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(54) **SOFT CRASH-BARRIER IMPACT-ATTENUATION SYSTEM, DEVICE, AND METHOD**

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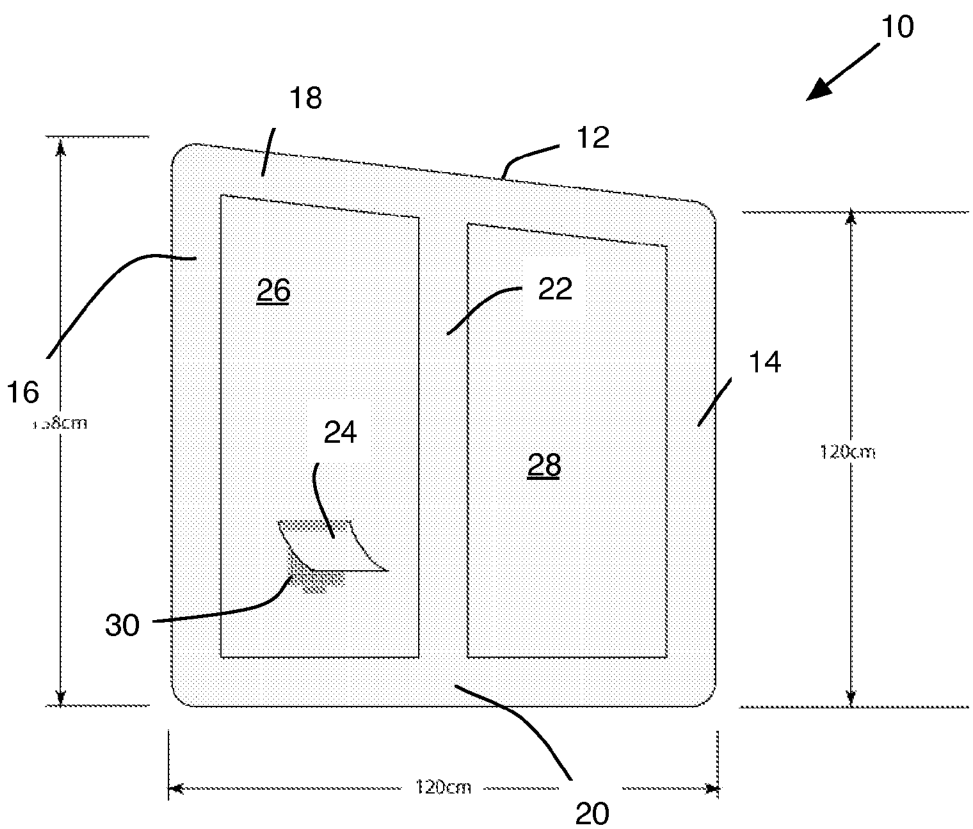
CPC ***E01F 15/14*** (2013.01); ***E01F 13/00*** (2013.01)

(57) **ABSTRACT**

In one embodiment of the present invention, a crash barrier system consists of a soft barrier system of a modular approach wherein each module includes an outer casing comprising a selectively closable top and at least one vertical side wall having a flap for directing effluent air flow upon compression; an inner structure comprising at least one baffle, or alternatively, a bladder, adapted to fit inside the outer casing; and an anti-lift weighted mat coupled to a front portion of the outer casing.



LEFT SIDE

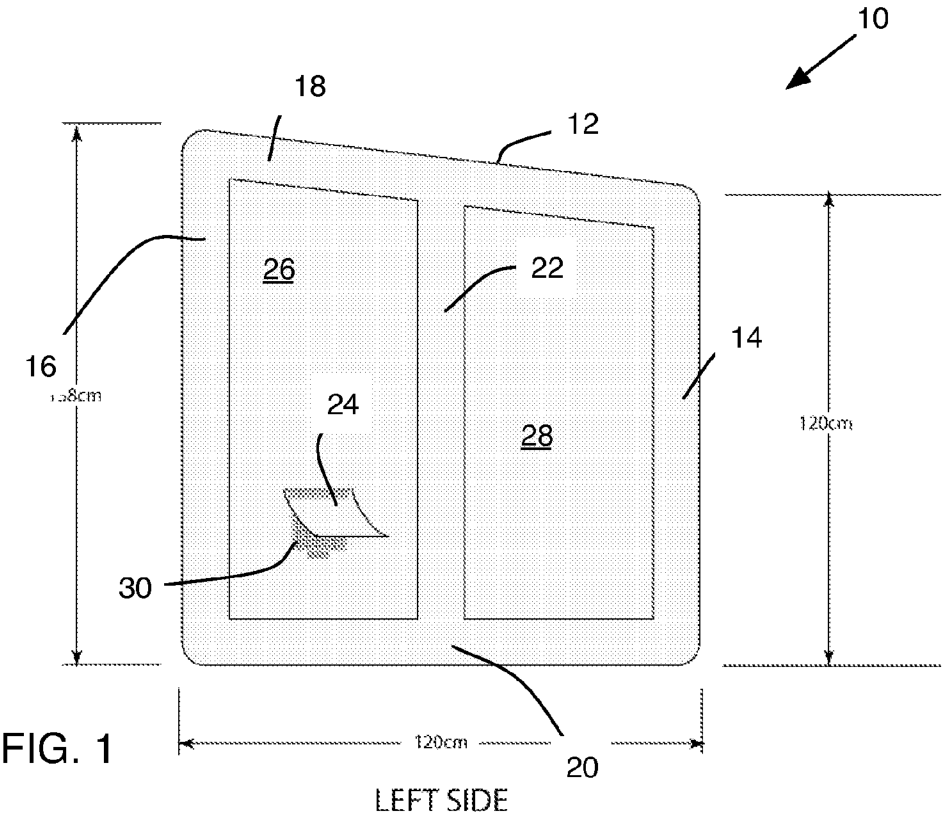

10
18
12
26
22
16
14
24
28
120cm
30
120cm
20
LEFT SIDE

FIG. 1

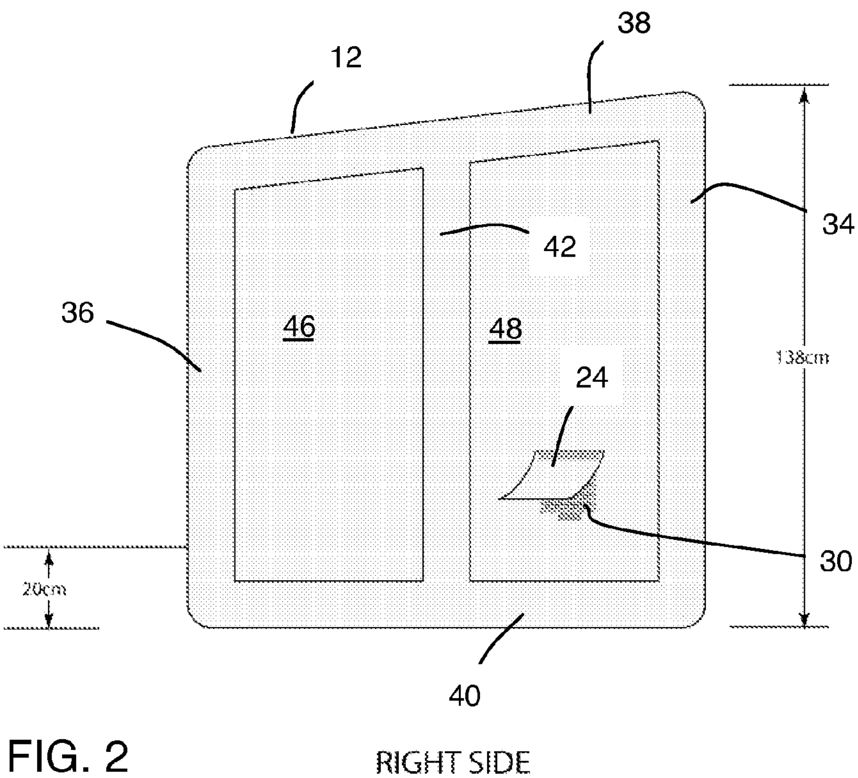

38
12
34
42
36
46
48
24
138cm
30
20cm
40
RIGHT SIDE

FIG. 2

FIG. 3

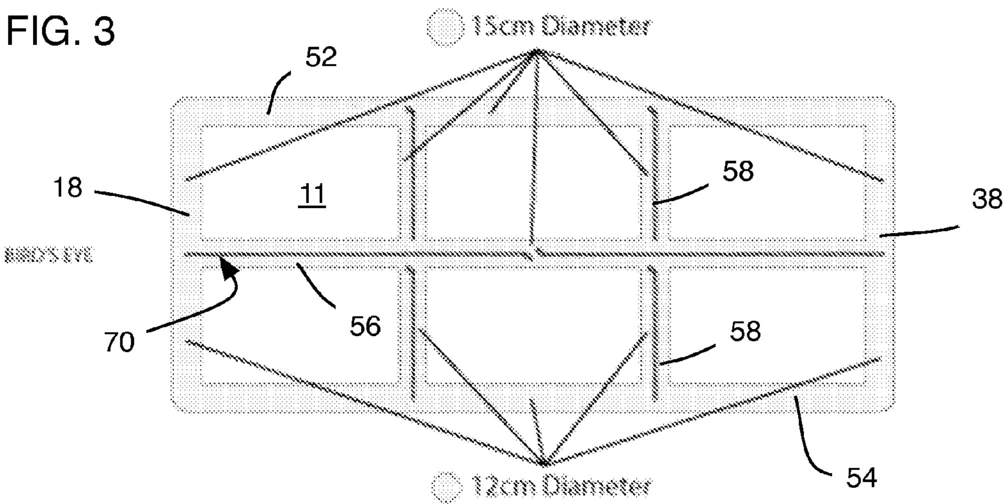


FIG. 4

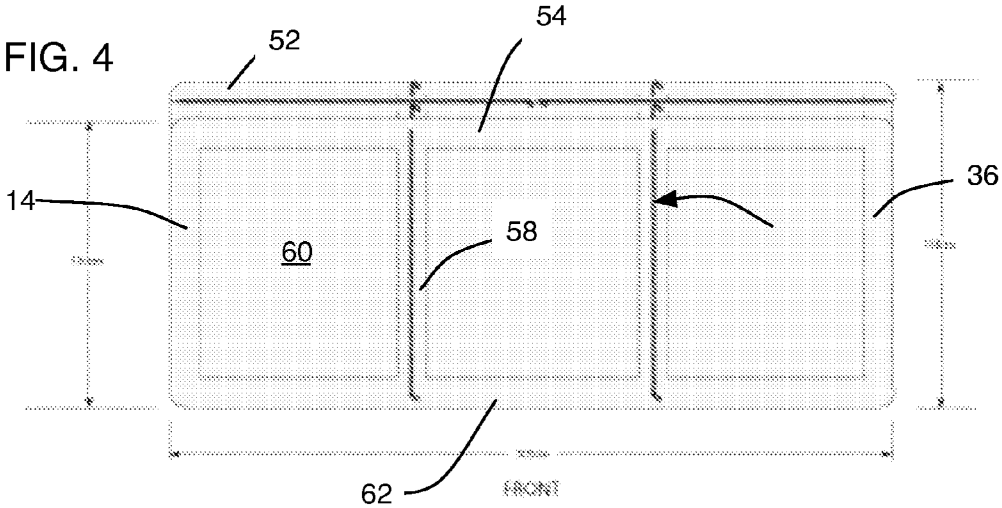
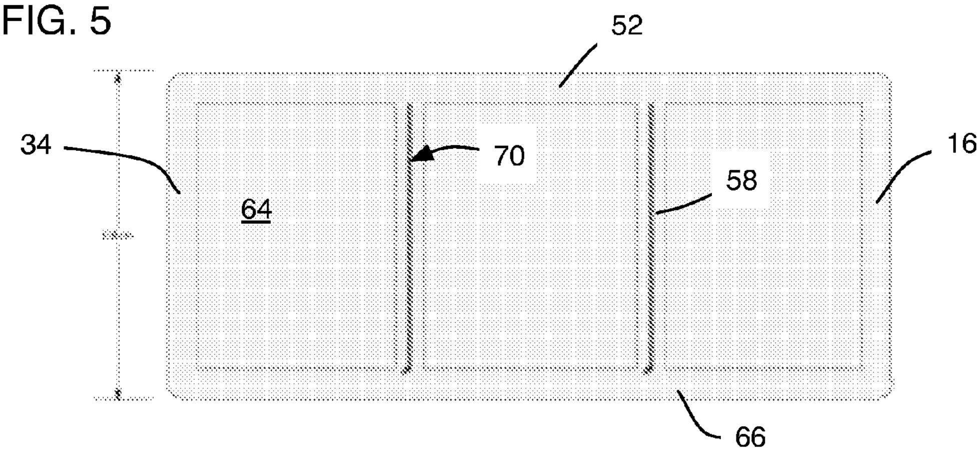


