STRUCTURE MOUNTED AIRBAG ASSEMBLIES AND ASSOCIATED SYSTEMS AND METHODS

TECHNICAL FIELD

[0001] The following disclosure relates generally to vehicle safety systems, and more specifically to structure mounted airbag assemblies for aircraft and associated systems and methods.

BACKGROUND

[0002] Various types of seat belt and airbag systems have been used to protect passengers in automobiles, aircraft and other vehicles. In automobiles, for example, airbags typically deploy from the steering column, dashboard, side panel, and/or other fixed locations. During a rapid deceleration event (e.g., a collision), a sensor detects the event and transmits a corresponding signal to an initiation device (e.g., a pyrotechnic device) on an airbag inflator. This causes the inflator to release compressed gas into the airbag, thereby rapidly inflating the airbag.

[0003] Although airbags that deploy from stationary locations (e.g., a steering column) may be effective in automobiles, they may not be as effective in other types of vehicles having other seating arrangements. Seats in commercial passenger aircraft, for example, can be configured in a variety of layouts that provide different spacing between succeeding rows and adjacent seats. The aircraft seatbacks may also rotate forward and downward during a crash or similar event, and thus may be unsuitable for airbag storage. As a result, airbags have been developed that deploy from seat belts to accommodate occupants in aircraft and other vehicles.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] Figure 1 is a top isometric view of a seating area in a vehicle having a seat provided with an airbag housing and related systems configured in accordance with an embodiment of the disclosure.

[0005] Figure 2A is a partially schematic isometric view of an interior portion of a structure mounted airbag system configured in accordance with an embodiment of the disclosure.

[0006] Figures 2B and 2C are enlarged front and back isometric views, respectively, of a structure mountable airbag assembly configured in accordance with an embodiment of the disclosure.

[0007] Figure 2D is front view of the structure mountable airbag assembly of Figures 2B and 2C during an intermediate assembly stage in accordance with an embodiment of the disclosure.

[0008] Figures 3A-3E are a series of views illustrating deployment of a structure mounted airbag system in accordance with an embodiment of the disclosure.

[0009] Figures 4A-4C are a series of views illustrating various structure mounted airbags configured in accordance with embodiments of the disclosure.

DETAILED DESCRIPTION

[0010] The present disclosure describes structure mounted air bag assemblies for use in, e.g., aircraft and associated systems and methods. In several embodiments, for example, a structure mounted airbag system in a commercial aircraft can include a housing positioned forward of and offset from a passenger seat. The housing can contain an airbag mounted behind a covered opening. During a crash or rapid deceleration event, the airbag can deploy through the opening toward the seat to reduce the impact experienced by the occupant. Since the structure mounted airbag system is offset from the vehicle seat, the airbag deploys in a manner that avoids direct contact with out-of-position seat occupants, such as occupants in the brace position (i.e., occupants with their head between their knees) and small children (e.g., children seated in a child seat or lap-held children). As used herein, the terms "structure mounted" and "structure mountable" refer to features that are or can be mounted to a substantially fixed structure (e.g., a wall, divider, or a fixed piece of furniture) rather than to a movable feature (e.g., a seat belt, a commercial aircraft seat back, etc.).

[0011] Certain details are set forth in the following description and in Figures 1-4C to provide a thorough understanding of various embodiments of the disclosure.

For example, several embodiments of structure mounted airbag systems are described below in the context of commercial passenger aircraft. However, the structure mounted airbag systems and aspects thereof disclosed herein may be used in a wide variety of other vehicles, including other aircraft (e.g., private and military aircraft), ground vehicles (e.g., automobiles, trucks, buses, trains, and motor homes), watercraft, etc. Other details describing well-known structures and systems often associated with airbags, circuitry, restraint systems, etc., have not been set forth below to avoid unnecessarily obscuring the description of the various embodiments of the disclosure.

