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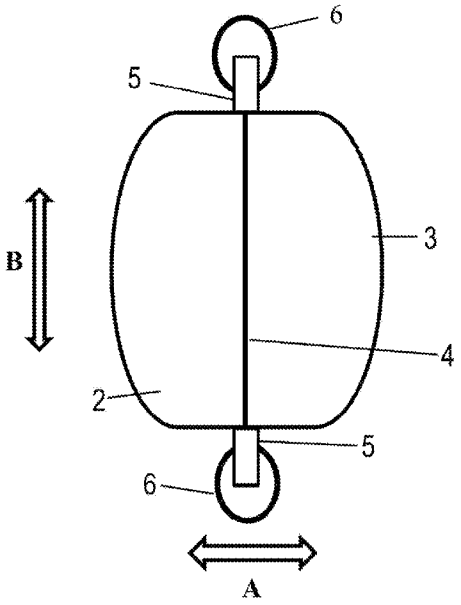

Fig. 1b

(57) Abstract: An energy absorber device has an elongate flexible element and a housing having a first body portion and a second body portion defining an internal cavity therebetween for receiving at least a portion of the elongate flexible element. The housing is movable between a closed condition in which the first body portion and the second body portion enclose the internal cavity and an open condition in which the first body portion and the second body portion are configured to open or separate. The device further has at least one loading element connected to the elongate flexible element and configured to engage at least a portion of the housing. In response to application of a predetermined loading force applied to the at least one loading element, the at least one loading element is configured to move to the housing to the open condition and deploy the elongate flexible element.

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ENERGY ABSORBER DEVICE

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to United Kingdom Patent Application Serial No. 1803992.5, filed March 13, 2018, the disclosure of which is hereby incorporated by reference in its entirety.

BACKGROUND OF THE DISCLOSURE

Field of the Disclosure

[0002] The present application generally relates to safety devices for use in a fall arrest system, and in particular to energy absorber devices having elongate flexible elements which are deployed to absorb the energy of a fall arrest event.

Description of the Related Art

[0003] Fall arrest systems are used to prevent personnel working at height from suffering injury as a result of falling. Fall arrest systems are often referred to as height safety systems or fall prevention systems or apparatus. Frequently such systems include a so called safety block arranged to be suspended overhead from an anchor structure. Such arrangements typically include a drum upon which a safety line is wound and a speed responsive mechanism arranged to inhibit the drum rotation above a predetermined rotational speed.

[0004] It is known to provide an energy absorber device within the safety block which is arranged to be activated if a load above a predetermined threshold is applied to the safety line when the speed responsive mechanism is deployed. These internal energy absorber devices are typically either friction brake devices or plastically deformable metallic strip arrangements that are plastically deformed during deployment in order to absorb energy.

[0005] It is also known to provide an external energy absorber device, separate to the safety block, which is usually connected between the safety line and the user. For example, the energy absorber device may be connected to a harness worn by a user.

[0006] The energy absorber device absorbs the energy, or shock of a fall arrest event. If an energy absorber device is not used as part of a fall arrest system, a user can continue to descend even after engagement of other safety arrangements, such as a speed responsive brake, due to the loading force of the user's weight acting on the safety line. This continued decent is prevented or limited by an energy absorber device.

[0007] An energy absorber device comprising an elongate flexible element, sometimes referred to as a textile energy absorber device, is a type of external energy absorber device.

In response to a fall arrest event, the elongate flexible or textile element is unfurled or deployed which absorbs the energy of the user's fall. An example of such an energy absorber device is described in WO 2017/078669.

[0008] There is a need in the art for an improved energy absorber device

SUMMARY OF THE DISCLOSURE

[0009] In some non-limiting embodiments or aspects, an energy absorber device for use in a fall arrest system may have an elongate flexible element, a housing having a first body portion and a second body portion defining an internal cavity therebetween for receiving at least a portion of the elongate flexible element. The housing may be movable between a closed condition in which the first body portion and the second body portion enclose the internal cavity and an open condition in which the first body portion and the second body portion are configured to open or separate. The device may have at least one loading element connected to the elongate flexible element and configured to engage at least a portion of the housing. In response to application of a predetermined loading force applied to the at least one loading element, the at least one loading element may be configured to move to the housing to the open condition and deploy the elongate flexible element.

[0010] In some non-limiting embodiments or aspects, the elongate flexible element may be deployed in a first direction and the housing may be configured to open or separate in a second direction substantially transverse to the first direction.

[0011] In some non-limiting embodiments or aspects, the device may have a fastener arrangement reconfigurable between a locked position in which the first and second body portions are secured together to enclose the internal cavity and an open position in which the first and second body portions are configured to open or separate to expose the internal cavity. The fastener arrangement may have a first part on the first body portion and a second part on the second body portion. The first part may be releasably connectable to the second part. The first part may be a clip and the second part may be an indentation or a slot.

[0012] In some non-limiting embodiments or aspects, the first body portion may be connected to the second body portion in the closed condition of the housing by a hinge. The hinge may be disposed at one end of the housing, and the fastener arrangement may be disposed at an opposing end of the housing.

[0013] In some non-limiting embodiments or aspects, the at least one loading element may have an attachment portion positioned outside of the internal cavity of the housing and

having an aperture. A connector may be connected to the at least one loading element with a pin extending through the aperture of the attachment portion.

[0014] In some non-limiting embodiments or aspects, the at least one loading element may have at least one shoulder portion positioned within the internal cavity of the housing and configured to transmit a loading force from the at least one loading element to the housing. The at least one loading element may have a spine portion positioned within the internal cavity of the housing. The elongate flexible element may be at least partially wrapped around the spine portion in a coiled formation prior to deployment.

[0015] In some non-limiting embodiments or aspects, the first body portion may be connected to the second body portion in the closed condition of the housing along a joint extending in a direction substantially parallel to a direction in which the elongate flexible element is deployed.

[0016] In some non-limiting embodiments or aspects, an energy absorber device for use in a fall arrest system may have an elongate flexible element and a housing having a first body portion and a second body portion defining an internal cavity therebetween for receiving at least a portion of the elongate flexible element. The housing may be movable between a closed condition in which the first body portion and the second body portion enclose the internal cavity and an open condition in which the first body portion and the second body portion are configured to open or separate. The device may have a fastener arrangement reconfigurable between a locked position in which the first and second body portions are secured together to enclose the internal cavity and an open position in which the first and second body portions are configured to open or separate to expose the internal cavity, and a first loading element configured to engage a first end of the housing and a second loading element configured to engage a second end of the housing. The first and second loading elements may be connected to the elongate flexible element. In response to application of a predetermined loading force applied to at least one of the first and second loading elements, at least one of the first and second loading elements may be configured to move to the housing to the open condition and deploy the elongate flexible element.

[0017] In some non-limiting embodiments or aspects, the fastener arrangement may have a first part on the first body portion and a second part on the second body portion. The first part may be releasably connectable to the second part.

[0018] In some non-limiting embodiments or aspects, the first body portion may be connected to the second body portion in the closed condition of the housing by a hinge. At

least one of the first and second loading elements may have an attachment portion positioned outside of the internal cavity of the housing and having an aperture configured for connecting to a connector, and at least one shoulder portion positioned within the internal cavity of the housing and configured to transmit a loading force from the at least one loading element to the housing. At least one of the first and second loading elements further may have a spine portion positioned within the internal cavity of the housing. The elongate flexible element may be at least partially wrapped around the spine portion in a coiled formation prior to deployment.

[0019] In some non-limiting embodiments or aspects, an energy absorber device for use in a fall arrest system may have an energy absorber device for use in a fall arrest system may have an elongate flexible element and a housing having a first body portion and a second body portion defining an internal cavity therebetween for receiving at least a portion of the elongate flexible element. The housing may be movable between a closed condition in which the first body portion and the second body portion enclose the internal cavity and an open condition in which the first body portion and the second body portion are configured to open or separate. The device may have a fastener arrangement reconfigurable between a locked position in which the first and second body portions are secured together to enclose the internal cavity and an open position in which the first and second body portions are configured to open or separate to expose the internal cavity, and a first loading element configured to engage a first end of the housing and a second loading element configured to engage a second end of the housing. The first and second loading elements may be connected to the elongate flexible element. In response to application of a predetermined loading force applied to at least one of the first and second loading elements, at least one of the first and second loading elements may be configured to move to the housing to the open condition and deploy the elongate flexible element. The elongate flexible element may be deployed in a first direction and the housing may be configured to open or separate in a second direction substantially transverse to the first direction.

[0020] In some non-limiting embodiments or aspects, at least one of the first and second loading elements may have an attachment portion positioned outside of the internal cavity of the housing and having an aperture configured for connecting to a connector, at least one shoulder portion positioned within the internal cavity of the housing and configured to transmit a loading force from the at least one loading element to the housing, and a spine portion positioned within the internal cavity of the housing. The elongate flexible element

may be at least partially wrapped around the spine portion in a coiled formation prior to deployment. The first body portion may be connected to the second body portion in the closed condition of the housing by a hinge.

[0021] In some non-limiting embodiments or aspects, an energy absorber device for use in a fall arrest system may have an elongate flexible element and a housing having a first body portion and a second body portion defining an internal cavity therebetween for receiving at least a portion of the elongate flexible element. The housing may be movable between a closed condition in which the first body portion and the second body portion enclose the internal cavity and an open condition in which the first body portion and the second body portion are configured to open or separate. The device may have a fastener arrangement reconfigurable between a locked position in which the first and second body portions are secured together to enclose the internal cavity and an open position in which the first and second body portions are configured to open or separate to expose the internal cavity. The device may have at least one loading element connected to the elongate flexible element and configured to engage at least a portion of the housing. In response to application of a predetermined loading force applied to the at least one loading element, the at least one loading element may be configured to move to the housing to the open condition and deploy the elongate flexible element.

[0022] In some non-limiting embodiments or aspects, the elongate flexible element may be deployed in a first direction and the housing may be configured to open or separate in a second direction substantially transverse to the first direction.

[0023] In some non-limiting embodiments or aspects, the device may have a fastener arrangement reconfigurable between a locked position in which the first and second body portions are secured together to enclose the internal cavity and an open position in which the first and second body portions are configured to open or separate to expose the internal cavity. The fastener arrangement may have a first part on the first body portion and a second part on the second body portion. The first part may be releasably connectable to the second part. The first part may be a clip and the second part may be an indentation or a slot.

[0024] In some non-limiting embodiments or aspects, the first body portion may be connected to the second body portion in the closed condition of the housing by a hinge. The hinge may be disposed at one end of the housing, and the fastener arrangement may be disposed at an opposing end of the housing.

[0025] In some non-limiting embodiments or aspects, the at least one loading element may have an attachment portion positioned outside of the internal cavity of the housing and having an aperture. A connector may be connected to the at least one loading element with a pin extending through the aperture of the attachment portion.

[0026] In some non-limiting embodiments or aspects, the at least one loading element may have at least one shoulder portion positioned within the internal cavity of the housing and configured to transmit a loading force from the at least one loading element to the housing. The at least one loading element may have a spine portion positioned within the internal cavity of the housing. The elongate flexible element may be at least partially wrapped around the spine portion in a coiled formation prior to deployment.

[0027] In some non-limiting embodiments or aspects, the first body portion may be connected to the second body portion in the closed condition of the housing along a joint extending in a direction substantially parallel to a direction in which the elongate flexible element is deployed.