FIG. 5



12cm Diameter

FIG. 6

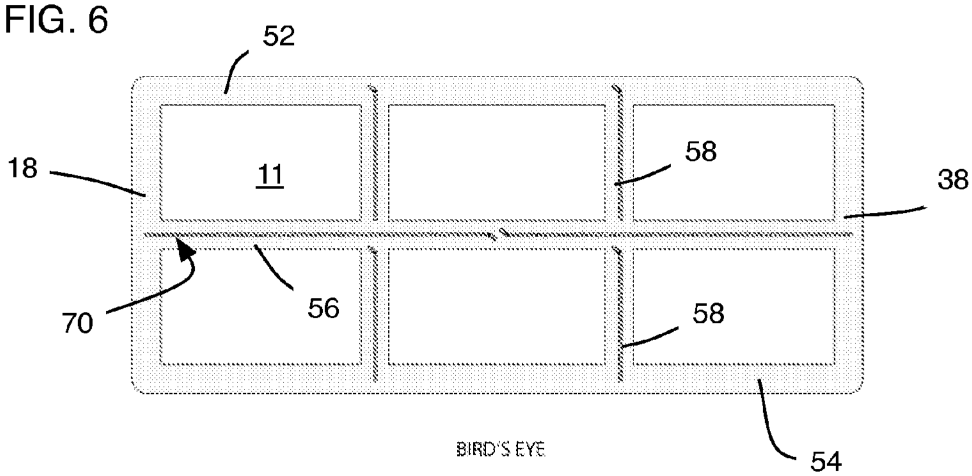


FIG. 7

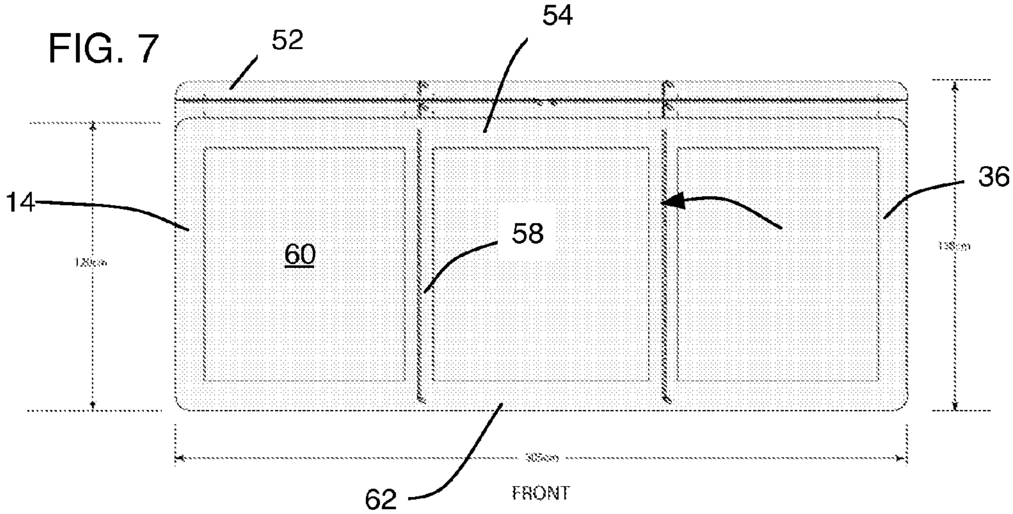


FIG. 8

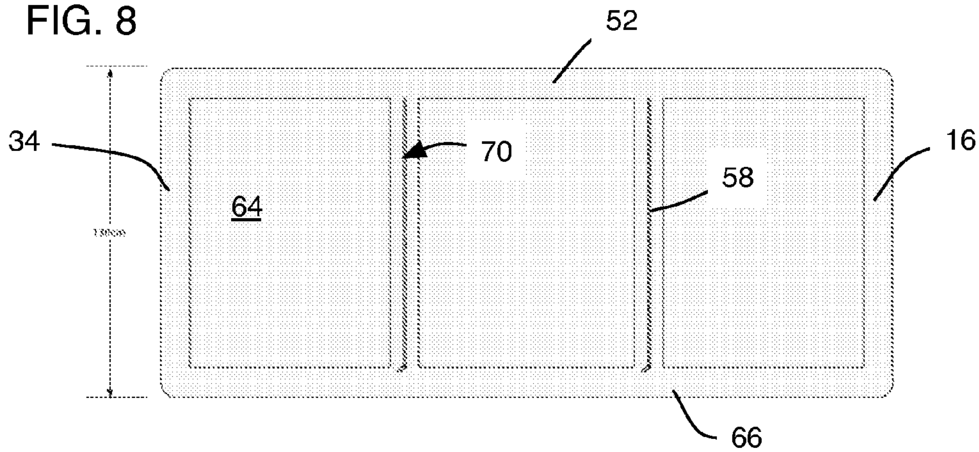
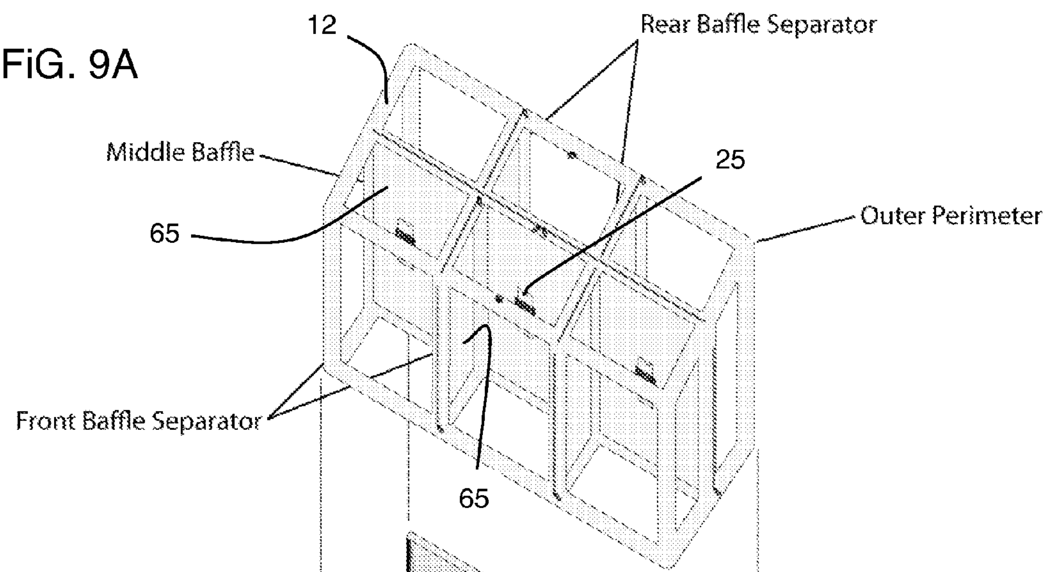


