.

[1282] As shown, the seat side members 18346, 18350 extend at an angle from the seat support surface 18340. The angle of the first seat side member 18346 relative to the seat support surface 18340 may but need not be the same as the angle of the first upright side member 18316 relative to the upright support surface 18310. Similarly, the angle of the second seat side member 18350 relative to the seat support surface 18340 may but need not be the same as the angle of the second upright side member 18320 relative to the upright support surface 18310.

[1283] In the illustrated, non-limiting embodiment, each seat side member 18346, 18350 has a slot 18354a, 18354b formed therein configured to function as a lap belt guide during at least one mode of use of the child seat 18300. The slot 18354a, 18354b may be configured to receive and position a lap belt portion of a vehicle restraint or a separate restraint belt to attach the child seat 18300 to a vehicle seat when the child seat 18300 is in a forward-facing high-back configuration as illustrated in the FIGS.

[1284] As shown, one or more SIP devices may be mounted to the child seat 18300. In an embodiment, the headrest 18330 includes at least one head SIP device. As shown, the headrest 18330 includes a back portion 18332, a first side member 18334 extending from a first side of the back portion 18332 and a second side member 18336 extending from a second, opposite side of the back portion 18332. An inwardly facing surface 18338 of the headrest 18330 defines a head receiving region 18339. A first head SIP device 18360a may be arranged at or adjacent to the first side member 18334 of the headrest 18330 and a second head SIP device 18360b may be arranged at or adjacent to the second side member 18336 of the headrest 18330. In the illustrated, non-limiting embodiment, a front end 18362a, 18362b of each of the first and second head SIP devices 18360a, 18360b extends beyond a front end 18331a, 18331b of the side members 18334, 18336. The head SIP devices 18360a, 18360b may have any suitable configuration, such as any of the configurations described with respect to FIGS. 1-32C, 82A-63, 122A-124B, 132A-135C, 242A-253B, and 261-261E.

[1285] In the illustrated, non-limiting embodiment, each SIP device 18360a, 18360b includes a respective inwardly facing surface 18364a, 18364b having a first side impact protection area 18366a, 18366b arranged closest to the back portion 18332 of the headrest 18330 and the second side impact protection area 18368a, 18368b extending from the first side impact protection area 18366a, 18366b toward the front end 18362a, 18362b of the headrest 18330. The first side impact protection area 18366a, 18366b may converge with the second side impact protection area 18368a, 18368b along a vertical line of intersection, represented by L23a, L23b. The line of intersection L23a, L23b may be arranged at any suitable angle relative to the back portion 18332. In an embodiment, the line of intersection L23a, L23b is the

portion of each head SIP device 18360a, 18360b positioned closest to a central longitudinal axis CLA of a head receiving region 18339 (in a lateral direction).

[1286] Although not shown, as in the previous embodiments, a recess may be at least partially defined within the head receiving region 18339 of the headrest 18330 by each head SIP device 18360a, 18360b. Each recess may extend from a respective line of intersection, L23a, L23b, towards a plane extending laterally between an inner edge of the front end 18362a, 18362b of the headrest 18330. A plane of each recess extending between the line of intersection L23a, L23b and the plane extending laterally from an inner edge of the front ends 18362a, 18362b may be coplanar with the adjacent first side impact protection area 18366a, 18366b. The recess may further be defined by the second side impact protection area 18368a, 18368b of the inwardly facing surface 18364a, 18364b. In an embodiment, the head SIP devices 18360a, 18360b are formed from an expanded polypropylene; however, it should be understood that any suitable material may be used.

[1287] The child seat 18300 may additionally include at least one external SIP device. In the illustrated, non-limiting embodiment, a first external SIP device 18370a is arranged at an exterior surface of the back portion 18304, such as proximate the first upright side member 18316, and a second external SIP device 18370b is arranged at the exterior surface of the back portion, such as proximate the second upright side member 18320. As shown, the first external SIP device 18370a may be arranged near a bottom of the belt path opening 18324a and the second external SIP device 18370b may be arranged near a bottom of the belt path opening 18324b. In an embodiment, the external SIP devices 18370a, 18370b may block a portion of each respective belt path opening 18324a, 18324b. Such positioning of the external SIP devices 18370a, 18370b raises the belt path of the vehicle belt when the child seat 18300 is in a forward facing, high back configuration.