[0028] In some non-limiting embodiments or aspects, an energy absorber device for use in a fall arrest system may have an elongate flexible element; and a housing, wherein the housing may be configured to be adjustable between a closed condition in which the housing encloses the energy absorber arrangement and an open condition in which the housing is configured to open or separate. In response to application of a predetermined loading force, the housing may be configured to move to the open condition and the elongate flexible element is deployed. The housing may open or separate without resulting in deployment of the elongate flexible element.

[0029] In some non-limiting embodiments or aspects, the housing may be configured such that the predetermined loading force at which the housing is reconfigured to the open condition is indicative of a fall arrest event. For example, the housing may be configured to move to the open condition and deploy the elongate flexible element when a loading force similar to the typical force generated by a falling user is applied to the housing.

[0030] Energy absorber device may have a frangible or tearable housing configured to break or tear in order to deploy an elongate flexible element. The housing may be reconfigurable between the open condition and the closed condition. In this manner, the housing can be re-used. The housing can be opened by a user without resulting in deployment of the elongate flexible element stored therein. This also allows the housing to

be opened for inspection, to check that the condition of the energy absorber arrangement complies with safety regulations.

[0031] In some non-limiting embodiments or aspects, the elongate flexible element may be deployed in a first direction and the housing may be configured to open or separate in a second direction substantially transverse to the first direction.

[0032] In some non-limiting embodiments or aspects, the housing may have a first body portion and a second body portion. In some non-limiting embodiments or aspects, a joint may be provided along which the first body portion is configured to at least partially open or separate from the second body portion. In some non-limiting embodiments or aspects, the joint may extend in a direction substantially parallel to the direction in which the elongate flexible element is deployed. In some non-limiting embodiments or aspects, the joint may extend substantially along a length of the housing. For example, the joint may extend from one end of the housing to the other end. Additionally or alternatively, the joint may extend around the entire circumference of the housing.

[0033] In some non-limiting embodiments or aspects, the first body portion may be configured completely separate from the second body portion. In other embodiments or aspects, in the open condition the first body portion may remain attached to the second body portion.

[0034] In some non-limiting embodiments or aspects, the energy absorber device may have a bore or channel disposed at each end of the housing, wherein each bore or channel is for receiving a connector therein. In some non-limiting embodiments or aspects, the joint between the first body portion and the second body portion may extend between the bores or channels in the housing. The housing may have a first body portion and a second body portion and a hinge connecting the first body portion to the second body portion.

[0035] In some non-limiting embodiments or aspects, a fastener arrangement may be provided which is reconfigurable between: i) a locked position in which the first and second body portions are secured together; and ii) an open position in which the first and second body portions pivot about the hinge, such that the housing is in the closed condition when the fastener arrangement is in the locked position.

[0036] In some non-limiting embodiments or aspects, the elongate flexible element may have a length of textile, and/or a length of fabric and/or a length of webbing.

[0037] In some non-limiting embodiments or aspects, provided is an energy absorber device for use in a fall arrest system. The energy absorber device may have a housing

having: a first body portion and a second body portion; a hinge connecting the first body portion to the second body portion; and a fastener arrangement reconfigurable between: i) a locked position in which the first and second body portions are secured together; and ii) an open position in which the first and second body portions pivot about the hinge; and an energy absorber arrangement comprising an elongate flexible element received within the housing. In response to application of a predetermined loading force on the housing, the fastener may move to the open position and the elongate flexible element may be deployed.

[0038] In some non-limiting embodiments or aspects, the hinged body portions and the fastener arrangement may allow the housing to be quickly and conveniently reconfigured between the locked and open positions. This also may ensure smooth and reliable deployment of the elongate flexible element.

[0039] In some non-limiting embodiments or aspects, the hinge may be disposed at one end of the first and second body portions, and the fastener arrangement may be disposed at the opposing end of the first and/or second body portions.

[0040] In some non-limiting embodiments or aspects, when the fastener arrangement is in the locked position, the housing may have a first bore or channel disposed adjacent to the hinge and a second bore or channel disposed adjacent to the fastener arrangement, wherein each bore or channel may be for receiving a connector therein.

[0041] In some non-limiting embodiments or aspects, the fastener arrangement may have a clip, or other type of snap-fit fastener.

[0042] In some non-limiting embodiments or aspects, the first and second body portions may be rigid. For example, they may be made of a rigid plastic material.

[0043] In some non-limiting embodiments or aspects, an energy absorber device may have an energy absorber arrangement having an elongate flexible element; a housing having a closed condition in which it encloses the energy absorber arrangement; and a loading element arranged to engage the housing. The loading element may have an attachment portion for mounting to a connector, such that the loading element is configured to transmit a loading force from the connector to the housing. In response to application of a predetermined loading force, the housing may be configured to open or separate and the elongate flexible element may be deployed.

[0044] The loading element may transmit force from a connector, which may be attached to a user or to a safety line, to the housing of the energy absorber device rather than to the

elongate flexible element. This may prevent the elongate flexible element from being stretched or deformed prior to deployment.

[0045] In some non-limiting embodiments or aspects, the attachment portion of the loading element may have an aperture configured to receive a connector therethrough.

[0046] In some non-limiting embodiments or aspects, the housing may have a first body portion and a second body portion and a hinge connecting the first body portion to the second body portion.

[0047] In some non-limiting embodiments or aspects, a fastener arrangement may be provided which is reconfigurable between: i) a locked position in which the first and second body portions are secured together; and ii) an open position in which the first and second body portions pivot about the hinge. The housing may be in the closed condition when the fastener arrangement is in the locked position.

[0048] In response to application of the predetermined loading force on the housing, the fastener arrangement may be configured to move to the open position.

[0049] In some non-limiting embodiments or aspects, the fastener arrangement may be disposed proximate the attachment portion of the loading element when the fastener arrangement is in the locked position.

[0050] In some non-limiting embodiments or aspects, when the loading force applied to the loading element is below a given threshold, the fastener arrangement may be moved to the open position and the housing may be opened or separated without resulting in deployment of the elongate flexible element. The threshold may be lower than the predetermined loading force at which the elongate flexible element is deployed.

[0051] In some non-limiting embodiments or aspects, the loading element may be at least partially enclosed within the housing when the housing is in the closed condition.

[0052] In some non-limiting embodiments or aspects, the loading element may have at least one shoulder portion configured to engage a slot or recess provided in the housing. The shoulder portion may project outwards from the loading element.

[0053] In some non-limiting embodiments or aspects, a loop may be provided at each end of the elongate flexible element and one of the loops is secured around the loading element.

[0054] In some non-limiting embodiments or aspects, the at least one shoulder portion may project outside of the loop in the elongate flexible element.

[0055] In some non-limiting embodiments or aspects, the loading element may have a spine portion and the elongate flexible element may be at least partially wrapped around the

spine portion in a coiled formation prior to deployment. The spine portion may extend into the cavity formed by the housing.

[0056] In some non-limiting embodiments or aspects, the at least one shoulder portion may extend in a direction transverse to the spine portion. For example, the spine portion may extend in a substantially vertical direction and the at least one shoulder portion may extend in a substantially horizontal direction.

[0057] In some non-limiting embodiments or aspects, a plurality of loading elements may be provided.

[0058] In some non-limiting embodiments or aspects, two devices may have two loading elements. In some non-limiting embodiments or aspects, the loading elements may be disposed at opposing ends of the housing.

[0059] In some non-limiting embodiments or aspects, the device may further have the connector(s) configured to be mounted to the loading element(s), wherein each connector allows the device to be secured to a safety line or to a user.

[0060] In some non-limiting embodiments or aspects, the connectors may have shackles, having shackle pins arranged to be inserted through the apertures in the loading elements.

[0061] In some non-limiting embodiments or aspects, the elongate flexible element may be stored within the housing in a coiled formation prior to deployment.

[0062] In some non-limiting embodiments or aspects, the device may have an adhesive, or an adhesive strip, arranged to retain the elongate flexible element in the coiled formation prior to deployment. In this manner, the elongate flexible element may be kept from unravelling if the housing is opened prior to deployment, for example to inspect the device's condition.

[0063] In some non-limiting embodiments or aspects, the elongate flexible element may have at least one folded portion, wherein each folded portion is formed by a seam configured to tear upon application of the predetermined loading force. This may improve the energy absorbing properties of the elongate flexible element.

[0064] In some non-limiting embodiments or aspects, an energy absorber device for use in a fall arrest system may have an energy absorber arrangement comprising an elongate flexible element, and a housing. The housing may be configured to be adjustable between a closed condition in which the housing encloses the energy absorber arrangement and an open condition in which the housing is configured to open or separate. The energy absorber further may have at least two spine portions disposed within the housing, wherein the spine

portions are spaced apart and the elongate flexible element is wrapped around the spine portions prior to deployment.

[0065] In response to application of a predetermined loading force, the housing may be configured to move to the open condition and the elongate flexible element may be deployed.

[0066] In some non-limiting embodiments or aspects, the spine portions may provide a structure around which the elongate flexible element can be wrapped. This makes it easier to safely position the elongate flexible element within the housing to ensure a smooth deployment process. The spine portions may also help to retain the elongate flexible element within the housing if the housing is opened prior to deployment.

[0067] In some non-limiting embodiments or aspects, the elongate flexible element may be wrapped around the spine portions in a coiled formation prior to deployment.

[0068] In some non-limiting embodiments or aspects, the spine portions may extend in the same direction within the housing. Additionally or alternatively, the spine portions may be aligned in the same plane.

[0069] Each spine portion may have a proximal end and a distal end. The distal ends of the spine portions may be adjacent and spaced apart.

[0070] In some non-limiting embodiments or aspects, each of the proximal ends of the spine portions may be mounted to the housing and/or configured to be mounted to a connector.

[0071] The elongate flexible element may have a length of textile and/or a length of webbing.

[0072] In some non-limiting embodiments or aspects, there may be provided a fall arrest system or a fall arrest arrangement having an energy absorber device described herein.

[0073] In some non-limiting embodiments or aspects, there may be provided a housing for an energy absorber device described herein.

[0074] In some non-limiting embodiments or aspects, an energy absorber device may be characterized by one or more of the following numbered clauses:

[0075] Clause 1. An energy absorber device for use in a fall arrest system, the energy absorber device comprising: an elongate flexible element; a housing having a first body portion and a second body portion defining an internal cavity therebetween for receiving at least a portion of the elongate flexible element, the housing being movable between a closed condition in which the first body portion and the second body portion enclose the internal cavity and an open condition in which the first body portion and the

second body portion are configured to open or separate; and at least one loading element connected to the elongate flexible element and configured to engage at least a portion of the housing, wherein, in response to application of a predetermined loading force applied to the at least one loading element, the at least one loading element is configured to move to the housing to the open condition and deploy the elongate flexible element.

[0076] Clause 2. The energy absorber device according to clause 1, wherein the elongate flexible element is deployed in a first direction and wherein the housing is configured to open or separate in a second direction substantially transverse to the first direction.

[0077] Clause 3. The energy absorber device according to clause 1 or 2, further comprising a fastener arrangement reconfigurable between a locked position in which the first and second body portions are secured together to enclose the internal cavity and an open position in which the first and second body portions are configured to open or separate to expose the internal cavity.

[0078] Clause 4. The energy absorber device according to any of clauses 1-3, wherein the fastener arrangement comprises a first part on the first body portion and a second part on the second body portion, and wherein the first part is releasably connectable to the second part.