FiG. 9A


12
Rear Baffle Separator
Middle Baffle
25
Outer Perimeter
65
Front Baffle Separator
65

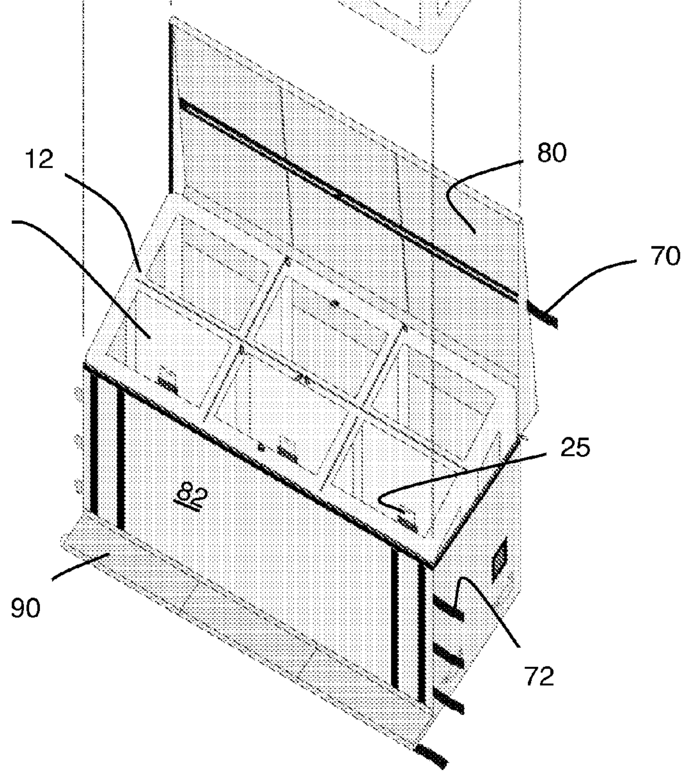

80
12
65
70
25
82
90
72

FIG. 9

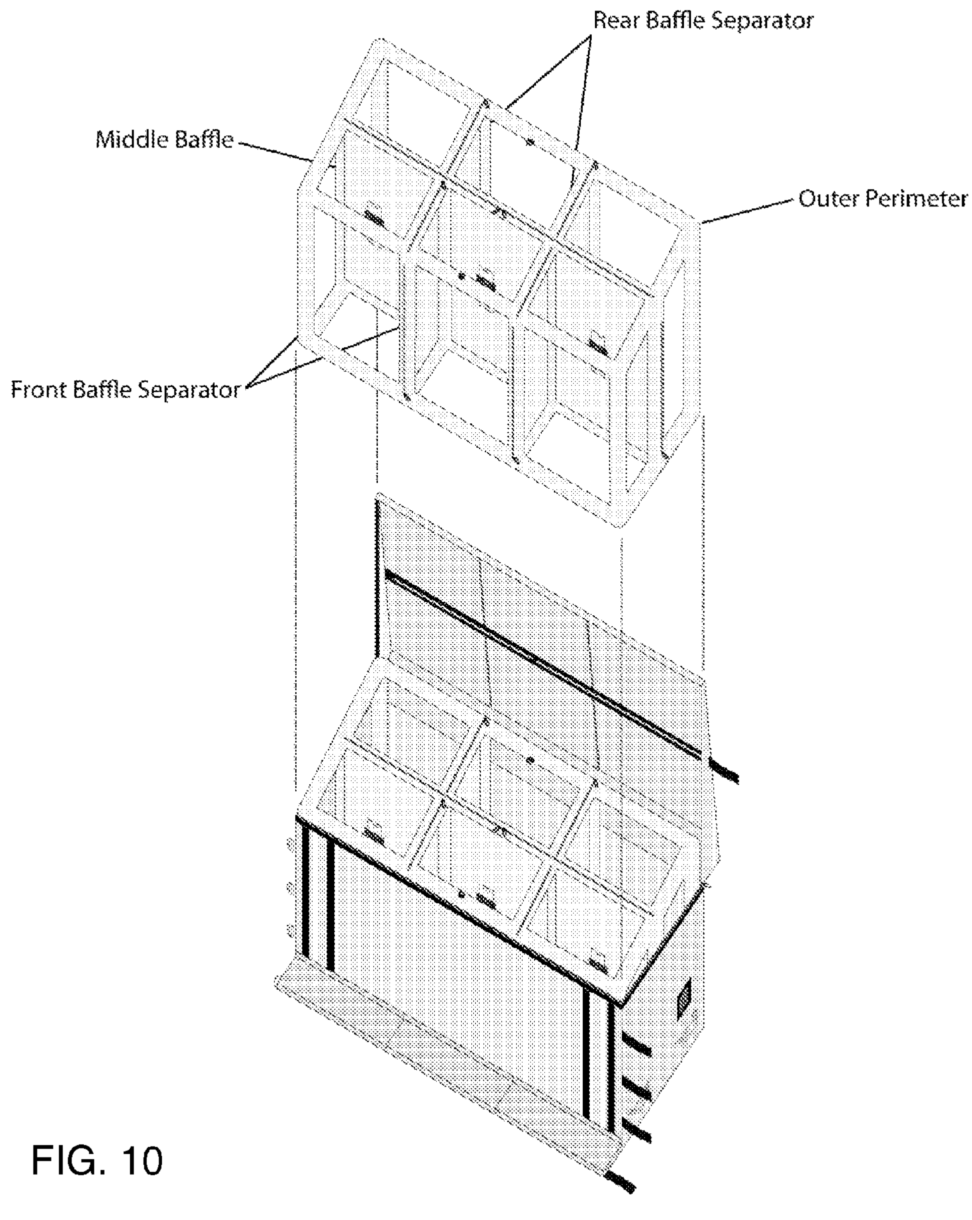

Rear Baffle Separator
Middle Baffle
Outer Perimeter
Front Baffle Separator

FIG. 10

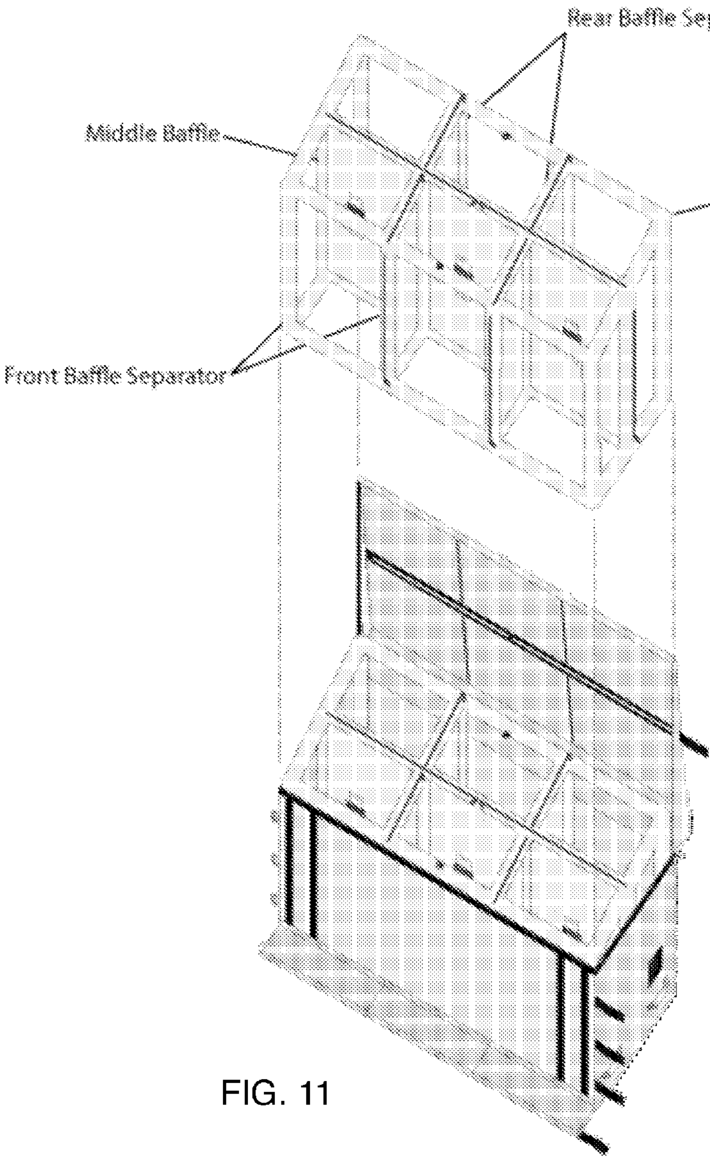

Rear Baffle Separator
Middle Baffle
Outer Perimeter
Front Baffle Separator

FIG. 11

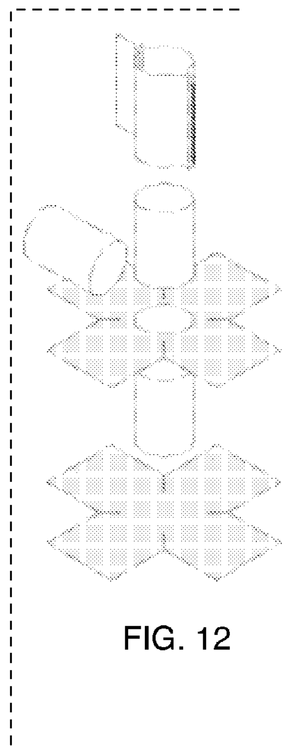


FIG. 12

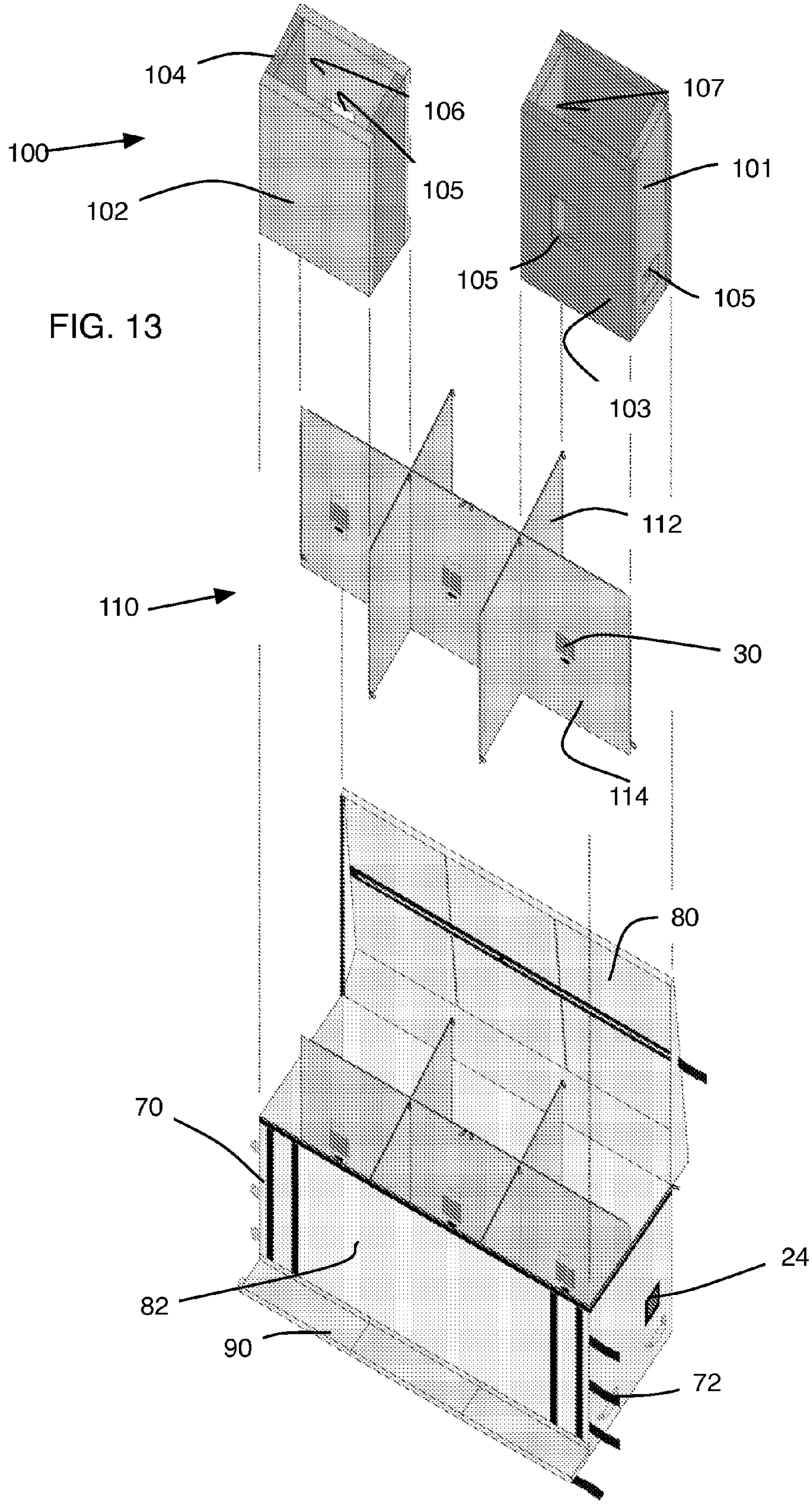

104
106
107
100
105
101
102
105
105
103
112
110
30
114
80
70
24
82
90
72

FIG. 13

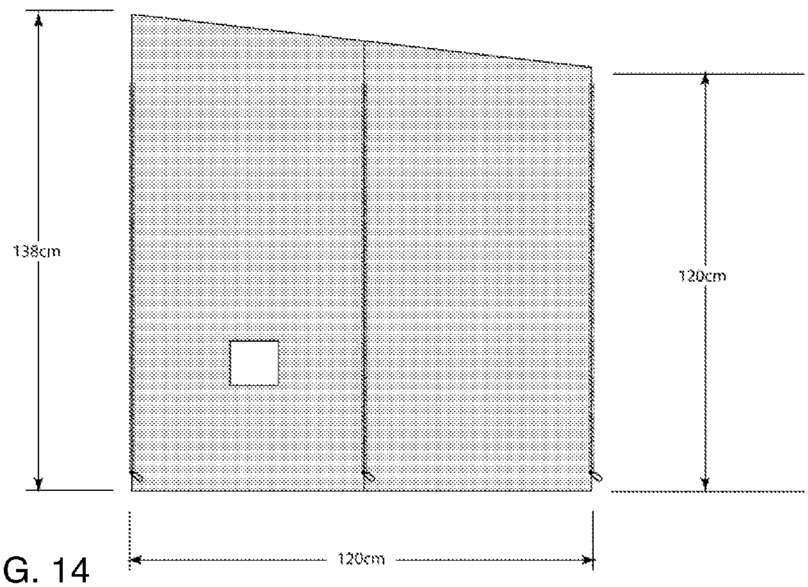


FIG. 14

LEFT SIDE

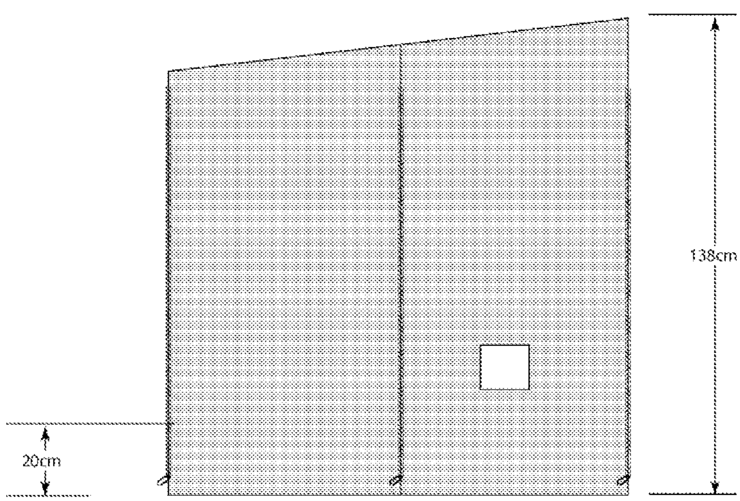
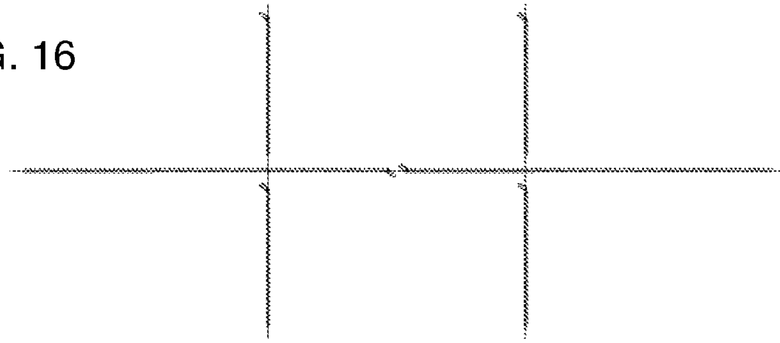


FIG. 15

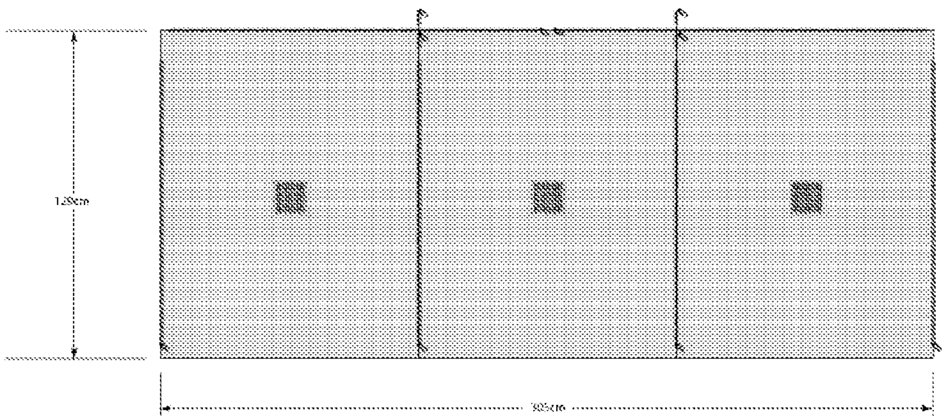
RIGHT SIDE

FIG. 16



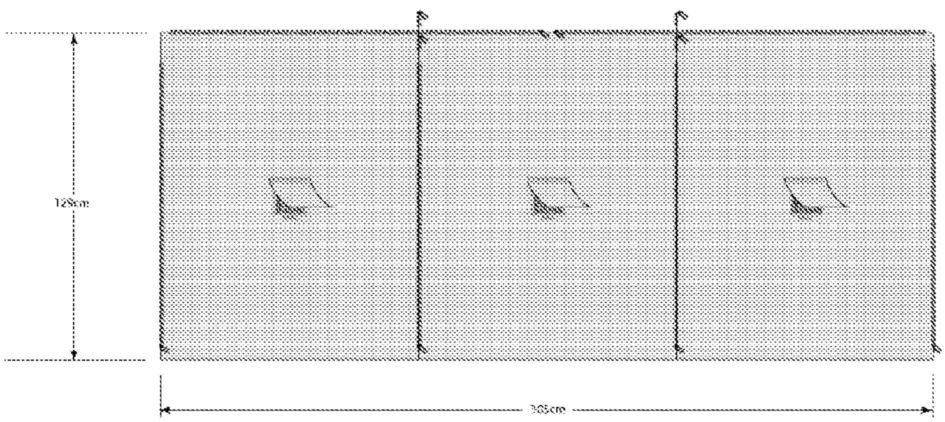
BIRD'S EYE

FIG. 17



FRONT

FIG. 18



BACK

FIG. 19

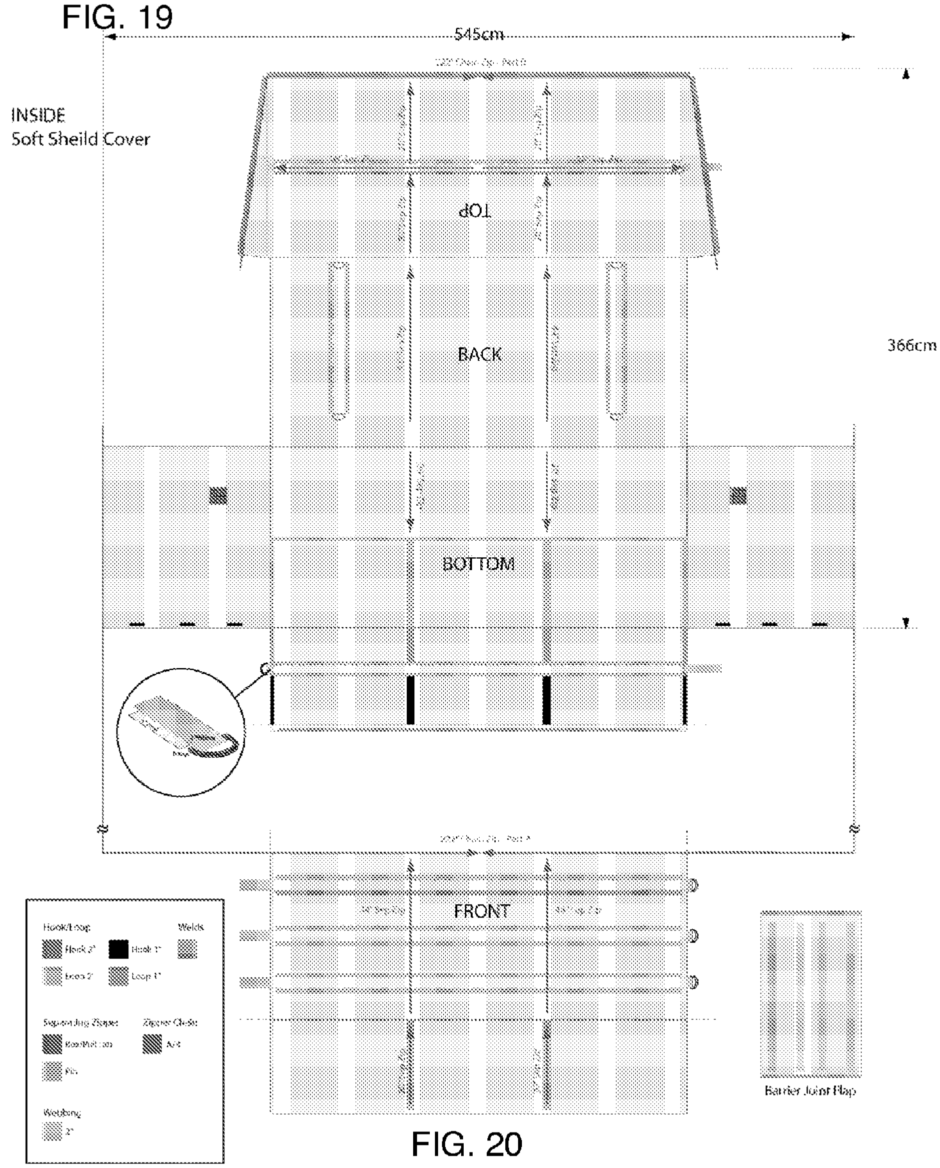

545cm
INSIDE
Soft Sheild Cover
TOP
BACK
366cm
BOTTOM
FRONT
Barrier Joint Flap

FIG. 20

FIG. 21

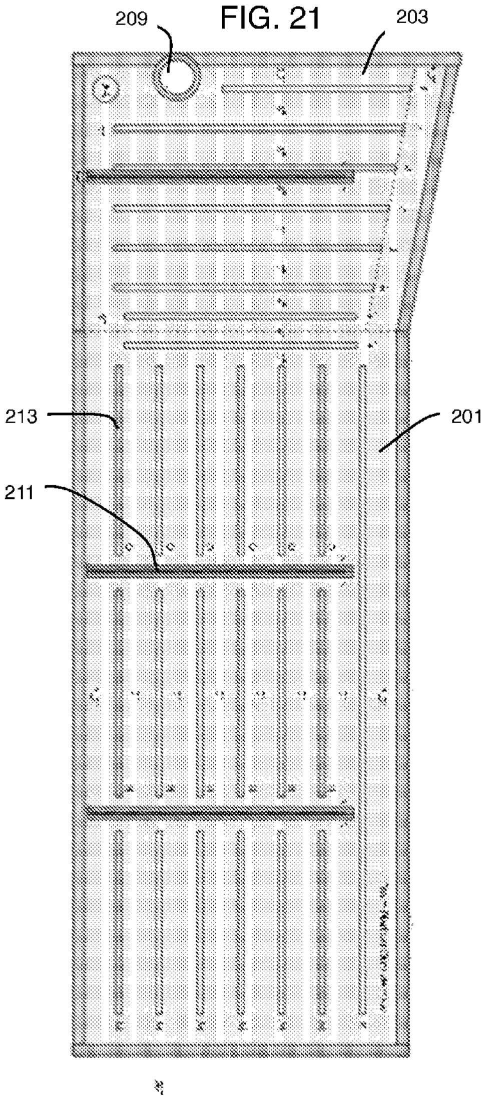
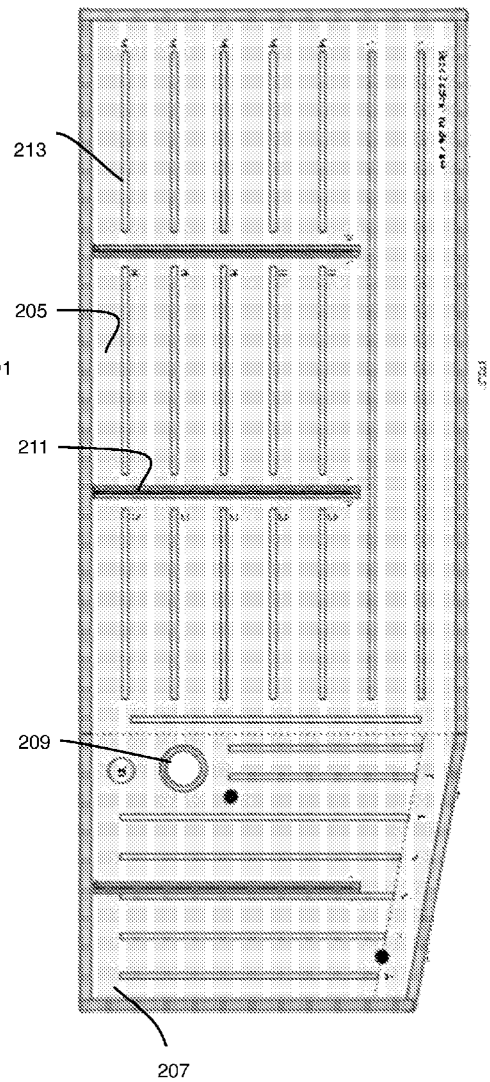