[1288] The child seat 18300 may alternatively or additionally include at least one torso SIP device. As shown, a first torso SIP device 18380a may be arranged adjacent to the first seat side member 18346, such as near the first upright side member 18316 and a second, substantially identical torso SIP device (not shown) may be arranged adjacent to the second seat side member 18350, such as near the second upright side member 18320 for example. The torso SIP devices 18380a may be permanently or removably mounted to one or more of an adjacent first seat side member 18346, first upright side member 18316, second seat side member 18350, second upright side member 18320, seat support surface 18340 or upright support surface 18310.

[1289] Another embodiment of a child seat 18400 configured as a booster seat, illustrated in FIGS. 264A- 264B, includes a seat body having a seat portion or seat base18402 and a back portion or seat back 18404 extending at a non-parallel angle relative to the seat portion 18402. The back portion 18404 may be removably connectable to the seat portion 18302. In an embodiment, the child seat 18400 is transformable between a first booster mode (shown), in which the back portion 18404 is connected to the seat portion 18402, and a second mode in which the back portion 18404 is separated from the seat portion 18402. In the second mode, only the seat portion 18402 is positionable on a vehicle seat.

[1290] The back portion 18404 of the child seat 18400 may include an upright support surface 18410 generally facing forward and that extends from a first end or top 18412 to a second, opposite end or bottom 18414 of the back portion 18404. A first upright side member 18416 may be arranged at a first side (not shown) of the upright support surface 18410 and a second upright side member 18420 may be arranged at a second, opposite side 18422 of the upright support surface 18410. The first and second upright side members 18416, 18420 may therefore form the left side and the right side of the back portion 18404, respectively. As shown, the first and second upright side members 18416, 18420 extend forward from the upright support surface 18410. The first and second upright side members 18416, 18420 may extend generally orthogonally to the upright support surface 18410, or alternatively, may extend therefrom at another angle, such as an angle greater than 90° for example (the respective angles therefore being at least 90° for example). Accordingly, the upright support surface 18410 and the first and second upright side members 18416, 18420 define a backrest region or upright support cavity within which an upper body of a child is received.

[1291] In the illustrated, non-limiting embodiment, the back portion 18404 of the child seat 18400 includes a headrest 18430. The headrest 18430 is attached to or integral with the back portion 18404. The headrest 18430 may be stationary or in some embodiments, may be configured to move relative to the upright support surface 18410. For example, the headrest 18430 may be configured to translate relative to the upright support surface 18410 between a vertically retracted position and a vertically extended position, allowing for adjustment based on the size of the child positioned within the child seat 18400.

[1292] As shown, the back portion 18404 of the child seat 18400 may include a headrest 18430. The headrest 18430 may be attached to or integral with the back portion 18404, and may be stationary or in some embodiments, may be configured to move relative to the upright support surface 18410, allowing for adjustment based on the size of the child positioned within the child seat 18400.

[1293] The seat portion 18402 includes a seat support surface 18340 facing generally upwardly and that extends from a first end or front 18442 to a second end or back 18434 of the seat portion 18402. A first seat side member 18446 may be arranged at a first side 18448 of the seat support surface 18440 and a second seat side member 18450 may be arranged at a second, opposite side 18452 of the seat support surface 18440. The first seat side member 18446 and the second seat side member 18450 extend upwardly and form the left side and the right side of the seat portion 18402. The seat support surface 18440 and the first and second seat side member 18446, 18450 in combination define a region within which at least part of a lower body of a child may be received.

[1294] As shown, the seat side members 18446, 18450 extend at an angle from the seat support surface 18440. The angle of the first seat side member 18446 relative to the seat support surface 18440 may but need not be the same as the angle of the first upright side member 18416 relative to the upright support surface 18410. Similarly, the angle of the second seat side member 18450 relative to the seat support surface 18440 may but need not be the same as the angle of the second upright side member 18420 relative to the upright support surface 18410.