[0079] Clause 5. The energy absorber device according to any of clauses 1-4, wherein the first part is a clip and wherein the second part is an indentation or a slot.

[0080] Clause 6. The energy absorber device according to any of clauses 1-5, wherein the first body portion is connected to the second body portion in the closed condition of the housing by a hinge.

[0081] Clause 7. The energy absorber device according to any of clauses 1-6, wherein the hinge is disposed at one end of the housing, and the fastener arrangement is disposed at an opposing end of the housing.

[0082] Clause 8. The energy absorber device according to any of clauses 1-7, wherein the at least one loading element comprises an attachment portion positioned outside of the internal cavity of the housing and having an aperture.

[0083] Clause 9. The energy absorber device according to any of clauses 1-8, further comprising a connector connected to the at least one loading element with a pin extending through the aperture of the attachment portion.

[0084] Clause 10. The energy absorber device according to any of clauses 1-9, wherein the at least one loading element comprises at least one shoulder portion positioned within the internal cavity of the housing and configured to transmit a loading force from the at least one loading element to the housing.

[0085] Clause 11. The energy absorber device according to any of clauses 1-10, wherein the at least one loading element comprises a spine portion positioned within the internal cavity of the housing and wherein the elongate flexible element is at least partially wrapped around the spine portion in a coiled formation prior to deployment.

[0086] Clause 12. The energy absorber device according to any of clauses 1-11, wherein the first body portion is connected to the second body portion in the closed condition of the housing along a joint extending in a direction substantially parallel to a direction in which the elongate flexible element is deployed.

[0087] Clause 13. An energy absorber device for use in a fall arrest system, the energy absorber device comprising: an elongate flexible element; a housing having a first body portion and a second body portion defining an internal cavity therebetween for receiving at least a portion of the elongate flexible element, the housing being movable between a closed condition in which the first body portion and the second body portion enclose the internal cavity and an open condition in which the first body portion and the second body portion are configured to open or separate; a fastener arrangement reconfigurable between a locked position in which the first and second body portions are secured together to enclose the internal cavity and an open position in which the first and second body portions are configured to open or separate to expose the internal cavity; and a first loading element configured to engage a first end of the housing and a second loading element configured to engage a second end of the housing, the first and second loading elements connected to the elongate flexible element, wherein, in response to application of a predetermined loading force applied to at least one of the first and second loading elements, at least one of the first and second loading elements is configured to move to the housing to the open condition and deploy the elongate flexible element.

[0088] Clause 14. The energy absorber device according to clause 13, wherein the fastener arrangement comprises a first part on the first body portion and a second part on the second body portion, and wherein the first part is releasably connectable to the second part.

[0089] Clause 15. The energy absorber device according to clause 13 or 14, wherein the first body portion is connected to the second body portion in the closed condition of the housing by a hinge.

[0090] Clause 16. The energy absorber device according to any of clauses 13-15, wherein at least one of the first and second loading elements comprises: an attachment portion positioned outside of the internal cavity of the housing and having an aperture configured for connecting to a connector; and at least one shoulder portion positioned within the internal cavity of the housing and configured to transmit a loading force from the at least one loading element to the housing.

[0091] Clause 17. The energy absorber device according to any of clauses 13-16, wherein at least one of the first and second loading elements further comprises a spine portion positioned within the internal cavity of the housing and wherein the elongate flexible element is at least partially wrapped around the spine portion in a coiled formation prior to deployment.

[0092] Clause 18. An energy absorber device for use in a fall arrest system, the energy absorber device comprising: an elongate flexible element; a housing having a first body portion and a second body portion defining an internal cavity therebetween for receiving at least a portion of the elongate flexible element, the housing being movable between a closed condition in which the first body portion and the second body portion enclose the internal cavity and an open condition in which the first body portion and the second body portion are configured to open or separate; a fastener arrangement reconfigurable between a locked position in which the first and second body portions are secured together to enclose the internal cavity and an open position in which the first and second body portions are configured to open or separate to expose the internal cavity; and a first loading element configured to engage a first end of the housing and a second loading element configured to engage a second end of the housing, the first and second loading elements connected to the elongate flexible element, wherein, in response to application of a predetermined loading force applied to at least one of the first and second loading elements, at least one of the first and second loading elements is configured to move to the housing to the open condition and deploy the elongate flexible element, and wherein the elongate flexible element is deployed in a first direction and wherein the housing is configured to open or separate in a second direction substantially transverse to the first direction.

[0093] Clause 19. The energy absorber device according to clause 18, wherein at least one of the first and second loading elements comprises: an attachment portion positioned outside of the internal cavity of the housing and having an aperture configured for connecting to a connector; at least one shoulder portion positioned within the internal cavity of the housing and configured to transmit a loading force from the at least one loading element to the housing; and a spine portion positioned within the internal cavity of the housing, wherein the elongate flexible element is at least partially wrapped around the spine portion in a coiled formation prior to deployment.

[0094] Clause 20. The energy absorber device according to clause 18 or 19, wherein the first body portion is connected to the second body portion in the closed condition of the housing by a hinge.

[0095] Clause 21. An energy absorber device for use in a fall arrest system, the energy absorber device comprising: an elongate flexible element; a housing having a first body portion and a second body portion defining an internal cavity therebetween for receiving at least a portion of the elongate flexible element, the housing being movable between a closed condition in which the first body portion and the second body portion enclose the internal cavity and an open condition in which the first body portion and the second body portion are configured to open or separate; a fastener arrangement reconfigurable between a locked position in which the first and second body portions are secured together to enclose the internal cavity and an open position in which the first and second body portions are configured to open or separate to expose the internal cavity; and at least one loading element connected to the elongate flexible element and configured to engage at least a portion of the housing, wherein, in response to application of a predetermined loading force applied to the at least one loading element, the at least one loading element is configured to move to the housing to the open condition and deploy the elongate flexible element.

[096] Clause 22. The energy absorber device according to clause 21, wherein the elongate flexible element is deployed in a first direction and wherein the housing is configured to open or separate in a second direction substantially transverse to the first direction.

[097] Clause 23. The energy absorber device according to clause 21 or 22, wherein the fastener arrangement comprises a first part on the first body portion and a second part on

the second body portion, and wherein the first part is releasably connectable to the second part.

[098] Clause 24. The energy absorber device according to any of clauses 21-23, wherein the first part is a clip and wherein the second part is an indentation or a slot.

[099] Clause 25. The energy absorber device according to any of clauses 21-24, wherein the first body portion is connected to the second body portion in the closed condition of the housing by a hinge.

[0100] Clause 26. The energy absorber device according to any of clauses 21-25, wherein the hinge is disposed at one end of the housing, and the fastener arrangement is disposed at an opposing end of the housing.

[0101] Clause 27. The energy absorber device according to any of clauses 21-26, wherein the at least one loading element comprises an attachment portion positioned outside of the internal cavity of the housing and having an aperture.

[0102] Clause 28. The energy absorber device according to any of clauses 21-27, further comprising a connector connected to the at least one loading element with a pin extending through the aperture of the attachment portion.

[0103] Clause 29. The energy absorber device according to any of clauses 21-28, wherein the at least one loading element comprises at least one shoulder portion positioned within the internal cavity of the housing and configured to transmit a loading force from the at least one loading element to the housing.

[0104] Clause 30. The energy absorber device according to any of clauses 21-29, wherein the at least one loading element comprises a spine portion positioned within the internal cavity of the housing and wherein the elongate flexible element is at least partially wrapped around the spine portion in a coiled formation prior to deployment.

[0105] Clause 31. The energy absorber device according to any of clauses 21-30, wherein the first body portion is connected to the second body portion in the closed condition of the housing along a joint extending in a direction substantially parallel to a direction in which the elongate flexible element is deployed.

[0106] Clause 32. The energy absorber device according to any of clauses 21-31, wherein a loop is provided at each end of the elongate flexible element and one of the loops is secured around the at least one loading element.

[0107] Clause 33. The energy absorber device according to any of clauses 21-32, further comprising adhesive, or an adhesive strip, arranged to retain the elongate flexible element in the coiled formation prior to deployment.

[0108] Clause 34. The energy absorber device according to any of clauses 21-33, wherein the at least one loading element comprises a first loading element engaging a first end of the housing and a second loading element engaging a second end of the housing.

[0109] Clause 35. The energy absorber device according to any of clauses 21-34, wherein, in response to application of a predetermined loading force applied to at least one of the first and second loading elements, at least one of the first and second loading elements is configured to move to the housing to the open condition and deploy the elongate flexible element.

[0110] Clause 36. An energy absorber device for use in a fall arrest system, the device comprising: an energy absorber arrangement comprising an elongate flexible element; and a housing, wherein the housing is configured to be adjustable between a closed condition in which the housing encloses the energy absorber arrangement and an open condition in which the housing is configured to open or separate; wherein, in response to application of a predetermined loading force, the housing is configured to move to the open condition and the elongate flexible element is deployed; and wherein the housing can open or separate without resulting in deployment of the elongate flexible element.

[0111] Clause 37. The energy absorber device of clause 36, wherein the elongate flexible element is deployed in a first direction and the housing is configured to open or separate in a second direction substantially transverse to the first direction.

[0112] Clause 38. The energy absorber device of clause 36 or 37, wherein the housing comprises: a first body portion and a second body portion; and a joint along which the first body portion is configured to at least partially open or separate from the second body portion; wherein the joint extends in a direction substantially parallel to the direction in which the elongate flexible element is deployed.

[0113] Clause 39. The energy absorber device of any of clauses 36-38, wherein the joint extends substantially along a length of the housing, and/or substantially around a circumference of the housing.

[0114] Clause 40. The energy absorber device of any of clauses 36-39, comprising a bore or channel disposed at each end of the housing, wherein each bore or channel is for receiving a connector therein.

[0115] Clause 41. The energy absorber device of any of clauses 36-40, wherein the joint between the first body portion and the second body portion extends between the bores or channels in the housing.

[0116] Clause 42. The energy absorber device of any of clauses 36-41, wherein the housing comprises: a first body portion and a second body portion; a hinge connecting the first body portion to the second body portion; and a fastener arrangement reconfigurable between: i) a locked position in which the first and second body portions are secured together; and ii) an open position in which the first and second body portions pivot about the hinge, such that the housing is in the closed condition when the fastener arrangement is in the locked position.

[0117] Clause 43. An energy absorber device for use in a fall arrest system comprising: a housing comprising: a first body portion and a second body portion; a hinge connecting the first body portion to the second body portion; and a fastener arrangement reconfigurable between: i) a locked position in which the first and second body portions are secured together; and ii) an open position in which the first and second body portions pivot about the hinge; and an energy absorber arrangement comprising an elongate flexible element received within the housing; wherein in response to application of a predetermined loading force on the housing, the fastener arrangement moves to the open position and the elongate flexible element is deployed.

[0118] Clause 44. The energy absorber device of clause 43, wherein the hinge is disposed at one end of the first and second body portions, and the fastener arrangement is disposed at the opposing end of the first and/or second body portions.

[0119] Clause 45. The energy absorber device of clause 43 or 44, wherein when the fastener arrangement is in the locked position, the housing comprises a first bore or channel disposed adjacent to the hinge and a second bore or channel disposed adjacent to the fastener arrangement, wherein each bore or channel is for receiving a connector therein.

[0120] Clause 46. The energy absorber device of any of clauses 43-45, wherein the fastener arrangement comprises a clip.

[0121] Clause 47. The energy absorber device of any of clauses 43-46, wherein the first and second body portions are rigid.

