

ENERGY ABSORBER

BACKGROUND

[0001] To protect workers that have to work at heights, lifelines coupled to safety harnesses donned by a worker are often required. If a fall event occurs, the lifeline (coupled to a support structure) limits the fall of the worker. A worker can be subject to injury even with the use of a lifeline system if a fall distance before the lifeline becomes taut is significant. Energy absorbers have been added to lifeline systems to provide a less abrupt stop when the lifeline becomes taut therein lessening the possibility of injuries. An energy absorber works by absorbing the some kinetic energy of the falling body (i.e. the kinetic energy of the falling worker). Various types of energy absorbers have been implemented in the past such as spring type arrangements and deforming metal arrangements. However, these types of arrangements tend to be bulky and relatively heavy.

[0002] For the reasons stated above and for other reasons stated below which will become apparent to those skilled in the art upon reading and understanding the present specification, there is a need in the art for an effective, efficient and compact energy absorber.

SUMMARY OF INVENTION

[0003] The above-mentioned problems of current systems may be addressed by embodiments of the present invention and will be understood by reading and studying the following specification. The following summary is made by way of example and not by way of limitation. It is merely provided to aid the reader in understanding some of the aspects of the invention.

[0004] In one embodiment, an energy absorber system is provided. The energy absorber system includes first and second strips of webbing. The first strip of webbing has a first end portion, a second end portion and a mid section between the first end portion and the second end portion. The second strip of webbing has a first end portion, a second end portion and a mid section between the first end portion and the second end portion. A plurality of tear yarns couple the mid sections of the first and second strips of webbing to form a centrally located mid portion of the first and second strips of webbing having a desired tear strength. The mid

portion of the first and second strips of webbing include at least one tear yarn ramp down arrangement with a transitioning tear strength that is positioned within the mid portion of the first and second strips with desired tear strength and proximate a centrally located portion of the mid portion of the first and second strips of webbing with the desired tear strength. The energy absorber system further

includes a first connection member and a second connection member. The first end portion of the first strip of webbing and the second end portion of the second strip of webbing are coupled to the first connection member. The first end portion of the second strip of webbing and the second end portion of the first strip of webbing are coupled to the second connection member, such that when the first and second connections members are pulled away from each other during a fall event the tear yarns holding the mid portion of the first and second strips of webbing are torn generally simultaneously from opposite ends of the mid portion of the first and second strips therein absorbing energy until the first and second strips of the webbing are separated.

[0005] In another embodiment another energy absorber is provided. The energy absorber includes first and second strips of webbing, a plurality of tear yarns and first and second connector portions. The first strip of webbing has a first webbing first end portion and an opposed first webbing second end portion. The second strip of webbing has a second webbing first end portion and an opposed second webbing second end portion. The plurality of tear yarns couple a central section of the first strip of webbing to a central section of the second strip of webbing to form a mid portion of the first and second strips of webbing in such a manner that the first webbing first end portion is positioned proximate the second webbing first end portion and the first webbing second end portion is positioned proximate the second webbing second end portion. The mid portion of the first and second strips of webbing has a centrally located unattached portion without tear yarns. The first connector portion is configured and arranged to couple the first webbing first end portion of the first strip of webbing and the second webbing second end portion of the second strip of webbing to a first connector. The second connector portion is configured and arranged to couple the first webbing second end portion of the first strip of webbing and the second webbing first end portion of the second strip of webbing to a second connector.