[0012] Many of the details, dimensions, angles and other features shown in Figures 1-4C are merely illustrative of particular embodiments of the disclosure. Accordingly, other embodiments can include other details, dimensions, angles and features without departing from the spirit or scope of the present invention. In addition, those of ordinary skill in the art will appreciate that further embodiments of the structure mounted airbag systems can be practiced without several of the details described below.

[0013] In the Figures, identical reference numbers identify identical or at least generally similar elements. To facilitate the discussion of any particular element, the most significant digit or digits of any reference number refers to the Figure in which that element is first introduced. For example, element 110 is first introduced and discussed with reference to Figure 1.

[0014] Figure 1 is a top isometric view of a seating area in an aircraft having one or more seats 102 provided with a structure mounted airbag system 100 ("airbag system 100") configured in accordance with an embodiment of the disclosure. In one aspect of the illustrated embodiment, the seats 102 can be at least generally similar to conventional seats in, for example, a first or business class cabin of a commercial passenger aircraft. Accordingly, each seat 102 can include a back portion 104 extending upwardly from a seat portion 106 fixedly mounted to the floor of the aircraft. The seats 102 can each include a two-point restraint or seat belt 110 (e.g., a lap belt) having a first web portion 112a and a corresponding second web portion 112b. A proximal end portion of the first web portion 112a can be fixedly attached to the seat mounting structure on one side of the seat 102 by means of a hook or other suitable device known in the art, and the proximal end portion of

the second web portion 112b can be similarly attached to the seat mounting structure on the opposite side of the seat 102. The distal end portion of the first web portion 112a can carry a connector 114 having a tongue portion, and the distal end portion of the second web portion 112b can carry a corresponding buckle 116 configured to receive and releasably engage the tongue portion of the connector 114 to couple the two web portions 112a, 112b together around a seat occupant in a conventional manner.

[0015] In one aspect of the illustrated embodiment, the airbag system 100 includes an enclosure or housing 120 fixedly attached to the floor of the vehicle forward of the seat 102 and offset to one side of the seat 102. The housing 120 can be positioned to the outside of the seat 102 proximate to the aisle of the aircraft and apart from the window and/or other inwardly positioned structure (e.g., a divider wall) as shown in Figure 1. In other embodiments, the housing 120 can be positioned proximate to the window, between individual seats 102 in a row, and/or otherwise positioned forward of the seat 102. As described in greater detail below, an airbag (not shown) can be stored in the housing 120 and deployed through an opening in the housing 120 toward the seat 102 during a rapid deceleration or other crash event to lessen the crash impact experienced by the seat occupant. The airbag system 100 can protect the passenger's head during forward rotation about the two-point seat belt 110, and the offset positioning of the housing 120 can also provide sufficient space around the seat 102 for the passenger to move to a brace position (i.e., with the passenger's head between his or her knees) and avoid impacting the airbag as it deploys. Additionally, the housing 120 can serve to hide the airbag from view of the seat occupant to provide an aesthetically pleasing seating environment.

[0016] Figure 2A is a partially schematic isometric view of an interior portion of the airbag housing 120 of Figure 1 configured in accordance with an embodiment of the disclosure. In the illustrated embodiment, the housing 120 includes a plurality of sidewalls 238 extending upwardly from a mounting structure 222 to form a cavity 224 (one sidewall 238 is removed to show the interior of the housing 120). At least one of the sidewalls 238 (e.g., the sidewall 238 facing the corresponding aircraft seat) can include an aperture or opening 226 in communication with the internal cavity 224. A structure mounted airbag assembly 228 ("airbag assembly 228") is

positioned in the cavity 224 in line with the opening 226 such that the corresponding airbag (not shown) can deploy through the opening 226 during airbag inflation. For clarity, the airbag assembly 228 is shown spaced behind the opening 226, but the airbag assembly 228 can be mounted directly adjacent the opening 226 and against the corresponding sidewall 238 via screws, mounting plates, and/or other suitable attachment features. In other embodiments, the airbag assembly 228 can be positioned in other suitable locations within the cavity 224 that allow the airbag to deploy through the opening 226 or a different opening in another suitable location.