[0122] Clause 48. An energy absorber device for use in a fall arrest system comprising: an energy absorber arrangement comprising an elongate flexible element; a housing having a closed condition in which it encloses the energy absorber arrangement; and

a loading element arranged to engage the housing, wherein the loading element comprises an attachment portion for mounting to a connector, such that the loading element is configured to transmit a loading force from the connector to the housing; wherein, in response to application of a predetermined loading force, the housing is configured to open or separate and the elongate flexible element is deployed.

[0123] Clause 49. The energy absorber device of clause 48, wherein the attachment portion of the loading element comprises an aperture configured to receive a connector therethrough.

[0124] Clause 50. The energy absorber device of clause 48 or 49, wherein the housing comprises: a first body portion and a second body portion; a hinge connecting the first body portion to the second body portion; and a fastener arrangement reconfigurable between: i) a locked position in which the first and second body portions are secured together; and ii) an open position in which the first and second body portions pivot about the hinge, wherein the housing is in the closed condition when the fastener arrangement is in the locked position and, in response to application of the predetermined loading force on the housing, the fastener arrangement moves to the open position.

[0125] Clause 51. The energy absorber device of any of clauses 48-50, wherein the fastener arrangement is disposed proximate the attachment portion of the loading element when the fastener arrangement is in the locked position.

[0126] Clause 52. The energy absorber device of any of clauses 48-51, wherein, when the loading force applied to the loading element is below a given threshold, the fastener arrangement can be moved to the open position and the housing can be opened or separated without resulting in deployment of the elongate flexible element.

[0127] Clause 53. The energy absorber device of any of clauses 48-52, wherein the loading element is at least partially enclosed within the housing when the housing is in the closed condition.

[0128] Clause 54. The energy absorber device of any of clauses 48-53, wherein the loading element comprises at least one shoulder portion configured to engage a slot or recess provided in the housing.

[0129] Clause 55. The energy absorber device of any of clauses 48-54, wherein a loop is provided at each end of the elongate flexible element and one of the loops is secured around the loading element.

[0130] Clause 56. The energy absorber device of any of clauses 48-55, wherein the at least one shoulder portion projects outside of the loop in the elongate flexible element.

[0131] Clause 57. The energy absorber device of any of clauses 48-56 wherein the loading element comprises a spine portion and the elongate flexible element is at least partially wrapped around the spine portion in a coiled formation prior to deployment.

[0132] Clause 58. The energy absorber device of any of clauses 48-57, comprising a plurality of loading elements.

[0133] Clause 59. The energy absorber device of any of clauses 48-58, wherein the loading elements are disposed at opposing ends of the housing.

[0134] Clause 60. The energy absorber device of any of clauses 48-59, further comprising the connector(s) configured to be mounted to the loading element(s), wherein each connector allows the device to be secured to a safety line or to a user.

[0135] Clause 61. The energy absorber device of any of clauses 48-60, wherein the connector(s) comprise shackles, having shackle pins arranged to be inserted through the apertures in the loading elements.

[0136] Clause 62. The energy absorber device of any of clauses 48-61, wherein the elongate flexible element is stored within the housing in a coiled formation prior to deployment.

[0137] Clause 63. The energy absorber device of any of clauses 48-62, further comprising adhesive, or an adhesive strip, arranged to retain the elongate flexible element in the coiled formation prior to deployment.

[0138] Clause 64. The energy absorber device of any of clauses 48-63, wherein the elongate flexible element comprises at least one folded portion, wherein each folded portion is formed by a seam configured to tear upon application of the predetermined loading force.

[0139] Clause 65. The energy absorber device of any of clauses 48-64, wherein the housing is as defined in any of clauses 43-47.

[0140] Clause 66. An energy absorber device for use in a fall arrest system comprising: an energy absorber arrangement comprising an elongate flexible element; a housing, wherein the housing is configured to be adjustable between a closed condition in which the housing encloses the energy absorber arrangement and an open condition in which the housing is configured to open or separate; and at least two spine portions disposed within the housing, wherein the spine portions are spaced apart and the elongate flexible element is wrapped around the spine portions prior to deployment; wherein, in response to application

of a predetermined loading force, the housing is configured to move to the open condition and the elongate flexible element is deployed.

[0141] Clause 67. The energy absorber device of clause 66, wherein the spine portions extend in the same direction within the housing, and/or wherein the spine portions are aligned in the same plane.

[0142] Clause 68. The energy absorber device of clause 66 or 67, wherein each spine portion comprises a proximal end and a distal end and the distal ends of the spine portions are adjacent and spaced apart.

[0143] Clause 69. The energy absorber device of any of clauses 66-68, wherein each of the proximal ends of the spine portions are mounted to the housing and/or configured to be mounted to a connector.

[0144] Clause 70. The energy absorber device of any of claims 66-69, wherein the housing is as defined in any preceding claim.

[0145] Clause 71. The energy absorber device of any of clauses 66-70, wherein the elongate flexible element comprises a length of textile and/or a length of webbing.

[0146] Clause 72. A fall arrest system comprising an energy absorber device according to clause 36.

[0147] Clause 73. A fall arrest arrangement comprising an energy absorber device according to clause 36.

[0148] Clause 74. A housing for an energy absorber device as defined in clause 42.

BRIEF DESCRIPTION OF THE DRAWINGS

[0149] Illustrative embodiments of the disclosure will now be described by way of example only and with reference to the accompanying drawings, in which:

[0150] **Figure 1a** shows a side view of a housing for an energy absorber device in an open condition;

[0151] **Figure 1b** shows a side view of an energy absorber device comprising the housing of Figure 1a;

[0152] **Figure 2a** shows a front perspective view of a housing for an energy absorber device in a closed condition;

[0153] **Figure 2b** shows the housing of Figure 2a in an open condition;

[0154] **Figure 3** shows a loading element and connector in accordance with an embodiment of the present disclosure;

[0155] **Figure 4** shows an elongate flexible element secured to two loading elements as depicted in Figure 3;

[0156] **Figure 5** is a close up illustrating how the loading elements engage the housing;

[0157] **Figure 6** is an exploded view of an energy absorber device of an embodiment of the present disclosure, with a portion of the housing removed;

[0158] **Figure 7** shows a perspective view of an assembled energy absorber device of the present disclosure, with a portion of the housing removed;

[0159] **Figure 8** shows the energy absorber device of Figure 7 without the elongate flexible element;

[0160] **Figure 9** shows a side view of an energy absorber device of the present disclosure during deployment of the elongate flexible element; and

[0161] **Figure 10** shows the device of Figure 9 when the elongate flexible element has been fully deployed.

[0162] It should be noted that Figures 1a to 10 are schematic diagrams which are not drawn to scale.

[0163] Figure 1a shows a housing 1 in accordance with an embodiment of the present disclosure, when in the open condition. In some non-limiting embodiments or aspects, the housing 1 has a first body portion 2 and a second body portion 3. As shown, in the open condition the two body portions are completely separated.

[0164] In some non-limiting embodiments or aspects, a joint 4 extends around the circumference of the first body portion 2, such that the first body portion 2 can be removably connected to the second body portion 3 in a snap-fit arrangement.

[0165] Figure 1b shows the housing of Figure 1a in the closed condition as part of an energy absorber device. The first body portion 2 is connected to the second body portion 3 by the joint 4. In some non-limiting embodiments or aspects, a bore or channel is provided at each end of the first and second body portions 2, 3 into which a connector 5 is inserted. The connectors 5 allow each end of the device to be mounted to a karabiner or other securing means 6 which may be mounted to a safety line or to a user.

[0166] In use, if a loading force indicative of a fall arrest event is applied to one of the connectors 5 the first body portion 2 separates from the second body portion 3 along the joint 4 in the direction indicated by arrow A. In some non-limiting embodiments or aspects, the elongate flexible element contained within the housing (not shown) and mounted to the connectors 5 is then deployed in the direction indicated by arrow B. As shown, directions A

is substantially transverse or perpendicular to direction B. This absorbs the energy of a fall arrest event.

[0167] In addition, as the housing separates in a direction A transverse to the direction in which the elongate flexible element is deployed, the housing can be opened without resulting in deployment of the elongate flexible element.

[0168] Figure 2a shows a housing 10 in accordance with an embodiment of the present disclosure. In some non-limiting embodiments or aspects, the housing 10 has a first body portion 11 and a second body portion 12. The first 11 and second 12 body portions are formed of a rigid plastic and/or metal material.

[0169] In some non-limiting embodiments or aspects, a hinge 15 connects the first body portion 11 to the second body portion 12 at one end of the housing.

[0170] At the other end of the housing 10 there is disposed a fastener arrangement 14. In some non-limiting embodiments or aspects, the fastener arrangement 14 is a clip.

[0171] At each end of the housing 10, disposed proximate the hinge 15 and fastener arrangement 14, is a bore 13. In some non-limiting embodiments or aspects, each bore 13 is configured to receive a connector therethrough (see Figures 6 to 8).

[0172] In Figure 2a, the housing is shown in the closed condition and the fastener arrangement 14 is in the locked position to secure the first 11 and second 12 body portions together. In this configuration, the housing 10 defines an internal cavity for receiving an energy absorber arrangement therein. In the closed condition, the housing 10 therefore protects the energy absorber arrangement from damage or wear prior to deployment.

[0173] Figure 2b shows the housing of Figure 2a in the open condition. The fastener arrangement 14 has been reconfigured to the open position allowing the first body portion 11 and second body portion 12 to separate and pivot about the hinge 15.

[0174] The hinge 15 is depicted in Figure 2b as a flexible joint between the two body portions 11, 12, but any type of hinge joint may be used which allows the first body portion 11 to pivot relative to the second body portion 12.

[0175] As shown, at each end of the first and second body portions 11, 12 there is provided a channel 13a, 13b which, when the housing is secured in the closed condition (see Figure 2a) form the bores 13.

[0176] In some non-limiting embodiments or aspects, the fastener arrangement 14 has a first part 14a provided on the first body portion 11 and a second part 14b provided on the second body portion 12. The fastener arrangement parts 14a, 14b are disposed at the

opposing end of the body portions 11, 12 to the hinge 15. In some non-limiting embodiments or aspects, the channels 13a are provided in the parts 14a, 14b of the fastener arrangement 14.

[0177] In some non-limiting embodiments or aspects, the first part 14a of the fastener arrangement has a clip which is configured to be secured in a corresponding indentation or slot in the second part 14b of the fastener arrangement (see Figure 2a). When parts 14a, 14b are secured together the fastener arrangement is in the locked position.

[0178] Figure 3 shows a loading element 16 configured to be received within the housing 10 and a connector 20 mounted to the loading element 16. In some non-limiting embodiments or aspects, the connector 20 is a shackle, but other types of connectors may be used.

[0179] In some non-limiting embodiments or aspects, the loading element 16 has a spine portion 18, an attachment portion 19 and two shoulder portions 17. In other embodiments or aspects, the loading element 16 may have only a single shoulder portion 17 and/or the spine portion 18 may not be provided.

[0180] In use, the spine portion 18 extends into the cavity enclosed by the housing 10 in the closed condition. In some non-limiting embodiments or aspects, the shoulder portions 17 are configured to transfer a loading force applied to the connector 20 to the housing 10. As such, the shoulder portions 17 are shaped to engage within a recess provided in the housing, as shown in Figures 5 and 7.