[0006] In still another embodiment, another energy absorber system is provided. The energy absorber system includes first and second strips of webbing. The first strip of webbing has a first webbing first end portion, a first webbing second end portion and a first central portion positioned between the first webbing first end portion and first webbing second end portion. The second strip of webbing has a second webbing first end portion, a second webbing second end portion and a second central portion between the second webbing first end

portion and the second webbing second end portion. A plurality of tear yarns couple the first central portion of the first webbing to the second central portion of the second webbing to form a mid portion of the first and second strips of webbing such that the first webbing first end portion of the first strip is positioned proximate the second webbing first end portion of the second strip and the first webbing second end portion of the first strip is positioned proximate the second webbing second end portion of the second strip. The mid portion of the first and second strips having a centrally located unattached portion without tear yarns. The mid portion of the first and second strips of webbing includes a pair of ramp down sections each having a tear yarn arrangement that produces transition tear strength sections that lead into the centrally located unattached portion. The energy absorber further includes first and second connection member. The first webbing first end portion of the first strip of webbing and the second webbing second end portion of the second strip of webbing are coupled to the first connection member. The second webbing first end portion of the second strip of webbing and the first webbing second end portion of the first strip of webbing are coupled to the second connection member such that when the first and second connection members are pulled away from each other during a fall event the tear yarns holding the mid portion of the first and second strips of webbing are torn generally simultaneously from opposite ends of the mid portion of the first and second strips therein absorbing energy until the first and second strips of the webbing are separated.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The present invention can be more easily understood and further advantages and uses thereof will be more readily apparent, when considered in view of the detailed description and the following figures in which:

[0008] Figure 1 is a side view of an energy absorber system of one embodiment of the present invention;

[0009] Figure 2 is a side perspective view of the energy absorber system of Figure 1;

[0010] Figure 3A is a side view of an energy absorber of one embodiment of the present invention prior to a fall event;

[0011] Figure 3B is a side view of an energy absorber of Figure 3A during a fall event; and

[0012] Figure 3C is a side view of the energy absorber of Figure 3A after a fall event has occurred.

[0013] In accordance with common practice, the various described features are not drawn to scale but are drawn to emphasize specific features relevant to the present invention. Reference characters denote like elements throughout Figures and text.

DETAILED DESCRIPTION

[0014] In the following detailed description, reference is made to the accompanying drawings, which form a part hereof, and in which is shown by way of illustration specific embodiments in which the inventions may be practiced. These embodiments are described in sufficient detail to enable those skilled in the art to practice the invention, and it is to be understood that other embodiments may be utilized and that changes may be made without departing from the spirit and scope of the present invention. The following detailed description is, therefore, not to be taken in a limiting sense, and the scope of the present invention is defined only by the claims and equivalents thereof.

[0015] Embodiments of the present invention provide an energy absorber system 100 that is effective and relatively compact. Moreover, Embodiments of the present invention provide an energy absorber without the need for an additional back strap as discussed below. Referring to Figure 1 an embodiment of an energy absorber system 100 is illustrated. The energy absorber system 100 includes a first snap hook 102 (first connector) and a second snap hook 104 (second connector). It will be understood that any type of connector can be used and the present invention is not limited to snap hooks. Coupled between the snap hooks is an energy absorber 200. In use, the energy absorber system 100 is coupled between a safety harness donned by a user and a lanyard by the snap hooks 102 and 104. The lanyard would then in turn be coupled to a support structure. If a fall event occurred, the snap hooks 102 and 104 would be pulled away from each other while the energy absorber 200 absorbs energy as further described below. The energy absorber 200 includes a first strip of webbing 110 and a second strip of webbing 120.

[0016] The first strip of webbing 110 and the second strip 120 of webbing are woven together with tear yarns as shown in Figures 3A and 3B. The first strip of webbing 110 and the second strip a webbing 120 can be referred to as tear webbing. An example of tear yarns used to couple the strips of webbing 110 and 120 together are polyester tear yarns 250. An example