[0017] The housing 120 can be a separate or independent structural assembly that can be fixedly attached to a portion of the aircraft interior via the mounting structure 222 and inhibit passengers from accessing the airbag assembly 228 and/or associated components stored within the housing 120 (e.g., to inhibit inadvertent airbag deployment). The housing 120 can be made from a durable composite material and/or other suitable materials for storing the components of the airbag system 100 (e.g., the airbag assembly 228) to reduce the likelihood of unintentional airbag deployment (e.g., due to passenger wear and tear on the housing 120). In certain embodiments, the housing 120 can also serve as a partial divider between aircraft seats 102 (Figure 1) and/or a table for seat occupants. A portion of the cavity 224 can also be used as storage for the seat occupant's belongings, for additional safety equipment (e.g., life vests), and/or for other items. In other embodiments, the housing 120 can be attached to or integrally formed with a portion of the aircraft (e.g., the interior sidewalls of the aircraft). The housing 120, for example, can be incorporated into a sidewall of the aircraft from which the airbag 228 can deploy.

[0018] In the illustrated embodiment, the housing 120 includes a cover or door 234 positioned across the opening 226 that at least substantially conceals the cavity 224 from view before airbag deployment. In Figure 2A, the door 234 is shown spaced apart from the opening 226 for clarity. The door 234 can be attached to the housing 120 using one or more releasable fasteners that swing or otherwise enable the door 234 to move away from the opening 226 under the force of the inflating airbag, thereby allowing the airbag to deploy through the opening 226. The door 234, for example, can be secured over the opening 226 with a plurality of screws that are configured to break under the force of airbag deployment. In other

embodiments, the door 234 can be configured to automatically move away from the opening 226 in response to a crash event rather than relying on the force of the airbag. The door 234, for example, can include electronics to automatically slide, pivot, and/or otherwise move away from the opening 226 in anticipation of airbag deployment.

[0019] In various embodiments, one or more lanyards 236 made from webbing material used for seat belts and/or other suitable materials can be attached between the door 234 and the housing 120. The lanyards 236 retain the door 234 to the housing 120 when the airbag projects through the opening 226 and prevent the door 234 from flying through the aircraft cabin. In certain embodiments, the lanyards 236 can be configured to enable the door 234 to rotate or otherwise move to an open position that is substantially flush with the adjacent sidewall 238 of the housing 120 and out of the way of the seat occupant during egress. In other embodiments, hinges and/or other suitable movable coupling mechanisms can be used to retain the door 234 to the housing 120 during and after airbag deployment.

[0020] The airbag assembly 228 can include various features that allow it to be preassembled before mounting it in the housing 120. Figures 2B and 2C, for example, are enlarged front and back isometric views, respectively, of the airbag assembly 228 configured in accordance with an embodiment of the disclosure, and Figure 2D is front view of the airbag assembly 228 during an intermediate assembly stage. As shown in Figures 2B and 2C, the airbag assembly 228 can include an airbag 254 folded or otherwise stowed within an airbag container or cover 256. The cover 256 can be made from a flexible material, such as a thin film material made from nylon or polyamide, and can include one or more tear seams (not shown) that are designed to rupture upon airbag inflation. In other embodiments, at least a portion of the cover 256 can be made from a semi-rigid and/or rigid material that ruptures and/or otherwise releases the airbag 254 during inflation.