[0181] In some non-limiting embodiments or aspects, the attachment portion 19 is configured for mounting the loading element 16 to the connector 20. In such embodiments or aspects, the attachment portion 19 has an aperture through which the shackle pin (or bolt) 21 is inserted. In use, the attachment portion 19 is positioned in one of the bores 13 in the housing 10 (see Figure 8).

[0182] In the present disclosure, the energy absorber arrangement has an elongate flexible element 30. In some non-limiting embodiments or aspects, the elongate flexible element 30 is a length of fabric or webbing that absorbs the force of a falling user in a fall arrest event.

[0183] Prior to deployment the elongate flexible element 30 is stored within the housing 10. Figure 4 shows the apparatus of Figure 3 with the elongate flexible element 30 wrapped around the spine portions 18 of two loading elements 16. In other embodiments, only a single loading element 16 may be provided.

[0184] The elongate flexible element 30 is wrapped around the spine portions 18 in a coiled formation, with one coil wrapped around each spine portion 18, as shown in Figure 4.

[0185] Figure 6 is an exploded view of the components of an energy absorber device having the arrangement shown in Figure 4.

[0186] In some non-limiting embodiments or aspects, a strip of adhesive or adhesive tape 32 is provided to secure the elongate flexible element 30 in the coiled formation around the spine portions 18 prior to deployment. This helps to keep the flexible element 30 in place if the housing is opened, and to ensure that the elongate flexible element 30 is not deployed until a force exceeding a predetermined loading force is applied to one of the connectors 20. The predetermined loading force is configured to correspond to a typical loading force resulting from a fall arrest event.

[0187] In some non-limiting embodiments or aspects, at each end of the elongate flexible element 30 there is formed a loop 31. Each loop 31 is secured around the attachment portion 19 of one of the loading elements 16. The elongate flexible element 30 and the loading elements 16 are then inserted into the housing. Only the second body portion 12 of the housing is depicted in Figure 6 for simplicity.

[0188] In some non-limiting embodiments or aspects, the shackle pins 21 can then be inserted through the connector 20, the channels 13a, 13b (forming bores 13), the loops 31 and the apertures 19a in the loading elements, as shown in Figure 7. Figure 8 shows the apparatus of Figure 7 with the elongate flexible element 30 removed.

[0189] When a loading force is applied to one of the connectors 20, the force is transmitted from the connector 20 to the shoulder portion 17 of the loading element 16 mounted thereto. The shoulder portion 17 transmits the loading force to the body portions 11, 12 of the housing, where it is transmitted to the shoulder portion 17 of the other loading element 16 and from there to the other connector 20. If the loading force is below the predetermined loading force, the housing remains in the closed condition with the fastener arrangement 14 in the locked position and the elongate flexible element 30 is not deployed.

[0190] If a user unlocks the fastener arrangement 14, for example to inspect the condition of the device, the elongate flexible element 30 will not be deployed unless a force exceeding a given threshold is applied to one of the connectors 20. The threshold is at least partially determined by the properties of the adhesive strip 32 (see Figure 6).

[0191] Figure 9 shows the energy absorber device (as in Figure 7 but with the second body portion 12 of the housing in place) when a fall arrest event occurs. In use, the connectors 20 are attached either to an anchor point, a safety line or to a user.

[0192] In response to the application of a loading force indicative of a fall arrest event on one of the connectors 20, the loading element 16 disposed proximate the fastener arrangement 14 exerts a sufficient force on the fastener arrangement 14 to cause it to move to the open position, thereby opening the housing.

[0193] In some non-limiting embodiments or aspects, the clip portions 14a, 14b of the fastener arrangement 14 disconnect and the first body portion 11 begins to pivot away from the second body portion 12 about hinge 15, as shown in Figure 9. The connector 20 and the loading element 16 that are spaced from the hinge 15 can no longer transmit the loading force to the housing 10, thus this force is now transmitted to the elongate flexible element 30.

[0194] This force pulls the elongate flexible element 30 away from the housing 10, causing the coiled formation to unravel, thereby absorbing the energy of the fall arrest event.

[0195] If the elongate flexible element 30 has a strip of adhesive or adhesive tape 32 (as in Figure 6) then the adhesive fails or the tape 32 is ripped or fails when the loading force applied is indicative of a fall arrest event. Accordingly, the adhesive or adhesive tape 32 does not interfere with the deployment of the elongate flexible element 30.

[0196] Figure 10 shows the device of Figure 9 when the elongate flexible element 30 has been fully deployed. The housing is in the open condition as also shown in Figure 2b.

[0197] In some non-limiting embodiments or aspects, the loops 31 at the ends of the elongate flexible element 30 remain secured between the connector 20 and the attachment portion 19 of the loading elements 16. The coiled formation of the elongate flexible element 30 has completely unwrapped or unravelled from around the spine portions 18 of the loading elements.

[0198] In some non-limiting embodiments or aspects, the first and second body portions 11, 12 remain secured to each other at one end by the hinge 15. In addition, the housing is secured to the connector 20 by the hinge 15 passing therethrough, as the body portions 11, 12 are too large to pass through the connector 20. This prevents the housing from falling away from the user during deployment of the elongate flexible element 30.

[0199] It should be noted that the above-mentioned embodiments illustrate rather than limit the disclosure, and that those skilled in the art will be capable of designing many

alternative embodiments or aspects without departing from the scope of the disclosure as defined by the appended claims. In the claims, any reference signs placed in parentheses shall not be construed as limiting the claims. The word "comprising" and "comprises", and the like, does not exclude the presence of elements or steps other than those listed in any claim or the specification as a whole. In the present specification, "comprises" means "includes or consists of" and "comprising" means "including or consisting of". The singular reference of an element does not exclude the plural reference of such elements and vice-versa. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

CLAIMS

1. An energy absorber device for use in a fall arrest system, the energy absorber device comprising:

an elongate flexible element;

a housing having a first body portion and a second body portion defining an internal cavity therebetween for receiving at least a portion of the elongate flexible element, the housing being movable between a closed condition in which the first body portion and the second body portion enclose the internal cavity and an open condition in which the first body portion and the second body portion are configured to open or separate; and

at least one loading element connected to the elongate flexible element and configured to engage at least a portion of the housing,

wherein, in response to application of a predetermined loading force applied to the at least one loading element, the at least one loading element is configured to move to the housing to the open condition and deploy the elongate flexible element.

2. The energy absorber device according to claim 1, wherein the elongate flexible element is deployed in a first direction and wherein the housing is configured to open or separate in a second direction substantially transverse to the first direction.

3. The energy absorber device according to claim 1, further comprising a fastener arrangement reconfigurable between a locked position in which the first and second body portions are secured together to enclose the internal cavity and an open position in which the first and second body portions are configured to open or separate to expose the internal cavity.

4. The energy absorber device according to claim 3, wherein the fastener arrangement comprises a first part on the first body portion and a second part on the second body portion, and wherein the first part is releasably connectable to the second part.

5. The energy absorber device according to claim 4, wherein the first part is a clip and wherein the second part is an indentation or a slot.

6. The energy absorber device according to claim 3, wherein the first body portion is connected to the second body portion in the closed condition of the housing by a hinge.

7. The energy absorber device according to claim 6, wherein the hinge is disposed at one end of the housing, and the fastener arrangement is disposed at an opposing end of the housing.

8. The energy absorber device according to claim 1, wherein the at least one loading element comprises an attachment portion positioned outside of the internal cavity of the housing and having an aperture.

9. The energy absorber device according to claim 8, further comprising a connector connected to the at least one loading element with a pin extending through the aperture of the attachment portion.

10. The energy absorber device according to claim 1, wherein the at least one loading element comprises at least one shoulder portion positioned within the internal cavity of the housing and configured to transmit a loading force from the at least one loading element to the housing.

11. The energy absorber device according to claim 1, wherein the at least one loading element comprises a spine portion positioned within the internal cavity of the housing and wherein the elongate flexible element is at least partially wrapped around the spine portion in a coiled formation prior to deployment.

12. The energy absorber device according to claim 1, wherein the first body portion is connected to the second body portion in the closed condition of the housing along a joint extending in a direction substantially parallel to a direction in which the elongate flexible element is deployed.

13. An energy absorber device for use in a fall arrest system, the energy absorber device comprising:

an elongate flexible element;

a housing having a first body portion and a second body portion defining an internal cavity therebetween for receiving at least a portion of the elongate flexible element, the housing being movable between a closed condition in which the first body portion and the second body portion enclose the internal cavity and an open condition in which the first body portion and the second body portion are configured to open or separate;

a fastener arrangement reconfigurable between a locked position in which the first and second body portions are secured together to enclose the internal cavity and an open position in which the first and second body portions are configured to open or separate to expose the internal cavity; and

a first loading element configured to engage a first end of the housing and a second loading element configured to engage a second end of the housing, the first and second loading elements connected to the elongate flexible element,

wherein, in response to application of a predetermined loading force applied to at least one of the first and second loading elements, at least one of the first and second loading elements is configured to move to the housing to the open condition and deploy the elongate flexible element.

14. The energy absorber device according to claim 13, wherein the fastener arrangement comprises a first part on the first body portion and a second part on the second body portion, and wherein the first part is releasably connectable to the second part.

15. The energy absorber device according to claim 13, wherein the first body portion is connected to the second body portion in the closed condition of the housing by a hinge.

16. The energy absorber device according to claim 13, wherein at least one of the first and second loading elements comprises:

an attachment portion positioned outside of the internal cavity of the housing and having an aperture configured for connecting to a connector; and

at least one shoulder portion positioned within the internal cavity of the housing and configured to transmit a loading force from the at least one loading element to the housing.

17. The energy absorber device according to claim 16, wherein at least one of the first and second loading elements further comprises a spine portion positioned within the internal cavity of the housing and wherein the elongate flexible element is at least partially wrapped around the spine portion in a coiled formation prior to deployment.

18. An energy absorber device for use in a fall arrest system, the energy absorber device comprising:

an elongate flexible element;

a housing having a first body portion and a second body portion defining an internal cavity therebetween for receiving at least a portion of the elongate flexible element, the housing being movable between a closed condition in which the first body portion and the second body portion enclose the internal cavity and an open condition in which the first body portion and the second body portion are configured to open or separate;

a fastener arrangement reconfigurable between a locked position in which the first and second body portions are secured together to enclose the internal cavity and an open position in which the first and second body portions are configured to open or separate to expose the internal cavity; and

a first loading element configured to engage a first end of the housing and a second loading element configured to engage a second end of the housing, the first and second loading elements connected to the elongate flexible element,

wherein, in response to application of a predetermined loading force applied to at least one of the first and second loading elements, at least one of the first and second loading elements is configured to move to the housing to the open condition and deploy the elongate flexible element, and

wherein the elongate flexible element is deployed in a first direction and wherein the housing is configured to open or separate in a second direction substantially transverse to the first direction.

19. The energy absorber device according to claim 18, wherein at least one of the first and second loading elements comprises:

an attachment portion positioned outside of the internal cavity of the housing and having an aperture configured for connecting to a connector;

at least one shoulder portion positioned within the internal cavity of the housing and configured to transmit a loading force from the at least one loading element to the housing; and

a spine portion positioned within the internal cavity of the housing, wherein the elongate flexible element is at least partially wrapped around the spine portion in a coiled formation prior to deployment.

20. The energy absorber device according to claim 18, wherein the first body portion is connected to the second body portion in the closed condition of the housing by a hinge.