FIG. 22



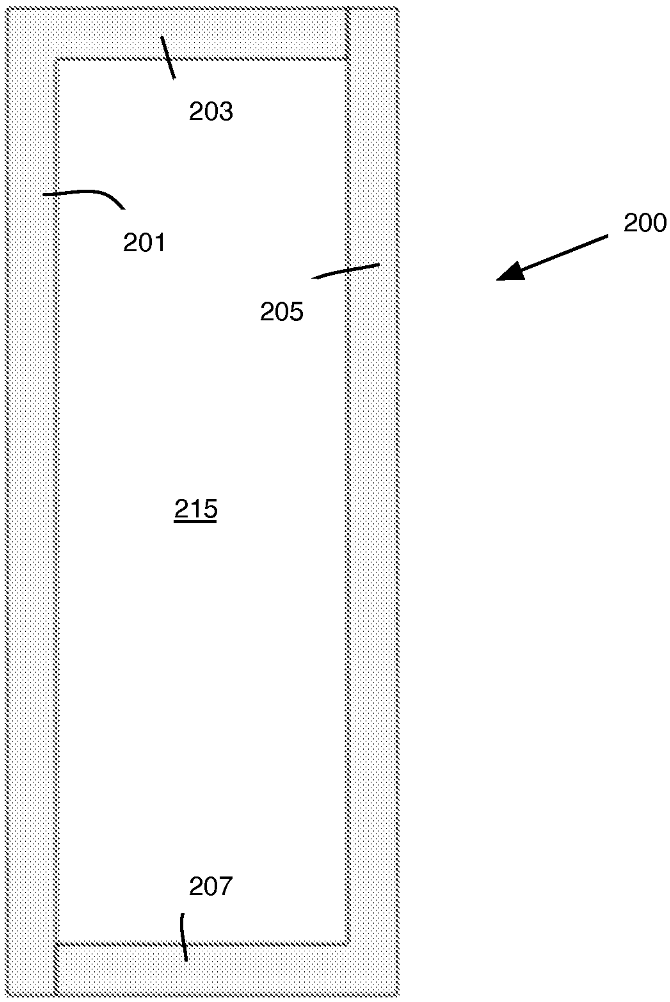


FIG. 23

FIG. 24

FIG. 25

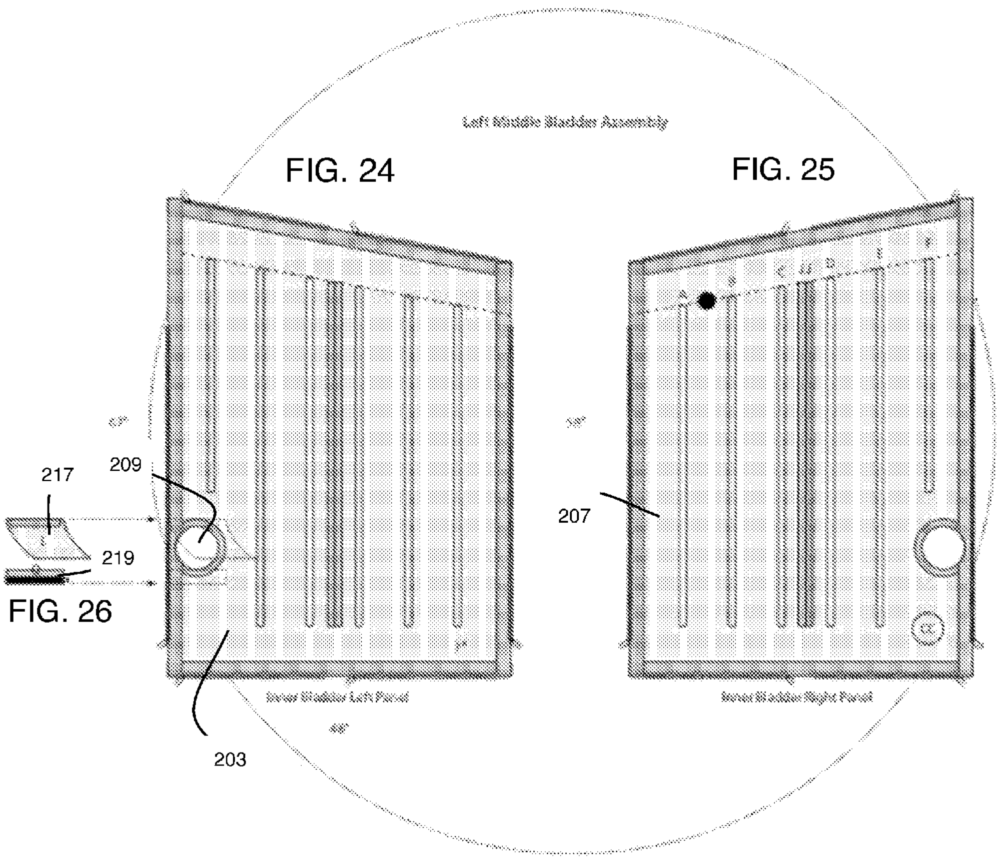


FIG. 26

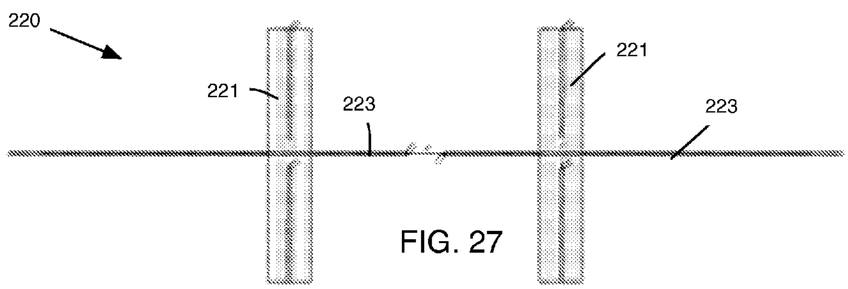


FIG. 27

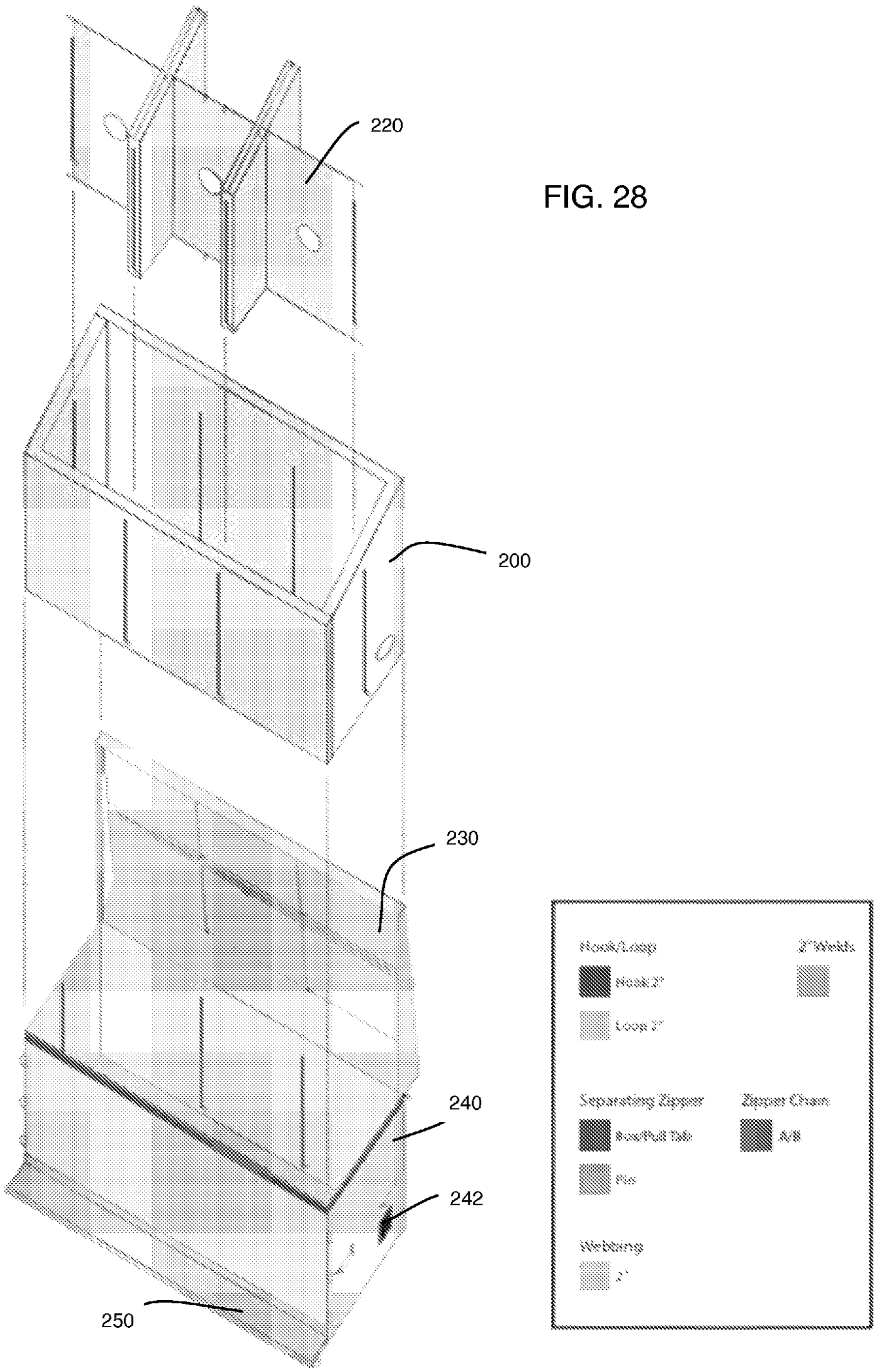

220
200
230
240
242
250
Hook/Loop
Hook 2"
Loop 2"
2" Welds
Separating Zipper
Box/Pull Tab
Pin
Zipper Chain
A/B
Webbing

FIG. 28

FIG. 29

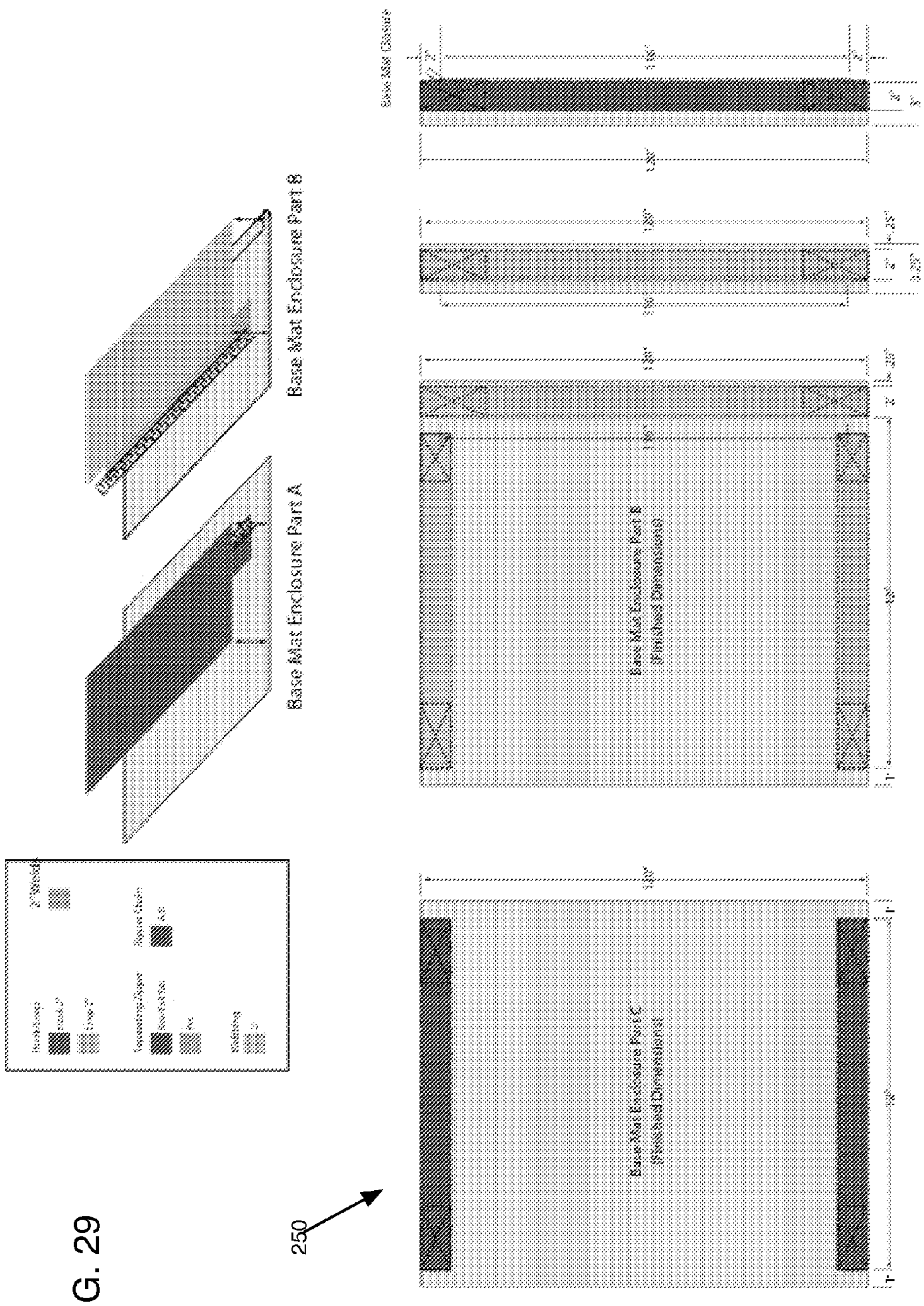
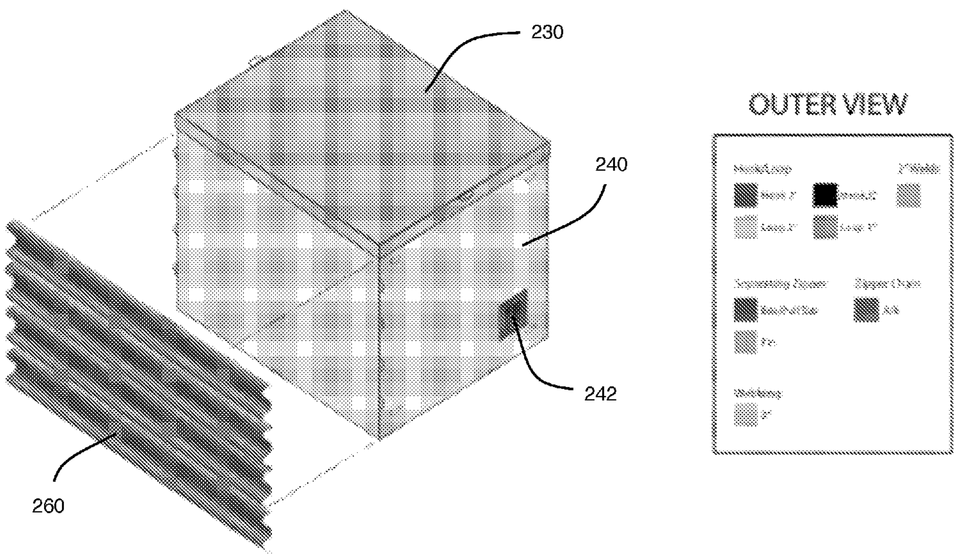