of a company that manufactures tear yarns is the Sturges Manufacturing, Inc. Company of Utica, New York. The first strip of webbing 110 and the second strip of webbing 120 in embodiments each include a centrally located mid section 110c and 120c (illustrated in Figure 3A). The centrally located mid sections 110c and 120c of the first and second strips of webbing 110 and 120 are woven together by tear yarns 250 to form a mid portion 130 of the first and second strips of webbing 110 and 120. The tear yarns 250 couple the first and second strips of webbing 110 and 120 together. The first and second strips of webbing 110 and 120 have opposed end portions 110a, 110b, 120a and 120b which are not held together by the tear yarns 250. In one embodiment the first and second strips of webbing 110 and 120 are made from Vectran. In other embodiments, other types of high strength fibers are used for the strips of webbing 110 and 120 such as, but not limited to, Dyneema, Spectra, etc. Typically, lower strength fibers of a different material is used for the tear yarns 250 such as, but not limited to, polyester fibers. The use of dissimilar materials between the strips of webbing 110 and 120 and the tear yarns 250 allows the energy absorbing material to exhibit high strength in a small amount of space. Also, because the fibers in the strips of webbing 110 and 120 are much stronger than the fibers of the tear yarns 250, the fibers in the strips of webbing 110 and 120 are not damaged as the tear yarns 250 are broken.

[0017] Referring back to Figure 1, the respective end portions (first webbing first end portion 110a, first webbing second end portion 110b, second webbing first end portion 120a and the second webbing second end portion 120b) of the first and second strips of webbing 110 and 120 are strategically coupled to the associated snap hooks 102 and 104. In particular, the first end portion 110a of the first strip of webbing 110 is coupled to the first snap hook 102. Also coupled to the first snap hook 102 is the second end portion 120b of the second strip of webbing 120. The second end portion 110b of the first strip of webbing 110 and the first end portion 120a of the second strip of webbing 120 are attached to the second snap hook 104. As illustrated in Figure 1, the first strip of webbing 110 in this embodiment includes a twist 111 so that the straps 110 and 102 can be passed by each other. The twist 111 however is not limited to the first strip of webbing 110. Hence, in another embodiment, the second strip of webbing 120 would include the twist 111. As further illustrated in Figure 1, the mid portion 130 of the energy absorber 200 in this embodiment is in a coiled configuration to form a coil of woven webbing 112. This configuration reduces the overall sized of the energy absorber 200 during

non-use. In other embodiments, the mid portion 130 is folded instead of coiled during non-use.

[0018] Figure 2 further illustrates the energy absorber system 100. In this Figure, the twist 111 is not illustrated. The first strip of webbing 110 is shown in Figure 2 as being disconnected at ends 111a and 111b for illustration purposes only. It will be understood that the ends 111a and 111b of the webbing are connected in a twist or bend 111 as shown in Figure 1. As further illustrated, the first end portion 110a of the first strip of webbing 110 and the second end portion 120b of the second strip of webbing 120 are passed through a first connection aperture 103 of the first snap hook 102 and folder over on themselves to form a first connector portion 215. They are then attached by attaching stitching 220 to couple the strips of webbing 110 and 120 to the first snap hook 102. The second end portion 110b of the first strip of webbing 110 and the first end portion 120a of the second strip of webbing 120 are passed through a second connection aperture 106 of the second snap hook 104 and folder over on themselves to form a second connector portion 217. They are then attached by attaching stitching 220 that couples the strips of webbing 110 and 120 to the second snap hook 104. As illustrated in Figure 1, the respective folder over portions of the end portions 110a, 120b and 110b and 120a form connector loops 108a and 108b in which the respective connectors 102 and 104 are received.

[0019] The snap hooks illustrated in Figure 2 include respective hook body portions 102a and 104a, locking gates 102b and 104b and connection portions 102c and 104c. The connection portions 102c and 104c include the respective connection apertures 103 and 106. As discussed above, although snap hooks 102 and 104 are shown it will be understood that any type of connector can be used that can be coupled to the connector loops 108a and 108b of the strips of webbing 110 and 120. In a typical application as discussed above, the snap hooks 102 and 104 would be used to couple the energy absorber system 100 between a safety harness donned by a worker and a lanyard coupled to a support structure.