21. An energy absorber device for use in a fall arrest system, the energy absorber device comprising:

an elongate flexible element;

a housing having a first body portion and a second body portion defining an internal cavity therebetween for receiving at least a portion of the elongate flexible element, the housing being movable between a closed condition in which the first body portion and the second body portion enclose the internal cavity and an open condition in which the first body portion and the second body portion are configured to open or separate;

a fastener arrangement reconfigurable between a locked position in which the first and second body portions are secured together to enclose the internal cavity and an open position in which the first and second body portions are configured to open or separate to expose the internal cavity; and

at least one loading element connected to the elongate flexible element and configured to engage at least a portion of the housing,

wherein, in response to application of a predetermined loading force applied to the at least one loading element, the at least one loading element is configured to move to the housing to the open condition and deploy the elongate flexible element.

22. The energy absorber device according to claim 21, wherein the elongate flexible element is deployed in a first direction and wherein the housing is configured to open or separate in a second direction substantially transverse to the first direction.

23. The energy absorber device according to claim 21 or 22, wherein the fastener arrangement comprises a first part on the first body portion and a second part on the second body portion, and wherein the first part is releasably connectable to the second part.

24. The energy absorber device according to claim 23, wherein the first part is a clip and wherein the second part is an indentation or a slot.

25. The energy absorber device according to any of claims 21-24, wherein the first body portion is connected to the second body portion in the closed condition of the housing by a hinge.

26. The energy absorber device according to claim 25, wherein the hinge is disposed at one end of the housing, and the fastener arrangement is disposed at an opposing end of the housing.

27. The energy absorber device according to any of claims 21-26, wherein the at least one loading element comprises an attachment portion positioned outside of the internal cavity of the housing and having an aperture.

28. The energy absorber device according to claim 27, further comprising a connector connected to the at least one loading element with a pin extending through the aperture of the attachment portion.

29. The energy absorber device according to any of claims 21-28, wherein the at least one loading element comprises at least one shoulder portion positioned within the internal cavity of the housing and configured to transmit a loading force from the at least one loading element to the housing.

30. The energy absorber device according to any of claims 21-29, wherein the at least one loading element comprises a spine portion positioned within the internal cavity of the housing and wherein the elongate flexible element is at least partially wrapped around the spine portion in a coiled formation prior to deployment.

31. The energy absorber device according to any of claims 21-30, wherein the first body portion is connected to the second body portion in the closed condition of the housing along a joint extending in a direction substantially parallel to a direction in which the elongate flexible element is deployed.

32. The energy absorber device according to any of claims 21-31, wherein a loop is provided at each end of the elongate flexible element and one of the loops is secured around the at least one loading element.

33. The energy absorber device according to any of claims 21-32, further comprising adhesive, or an adhesive strip, arranged to retain the elongate flexible element in the coiled formation prior to deployment.

34. The energy absorber device according to any of claims 21-33, wherein the at least one loading element comprises a first loading element engaging a first end of the housing and a second loading element engaging a second end of the housing.

35. The energy absorber device according to claim 34, wherein, in response to application of a predetermined loading force applied to at least one of the first and second loading elements, at least one of the first and second loading elements is configured to move to the housing to the open condition and deploy the elongate flexible element.

36. An energy absorber device for use in a fall arrest system, the device comprising:

an energy absorber arrangement comprising an elongate flexible element; and

a housing, wherein the housing is configured to be adjustable between a closed condition in which the housing encloses the energy absorber arrangement and an open condition in which the housing is configured to open or separate;

wherein, in response to application of a predetermined loading force, the housing is configured to move to the open condition and the elongate flexible element is deployed; and

wherein the housing can open or separate without resulting in deployment of the elongate flexible element.

37. The energy absorber device of claim 36, wherein the elongate flexible element is deployed in a first direction and the housing is configured to open or separate in a second direction substantially transverse to the first direction.

38. The energy absorber device of claim 36, wherein the housing comprises:

a first body portion and a second body portion; and

a joint along which the first body portion is configured to at least partially open or separate from the second body portion;

wherein the joint extends in a direction substantially parallel to the direction in which the elongate flexible element is deployed.

39. The energy absorber device of claim 38, wherein the joint extends substantially along a length of the housing, and/or substantially around a circumference of the housing.

40. The energy absorber device of claim 38, comprising a bore or channel disposed at each end of the housing, wherein each bore or channel is for receiving a connector therein.

41. The energy absorber device of claim 40, wherein the joint between the first body portion and the second body portion extends between the bores or channels in the housing.

42. The energy absorber device of claim 36, wherein the housing comprises:

a first body portion and a second body portion;

a hinge connecting the first body portion to the second body portion; and

a fastener arrangement reconfigurable between:

i) a locked position in which the first and second body portions are secured together; and

ii) an open position in which the first and second body portions pivot about the hinge,

such that the housing is in the closed condition when the fastener arrangement is in the locked position.

43. An energy absorber device for use in a fall arrest system comprising:

a housing comprising:

a first body portion and a second body portion;

a hinge connecting the first body portion to the second body portion; and

a fastener arrangement reconfigurable between:

i) a locked position in which the first and second body portions are secured together; and

ii) an open position in which the first and second body portions pivot about the hinge; and

an energy absorber arrangement comprising an elongate flexible element received within the housing;

wherein in response to application of a predetermined loading force on the housing, the fastener arrangement moves to the open position and the elongate flexible element is deployed.

44. The energy absorber device of claim 43, wherein the hinge is disposed at one end of the first and second body portions, and the fastener arrangement is disposed at the opposing end of the first and/or second body portions.

45. The energy absorber device of claim 43, wherein when the fastener arrangement is in the locked position, the housing comprises a first bore or channel disposed

adjacent to the hinge and a second bore or channel disposed adjacent to the fastener arrangement, wherein each bore or channel is for receiving a connector therein.

46. The energy absorber device of claim 43, wherein the fastener arrangement comprises a clip.

47. The energy absorber device of claim 38, wherein the first and second body portions are rigid.

48. An energy absorber device for use in a fall arrest system comprising:

an energy absorber arrangement comprising an elongate flexible element;

a housing having a closed condition in which it encloses the energy absorber arrangement; and

a loading element arranged to engage the housing, wherein the loading element comprises an attachment portion for mounting to a connector, such that the loading element is configured to transmit a loading force from the connector to the housing;

wherein, in response to application of a predetermined loading force, the housing is configured to open or separate and the elongate flexible element is deployed.

49. The energy absorber device of claim 48, wherein the attachment portion of the loading element comprises an aperture configured to receive a connector therethrough.

50. The energy absorber device of claim 48, wherein the housing comprises:

a first body portion and a second body portion;

a hinge connecting the first body portion to the second body portion; and

a fastener arrangement reconfigurable between:

i) a locked position in which the first and second body portions are secured together; and

ii) an open position in which the first and second body portions pivot about the hinge,

wherein the housing is in the closed condition when the fastener arrangement is in the locked position and, in response to application of the predetermined loading force on the housing, the fastener arrangement moves to the open position.

51. The energy absorber device of claim 50, wherein the fastener arrangement is disposed proximate the attachment portion of the loading element when the fastener arrangement is in the locked position.

52. The energy absorber device of claim 50, wherein, when the loading force applied to the loading element is below a given threshold, the fastener arrangement can be moved to the open position and the housing can be opened or separated without resulting in deployment of the elongate flexible element.

53. The energy absorber device of claim 48, wherein the loading element is at least partially enclosed within the housing when the housing is in the closed condition.

54. The energy absorber device of claim 48, wherein the loading element comprises at least one shoulder portion configured to engage a slot or recess provided in the housing.

55. The energy absorber device of claim 48, wherein a loop is provided at each end of the elongate flexible element and one of the loops is secured around the loading element.

56. The energy absorber device of claim 54, wherein the at least one shoulder portion projects outside of the loop in the elongate flexible element.

57. The energy absorber device of claim 48, wherein the loading element comprises a spine portion and the elongate flexible element is at least partially wrapped around the spine portion in a coiled formation prior to deployment.

58. The energy absorber device of claim 48, comprising a plurality of loading elements.

59. The energy absorber device of claim 58, wherein the loading elements are disposed at opposing ends of the housing.

60. The energy absorber device of claim 48, further comprising the connector(s) configured to be mounted to the loading element(s), wherein each connector allows the device to be secured to a safety line or to a user.

61. The energy absorber device of claim 60, wherein the connector(s) comprise shackles, having shackle pins arranged to be inserted through the apertures in the loading elements.

62. The energy absorber device of claim 48, wherein the elongate flexible element is stored within the housing in a coiled formation prior to deployment.

63. The energy absorber device of claim 48, further comprising adhesive, or an adhesive strip, arranged to retain the elongate flexible element in the coiled formation prior to deployment.

64. The energy absorber device of claim 48, wherein the elongate flexible element comprises at least one folded portion, wherein each folded portion is formed by a seam configured to tear upon application of the predetermined loading force.

65. The energy absorber device of claim 48, wherein the housing is as defined in claim 43.

66. An energy absorber device for use in a fall arrest system comprising:

an energy absorber arrangement comprising an elongate flexible element;

a housing, wherein the housing is configured to be adjustable between a closed condition in which the housing encloses the energy absorber arrangement and an open condition in which the housing is configured to open or separate; and

at least two spine portions disposed within the housing, wherein the spine portions are spaced apart and the elongate flexible element is wrapped around the spine portions prior to deployment;

wherein, in response to application of a predetermined loading force, the housing is configured to move to the open condition and the elongate flexible element is deployed.

67. The energy absorber device of claim 66, wherein the spine portions extend in the same direction within the housing, and/or wherein the spine portions are aligned in the same plane.

68. The energy absorber device of claim 66, wherein each spine portion comprises a proximal end and a distal end and the distal ends of the spine portions are adjacent and spaced apart.

69. The energy absorber device of claim 68, wherein each of the proximal ends of the spine portions are mounted to the housing and/or configured to be mounted to a connector.

70. The energy absorber device of claim 66, wherein the housing is as defined in claim 43.

71. The energy absorber device of claim 48, wherein the elongate flexible element comprises a length of textile and/or a length of webbing.