[0021] The airbag assembly 228 can be secured to the housing 120 (Figure 2A) with a dual-plate mounting structure. The mounting structure can include an internal mounting plate 258 (e.g., a U-shaped mounting plate as shown in Figure 2D) positioned inside the airbag 254 and affixed to an external mounting plate 260 (Figure 2C) via a plurality of fasteners (e.g., screws 262). This configuration enables the peripheral portions of the external mounting plate 260 to be secured across the

opening 226 of the housing 120. This dual-plate mounting structure allows the airbag assembly 228 to be preassembled before mounting to a suitable housing (e.g., the housing 120 shown in Figure 1). Figures 2B-2D illustrate a certain embodiment of such a dual plate mounting structure. As those skilled in the art will understand, however, the dual-plate mounting structure as well as other suitable mounting structures can have a variety of different configurations to accommodate the structural features to which they are attached.

[0022] In various embodiments of the airbag assembly 228, the airbag 254 can include an active vent (not shown) that opens when the pressure within the airbag 254 reaches a predetermined threshold. The vent, for example, can be a discrete seam on the airbag 254 that is sewn shut and tears open at a designated pressure (e.g., when the occupant contacts the airbag 228). This feature can be of particular use with two-point restraints that do not restrain forward movement of the occupant's upper body because it limits the force with which the seat occupant impacts the airbag and reduces the rebound of the occupant from the airbag 254. The vent can also allow the airbag 254 to deflate rapidly (e.g., within seconds) after inflation so it does not impede occupant egress from the seat in an emergency situation.

[0023] Referring back to Figure 2A, the airbag system 100 can further include an airbag inflator 230 (shown schematically) in fluid communication with the airbag assembly 228, and an electronics module assembly 232 (shown schematically) operably coupled to the inflator 230. The inflator 230 can include a container of compressed gas (e.g., air) and a pyrotechnic device (e.g., a squib connector) that can be activated by a signal sent by the electronics module assembly 232 in response to a crash event. The signal initiates the squib, which causes the container to release the expanding gas into the airbag. In other embodiments, the inflator 230 can include other suitable initiation and/or inflation devices (e.g., gas-generating inflators) well known in the art.

[0024] In various embodiments, the inflator 230 can be spaced apart from the airbag assembly 228 and fluidly coupled thereto using a gas delivery hose 240 and/or other suitable fluid passageway. The gas delivery hose 240 can include a first end fitting 241a in fluid communication with the interior of the airbag and a second end fitting 241b (e.g., an inflator connector as disclosed in U.S. Patent Application No. 13/194,411, which is herein incorporated by reference in its entirety)

threadably or otherwise engaged with an outlet of the inflator 230. The gas delivery hose 240 can have suitable dimensions for rapid gas delivery to the airbag depending at least in part on the distance between the inflator 230 and the airbag assembly 228. In certain embodiments, for example, the gas delivery hose 240 may have a deflated width of 1.125 inches (28.58 mm) and an inflated outer diameter of 0.75 inch (19.05 mm).

[0025] In some embodiments, the inflator 230 can be positioned outside the housing 120 and/or spaced apart from the airbag assembly 228 in the cavity 224, and the gas delivery hose 240 can extend between the airbag assembly 228 and the inflator 230. The remotely positioned inflator 230, for example, can be mounted in any suitable orientation and secured to a portion of the aircraft (e.g., under the housing 120, under the floor of the aircraft proximate the housing 120, etc.) using brackets and/or other suitable mounting structures that can withstand loads encountered during normal aircraft operation, gas deployment from the inflator 230, and certain impact loads (e.g., loads applied under a 16g dynamic test). The gas delivery hose 240 can be made from a suitable flexible material that can accommodate the positioning of the inflator 230 relative to the airbag assembly 228 and yet be durable enough to withstand the delivery of the expanding gas to the airbag and regular wear. The modular positioning of the inflator 230 with respect to the airbag assembly 228 provided by the gas delivery hose 240 allows the airbag system 100 to accommodate the space constraints of the housing 120 and the vehicle itself. In further embodiments, the gas delivery hose 240 can be omitted, and the outlet of the inflator 230 can be positioned in direct fluid communication with the airbag assembly 228.