FIG. 30



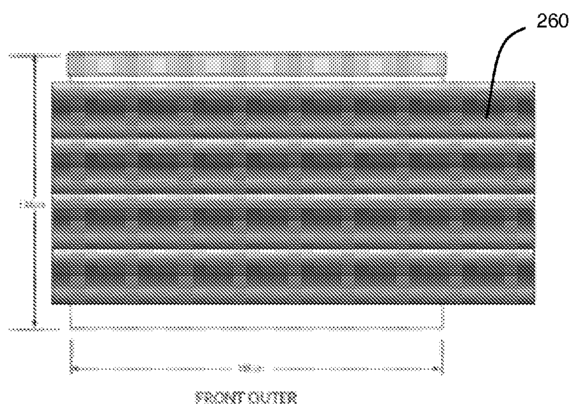
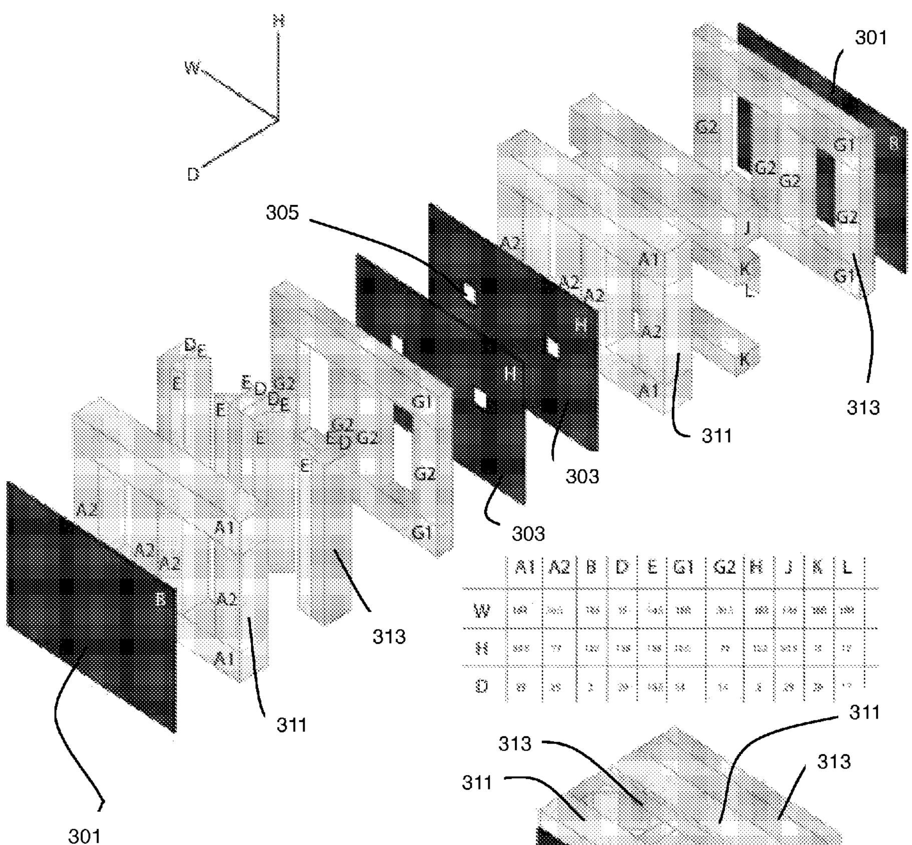


FIG. 31

FIG. 32



	A1	A2	B	D	E	G1	G2	H	J	K	L
W	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
H	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
D	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

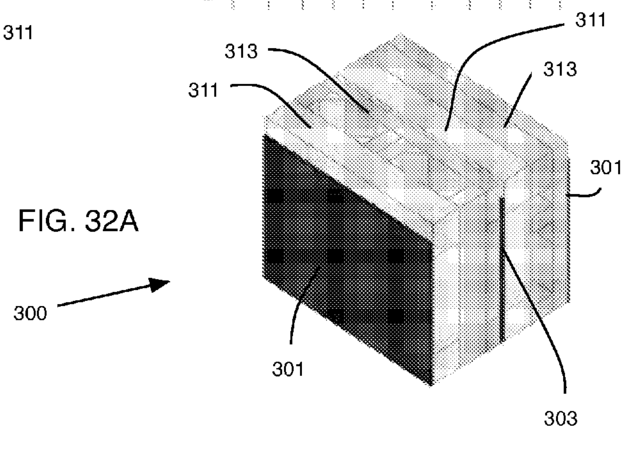


FIG. 32A

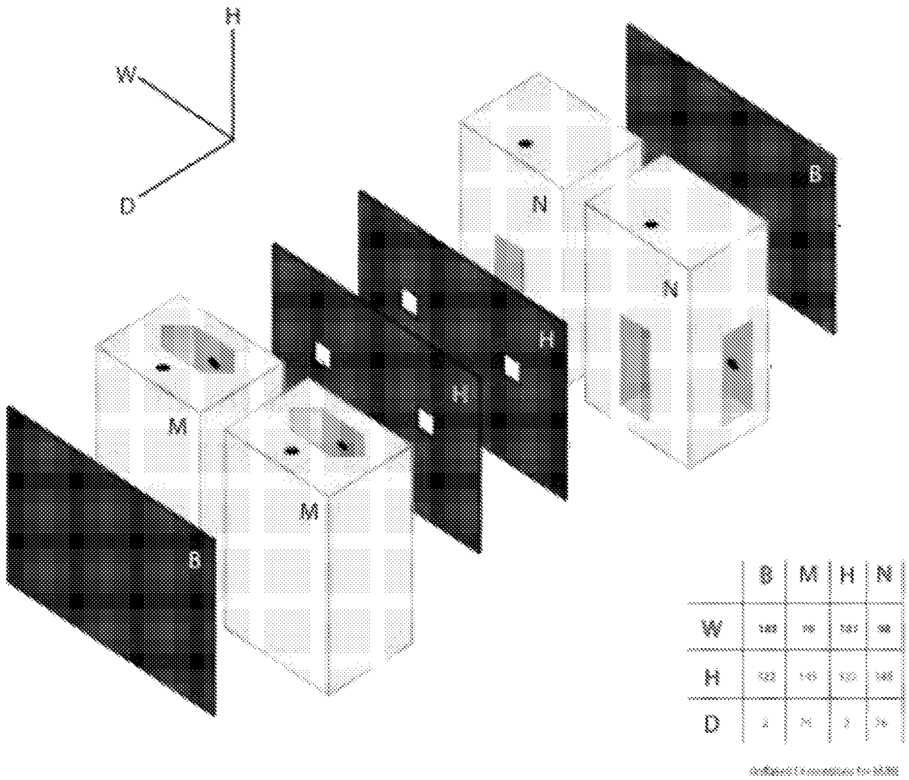
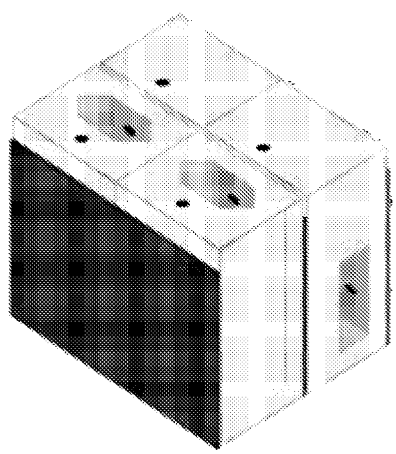


FIG. 33

FIG. 33A



SOFT CRASH-BARRIER IMPACT-ATTENUATION SYSTEM, DEVICE, AND METHOD

PRIORITY CLAIM

[0001] The present application claims benefit under 35 USC Section 119(e) of U.S. Provisional Patent Application Ser. No. 61/901,716 filed on 2013-11-08: The present application is based on and claims priority from this application, the disclosure of which is hereby expressly incorporated herein by reference.

FIELD OF THE INVENTION

[0002] This invention relates to attenuation of impact forces in motorsport closed-course events. More specifically, the present invention relates collapsible-on-impact soft crash barrier systems and even more specifically to compartmentalized modular barrier systems using contained ambient/atmospheric air with directional controlled discharge of the impacted pressurized ambient air upon impact.

BACKGROUND

[0003] The present invention, in one embodiment, is particularly well-suited to protect motorcycle riders, but can be used in other applications including, but not limited to, snowmobile racing, protecting downhill skiers, bicycle events, street luge, karting, and other light-weight vehicle and motorized vehicle, or non-motorized, but high-speed sporting events, competitions, and for recreational use to protect participants from direct impact into fixed, rigid, or semi-rigid barriers. Other embodiments of the present invention are well suited for crash barriers for automotive motorsports replacing conventional tire barriers, for example.

[0004] Racetracks and, in some instances, highways or other public roadways, include rigid barrier walls to contain errant vehicles within the roadway. Often, such systems are designed to keep bystanders safe from errant vehicles more so than to reduce the impact forces on the vehicle. The possibility exists where the human body is subjected directly to the impact energy to the rigid barrier walls (i.e., fallen motorcycle/bicycle rider, karting drivers, street luge participants, downhill skiing/skating, snowmobile flat track, etc.). Rigid or semi-rigid barriers MAY be suitable for retaining or possibly dissipating impact energy of VEHICLES, but direct human impact with this type of barrier system (i.e., concrete wall, earthen embankment, steel rail, bundled tires, etc.) is far too hard/stiff.

[0005] In other instances, motorsport venues utilize stacked and bundled tires to attenuate impact forces before vehicles strike rigid (i.e. concrete wall) barriers. In these systems, the driver of the automobile must rely on safety systems integral to the vehicle (crumple zones, safety harnesses, crash cages, etc.) to survive impact with such barriers.

[0006] In certain locations on public roadways, collapsible container barriers are sometimes employed to reduce the impact on the vehicle before the vehicle impacts the rigid barrier. Common approaches include plastic barrels filled with water or sand. More recently, Wilson describes a Compact Barrier System in U.S. Pat. No. 7,100,903 issued on 2006 Jul. 5. Therein, an impact barrier system includes a plurality of bow-shaped panels attached to a rigid retaining wall in overlapping, side-by-side relationship. This system absorbs some of the impact should a vehicle crash into the barrier.

[0007] On closed-course raceways, such as multi-use road courses, stacked tire wall barriers are used to absorb kinetic energy upon a vehicle collision. One example of this well-understood technique is the impact-absorbing device described by Hildreth, Jr. in U.S. Pat. No. 3,951,384 granted on 1976 Apr. 20. One over-looked problem with such barriers is that they are designed to protect the structure that they are placed in front of and/or are designed to prevent a vehicle from traveling past the barrier (and into the spectators, for example). This design feature requires that the vehicle protect the occupants from the impact force as the primary design feature is to protect the structure (i.e. bridge abutment, retaining wall, etc., or to prevent the vehicle from passing through the barrier), thus the vehicle attenuates much of the impact forces often resulting in significant damage to the vehicle and placing occupants at risk.

[0008] Also overlooked is protection to ejected occupants of vehicles, particularly motorcycle riders and other similar low-mass vehicles. This is particularly true on racetracks including closed course temporary circuits that serve both automobile events and motorcycle events. Existing compressible barrier systems, adopted for use primarily by automobiles, are optimized to attenuate the impact energy (“G”) high performance track-going vehicles weighing 1000 to 4000-lbs or more with some capable of speeds near 200-mph. Such systems are not safe to protect-from-harm motorcycle riders in a crash during a motorcycle race or other such event.

[0009] Existing motorcycle-specific crash barrier systems are extremely costly to produce and install repair and maintain. As a result, only limited venues and/or organizing sanctioning bodies that have significant budgets allocated toward proactive safety improvements for all participants (i.e. world-class professional motorcycle road-races) can afford to own, install, set-up, and maintain. The current art, therefore, ignores or otherwise fails to adequately address safety needs of semi-professional, recreational, and amateur riders—despite that their needs for safety are at least, if not greater, a concern than the professionals.

[0010] Other limitations of existing crash barriers are inadequate design and/or construction to eliminate the rider from sliding underneath the barrier. Further, there is a need to not just dissipate the outflow of discharged air, but to manage this outflow, store it and reuse it in adjacent systems, so that when impacted by a rider, the systems work in concert to ensure that the rider is not rebounded back into the racecourse, and the systems can rapidly reconfigure ready for the next potential impact. Another common failure and inadequate design and/or construction that is a contributing factor to riders sliding beneath the barriers are the joint anchor failures resulting in crash barrier lift. High wind environments often show the existing inadequacies of design to keep the barriers on the ground.