[1295] In the illustrated, non-limiting embodiment, each seat side member 18446, 18450 has a slot 18454a, 18454b formed therein configured to function as a lap belt guide during at least one mode of use of the child seat 18400. The slot 18454a, 18454b may be configured to receive and position a lap belt portion of a vehicle restraint or a separate restraint belt to attach the child seat 18400 to a vehicle seat when the child seat 18400 is in a forward-facing high-back configuration.

[1296] As shown, the headrest 18430 may include at least one head SIP device. As shown, the headrest 18430 includes a back portion 18432, a first side member 18434 extending from a first side of the back portion 18432 and a second side member 18436 extending from a second, opposite side of the back portion 18432. An inwardly facing surface 18438 of the headrest 18430 defines a head receiving region 18439. A first head SIP device 18460a may be arranged at or adjacent to the first side member 18434 of the headrest 18430 and a second head SIP device 18460b may be arranged at or adjacent to the second side member 18436 of the headrest 18430. In the illustrated, non-limiting embodiment, a front end 18462a, 18462b of each of the first and second head SIP devices 18460a, 18460b extends beyond a front end 18431a, 18431b of the side members 18434, 18436. The head SIP devices 18460a, 18460b may have any suitable configuration, such as any of the configurations described with respect to FIGS. 1-32C, 82A-63, 122A-124B, 132A-135C, 242A-253B, and 261-261E.

[1297] As shown, the child seat 18400 may include at least one connector member 18470 operable to selectively retain the back portion 18404 at a position relative to the seat portion 18402. In the illustrated, non-limiting embodiment, a first connector member 18470 is arranged at an exterior surface of the back portion 18404, such as proximate the first upright side member 18416. Alternatively, or in addition, the first connector member 18470 is arranged at an exterior surface of the seat portion 18402, such as proximate the first seat side member 18446. In the illustrated, non-limiting embodiment, the first connector member 18470 is located at the interface between the seat portion 18402 and the back portion 18404, such that a front end 18472 of the connector member 18470 is in overlapping arrangement with the first seat side member 18450 and a back end 18474 of the first connector member 18470 is in overlapping arrangement with the first upright side member 18416. As shown, the first connector member 18470 extends outwardly from the child seat 18400 and a front end 18472 of the first connector member 18470 may be positioned behind the adjacent slot 18454a, and the back end 18474 of the first connector member 18470 may be forward of the rear exterior surface 18405 of the back portion 18404 positionable in contact with a seat back of a vehicle seat. In such embodiments, the connector member may extend outwardly from both the back portion 18404 and the seat portion 18402 to define a maximum width of the child seat 18400. The first connector member 18470 may therefore be positioned between the child seat 18400 and a first vehicle door when the child seat 18400 is installed near first side of the vehicle.

[1298] Although not shown, it should be understood that the child seat 18400 may additionally include a second connector member. The second connector member may be arranged at the exterior surface of the back portion 18404, such as proximate the second upright side member 18420, and/or may be arranged at the exterior surface of the seat portion 18402, such as proximate the second seat side member 18450. The second connector member may therefore be positioned between the child seat 18400 and a second vehicle door when the child seat 18400 is installed near a second side of the vehicle. It should be appreciated that the above and following description of the first connector member 18470 may similarly apply to a second connector member.

[1299] The first external SIP device 18470 may be removably connectable to at least a portion of the child seat 18400. In an embodiment, the first external SIP device 18470 is removably connectable to the seat portion 18402. The first external SIP device 18470 may be connected thereto, such as via connector assembly described above with respect to FIGS. 171A-171B. Examples of suitable connector of a connector assembly include but are not limited to snaps, hooks and loops fasteners, resilient tabs, magnets, or other suitable connectors.

In other embodiments, the first external SIP device 18470 may be permanently affixed to the seat portion 18402 of the child seat 18400. A permanent connection between the first external SIP device 18470 and the seat portion 18402 ensures that the first external SIP device 18470 is present during use of the child seat 18400, regardless of whether or not the back portion 18404 is attached to the seat portion 18402.