[0026] In the illustrated embodiment, the electronics module assembly 232 includes a processor 244 that receives electrical power from a power source 246 (e.g., one or more lithium batteries), a deployment circuit 252 that initiates the inflator 230, and at least one crash sensor 248 that detects rapid decelerations and/or other crash events. The crash sensor 248, for example, can include a spring-mass-damper type sensor with an inertial switch calibrated for the vehicle's operating environments that initiates airbag deployment upon a predetermined deceleration level. In other embodiments, the crash sensor 248 can include other suitable types of sensors known in the art. Optionally, the electronics module

assembly 232 can also include one or more magnetic field sensors 250 that detect the presence of an external magnetic field (e.g., from a speaker) and communicate with the processor 244 to deactivate the crash sensor 248 and prevent inadvertent deployment of the airbag assembly 228. The magnetic field sensor 250 can include, for example, the circuitry disclosed in U.S. Patent No. 6,535,115, entitled "AIR BAG HAVING EXCESSIVE EXTERNAL MAGNETIC FIELD PROTECTION CIRCUITRY," which is herein incorporated by reference in its entirety. In other embodiments, the electronics module assembly 232 can include other sensors and/or additional features to aid in airbag deployment, and/or some of the components of the electronics module assembly 232 may be omitted. In certain embodiments, for example, the electronics module assembly 232 can include only the power source 246 and the crash sensor 248, which completes a circuit to activate the inflator 230 during a crash event. The components of the electronics module assembly 232 can be housed in a protective cover (e.g., a machined or injection-molded plastic box) that can reduce the likelihood of damaging the electronics module assembly 232 and a magnetic shield that can prevent the electronics module assembly 232 from inadvertently deploying the airbag assembly 228. In other embodiments, the electronics module assembly 232 can be stored in the housing disclosed in U.S. Provisional Patent Application No. 61/533,105, entitled "ELECTRONICS MODULE ASSEMBLY FOR INFLATABLE PERSONAL RESTRAINT SYSTEM AND ASSOCIATED METHODS," which is herein incorporated by reference in its entirety, and/or other suitable electronics housings known in the art. In further embodiments, the electronics module assembly 232 can include diagnostic testing features, such as those described in U.S. Patent Application No. 13/174,659, entitled "INFLATABLE PERSONAL RESTRAINT SYSTEMS" and U.S. Patent Application No. 13/228,333, entitled "COMPUTER SYSTEM FOR REMOTE TESTING OF INFLATABLE PERSONAL RESTRAINT SYSTEMS," which are herein incorporated by reference in their entireties.

[0027] Similar to the modular positioning of the inflator 230, the electronics module assembly 232 can also be housed within the cavity 224 or in a remote location proximate the housing 120 and coupled to the inflator 230 via suitable electrical connectors. The electronics module assembly 232, for example, can be positioned on the underside of the housing 120, under a seat, or elsewhere in the

aircraft. When mounted remotely, the electronics module assembly 232 can be positioned to properly transmit the crash pulse and reduce vibration effects.

[0028] During a crash event above a predetermined threshold, the crash sensor 248 of the electronics module assembly 232 can close one or more switches, thereby causing the processor 244 to send a corresponding signal to the deployment circuit 252. Upon receiving a signal from the processor 244, the deployment circuit 252 can apply a sufficient voltage to an igniter (e.g., a squib) that causes the inflator 230 to discharge its compressed gas into the airbag 254 via the gas delivery hose 240. The expansion of the compressed gas inflates the airbag 254 (Figures 2B-2D) and causes it to deploy through the opening 226 in the housing 120. The door 234 moves away from the opening 226 (e.g., due to the force applied by the inflating airbag 254), allowing the airbag 254 to expand toward the occupant in the corresponding seat. The lanyards 236 can retain the opened door 234 substantially flush to the housing 120 such that it does not interfere with the occupant during subsequent egress. The airbag 254 can be offset from the seat so that it deploys in a direction that avoids direct contact with the seat occupant if the occupant is in the brace position. The airbag 254 is also positioned forward enough from the seat and sized appropriately to avoid contact with lap-held children or children in child seats. The active vent on the airbag 254 can reduce the force on the occupant at impact with the airbag 254 (e.g., a head impact criterion under 1,000), reduce rebound of the occupant's head from the airbag 254, and can also allow the airbag 254 to deflate quickly after impact (e.g., within 10 seconds) to further facilitate egress from the seat. Additionally, the modular airbag system 100 (e.g., the self-contained airbag assembly 228, inflator 230 and the electronics module assembly 232) can accommodate the space constraints of differing structural mounting locations and can be independent of other aircraft systems (e.g., without needing to be interfaced with the aircraft wiring).