[0011] More specific limitations of the current art will be better appreciated by a brief discussion of some representational disclosures. For example, a lack of compression volume to ensure motorcycle rider safety is a common shortcoming in the art. One such example includes the teaching of Williams et al. in U.S. Pat. No. 6,533,495 issued on 2003 Mar. 18. Therein Williams et al. describes a panel member adapted to be connected to a rigid member. The panel member has a front wall, a rear wall and two sidewalls extending between and interconnecting the front and rear walls. A support member in panel member extends between and interconnects at least two of the walls. The sidewalls are adapted to be angled relative to the rigid member in a direction of movement of the object when the panel member is mounted to the rigid member. An impact on the panel member will tend to deform the panel member toward the rigid member in the direction of movement of the object. This deformation allows the panel member to absorb the energy of the object for decelerating and redirecting the object subsequent to impact. The panel members are positioned in adjacent relation for allowing relative independent movement of the panel members upon impact. Impact of a panel member will transmit the force of the impact to adjacent panel members that are similarly deformed for successively absorbing energy and redirecting the object subsequent to impact at an angle relative to the rigid member less than the angle of impact.

[0012] Other advantageous features include a modular design that allows quick and economical replacement of sections of the barrier after an impact occurs should damage result in the system or its components require repair or replacement. One example of an attempt to modularize a crash barrier system includes a soft wall for racetracks as described by Witcher in U.S. Pat. No. 6,932,537 issued on 2005 Aug. 23 (See also Witcher, U.S. Pat. No. 6,773,201 issued 2004 Aug. 10). Therein Witcher teaches a modular energy absorbing soft wall system consisting of a plurality of partially overlapping interlocking panel structures mounted on anchors on the side surface of an elongated concrete roadway barrier or median. Each panel consists of a flexible core layer sandwiched between a front and rear high-density plastic layer. The core layer consists of a plurality of vertically extending air chambers. An elongated top piece with a flat bottom and an arched top is secured to the top portion of the core layer. The bottom portion of the system rests upon intermittent supports that extend to the road surface. During a vehicular impact energy is absorbed when the plastic layers deform, the chambers collapse, and the trapped air in the chambers escape out apertures in the inner plastic layer and through the bottom of the rubber layer. However, the Witcher system is directed to containing automobiles and therefore is ill-suited to protect a rider of a motorcycle and death or serious injury will occur if a motorcycle rider impacts this barrier system as there is an insufficient volume for compression and the outer materials are too hard.

[0013] Yet another desirable feature is a barrier system that includes flexible connecting portions. For example, Galiana et al. disclose a protective or delimiting barrier having a flexible connecting system in U.S. Pat. No. 6,439,801 issued on 2002 Aug. 27. Therein Galiana et al. teach a plurality of hollow separating elements. Each of the separating elements includes a cylindro-convex end and a cylindro-concave end. Each of the separating elements is capable of containing a shock absorbing volume of air. A lower flexible member is provided and is one of a strap and a band. The lower flexible member extends through at least one separating element and into an adjacent separating element. An upper flexible member is provided and is one of a strap and a band. The upper flexible member extends through at least one separating element and into an adjacent separating element. The upper flexible member is arranged above the lower flexible member. The plurality of separating elements are connected end-to-end such that the cylindro-convex end of one separating element is disposed adjacent the cylindro-concave end of another separating element. An articulation is formed between the cylindro-convex end of one separating element and the cylindro-concave end of an adjacent separating element. However, a limitation of this system is again, a lack of suitable compression volume and overly rigid materials that will result in serious bodily harm or death to a motorcycle rider in a crash.

[0014] One example of the current state of the art for motorcycle crash barrier systems at motorcycle racetracks is the Alpina brand, which is currently the top brand of FIM homologated soft barriers, and holds the contract with the FIM for all world level motorcycle road race events. Alpina-brand barriers are made from heavy-duty, reinforced polymer fabric that is extremely strong yet flexible and highly UV stabilized. The modular units are strapped together. Each inflatable section consists of front and back cushions, separating cushions dividing the front from the back, and normal or ambient air pressure cells. All the cushions are lightly inflated above the ambient air pressure. There are also non-inflatable Alpina-brand barriers utilizing foam to form the desired shapes.

SUMMARY OF THE INVENTION

[0015] Closed course motorcycle riding, for example, is incredibly fun for the thousands of riders who participate annually across the United States. Triple digit speeds are the norm and part of the allure of this sport is the element of danger, harnessing the power of a high-horsepower, low-weight machine and pushing personal skill limits.

[0016] Similarly, other high-speed recreational activities, competitions, and professional sporting events subject human participants to tremendous impact forces when deviating from the intended path and then striking a barrier placed to separate participants from spectators or prevent participants from additional harm. Such events include a variety of closed course activities i.e., temporary street circuit closed course use as in street luge or other barrier-lined events such as downhill skiing, skating, snowboarding, skateboarding, bicycling, and the like.

[0017] As more and more riders (or other participants just mentioned) push their own ability and test the limits of their bravado and physical limits of their machine, crashes are inevitable. And, most tracks—despite efforts to make them safer—vary widely venue to venue, depends on vehicle corner speed, proximity to rigid or semi-rigid barriers such as bundled tire barriers and/or concrete/steel walls. Many accidents occur at high-enough speeds that the rider is still traveling at a high rate of speed with potential to hit rigid barriers.

[0018] The present invention offers a solution that greatly increases the likelihood that a rider will simply stand up and walk away from such a crash. The present invention, in one embodiment, is branded as "Soft Shield" soft barriers and or "Soft Shield Air", both of which are common-law trademarks of SB Holdings, LLC, an Oregon Limited Liability Company. And, the various embodiments of the present invention are designed to exceed the highest FIM Type A-level protection for everyone, at every event, every time. The FIM is the global sanctioning body for all things motorcycle from racing events, to safety devices, to course design.

[0019] In the art, a "soft barrier" is either an inflatable or non-inflatable soft-wall safety barrier system deployed around the perimeter of closed course venues directly in front of hard walls or objects to safely dissipate the impact energy.

[0020] Further, as tire technology and machine technology advances, it allows increasingly later and later braking points, higher entry/corner speeds, and higher corner exit speeds. With higher speeds, distances to rigid barriers that may have been safe in 1990 are dangerously close in 2013. Most venues want to maintain a high level of safety, but course reconfigurations are highly expensive. Even with the desire to provide increased safety, the available funds to undertake the effort is the ultimate deciding factor. Currently available soft barrier brands are very expensive to outright purchase, ship, store, deploy and maintain for the individual venues. Competing brands often require significant repairs after just one impact at significant expense to the venue. Today, most soft barrier deployments in the North American market are almost exclusively for major events. It is rare for a venue to own soft barriers due to the high costs of ownership. Typically only the professional level AMA Pro Racing events have close to a proper FIM level of safety. That leaves over 98% of events without adequate safety coverage.

[0021] To address these issues, the various preferred embodiments of the present invention provide a comprehensive and unique apparatus and a unique business method. Thus, the present invention provides both increased safety and lower operating/ownership costs than previously available from the current art.

[0022] In at least one contemplated an preferred embodiment, the present invention use a variety of performance materials including high-strength, UV stabilized polymer coated performance fabric, stainless steel, a variety of urethane foam compounds, high-strength performance webbing, etc., for example. Other suitable materials include Dyneema or Spectra filament lines.

[0023] When a rider crashes the impacts are often violent: Fallen motorcycle riders and 400-lbs motorcycles travelling at three digit speeds. To attenuate the crash the various embodiments of the present invention, one of which is an inflatable version and another is a non-inflatable version, designed to exceed the highest FIM Type A-level of safety.

[0024] For example, the system of the present invention uses a modular approach. Each full size module is 120" long by 48" deep, and is 54" tall in the back and 48" tall in the front.

[0025] The front of the external cover has to sustain the impact energy, rapid air pressure rise while resisting penetrating forces and tearing, even when impacted with jagged edges of fiberglass, carbon fiber, aluminum, steel, etc. That rapid air pressure increase is then metered through a series of vents on the soft barrier system (and soft barrier air system) Insert designed to control the rate air pressure dissipation and reduce the overall impact energy. At the base and rear of the outer cover are two external vents that permits the over pressure impact air to travel to the adjacent barriers (or to atmosphere if mounted at the end). Each module does its part to reduce the impact energy, even if the main energy is focused on a singular unit. At the base of the outer cover are three pockets with flaps that extend from the base at ground level. Within this pocket are the weighted base mats (an innovation only available with the Soft barrier systems), this helps to prevent the barrier from lifting, either from impact or in high wind environments, preventing instances of a rider careening beneath the barrier. The external cover contains ALL of the high strength anchoring or mounting points to connect units to one another on the interior of the cover safely away from penetrating and impact forces. These anchoring points extend continuously through the entire length of the module. Each end has the double D-ring configuration or other appropriate hardware configuration while the other has the extended free strap. This enables each unit to be anchored together and share the impact energy across multiple stress points. The continuous anchoring attachment points are a huge competitive design advantage. Each module contains a total of over 60 linear feet of 2", high-strength, performance “seat belt” type webbing with number 14 stainless steel 2" D-rings. High-strength zippers in combination with high strength hook and loop fasteners securely enclose the outer cover “top” yet permit opening for maintenance inspections. Alternatively, this webbing can be replaced with braided stainless steel cable and chain links. Other suitable, preferred, and contemplated materials include Dyneema-brand or Spectra-brand, or similar, lines, braided filaments, ropes, or cables, which are known, lightweight, high-strength, oriented-strand gel spun through a spinneret. They have strength-to-weight ratios in a range from 8 to 15 times higher than steel. Further, such cables have less stretch, are more abrasion-resistant, and are thinner than traditional metal lines.

[0026] The outer cover is only part of the solution. The internal structure assists in containing and metering the impact air compression. High strength zippers or, alternatively, hook-and-loop type fastener systems, connect either the inflatable insert or the non-inflatable insert to the inside of the outer cover. There are multiple zippered (or other coupling mechanisms that enable selective joining of adjacent modules or components and the like) mounting locations to secure the appropriate insert, whether inflatable or non-inflatable.

[0027] The full-size non-inflatable embodiment contains the “zip in” insert and six individual foam frames and other components that work in concert with the outer cover to effectively reduce impact energy. The cover and non-inflatable insert is responsible for controlling the rapid ambient air compression rise in each “cell” without bursting apart. It is the foam that helps to absorb any remaining impact energy, store it, then, immediately reuse that stored energy to return the system to its pre-impact shape, making the soft barrier system ready for the next impact. Each full-size soft barrier system has six ambient air pressure cells formed by a combination of the insert and the outer cover. Within these six single ambient cells are six separate foam skeletons. Upon impact, the compressed ambient air from the front cell is allowed to move at a metered rate from the front cell into the rear cell directly behind. As the air pressure rises in the rear cell, the over pressure is released to the adjoining cells (if the middle rear cell) and/or through the compression air impact transfer system to the adjacent soft barrier system unit (or to atmosphere) absorbing the impact. After impact energy absorption is complete the kinetic energy stored within the foam skeletons rapidly reintroduces atmospheric air pressure to refill the ambient air cells. These innovations, along with the full linear anchor joints and anti-lift components, are what set the soft barrier system barriers apart from any non-inflatable soft barrier available on the market today.

[0028] Another contemplated embodiment includes an inflatable and portable model and, as such, contains an inflatable bladder and other components that work in concert with the outer cover to reduce impact energy. As in the non-inflatable model, the soft barrier air system uses the exact same soft barrier system external cover. This is a design innovation of the soft barrier air system. The inflatable insert zips into the outer cover at the same points as the non-inflatable insert. This insert has similar pressurized air metering devices to the non-inflatable insert. This is very different from the competitor’s inflatable systems.

[0029] Other stark differences are the fact that the soft barrier air system has a much smaller length, lighter deflated weight, capability for single inflation fill location, and can be installed quickly with one person. Similar to its non-inflatable stable-mate, the full-size soft barrier air system barrier unit has six ambient air cells via the single inflated soft barrier air system insert. This inflated skeleton helps to absorb the remaining impact energy, store it, and then immediately reuse that stored energy to return the cover to its pre-impact shape, making the soft barrier air system ready for the next impact.

[0030] Other advantages of the present invention include:

- [0031] Commonality of components, for examples both the inflatable or non-inflatable frame structures use the same outer cover and the size of each of the ambient atmospheric air cells are similar regardless of configuration of the barrier system;
- [0032] Designed with ultimate durability and functionality for long-term use;
- [0033] The individual barrier modules are designed to work in concert with the other modules so a customized installment can be made regardless of racetrack configuration; and
- [0034] Module components are configured for ease of assembly, maintenance, repair or replacement.

DRAWING

[0035] FIG. **1** is a left-side view of an inflatable insert (inflated tube framework) of a soft barrier system of one preferred embodiment according to the present invention.

[0036] FIG. **2** is a right-side view of the system of FIG. **1**.

[0037] FIG. **3** is a top view of the system of FIG. **1**.

[0038] FIG. **4** is a front view of the system of FIG. **1**.

[0039] FIG. **5** is a back view of the system of FIG. **1**.

[0040] FIG. **6** is an alternative top view of the system of FIG. **1**.

[0041] FIG. **7** is an alternative front view of the system of FIG. **1**.

[0042] FIG. **8** is an alternative back view of the system of FIG. **1**.

[0043] FIG. **9** is an offset top view of the system of FIG. **1**.

[0044] FIG. **9*a*** is an offset view of one embodiment of a system according to the present invention.

[0045] FIG. **10** is an alternative offset top view of the system of FIG. **9*a***.

[0046] FIG. **11** is yet another offset top view of the system of FIG. **1**.

[0047] FIG. **12** is a detail view of a coupling mechanism for components of the present invention in various preferred embodiments.

[0048] FIG. **13** is an offset view of one possible non-inflatable complete version of a soft barrier system according to another preferred embodiment of the present invention.

[0049] FIG. **14** is a left side view of a possible non-inflatable version of a soft barrier system according to another preferred embodiment of the present invention.

[0050] FIG. **15** is a right side view of a possible non-inflatable version of a soft barrier system according to another preferred embodiment of the present invention.

[0051] FIG. **16** is a top view of a possible non-inflatable version of a soft barrier system according to another preferred embodiment of the present invention.

[0052] FIG. **17** is a front view of a possible non-inflatable version of a soft barrier system according to another preferred embodiment of the present invention.

[0053] FIG. **18** is a back view of a possible non-inflatable version of a soft barrier system according to another preferred embodiment of the present invention.

[0054] FIG. **19** is a top view of a fabric pattern adapted for use in various embodiments of the present invention.

[0055] FIG. **20** is a front view of the pattern of FIG. **19**.

[0056] FIG. **21** is a top view of a flat pattern for an inflatable bladder construction for a front and left sidewall according to one embodiment of the present invention.

[0057] FIG. **22** is a top view of a flat pattern for an inflatable bladder construction for a back and right sidewall according to one embodiment of the present invention.

[0058] FIG. **23** is a top view of one possible inflatable insert according to one preferred embodiment.

[0059] FIG. **24** is a top view of a flat pattern for an inflatable insert according to one embodiment of the present invention.