72. A fall arrest system comprising an energy absorber device according to claim 36.

73. A fall arrest arrangement comprising an energy absorber device according to claim 36.

74. A housing for an energy absorber device as defined in claim 42.

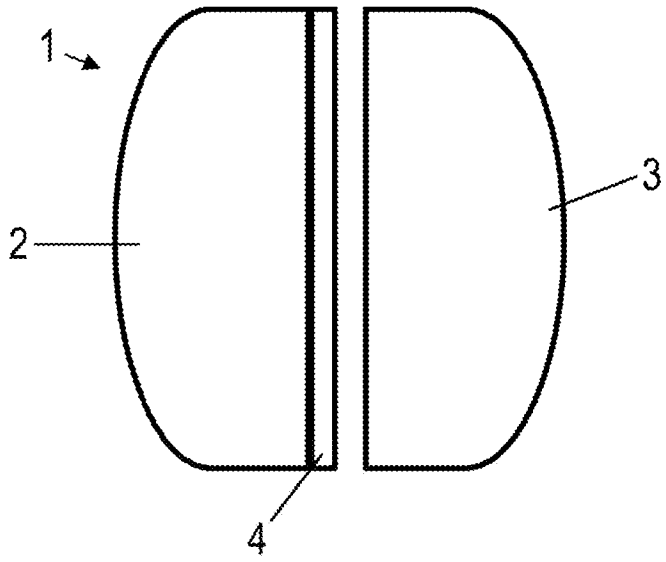


Fig. 1a

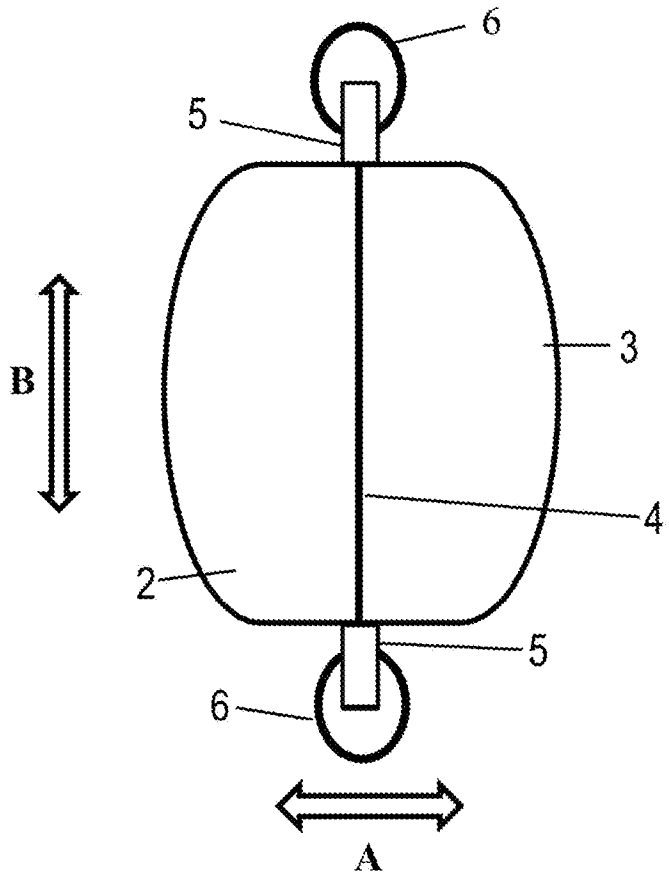


Fig. 1b

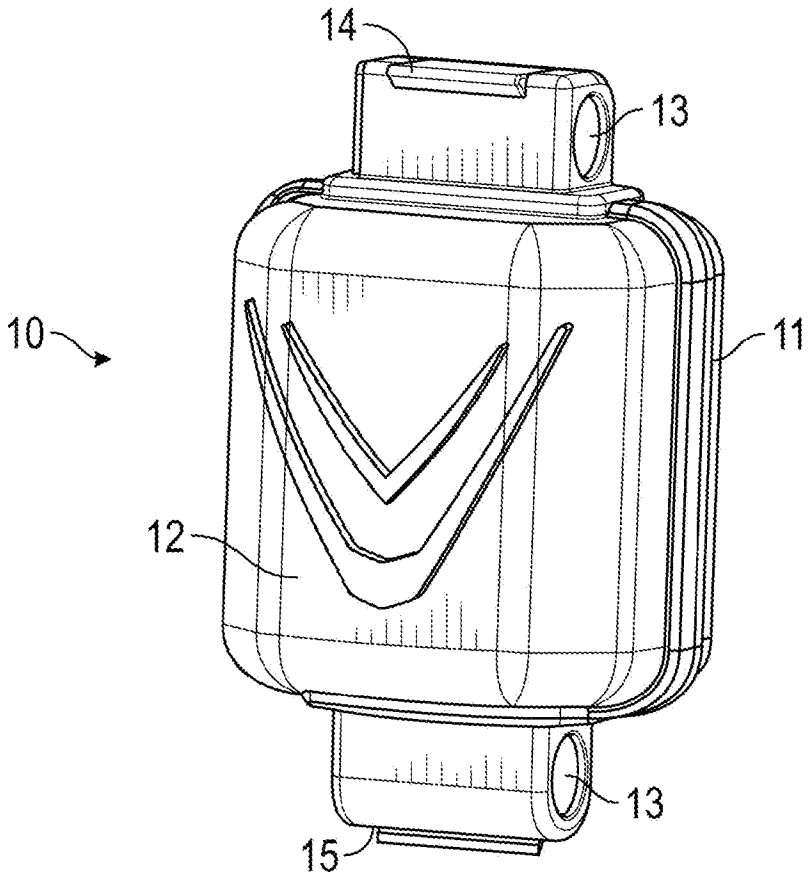


Fig. 2a

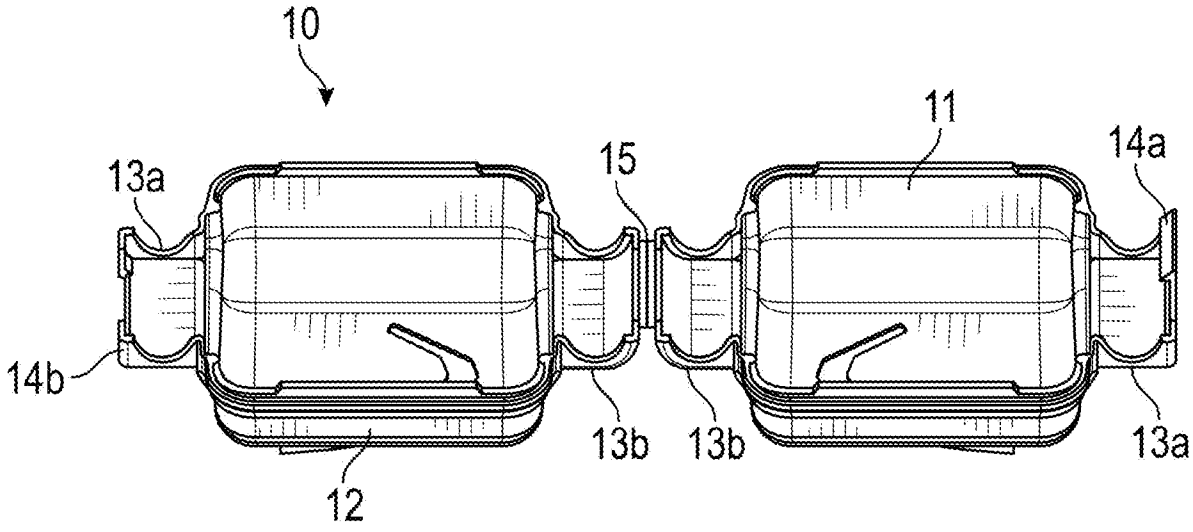


Fig. 2b

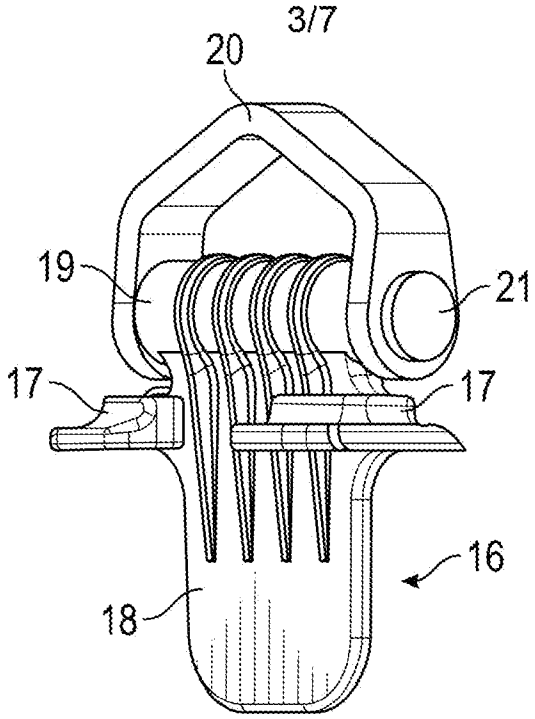


Fig. 3

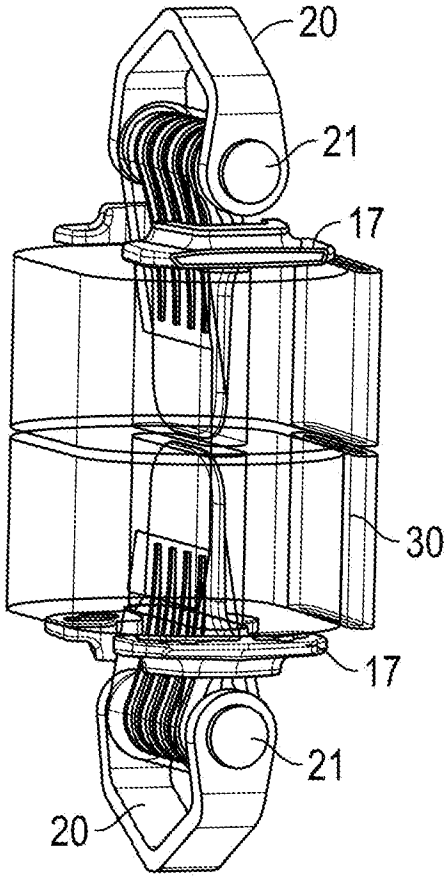


Fig. 4

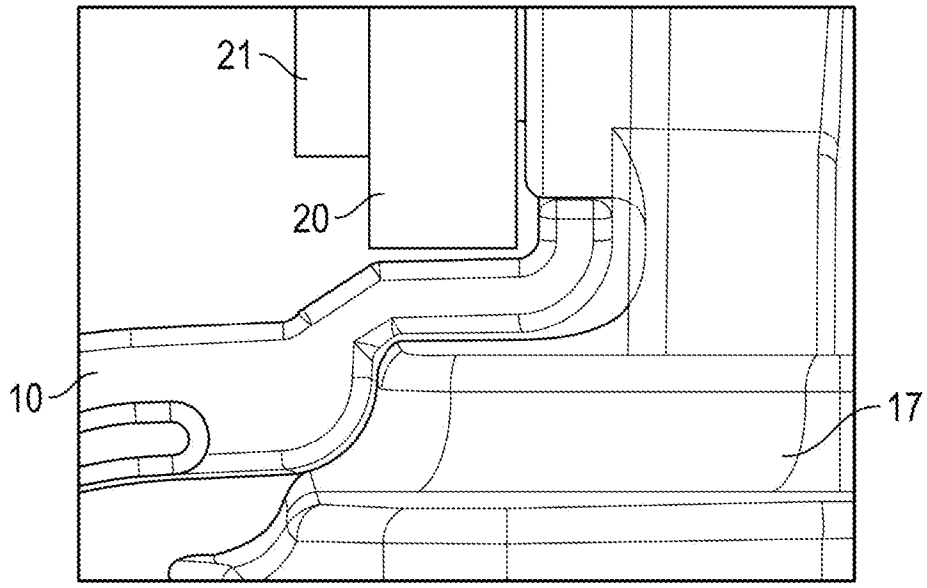
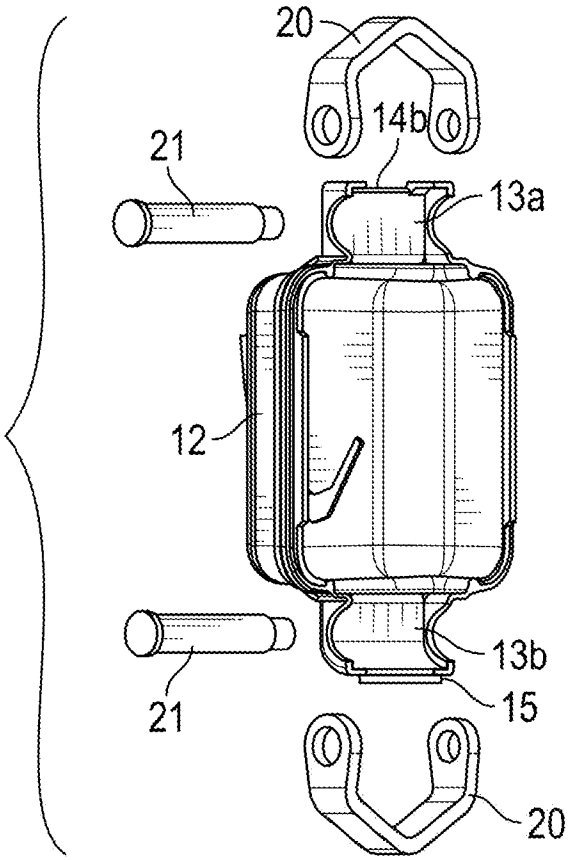