[0029] Figures 3A-3E are a series of isometric views illustrating deployment of a structure mounted airbag system 300 configured in accordance with an embodiment of the disclosure. The structure mounted airbag system 300 can include features generally similar in structure and function to the features of the structure mounted airbag system 100 described above with reference to Figures 1-2D. The structure mounted airbag system 300 can include, for example, a structurally mounted airbag

assembly (not shown) positioned in a housing 320 positioned in front of and offset from an aircraft seat 302. Referring to Figure 3A, upon detection of a crash event (e.g., by a crash sensor operably coupled to the airbag assembly in the housing 320), an airbag 354 inflates and through an opening 326 in the housing 320 toward a seat occupant 301, thereby moving a door 334 away from the opening 326. One or more hinges 336, lanyards, and/or other suitable features can be secured to the lower portion of the door 334 to retain the door 334 to the housing 320 and prevent it from launching toward the seat occupant 301.

[0030] Referring to Figure 3B, the inflation of the airbag 354 can rotate the door 334 downward against the housing 320, and thereby move it out of the way of the seat occupant 301 to facilitate subsequent egress (e.g., after a crash). In the illustrated embodiment, the airbag 354 includes a first portion 364 extending in a generally vertical direction adjacent to the housing 320 and having a substantially tubular shape, and a second portion 366 that extends generally laterally with respect to the first portion 364 toward the seat occupant 301 giving the airbag 354 a generally L-shaped cross-section. The second portion 366 can have a generally triangular cross-sectional shape that impedes the forward acceleration of the seat occupant's upper torso before the airbag 354 makes contact with the seat occupant's head, and therefore decreases the force with which the seat occupant's head strikes the airbag 354. In further embodiments, the airbag 354 can have other suitable configurations to accommodate the seat configuration, such as the airbags described below with references to Figures 4A-4C.

[0031] The airbag 354 can include an active vent 368 that remains closed until the internal pressure of the airbag 354 reaches a predetermined threshold, such as when the seat occupant's head impacts the airbag 354 and/or when the airbag 354 is fully inflated. In the illustrated embodiment, the vent 368 is an elongated seam at the underside of the second portion 366 of the airbag 354 that tears or otherwise ruptures at the threshold pressure to release the gas (e.g., air) from within the airbag 354. In other embodiments, the vent 368 can be positioned elsewhere on the airbag 354 and/or have other suitable configurations (e.g., a valve or plug), or it can be omitted.

[0032] Figure 3C is a top view of the seating arrangement of Figure 3B illustrating that the structure mounted airbag system 300 provides a first area or

zone 370 and a second area or zone 372 spaced apart from the inflated airbag 354. The first zone 370 is located at the seat 302 to provide sufficient space between the inflated airbag 354 and the seat 302 to prevent direct airbag deployment directly into a child (not shown) sitting in the seat 302, in the lap of the seat occupant 301, and/or in a child seat secured to the seat 302. The second zone 372 is spaced in front of the seat 302 to avoid airbag deployment directly into the seat occupant's head when he or she is in a brace position. As the foregoing illustrates, the structure mounted airbag system 300 can accommodate a wide range of occupant sizes and positions.