[0020] Referring to Figure 3A an illustration of the energy absorber 200 of one embodiment in an inactivated state is illustrated. In this illustration, the energy absorber 200 is shown not having its mid portion 130 in a coil for illustration purposes. Figure 3A further shows the arrangement of the strips of webbing 110 and 120. In particular Figure 3A illustrates the positioning of the respective end portions 110a, 120b and 110b, 120a of the

strips of webbing 110 and 120 and the positioning of the centrally located mid portion 130. As illustrated, the centrally located mid portion 130 of the webbing strips 110 and 120 are held together by the tear yarns 250. In one embodiment, the mid portion 130 of the webbing strips 110 and 120 includes first and second ramp up transition sections 225a and 225b that are located proximate the respective beginning areas of the mid portion 130. The ramp up transition sections 225a and 225b provide ramp up tear strengths so that when a fall event occurs, the mid portion 130 of the webbing strips 110 and 120 starts pulling apart from each other relatively easily due to a relatively low tear strength and then transitions to a higher desired tear strength. This prevents webbing shock (from going from no tear yarns ((i.e. no tear strength)) to the desired tear strength) from damaging the webbing sections 110 and 120. The transition sections 225a and 225b can be achieved by varying one of the densities of tear yarns, the tear yarn material used and the diameter of the tear yarns.

[0021] In the embodiment of the energy absorber 200 of Figure 3A, the mid portion 130 further includes a centrally located unattached section 230. In the centrally unattached section 230, the first and second strips of webbing 110 and 120 are not attached by tear yarns. In one embodiment, the centrally unattached section 230 of the mid portion 130 is approximately 4 inches. The centrally unattached section 230 prevents the strips of webbing 110 and 120 from binding up (knotting up) on each other. This unintentional binding of the strips of webbing 110 and 120 can occur due to the twist 111 (discussed above) in webbing 110 as the strips of webbing 110 and 120 become separated. This binding of the strips of webbing 110 and 120 can damage the overall strength of the strips of webbing 110 and 120. As discussed above, the strength of the strips of webbing 110 and 120 needs to be maintained since the strips of webbing 110 and 120 double as not only an energy absorber but as back straps. Hence, the centrally unattached section 230 prevents the twist 111 from binding the unattached strips of webbing 110 and 120 together upon conclusion of a fall event.

[0022] The mid portion 130 of embodiment of 3A further includes first and second transition ramp down sections 227a and 227b that respectfully lead into the centrally unattached section 230. The first and second transition ramp down sections 227a and 227b transition from the desired tear strength of the mid portion 130 to no tear strength of the centrally unattached section 230. This prevents an instantaneous webbing shock in the strips of webbing 110 and 120 as the strips of webbing 110 and 120 become separated. This

webbing shock could damage the overall strength of the strips of webbing 110 and 120. As pointed out above, the overall strength of the strips of webbing 110 and 120 should be preserved since the strips of webbing 110 and 120 are used as back straps. In one embodiment, the first and second transition ramp down sections 227a and 227b are approximately 1 inch in length.

[0023] Figure 3B illustrates the energy absorber 200 during a fall event. During a fall event the end portions 110a, 120b and 110b, 120a respectfully are pulled apart from each other as illustrated. As they are pulled apart from each other the tear yarns 250 are broken along separating areas 302a and 302b. Hence in this embodiment, the mid portion 130 of the strips of webbing 110 and 120 are pulled away from each other at two locations 302a and 302b generally simultaneously. The energy absorber 200 continues to absorb energy until the mid-portion 130 of the strips of webbing 110 and 120 are fully separated from each other. This is shown in Figure 3C. As illustrated in Figure 3C, the mid portion 130 of the straps of webbing 110 and 120 are not connected. However, because of the coupling configuration, the strips of webbing 120 and 110 remain coupled between connector loops 108a and 108b. Hence, a traditional back strap required in a typical energy absorbing system is not needed with the embodiments of the present invention. In embodiments, the configuration will retain the strength necessary for tensile requirements post development. For example, in one embodiment, the strips of webbing provide a tensile strength of 8,500 lbs. Moreover, the dual straps of webbing 110 and 120 provide an additional back strap over a typical system to provide an added safety feature. Hence, even if one of the straps of webbing 110 and 120 fails during a fall event, the other strap will still provide the back strap function which is to retain a connection between a lanyard and a safety harness donned by the worker after the energy absorber is spent.