[1300] Alternatively, or in addition, the first external SIP device 18470 may be removably connectable to the back portion 18404 of the child seat 18400. The first external SIP device 18470 may similarly be connected to the back portion 18404 via a connector assembly of any suitable configuration. The connector assembly associated with the seat portion 18402 may be the same or may be different than the connector assembly associated with the back portion 18404. In embodiments where the first external SIP device 18470 and the second external SIP device (not shown) are connected or connectable to the seat portion 18402 and are connectable to the back portion 18404, the first external SIP device 18470 and the second external SIP device (not shown) may form the mechanism that couples the seat portion 18402 and back portion 18404.

[1301] While each of the various types of SIP devices illustrated and described herein may provide enhanced protection to an occupant of a child seat system, the benefits may be compounded by integrating a plurality of different types of SIP devices into a child seat system. The National Highway Transit Safety Administration (NHTSA) has several injury criteria, set forth in the Federal Motor Vehicle Safety Standard (FMVSS), associated with a child safety system during a crash event. These criteria include head injury criterion (HIC_{15}) and chest deflection in one or both of a forward-facing configuration and a rearward-facing configuration. In some embodiments, each type of SIP device integrated into a child safety system may target a specific injury criterion or type of movement of the child safety system and/or the child occupant of the child safety system during a crash event. For example, a head SIP device may be designed to control head kinematics during a crash event, such as by rolling the occupant's head forward, an external SIP may redirect the load within the child safety seat away from the occupant, a shoulder SIP may reduce lateral translation of an occupant torso, and a torso SIP may reduce lateral translation of an occupant torso. However, because an occupant's head, shoulders, and torso are interconnected, the control provided by an SIP device at a given region of the occupant's body may further affect the movement of other portions of the occupant's body. For example, by directing movement of the occupant's head in a specific manner, a head SIP device may positively influence the torso kinematics of the occupant, making the shoulder SIP device and/or a torso SIP device more effective.

[1302] Accordingly, a child seat system may include a combination side impact protection (SIP) assembly including any combination of SIP devices described herein. A combination SIP assembly of a child seat system may include at least two SIP devices. For example, a child seat system 6800 having a combination SIP assembly including at least one head SIP device 6802 and at least one shoulder SIP device 6804 is illustrated in FIG. 71. A child seat system 6900 having a combination SIP assembly including at least one head SIP device 6902 and at least one torso SIP device 6904 is illustrated in FIG. 72. FIG. 73 shows a child seat system 7000 having a combination SIP assembly including at least one head SIP device 7002 and at least one external SIP device 7004. A child seat system 7100 having a combination SIP assembly including at least one shoulder SIP device 7102 and at least one torso SIP device 7104 is illustrated in FIG. 74, and a child seat system 7200 having a combination SIP assembly including at least one shoulder SIP device 7202 and at least external SIP device 7204 is illustrated in FIG. 75. FIG. 76 illustrates a child seat system 7300 having a combination SIP assembly including at least one torso SIP device 7302 at least one external SIP device 7304.

[1303] Further in some embodiments, the combination SIP assembly of a child seat system include at least three SIP devices. For example, as shown in FIG. 77, a combination SIP assembly of a child seat system 7400 may include at least one head SIP device 7402, at least one shoulder SIP device 7404, and at least one torso SIP device 7406. Alternatively, a combination SIP assembly of a child seat system 7500, shown in FIG. 78, may include at least one head SIP device 7502, at least one shoulder SIP device 7504, and at least one external SIP device 7506. A child seat system 7600 having a combination SIP assembly including at least one head SIP device 7602, at least one torso SIP device 7604, and at least one external SIP device 7606 is illustrated in FIG. 79 and a child seat system 7700 having a combination SIP assembly including at least one shoulder SIP device 7702, at least one torso SIP device 7704, and at least one external SIP device 7406 is illustrated in FIG. 80. In an embodiment, as illustrated in FIG. 81, the child seat system 7800 includes a combination SIP assembly including at least one of each of a head SIP device 7802, a shoulder SIP device 7804, a torso SIP device 7806, and an external SIP device 7808.