[0033] Figure 3D illustrates the structure mounted airbag system 300 after the seat occupant 301 impacts the airbag 354. The load experienced by the occupant's upper body is distributed across the expanded airbag 354 to mitigate injury. In various embodiments, the impact of the seat occupant 301 against the airbag 354 can activate the vent 368 (Figure 3B) to rapidly decrease the pressure within the airbag 354 and further reduce the impact experienced by the seat occupant 301. As shown in Figure 3E, the vent 368 can also serve to quickly deflate the airbag 354 to provide a substantially clear passageway for the seat occupant 301 to move away from the seat 302.

[0034] Figures 4A-4C are a series of views illustrating various airbags 454a-c for use with structure mounted airbag assemblies configured in accordance with embodiments of the disclosure. In Figure 4A, airbag 454a can include a lateral portion 474 that projects from the main body portion of the airbag 454a. The airbag 454a, therefore, has a complex shape that at least generally conforms to the complex shape of the structure or monument forward of the seat occupant 401 to provide a suitable barrier there between. Similar to the airbags described above, the airbag 454a shown in Figure 4A is configured to avoid contact with seat occupants that are in the brace position and out-of-position occupants (e.g., lap-held children). In other embodiments, the airbag 454a can have other suitable complex shapes that conform to the shape of monuments positioned forward of an aircraft seat.

[0035] As shown in Figure 4B, in further embodiments, the airbag 454b can be mounted to a structure (e.g., a dividing wall) substantially or directly in front of the seat occupant 401. In the illustrated embodiment, the airbag 454b has a generally hemispherical cross-sectional shape, but in other embodiments the airbag 454b may

have a generally triangular cross-sectional shape to absorb upper body impact before the seat occupant's head hits the airbag and/or other suitable airbag shapes.

[0036] In still further embodiments, the airbag 454c can be mounted to a permanent or semi-permanent structure proximate to the seat and in line with the vehicle direction. As shown in Figure 4C, for example the airbag 454c can be positioned to the side of the aircraft seat (e.g., on a divider wall between aircraft seats) and generally in line with the aircraft direction (i.e., as indicated by arrow 476). In additional embodiments, the structure mounted airbag systems and assemblies disclosed herein can be mounted to other suitable structures and/or have other suitable configurations.

[0037] From the foregoing, it will be appreciated that specific embodiments have been described herein for purposes of illustration, but that modifications may be made without deviating from the spirit and scope of the various embodiments of the disclosure. The airbag system 100 illustrated in Figures 1-2D can include, for example, additional airbags assemblies 228 and/or inflators 230 operably coupled to the electronics module assembly 232 for use with the additional vehicle seats (e.g., within the same row as the seat 102). In various other embodiments, the housing 120 may be omitted and the airbag assembly 228 can be mounted directly to a portion of the aircraft (e.g., within the wall of the aircraft). Specific elements of any of the foregoing embodiments can also be combined or substituted for elements in other embodiments. Moreover, the restraint system described above can be incorporated in non-automobile or non-aircraft systems. Certain aspects of the disclosure are accordingly not limited to automobile or aircraft systems. Furthermore, while advantages associated with certain embodiments of the disclosure have been described in the context of these embodiments, other embodiments may also exhibit such advantages, and not all embodiments need necessarily exhibit such advantages to fall within the scope of the technology. Accordingly, the disclosure is not limited except as by the appended claims.

CLAIMS

1. An airbag system for use with an aircraft seat, the airbag system comprising:

a housing having a cavity and an opening in communication with the cavity; and

an airbag assembly positioned within the cavity, wherein the airbag assembly comprises—

an airbag configured to deploy through the opening toward the aircraft seat to protect an occupant in the aircraft seat during a crash event, and

a mounting structure including at least one mounting plate within the airbag and configured to attach the airbag assembly to the housing.