[0060] FIG. **25** is a top view of a flat pattern for an inflatable insert according to one embodiment of the present invention.

[0061] FIG. **26** is a detail front view of a one-way flap for the panel of FIG. **24**.

[0062] FIG. **27** is a top view of a middle bladder assembly as configured to be attached within the inflatable insert of FIG. **23**.

[0063] FIG. **28** is an offset view of the inflatable bladders as assembled and inflated and inserted into a cover according to the present invention.

[0064] FIG. **29** is a detailed top view of a base mat according to the present invention.

[0065] FIG. **30** is an assembly view of a soft barrier outer cover with one possible version of a semi-rigid out front panel according to a possible embodiment of the present invention.

[0066] FIG. **31** is a partial front view of the semi-rigid panel of FIG. **30**.

[0067] FIG. **32** is an exploded view of non-inflatable internal components including foam frames and flexible sheet rubber panels of a soft barrier system according to the present invention.

[0068] FIG. **32**A is an offset view of bonded, non-inflatable internal components of a soft barrier according to a possible embodiment of the present invention.

[0069] FIG. **33** is an exploded view of the inflatable internal components including inflatable bladders and flexible sheet rubber panel of another embodiment of the present invention.

[0070] FIG. **33**A is an offset frontal view of the assembled inflatable internal components of a soft barrier system according to one embodiment of the present invention.

DESCRIPTION OF THE INVENTION

[0071] Possible embodiments will now be described with reference to the drawings and those skilled in the art will understand that alternative configurations and combinations of components may be substituted without subtracting from the invention. Also, in some figures certain components are omitted to more clearly illustrate the invention.

[0072] The present invention presents a solution that, in various embodiments, easily scales for various uses from an appropriate barrier that increases rider safety for motorcycle events to an automobile barrier suitable for higher impact force experienced in high-speed auto racing, for example. In each embodiment, impact forces are attenuated by controlled and directed displacement of airflow from a relatively soft barrier system. Key components and various embodiments of the present invention will now be discussed in depth. However, there are similar components that need only be scaled for particular use. Other components remain the same, regardless of intended use or application.

The Outer Cover

[0073] In one embodiment, a soft barrier termed "soft barrier air system" and developed under the brand Soft Shield Air (a trademark of SB Holdings, LLC) barrier air system includes a high-strength, UV stabilized, and flame-retardant polymer-coated, high strength specialty fabric to contain pressurization upon impact. The front face uses multiple fabric and coating layers to prevent puncture. Inside, a high-strength, full linear, stainless steel or composite filament strand (as described below), barrier-to-barrier joints shielded between layers of polymer fabric enable multiple barriers to be linked together by fixed barrier anchoring points. Additionally, weighted base mats are designed to prevent lift in high-wind environments and prevent people and things from careening beneath the barrier system.

[0074] It is highly serviceable and utilizes zippers, hook-and-loop fastener systems, chain links, or other known mechanisms designed to enable selective attaching or coupling of adjacent modules to one another or to a provided fixed element (such as an existing rigid barrier already in place on a given race course, for example). Further benefits include integrated advertising panels to provide the owner alternative revenue streams.

[0075] Each individual barrier unit is individually pressurized and includes an ambient air pocket. In the event of impact, the affected individual barriers displace the ambient air from the pocket in a controlled and directed manner venting from barrier to barrier in a system of linked barriers. Individual impact barriers are easily configurable into a variety of shapes, sizes, and are fully customizable to a given installation.

The Inflatable Bladder Inserts.

[0076] Common to many of the preferred embodiments, the system includes inner bladders, which are configured to hold slightly pressurized air. The bladder inserts consist of high-strength, air holding POLYMER-coated performance fabric and include welded ribbed I-beam construction, which provides durability and strength. Upon inflation the bladders and outer cover form atmospheric air pressure cells and three-dimensional shape. The bladders zip in and attach (or use a hook-and-loop fastener system, or other known means to provide selective coupling) to the system for ease of use and serviceability. The bladders include pressure relief valves at less than 1-pound per square inch (psi), for example, to prohibit over pressurization. The bladders are shielded from puncture by the high-strength outer cover. A single-location manifold can be used to inflate multiple bladders in multiple individual barriers in a given system and this further enables autonomous inflation and pressure control. Again, shape, sizes, and configurations are customizable to any install, or can be made from standard shapes and sizes.

[0077] In another embodiment, a soft barrier system branded as Soft Shield (a trademark of SB Holdings, LLC) barrier system utilizes the same outer cover as just described above, but also includes a performance fabric insert to form separate ambient air cells with rigid-like foam inserts, which are detailed below.

The Soft Barrier System Foam Inserts and Ambient Air Cell Separator:

[0078] As in the aforementioned inflatable embodiment, the structure of this non-inflatable soft barrier includes high-strength, air-holding polymer-coated performance fabric to separate the atmospheric air cells and control impact pressurization. Additionally, a frame system—consisting of foam—configures to create the desired three-dimensional shape and add additional rigidity to the system. As in the other embodiment discussed above, the zip-in insert and outer cover form an atmospheric air pressure cell, or more particularly, a group of cells. The zip-in feature provides ease of use and unlimited access for serviceability. And, the cells can be in standard shapes, or created in a variety of shapes and sizes NOT just the one(s) illustrated in the drawing, as would be appreciated by those skilled in the art.

[0079] These first two, just-discussed-above, embodiments are well suited for track use to protect motorcycle riders and other users of low-mass vehicles where the vehicle is not designed to protect the user from impact forces and where the rider is more susceptible to impact, preferably a higher functioning and more capable impact-dissipating soft barrier: Accordingly, these embodiments are better suited to protect people and attenuate less impact forces.

[0080] In yet another embodiment, this version is inflatable and branded the "TrackShield Air" (a trademark of SB Holdings, LLC) barrier system. Its description and potential applications designed specifically to safely attenuate vehicular impact energy and can be considered an alternative to the well-established tire barrier and its various iterations. Again, as discussed with the first two previous embodiments, this soft barrier system includes an outer cover, multiple layers of nearly 1-inch thick, yet flexible rubber sheets, and inflatable bladder inserts sandwiched between the rubber sheets, all of which are very similar in function and design as previously discussed, above. Accordingly, those descriptions are not repeated here in the interest of brevity and clarity. The atmospheric ambient pressure cells are smaller while the inflated internal bladder structures are larger with higher setting pressure relief valves. And, again, the shapes and sizes are varied, with customization for a particular installation easily accomplished.

[0081] Yet another embodiment branded as "Track Shield" (a trademark of SB Holdings, LLC) barrier system soft barrier system, which is non-inflatable, well suited and designed specifically to safely attenuate vehicular impact energy consists of the same outer cover, as discussed in relation to the other embodiments, above. Further, this barrier includes foam inserts sandwiched between layers of nearly 1-inch thick, yet flexible, rubber sheets to form ambient air cell separators, as discussed above. Again, this is better suited to higher impact forces of motor vehicles—such as racecars.

[0082] Additional details are now discussed with reference to the drawing to better describe the present invention.

Low Pressure, Tubeless, High-Yield Barrier System.

[0083] Another preferred embodiment of the present invention contemplates a low pressure, tubeless "soft" barrier system configured for use at motorsport events including motorcycles, but also is suitable for karting, lightweight sports racers, as well as and non-motorized events including bicycle races and cycle-cross races and the like. Because the impact forces of these types of activities are lower than—say—an automotive event, this embodiment utilizes components that are better suited to protect a person from impacting fixed or rigid barriers and this system further replaces traditional 'tire walls' common at many venues.

[0084] This preferred embodiment uses a system of both vertical and horizontal strips constructed of high-strength performance fabric. These strips join an outer fabric to an inner fabric, which are sealed and joined to form an air passageway that is configured to be inflated at slightly above atmospheric pressure. The strips mechanically restrict the inner and outer fabrics to separate under pressure to a predetermined distance and arrangement.

[0085] Accordingly, the inflatable insert system includes an outer fabric layer having an outside face and an inside face. The system also includes an inner fabric layer having an outside face and an inside face. The outer fabric layer and inner fabric layer couple together either directly or by means of at least one intermediate and continuous sidewall. The outer fabric layer and inner fabric layer are configured to define an air volume. Coupling to both the inner face of the outside layer and the inner face of the inner layer, at least one vertical strip and at least one horizontal strip are configured to restrict and limit the movement between the outside fabric layer and the inside fabric layer when pressurized. The inner fabric layer and outer fabric layer are further configured to arrange in an elongated, rectangular, box-shape having an open top and an open bottom, thus defining an ambient-air volume. This box-shape, importantly contained within an outer cover, has a trackside panel, two oppositely disposed sidewall panels coupled to the trackside panel, and a back panel opposite the trackside panel. Each sidewall panel is further configured to have an air-release port positioned in the rear and near the base of the outer cover. The location of this port is configured to present the air-release and air-intake from one module system to another. This enables identical box-shape units to position side-by-side, in close proximity to each other to create a continuous barrier system for any desired length.

[0086] FIGS. **21** and **22** show two major component inflatable assemblies prior to inflation, that when inflated form the inner perimeter of the full size soft barrier air system insert **200** (See the assembly view of FIG. **28**) prior to pressurization. FIG. **21** shows a combined trackside **201** panel and left sidewall panel **203** of the inflatable bladder. FIG. **22** shows a combined back panel **205** and right sidewall panel **207** of the inflatable bladder. Visible from the exterior, as FIGS. **21** and **22** show, the welds that correspond to the plurality of horizontal strips **213** and vertical strips **211** appear. However, the strips are actually located between the inner and outer fabric layers and are not directly visible from the outside of the panels. Both the left and right sidewall panels include air-directing vents or ports **209**. FIG. **23** shows the pressurized panels of FIGS. **21** and **22** from a top view, the panels are assembled to form a rectangular box with an open-air volume (ambient) in the center. A cover assembly **240** and **230** (discussed below) serve to encapsulate the ambient air chamber **215**. When the chamber **215** collapses (due to a collision, for example), the displaced air is vented out through the ports **209**. **250** denotes the pocket enclosure that contains the weighted base mats which serve to reduce lift on impact or in high wind environments.

[0087] FIGS. **25-27** illustrate the middle bladder assembly panel system **220** of this embodiment. FIG. **24** shows the left inner bladder panel **203** and FIG. **25** shows the right inner bladder panel **205/207**, sealed together and inflated as just described in the previous paragraph. Two of these middle bladder subassemblies are assembled with the middle divider **223** to complete the FIG. **27** assembly. FIG. **26** shows a flap for the ports **209**. The ports **209** are one-way ports and include a flap **217** that opens on impact exhaust then closes and covers and is selectively secured at one end by a hook and loop fastener **219** and welded at an opposite end so it can selectively hinge at the weld.

[0088] FIG. **27**, a top view, shows the middle bladders **221** for the bladder panel system **220**. The bladders are pressurized less than 1 psi. An un-inflatable, fabric panel center divider **223** forms part of the ambient atmospheric pressure cells to create six cells in the chamber **215** of the panel insert **200** of the full size soft barrier air system.

[0089] The system further includes a cover **240** consisting **5**-sided sleeve **240** and snug fitting top **230**. The sleeve includes air-release ports **242** at a lower portion of each side. The cover cooperates with the weighted base-mat enclosure **250**. Assemblies **200** and **220** are secured to the outer cover assembly **240**. The cover is similar in function and form as previously discussed with the first two preferred embodiments.

[0090] Additionally, the cover includes stainless steel braided cable encapsulated by a performance, polymer-coated fabric and sandwiched between the outer cover front panel layers. Each end of the braided cable includes a loop so that adjacent units can be coupled together by means of a chain link or other suitable high strength device. And the units can be further secured to rigid objects found at the venue of choice.

[0091] When a crash occurs and rider or vehicle travels into the barrier system as just described, the ambient air space compresses. The compressed (nominally ambient) air is forced out of the air-release port in a directed in an intentional manner so to absorb impact forces, but also direct the release of the air so that the vehicle or person does not launch up and over the barrier.

Higher-Pressure, Tubeless, Lower-Yield Barrier System.

[0092] For automobile racing, in another preferred embodiment the present invention contemplates an improved system that incorporates the elements discussed with regard to the third preferred embodiment, but bolstered with additional components and configured to receive higher inflated pressures and contain higher impact pressurization forces.

[0093] Similar to the third preferred embodiment, this higher-pressure, tubeless barrier system includes some additional components. First, the ambient air space is a smaller volume, and includes a more robust inflatable bladder inserts (M and N) sandwiched between weighted rubber sheets (B and H) or non-inflatable foam frame sandwiched between weighted rubber sheets (B and H) as illustrated in FIG. **32**A/**300**. Notably, the ambient air space is similar in size regardless of whether the system is inflatable or non-inflatable. FIGS. **32** and **32**A detail this exploded view of the foam frames sandwiched between the weighted sheets contained within the outer cover. The weighted rubber sheet **301** arranges vertically within the outer cover and bookends the foam frame structures, one at the front and the other at the back within the cover. An intermediate weighted rubber sheet **303** (or H) arranges vertically on either side of a fabric ambient cell separator that contains a similar valve structure (FIG. **26** in previous embodiment) thus dividing this full size soft barrier track system into three ambient chambers (2 fronts and 1 rear). The intermediate weighted rubber sheet **303** further includes air-directing ports **305** to meter pressurized ambient air upon impact from the front cells to the rear cell. The subassembly **300** includes a set of 3 ambient-air chambers (a symmetrical pair in the front and one in the rear) formed by foam frames sandwiched between the weighted rubber sheets **301** and **303** configured to create a bellows affect when compressed.

[0094] Using the same external cover as the non-inflatable system described above, this higher-pressure, tubeless inflatable barrier system includes much of the same assembly components. Most notably, the foam frames are replaced with inflatable bladders. As in its non-inflatable stable mate, the ambient air space is a smaller volume, and includes a more robust inflatable bladder inserts (M and N) sandwiched between weighted rubber sheets (B and H) as illustrated in FIGS. **33** and **33**A. The front inflatable bladders are symmetrical and each contains a single inflation valve and multiple pressure relief valves. These pressure relief valves are varied from 1 psi to 3 psi and exhaust into the ambient air void. This PRV configuration permits staged relief and storage of kinetic energy. FIGS. **33** and **33**A detail this view of the inflatable bladders sandwiched between the weighted sheets contained within the outer cover. The weighted rubber sheet **301** arranges vertically within the outer cover and bookends the inflatable bladders, one at the front and the other at the back within the cover. An intermediate weighted rubber sheet **303** (or H) arranges vertically on either side of a fabric ambient cell separator that contains a similar valve structure (FIG. **26** in previous embodiment) thus dividing this full size Soft barrier track system into three ambient chambers (2 fronts and 1 rear). The intermediate weighted rubber sheet **303** further includes air-directing ports **305** to meter pressurized ambient air upon impact from the front cells to the rear cell configured to create a bellows affect when compressed.