[1304] It should be understood that the head SIP devices that are schematically shown in FIGS. 71-81 can be any of the previously described head SIP devices 70, 70a, 70b, 120, 120b, 202a, 202b, 302, 402, 502, 602, 702, 802, 902, 1002, 1102a, 1102b, 1204a, 1204b, 1304a, 1304b, 1404a, 1404b, 1504a, 1504b, 1604a, 1604b, 1704a, 1704b, 1804, 1804b, 1806a, 1806b, 1910a, 1910b, 1920a, 1920b, 2010a, 2010b, 2012a, 2012b, 2104a, 2104b, 2016a, 2106b, 2108a,

2108b, 2210a, 2210b, 2212a, 2212b, 2214a, 2214b, 2216a, 2216b, 2306a, 2306b, 2308a, 2308b,2408a, 2408b, 2410a, 2410b, 2512a, 2512b, 2514a, 2514b, 2604a, 2604b, 2604c, 2704a, 2704b, 2804a, 2804b, 2904, 6504a, 6504b, 6506a, 6506b and 6602 and the like. Similarly, the shoulder SIP devices that are schematically shown can be any one or more of the previously described shoulder SIP devices 72a, 72b, 3012a, 3012b, 3100, 3202, 3300, 3402a, 3402b, 6220a, 6220b, 6320a, 6320b, 6402, 6715a, and 6712b and the like. The torso SIP devices that are schematically shown in FIGS. 71-81 can be any one or more of the previously described torso SIP devices 3502a, 3502b, 3602a, 3602b, 3702a, 3702b, 3804a, 3804b, 3904a, 3904b, 3914a, 3914b, 4002a, 4002b, 4102a, 4102b, 4202a, 4202b, 4302, 4402a, 4402b, 4502a, 4502b, 4602a, 4602b, 6202a, 6202b, 6302a, 6302b and the like. Further, the external SIP devices that are schematically shown can be any one or more of the previously described external SIP devices 74, 4702, 4802, 4902, 5020, 5120, 5220a, 5220b, 5320, 5402, 5502, 5602, 5702, 5808, 5810, 5920a, 5920b, 6020, 6120, and 6410 and the like.

[1305] The term “about” is intended to include the degree of error associated with measurement of the particular quantity based upon the equipment available at the time of filing the application. As used herein, the term “substantially” and derivatives thereof, and words of similar import, when used to describe a size, shape, orientation, distance, spatial relationship, or other parameter includes the stated size, shape, orientation, distance, spatial relationship, or other parameter, and can also include a range up to 10% more and up to 10% less than the stated parameter, including 5% more and 5% less, including 3% more and 3% less, including 1% more and 1% less.

[1306] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the present disclosure. As used herein, the singular forms “a,” “an” and “the” are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms “comprises” and/or “comprising,” when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, element components, and/or groups thereof.

[1307] While the present disclosure has been described with reference to an exemplary embodiment or embodiments, it will be understood by those skilled in the art that various changes may be made, and equivalents may be substituted for elements thereof without departing from the scope of the present disclosure. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the present disclosure without

departing from the essential scope thereof. Therefore, it is intended that the present disclosure not be limited to the particular embodiment disclosed as the best mode contemplated for carrying out this present disclosure, but that the present disclosure will include all embodiments falling within the scope of the claims.

WHAT IS CLAIMED IS:

1. A child seat for receiving an occupant, the child seat comprising:

a seat body having a seat portion, a back portion extending from the seat portion, and a headrest, the back portion defining a cavity for receiving an upper body of the occupant; and

a side impact protection (SIP) device affixed to the seat body within the cavity, wherein a position of the SIP device is adjustable relative to the seat body.

2. The child seat of claim 1, wherein the SIP device is rotatable between a plurality of positions relative to the seat body.

3. The child seat of claim 2, wherein the plurality of positions includes a first position in which a distal end of the SIP device is arranged adjacent to an inward facing surface of the headrest, and a second position, in which the distal end of the SIP device is arranged adjacent to an outer surface of the headrest.