[0024] Although specific embodiments have been illustrated and described herein, it will be appreciated by those of ordinary skill in the art that any arrangement, which is calculated to achieve the same purpose, may be substituted for the specific embodiment shown. This application is intended to cover any adaptations or variations of the present invention. Therefore, it is manifestly intended that this invention be limited only by the claims and the equivalents thereof.

CLAIMS

1. An energy absorber system comprising:
 - a first strip of webbing having a first end portion, a second end portion and a mid section between the first end portion and the second end portion;
 - a second strip of webbing having a first end portion, a second end portion and a mid section between the first end portion and the second end portion;
 - a plurality of tear yarns coupling the mid sections of the first and second strips of webbing to form a centrally located mid portion of the first and second strips of webbing having a desired tear strength, the mid portion of the first and second strips of webbing including at least one tear yarn ramp down arrangement with a transitioning tear strength that is positioned within the mid portion of the first and second strips with the desired tear strength and proximate a centrally located portion of the mid portion of the first and second strips of webbing with the desired tear strength;
 - a first connection member, the first end portion of the first strip of webbing and the second end portion of the second strip of webbing coupled to the first connection member; and
 - a second connection member, the first end portion of the second strip of webbing and the second end portion of the first strip of webbing coupled to the second connection member, such that when the first and second connection members are pulled away from each other during a fall event the tear yarns holding the mid portion of the first and second strips of webbing are torn generally simultaneously from opposite ends of the mid portion of the first and second strips therein absorbing energy until the first and second strips of the webbing are separated.
2. The energy absorber system of claim 1, further comprising:
 - the first strip of webbing including a twist.
3. The energy absorber system of claim 1, further comprising:
 - the mid portion of the first and second strip of webbing rolled into a coil.

4. The energy absorber system of claim 1, further wherein the mid portion of the first and second strips of webbing includes an unattached portion without tear yarns located at the centrally located portion of the mid portion.
5. The energy absorber system of claim 4, wherein the at least one tear yarn ramp down arrangement of the mid portion of the first and second strips of webbing includes a pair of ramp down sections each having a tear yarn arrangement that produces transition tear strength sections that lead into the centrally located unattached portion.
6. The energy absorber system of claim 1, further comprising:
 - a first stitching area configured to couple the first end portion of the first strip of webbing and the second end portion of the second strip of webbing to the first connection member; and
 - a second stitching area configured to couple the first end portion of the second strip of webbing and the second end portion of the first strip of webbing to the second connection member.
7. The energy absorber system of claim 1, further comprising:
 - the first connection member having a first connection aperture, the first end portion of the first strip of webbing and the second end portion of the second strip of webbing passing through the first connector aperture of the first connection member; and
 - the second connection member having a second connection aperture, the second end portion of the first strip of webbing and the first end portion of the second strip of webbing passing through the second connector aperture of the second connection member.
8. The energy absorber system of claim 1, wherein the first and second connection members are snap hooks.
9. An energy absorber comprising:
 - a first strip of webbing having a first webbing first end portion and an opposed first webbing second end portion;

a second strip of webbing having a second webbing first end portion and an opposed second webbing second end portion;

a plurality of tear yarns coupling a central section of the first strip of webbing to a central section of the second strip of webbing to form a mid portion of the first and second strips of webbing in such a manner that the first webbing first end portion of the first strip of webbing is positioned proximate the second webbing first end portion of the second webbing and the first webbing second end portion of the first webbing is positioned proximate the second webbing second end portion of the second webbing, the mid portion of the first and second strips of webbing having a centrally located unattached portion without tear yarns;

a first connector portion configured and arranged to couple the first webbing first end portion of the first strip of webbing and the second webbing second end portion of the second webbing to a first connector; and

a second connector portion configured and arranged to couple the first webbing second end portion of the first strip of webbing and the second webbing first end portion of the second webbing to a second connector.