2. The airbag system of claim 1 wherein the mounting plate is an interior mounting plate, and wherein the airbag assembly further includes an exterior mounting plate attached to the interior mounting plate and configured to attach the airbag assembly across the opening of the housing.

3. The airbag system of claim 1, further comprising a door removably covering the opening, the door being configured to move away from the opening during airbag deployment.

4. The airbag system of claim 1, further comprising:

an inflator spaced apart from the airbag; and

a gas delivery hose extending from the inflator to the airbag, wherein the gas delivery hose is configured to provide a fluid passageway from the inflator to the airbag.

5. An airbag assembly for a seat in an aircraft, the airbag assembly comprising:

an airbag; and

a mounting structure comprising an internal mounting plate positioned within the airbag and an external mounting plate positioned outside of the airbag and attached to the internal mounting plate, wherein a peripheral portion of the external mounting plate is configured to fixedly attach to a portion of the aircraft.

6. The airbag assembly of claim 5, further comprising a monument having a plurality of sidewalls that form a cavity, at least one of the sidewalls having an opening, wherein the airbag and the mounting structure are positioned in the cavity and generally aligned with the opening.

7. An airbag system configured for use with an aircraft seat, the airbag system comprising:

a monument configured to be positioned forward of the aircraft seat, wherein the monument includes a covered opening; and

an airbag assembly comprising a mounting structure and an airbag, wherein the mounting structure comprises a mounting plate configured to be secured to the monument, wherein the airbag is affixed to the mounting plate and configured to deploy through the opening in the monument during a crash event.

8. The airbag system of claim 7 wherein the mounting plate is an external mounting plate, and wherein the mounting structure further comprises an internal mounting plate positioned within the airbag and attached to the external mounting plate, and further wherein a peripheral portion of the external mounting plate is configured to fixedly attach to the monument within the aircraft.

9. An airbag system for use with an aircraft seat in an aircraft, the airbag system comprising:

a monument having a cavity, wherein the monument is an independent structural assembly fixedly attached to an interior of the aircraft, and wherein the

entire monument is offset to one side of a centerline of the aircraft seat and forward of the aircraft seat in line with a forward vehicle direction;

an airbag assembly positioned within the cavity of the monument, the airbag assembly having an airbag configured to deploy toward an aircraft seat through an opening in the monument to protect an occupant in the aircraft seat during a crash event; and

an inflator operably coupled to the airbag.

10. The airbag system of claim 9 wherein the airbag, when inflated, is offset to one side of the centerline of the aircraft seat to avoid direct contact with the occupant when the occupant is in a brace position.

11. The airbag system of claim 9 wherein the monument is adjacent to an aisle of the aircraft.

12. The airbag system of claim 9 wherein the monument is adjacent to an interior wall of the aircraft between a foot well of the aircraft seat and the interior wall of the aircraft.

13. The airbag system of claim 9 wherein the monument is positioned forward of and between the aircraft seat and an adjacent seat in the aircraft.

14. The airbag system of claim 9 wherein the airbag, when inflated, is configured to protect a head of the occupant during forward rotation about a two-point seat belt of the aircraft seat.

15. The airbag system of claim 9 wherein the aircraft seat is positioned at an angle relative to the vehicle direction.

16. An airbag system for use with an aircraft seat in an aircraft, the airbag system comprising:

a housing having a cavity, wherein the housing is forward of and offset to one side of the aircraft seat;

an airbag assembly positioned within the cavity of the housing, the airbag assembly having an airbag configured to deploy through a portion of the housing and inflate toward the aircraft seat to protect an occupant in the aircraft seat during a crash event, wherein—

the aircraft seat defines a first zone,

an area directly forward of the aircraft seat defines a second zone, and

the airbag, when inflated, is spaced apart from and avoids entering the first zone and the second zone; and

an inflator operably coupled to the airbag.

17. The airbag system of claim 16 wherein the aircraft seat is positioned at an angle relative to a vehicle direction.