4. The child seat of claim 2, wherein the headrest further comprises a head SIP device.

5. The child seat of claim 4, wherein the plurality of positions includes a first position in which a distal end of the SIP device is arranged adjacent to the head SIP device, and a second position, in which the distal end of the SIP device is spaced away from the head SIP device.

6. The child seat of claim 1, wherein the SIP device is mounted to the headrest.

7. The child seat of claim 6, wherein the SIP device is movable between a plurality of positions relative to the headrest.

8. The child seat of claim 6, wherein the headrest is movable relative to the back portion of the seat body, the SIP device being movable with the headrest relative to the seat body.

9. The child seat of claim 8, wherein the SIP device is rotatable about an axis, the axis being oriented generally parallel to a path of movement of the headrest.

10. The child seat of claim 1, wherein the SIP device is mounted to the back portion of the seat body.

11. The child seat of claim 1, wherein the back portion further comprises an upright support surface and at least one upright side member extending from the upright support surface, the SIP device being arranged at the at least one upright side member.

12. A child seat for receiving an occupant, the child seat comprising:

a seat body having a seat portion and a back portion extending from the seat portion, the back portion being separable from the seat portion; and

a connector member arranged at the seat body, the connector member being connectable to at least one of the seat portion and the back portion to detachably couple the back portion to the seat portion, wherein the connector member is a side impact protection (SIP) device.

13. The child seat of claim 12, wherein the connector member fixes a position of the back portion relative to the seat portion.

14. The child seat of claim 12, wherein the connector member is removably couplable to the back portion.

15. The child seat of claim 14, wherein the connector member is permanently coupled to the seat portion.

16. The child seat of claim 14, wherein the connector member is removably couplable to the seat portion.

17. The child seat of claim 12, wherein the back portion includes an upright side member arranged at a side of the back portion and the seat portion includes a seat side member arranged at a side of the seat portion, the connector member being connectable to the upright side member and the seat side member.

18. The child seat of claim 17, wherein a body of the connector member is positioned in overlapping arrangement with a portion of the upright side member and a portion of the seat side member.

19. The child seat of claim 12, wherein the connector member is arranged at an exterior of the seat body.

20. The child seat of claim 19, wherein the connector member extends outward from both of the seat back and the seat base to define a maximum width of the child seat.

21. The child seat of claim 19, wherein the connector member is an external SIP device.

22. The child seat of claim 12, wherein the connector member is arranged at an interior of the seat body.

23. The child seat of claim 22, wherein the connector member is a torso SIP device.

24. The child seat of claim 12, wherein the child seat is a booster seat.

25. A child seat for receiving an occupant, the child seat comprising:

a seat body having a seat portion and a back portion extending from the seat portion, the seat body being transformable between a first configuration and a second configuration; and

a side impact protection (SIP) device connectable to the seat body.

26. The child seat of claim 25, wherein the SIP device is connectable to the seat body in both the first configuration and the second configuration.

27. The child seat of claim 25, wherein the SIP device is connectable to the seat body in only one of the first configuration and the second configuration.

28. The child seat of claim 25, wherein in the first configuration, the back portion is attached to the seat portion, and in the second configuration, the back portion is separated from the seat portion.

29. The child seat of claim 25, wherein the SIP device is arranged at the back portion.

30. The child seat of claim 29, wherein the SIP device is arranged at an exterior surface of the back portion.

31. The child seat of claim 25, wherein the seat body includes at least one belt path opening associated with a vehicle belt path, and the SIP device is affixed to the seat body proximate the vehicle belt path.

32. The child seat of claim 31, wherein the SIP device overlaps a portion of the at least one belt path opening.

33. The child seat of claim 31, wherein the at least one belt path opening is formed at the back portion.

34. A child seat for installation on a vehicle seat, the child seat comprising:

a seat body having a seat portion and a back portion extending from the seat portion, the seat body having a vehicle belt path for receiving a belt associated with the vehicle seat; and

wherein a wall of the seat body proximate the vehicle belt path has a first thickness and the wall of the seat body at a location remote from the vehicle belt path has a second thickness, the first thickness being greater than the second thickness.