10. The energy absorber of claim 9, wherein the mid portion of the first and second strips of webbing includes a pair of ramp down sections having a tear yarn arrangement that produces transition tear strength sections that lead into the centrally located unattached portion.

11. The energy absorber of claim 10, wherein the transition tear strength sections transition from a higher tear strength to a lower tear strength as the transition tear strength sections near the centrally located unattached portion.

12. The energy absorber of claim 9, wherein at least one of the first strip of webbing and the second strip of webbing includes a twist.

13. The energy absorber of claim 9, the mid section of the first and second strips further including a pair of ramp up sections having a tear yarn arrangement that produces transition tear strength sections proximate opposed ends of the mid portion of the first and second strips of webbing.

14. The energy absorber of claim 13, wherein the transition tear strength sections transition from a lower tear strength to a higher tear strength.

15. An energy absorber system comprising:

a first strip of webbing having a first webbing first end portion, a first webbing second end portion and a first central portion positioned between the first webbing first end portion and first webbing second end portion;

a second strip of webbing having a second webbing first end portion, a second webbing second end portion and a second central portion between the second webbing first end portion and the second webbing second end portion;

a plurality of tear yarns coupling the first central portion of the first webbing to the second central portion of the second webbing to form a mid portion of the first and second strips of webbing such that the first webbing first end portion of the first strip is positioned proximate the second webbing first end portion of the second strip and the first webbing second end portion of the first strip is positioned proximate the second webbing second end portion of the second strip, the mid portion of the first and second strips having a centrally located unattached portion without tear yarns, the mid portion of the first and second strips of webbing includes a pair of ramp down sections each having a tear yarn arrangement that produces transition tear strength sections that lead into the centrally located unattached portion;

a first connection member, the first webbing first end portion of the first strip of webbing and the second webbing second end portion of the second strip of webbing coupled to the first connection member; and

a second connection member, the second webbing first end portion of the second strip of webbing and the first webbing second end portion of the first strip of webbing coupled to the second connection member, such that when the first and second connections members are pulled away from each other during a fall event the tear yarns holding the mid portion of the first and second strips of webbing are torn generally simultaneously from opposite ends of the mid portion of the first and second strips therein absorbing energy until the first and second strips of the webbing are separated.

16. The energy absorber system of claim 15, wherein one of the first and second strips of webbing includes a twist.

17. The energy absorber system of claim 15, wherein the transition tear strength sections transition from a higher tear strength to a lower tear strength as the transition tear strength sections near the centrally located unattached portion.

18. The energy absorber system of claim 15, further comprising:

a first stitching area configured to couple the first webbing first end portion of the first strip of webbing and the second webbing second end portion of the second strip of webbing to the first connection member; and

a second stitching area configured to couple the second webbing first end portion of the second strip of webbing and the first webbing second end portion of the first strip of webbing to the second connection member.

19. The energy absorber system of claim 15, further comprising:

the first connection member having a first connection aperture, the first webbing first end portion of the first strip of webbing and the second webbing second end portion of the second strip of webbing passing through the first connector aperture of the first connection member; and

the second connection member having a second connection aperture, the first webbing second end portion of the first strip of webbing and the second webbing first end portion of the second strip of webbing passing through the second connector aperture of the second connection member.

20. The energy absorber system of claim 15, further comprising:

the mid portion of the first and second strips of webbing rolled into a coil.