[0095] When an automobile crashes into this soft barrier track system (such as a "Track Shield" brand—see trademark notice, above), the ambient air space builds pressure and compresses, forcing the volume of air out of the air-release port in a directed and intentional manner so to absorb impact forces, but also direct the release of the air so that the vehicle or person does not launch up and over the barrier.

Weighted Base Mat.

[0096] All the foregoing soft barrier system embodiments configure to include a base mat enclosure to contain a weighted base mat to limit lift upon impact or in high wind environments, for example the base mat enclosure is illustrated in FIG. **29**. The base mat slides into the cover enclosure and is designed to anchor the barrier so that riders do not careen beneath the barrier.

Semi-Rigid Exterior Panel Option.

[0097] In each of the foregoing embodiments, a semi-rigid outer panel **260** configured to arrange on the trackside of the exterior cover **240** is contemplated. FIGS. **30** and **31** show a contemplated configuration for such a semi-rigid panel. The semi-rigid panel is, for example, a continuous piece of polyethylene guard rail-like material. It flexes under impact, but is resilient and re-forms after impact. These can also be made to configure rigid or semi-rigid panels to display advertising.

Other.

[0098] Although not expressly indicated in the many views of the drawing, those skilled in the art will appreciate other features are implicitly included in the figures based on the following discussion. Due to natural and normal thermal expansion and contraction, the entire system includes one or more pressure relief valves that release excess pressure to the atmosphere. To compensate for low-pressure conditions, the present invention contemplates different mechanisms to introduce pressurized air into the system. One such device is an autonomous system for maintaining pressure, whereby a power source (such as solar charged batteries powering an inflation pump, direct coupling to existing power grid to power an inflation pump, or other such means) combined with at least one sensor and an automatically engaging the pump motor couple to the system and provide pressurized air as needed based on pre-set conditions. Part of such a system may include a manifold fill system.

Tube Design of Two Embodiments.

[0099] Two embodiments of the present invention each include a soft barrier system with rigid-foam panels to provide an internal support structure and a soft barrier system having slightly pressurized air tubes that are interconnected to form an internal support skeleton. Both embodiments use the same external fabric cover and both embodiments utilized controlled flow rate and directional flow of the captured ambient air in the event of a crash—which compresses the cells of each respective system rapidly, thus instantly causing the ambient air to pressurize due to the decreased volume upon impact of the cell. This air volume is directed in a controlled manner, as will be appreciated and explained herein.

[0100] These two preferred embodiments are collapsible-on-impact consisting of a system of interconnected air cells (having an air volume at ambient pressure) defined by a cell-on-frame structure that includes directional, controlled release of trapped air upon impact. One preferred embodiment consists of hollow, air-holding fabric tube member that are slightly pressurized above ambient pressure. In another preferred embodiment the frame structure the frame structure is provided by rigid closed-cell foam supports wrapped in a fabric-like material. Details of the various preferred embodiments will now be discussed with reference to the various figures of the drawing.

[0101] FIGS. **1-12** illustrate system **10** of a preferred embodiment according to the present invention. This one preferred embodiment includes an outer perimeter inflatable frame structure and fabric panel insert **12** that when inserted within the outer cover consisting of a plurality of interconnected cells **11** defining a volume of air at ambient pressure. The cells are defined by various components of the frame structure. Accordingly, the frame structure **12** forms a generally parallel rectilinear structure when viewed from the front, top, bottom, or rear views. This frame structure consists of interconnected tubes that hold slightly above 1 atmosphere of pressure to provide an internal framework to support the exterior cover and define the interior cells. These tubes consist essentially of layers of fabric sealed together with an air space. This air space is not intended to deflate on impact and displace crash forces. However, to account for thermal expansion and severe impact forces, the interconnected tubes do include a one-way pressure relief valve and means for inflating.

[0102] FIG. **1**, a left side view, shows the system **10** of the one preferred embodiment. This system has a frame structure **12** comprising a front-left-upright tube **14** extending vertically. Opposite this vertical tube **14** is a rear-left upright tube **16**, also vertically arranged. Linking the two left-side vertical tubes **14** and **16** is a left-side lower horizontal tube **20** and a left-side upper horizontal tube **18**. At an approximate midpoint of both the upper and lower horizontal tubes **18** and **20** is a mid-baffle vertical tube member **22**. Between the cooperating frame members just described, the system **10** includes a front left-side baffle panel **28** and a rear left-side baffle panel **26**. Also visible in FIG. **1**, the rear baffle panel **26** includes a flap **24**, which—in cooperation with a restrictor device **30**—directs the direction of escaping air and controls the velocity of escaping air in the event of collapse due-to-collision with the soft barrier system **10**.

[0103] FIG. **2** is a right side view and it mirrors the left side, just described and includes the frame structure **12** comprising a front-right-upright tube **34** extending vertically. Opposite this vertical tube **34** is a rear-right upright tube **36**, also vertically arranged. Linking the two right-side vertical tubes **34** and **36** is a right-side lower horizontal tube **40** and a right-side upper horizontal tube **38**. At an approximate midpoint of both the upper and lower horizontal tubes **38** and **40** is a mid-baffle vertical tube member **42**. Between the cooperating frame members just described, the system **10** includes a front right-side baffle panel **48** and a rear right-side baffle panel **46**. Also visible is a flap **24**, which—in cooperation with a restrictor device **30**—directs the direction of escaping air and controls the velocity of escaping air in the event of collapse due-to-collision with the soft barrier system **10**.

[0104] As can be better appreciated from FIGS. **3-8**, this one preferred system **10** is modular. A first module consists of a frame structure **12** having 6 cells **11** arranged three in front and three behind the front cells. The structure **12**, accordingly, has a series of interconnected (and in fluid communication) tube members including a rectilinear top portion consisting of a top-front long tube member **54** and an oppositely disposed top-rear long tube member **54** coupled to a left-side top tube **18** and a right-side top tube **38**. Intermediate to the left and right top tubes is a long top mid tube member **56** and intermediate front-to-back mid baffle members **58** to form the six cells pictured in the top view drawing (FIG. **3**). Each cell of the three cells positioned adjacent to the front portion of the frame structure includes a front baffle panel **60**, and each of the three rear cells has a corresponding rear baffle panel **64**. Further, each pair for front to back panels includes an intermediate or mid panel **65** both in the front-to-back direction and in the left-to-right direction (not numbered in FIGS. **1-5**).

[0105] At various locations along faces of the soft barrier system, welds **70**, consisting of a heavy-duty strap fabric that is stitched onto the adjacent panel or support member serve to mechanically link various components together and add structural support, yet remain pliable in the event of a collision.

[0106] FIGS. **9**, **9A** and **10**—**12**, illustrates how the frame structure **12** is surrounded by a fabric casing structure that includes sidewalls **82** and a top **80**. Welds **70** provide additional structural support and the ability to link barrier modules to adjacent barrier models by means of an overlapping portion **72**. These overlapping portions can include a hook and loop mechanical fastening system to selectively secure to an adjacent and cooperating portion.

[0107] Also, the mid panel (baffle separators) **65**, in cooperating with the fabric casing and directional vent windows **25** (or openings) enable the system of FIG. **9** to control the speed at which the air volume escapes and the direction of high volume air flow of the system upon impact by a motorcycle rider. High volume airflow is permitted to flow from front to back and from the back middle cell outward left and right. A one-way valve restricts flow in the opposite direction to reduce rebound energy. In FIGS. **9** and **9**A, the top panel **80** is in an open position; this is shown merely to allow the viewer to see the internal structure **12** relative to the outside casing. In normal operation this top **80** is closed and secured to the front sidewall **82** by means of zipper with hook and loop. In this way, there is a constrained volume of air in each of the six modules in one barrier structure and the only path for escaping air to follow upon an impact of the system is first rearward out of the front three baffles via ports **25** into the set of rear baffles, and then out the sides of the barrier from the left rear and right rear baffle. The center rear baffle includes side ports (not shown in this view).

[0108] FIGS. **13-18** illustrate another preferred embodiment of a soft barrier system according to the present invention. In this particular embodiment, the soft structure **12** of the first two embodiments is replaced by a system of rigid foam panel members **100** to form the desired 3-dimensional shape. This system **100** includes rectilinear symmetrical assemblies. The front foam assemblies include a foam front panel and two oppositely positioned solid panel sidewalls and a back wall having an opening **106** to allow the volume of air to escape in a controlled direction. There are three front modules in one barrier. The rear modules are very similar to the front modules. However the rear modules include a foam front panel having a window or opening **25** to receive the displaced air (upon impact). The foam panels for the sidewalls of the rear modules also include a window or opening **25** on each side panel to direct air to flow out the sides of the module. Cooperating with these six modules is a fabric baffle separator **110** that includes flaps **24** and air-restrictors **30** on the rear left-to-right baffle separator walls **112** and on the front-to-rear baffle separator wall **114**. The baffle separator **110** along with the six baffle modules are encased in an outer fabric casing having a lid **80** and sidewalls **82**, as previously described in the first two preferred embodiments.

[0109] FIGS. **19-20** illustrate the outer casing common to all three preferred embodiments, and this has already been described, above.

[0110] In each of the preferred embodiments, the outer casing system includes an anti-lift weighted base mat **90**, consisting of a thick rubber-like material.

[0111] Another contemplated embodiment includes the use of rigid front panels. Contemplated material for rigid front panel includes a solid or extruded polyethylene or other plastic.

[0112] Each unit, including those having a rigid front panel contemplate reinforcement of the panels by means of a strapping element to interconnect the barriers, the strapping element is a braided metal cable, such as a steel ply cable. Alternatively the strapping element is a webbed fabric material. Units can be coupled tighter by cooperating hook and loop fastener elements.

Business Method:

[0113] The revolutionary product design features enable our comprehensive product and service model to transform the way that racetracks, temporary circuits, event promoters, individual participants and spectators look at soft barrier safety. Design and development of these safety systems focused on three key factors: 1. Unmatched performance, 2. Unsurpassed product durability, 3. Affordability and ease of use.

[0114] Not all venues have access to capital to adequately provide the Soft Barrier safety needed to their user groups. This unique procurement model is an alternative to the typical sales/lease transaction. This procurement model provides a semi-permanent, modular installation of Soft Barrier safety systems under a long-term (typically 10-year) contract at an exceedingly affordable, per event rate. Under this model, the venues have no risk/cost for repairs or replacement of the systems during the contract period. Pricing is based on the venues' historic and projected events calendar and the amount of Soft Barriers required.

[0115] The present invention contemplates a business method whereby a series of soft barrier systems, as previously described in any one or combination of the foregoing embodiments of the present invention are owned by, maintained by, and installed by an owner. The owner then rents, leases, or otherwise contracts with a track owner/operator whereby the track pays a fee for daily use of the installed systems. Under this method, ongoing maintenance, repairs, and even complete replacement of the system modules is included in the event fee without follow-on additional costs or additional liability to the owner for the duration of the agreement.

[0116] Although the invention has been particularly shown and described with reference to certain embodiments, it will be understood by those skilled in the art that various changes in form and detail may be made without departing from the spirit and scope of the invention.

I claim:

1. A soft barrier system comprising:

an outer casing comprising a selectively closable top and at least one vertical sidewall adapted to enclose a volume, the outer casing further comprising at least one flap for directing effluent airflow upon compression;

an inner structure comprising at least one baffle adapted to fit inside the outer casing.

2. The soft barrier system of claim **1** further comprising:

an anti-submerging mat coupled to a front portion of the outer casing.

3. The soft barrier of claim **1** wherein the inner structure comprises:

at least one vertical baffle support member and at least one horizontal baffle support member, the horizontal baffle support member cooperating with the at least one vertical support member to define a baffle module;

the baffle module adapted to enclose at least one front baffle comprising at least one left-right baffle panel separator and a front-back baffle panel separator having an opening;

the baffle module further adapted to enclose at least one rear baffle adjacent to the at least one front baffle, the at least one rear baffle defining a volume in fluid communication with the front-back baffle panel separator having an opening and at least one left-right baffle separator wall having an associated opening; and

the outer casing sidewall flap being adapted to arrange adjacent to the associated opening of the rear baffle at least one left-right baffle separator.

4. The soft barrier of claim **1** wherein the inner structure comprises:

a fabric baffle separator defining at least two baffle modules comprising of a front baffle module adapted to fit inside the outer casing, the front baffle module comprising a front solid foam panel, at least one solid foam side wall and a rear solid foam panel having an opening; and

a rear baffle module disposed adjacent to the front baffle module, the rear baffle module comprising a front solid foam panel having a corresponding opening arranged to be in fluid communication with the front baffle, at least one side wall having a side opening in fluid communication with the flap and a rear solid panel wall coupled to the sidewall.

5. The soft barrier of claim **1** wherein the inner structure comprises:

An inner bladder structure defining an encapsulated air volume, the inner bladder structure adapted to fit inside the outer casing.

6. A system for attenuating impact forces of a moving vehicle relative to a stationary barrier, the system comprising:

a soft frame defining a first volume;

an inner volume of air encapsulated within at least one compartment defined by the soft frame inside the first volume, the at least one compartment further comprising at least one air-release port adapted to direct the direction and volume of air flow passing therethrough upon rapid compression of the inner volume of air due to an impact of a moving vehicle against the system.

7. The system of claim **6** wherein:

the at least one compartment further comprises a bladder.

8. The system of claim **6** wherein:

the soft frame further comprises a tubeless air volume that is pressurized above ambient air pressure.

9. The system of claim **6** wherein:

the soft frame further comprises an inner fabric layer having an outside face and an inside face wherein the outer fabric layer and inner fabric layer couple together either directly or by means of at least one intermediate and continuous sidewall and further the outer fabric layer and inner fabric layer are configured to define the compartment.

10. The system of claim **6** wherein:

the soft frame comprises an outer perimeter inflatable frame structure supporting a fabric panel insert;

an outer cover adapted to fit over the soft frame;

the soft frame further defining a plurality of interconnected interior cells, each interior cell defining a corresponding volume of air at ambient pressure.

11. The system of claim **10** wherein:

the soft frame further comprises a generally parallel rectilinear structure when viewed from the front, top, bottom, or rear views and further comprises a plurality of interconnected tubes that hold slightly above 1 atmosphere of pressure to provide an internal framework to support the exterior cover and define at least on of the interior cells;

the plurality of interconnected tubes comprise at least one layer of fabric sealed together with an air space, the interconnected tubes further comprise a one-way pressure relief valve.

12. The system of claim **6** further comprising:

at least one rigid-foam panel adapted to fit within the soft frame whereby the rigid-foam panel provides an internal support skeleton.

13. The system of claim **1** further comprising:

at least one rigid-foam panel adapted to fit within the soft frame whereby the rigid-foam panel provides an internal support skeleton.

14. The system of claim **6** further comprising:

a semi-rigid outer panel configured to arrange on a track-side of the soft frame.

15. The system of claim **1** further comprising:

a semi-rigid outer panel configured to arrange on a track-side of the soft frame.

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