35. The child seat of claim 34, wherein the seat body includes an opening formed in the wall, the opening being associated with the vehicle belt path.

36. The child seat of claim 35, wherein the wall has the first thickness adjacent to the opening.

37. The child seat of claim 35, wherein the wall includes a ridge formed about a periphery of the opening, the wall at the ridge having the first thickness.

38. The child seat of claim 35, further comprising a side impact protection (SIP) device arranged at the back portion of the seat body.

39. The child seat of claim 35, wherein the SIP device is positioned proximate the opening.

40. A child seat for receiving an occupant, the child seat comprising:

a seat body having a seat portion and a back portion extending from the seat portion, the back portion being detachably couplable to the seat portion; and

a side impact protection (SIP) device connected to the back portion, the SIP device being aligned with a hip of the occupant.

41. The child seat of claim 40, wherein the SIP device is arranged at an interior of the back portion.

42. The child seat of claim 41, wherein the back portion includes an upright support surface and an upright side member extending from the upright support surface, the SIP device being connectable to the upright side member.

43. The child seat of claim 41, wherein the back portion includes an upright support surface and an upright side member extending from the upright support surface, the SIP device being connectable to the upright support surface.

44. The child seat of claim 40, wherein the SIP device is permanently connected to the back portion.

45. The child seat of claim 40, wherein the SIP device is removably connected to the back portion.

46. The child seat of claim 40, wherein the SIP device is arranged proximate an interface between the seat portion and the back portion.

47. The child seat of claim 40, wherein the SIP device is removably connectable to the back portion.

48. The child seat of claim 47, wherein the SIP device is operable to affix the back portion in position relative to the seat portion.

49. The child seat of claim 47, wherein the seat portion includes a seat support surface and a seat side member extending from the seat support surface, the SIP device being connectable to the seat side member.

50. The child seat of claim 47, wherein the seat portion includes a seat support surface and a seat side member extending from the seat support surface, the SIP device being connectable to the seat support surface.

51. A child seat for receiving an occupant, the child seat comprising:

a seat body having a seat portion and a back portion extending from the seat portion; and

a side impact protection (SIP) device arranged at an exterior of the back portion, wherein the SIP device is permanently affixable to the seat body.

52. The child seat of claim 51, wherein the seat body includes at least one slot and the SIP device includes at least one mounting member, the at least one mounting member being receivable within the at least one slot.

53. The child seat of claim 52, wherein the at least one slot includes a plurality of slots and the at least one mounting member includes a plurality of mounting members, each of the plurality of mounting members being receivable within one of the plurality of slots.

54. The child seat of claim 52, wherein when the at least one mounting member is installed at the at least one slot, movement of the at least one mounting member in a direction away from the at least one slot if restricted.

55. The child seat of claim 52, wherein the at least one mounting member includes a locking element, the locking element being permanently engageable with the at least one slot.

56. The child seat of claim 55, wherein a diameter of the locking element varies over an axial length of the locking element.

57. The child seat of claim 55, wherein the at least one slot includes a directional control member, the directional control member being movable in only a first direction.

58. The child seat of claim 57, wherein the directional control member includes at least one resilient tooth operable to flex in the first direction.

59. The child seat of claim 57, wherein the directional control member defines an opening, the opening having a diameter equal to a minimum diameter of the locking element.

60. The child seat of claim 57, wherein the locking element has a head and a neck, a diameter of the head being greater than a diameter of the neck, wherein the directional control member defines an opening, the opening having a diameter equal to or greater than the diameter of the neck and smaller than a maximum diameter of the head.

61. The child seat of claim 60, wherein the directional control member is movable in the first direction to increase the diameter of the opening to equal to or greater than the maximum diameter of the head.

62. The child seat of claim 52, wherein the SIP device further comprises an energy absorbing structure arranged within an interior of the SIP device.

63. The child seat of claim 62, wherein the energy absorbing structure is interconnected with the at least one mounting member.

64. The child seat of claim 62, wherein the energy absorbing structure is a crushable structure.