Fig. 5



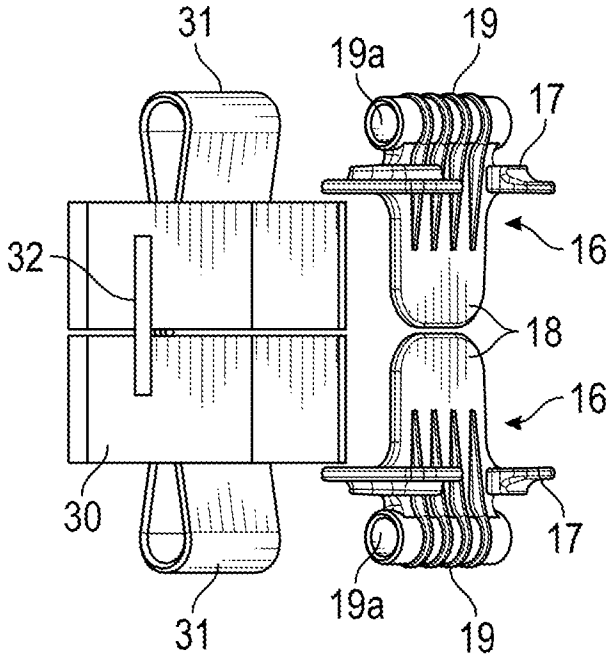


Fig. 6

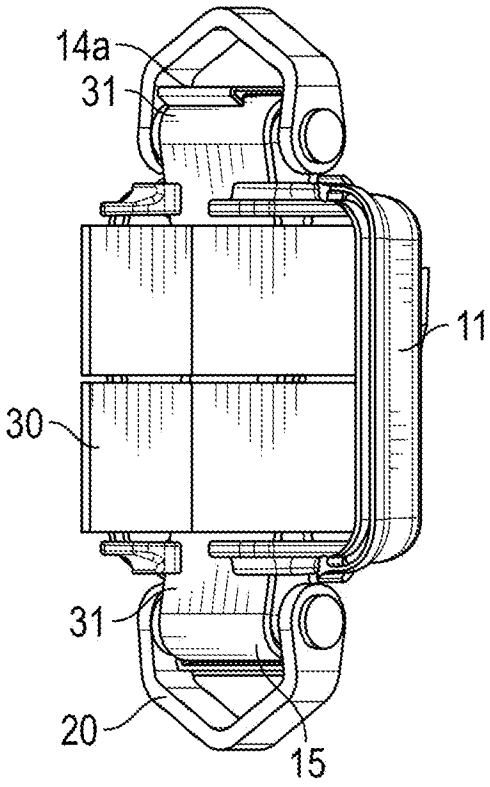


Fig. 7

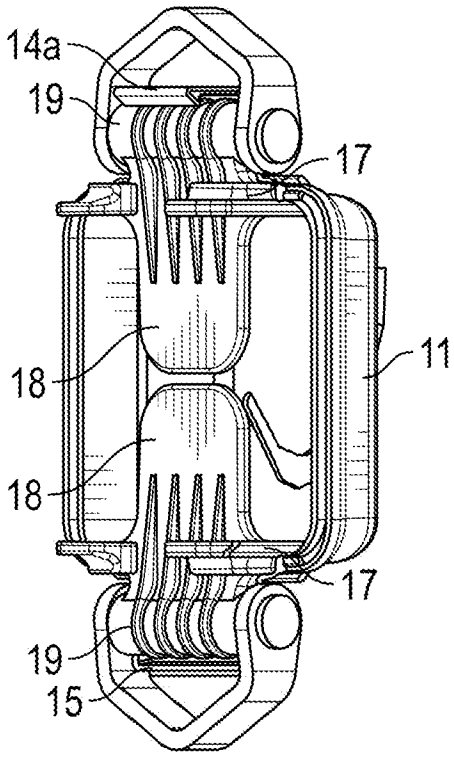


Fig. 8

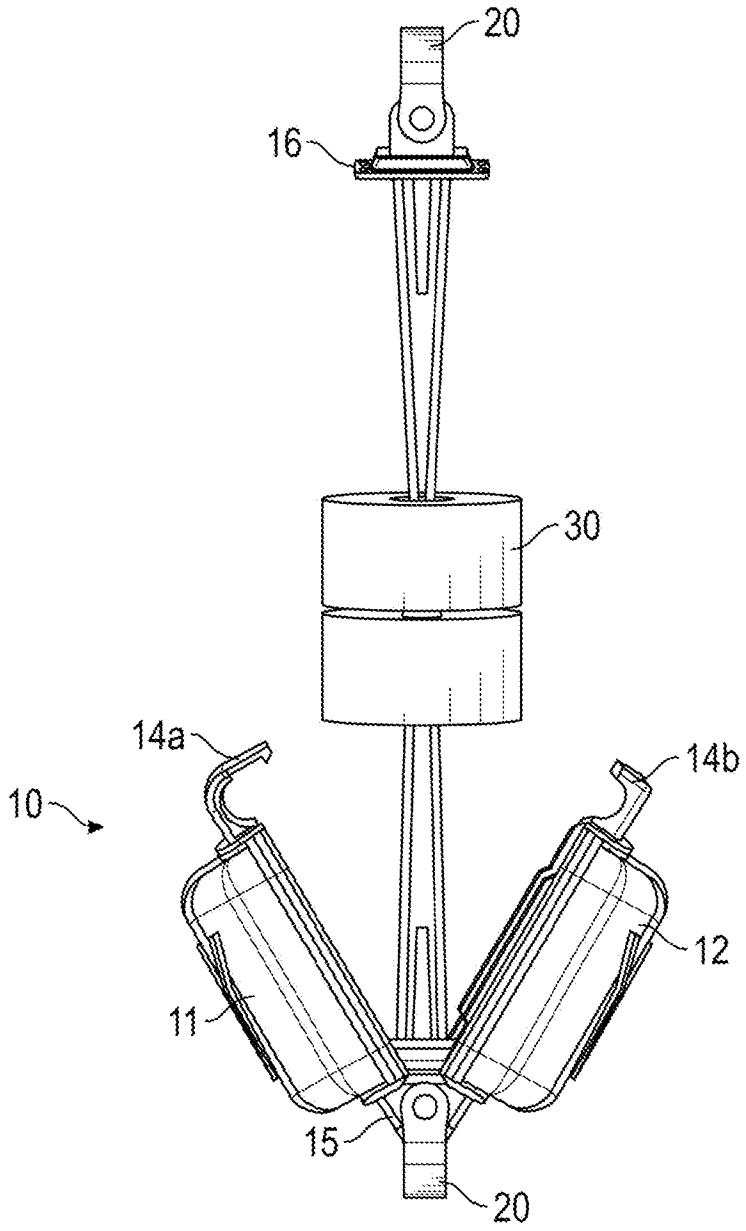


Fig. 9

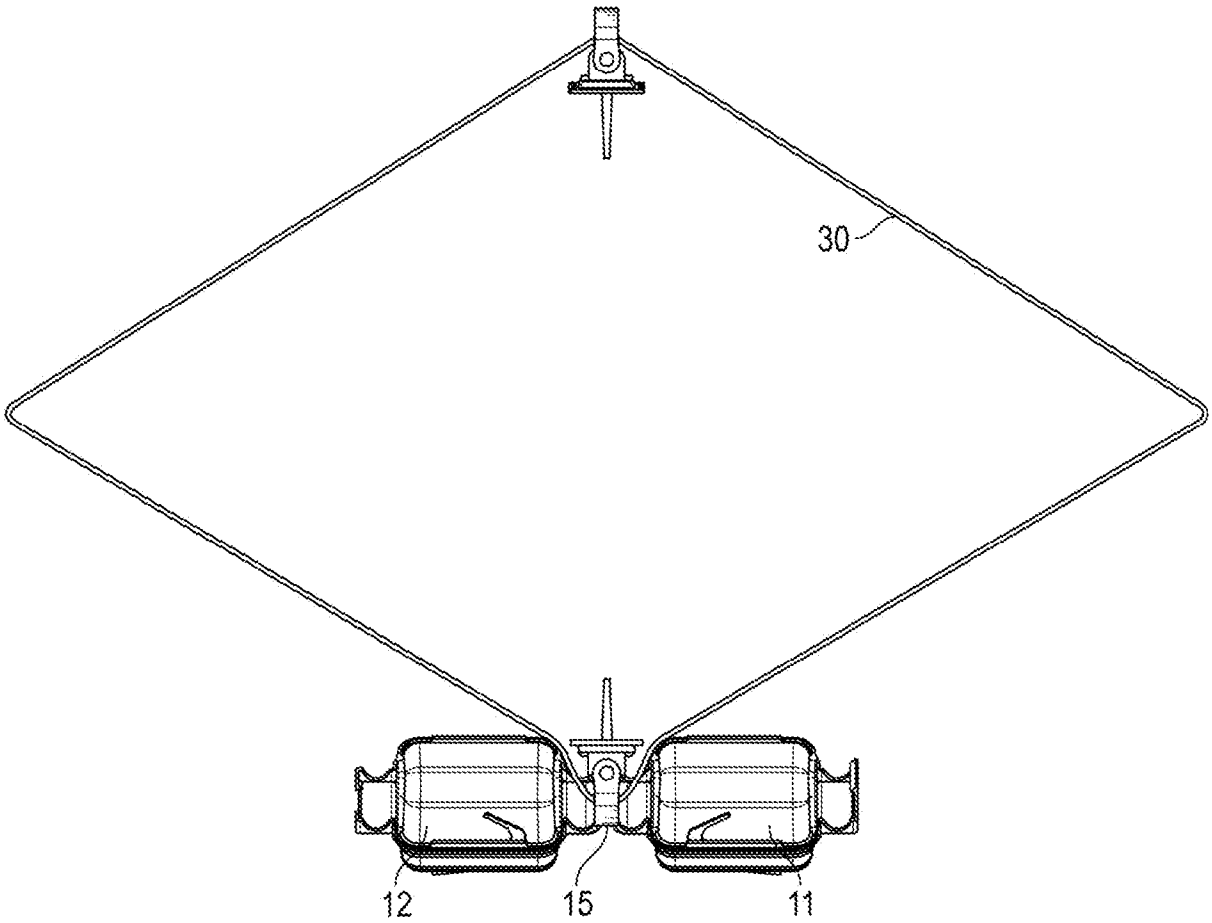


Fig. 10

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2019/050622

A. CLASSIFICATION OF SUBJECT MATTER
INV. A62B35/04
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A62B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 174 410 A (CASEBOLT SCOTT C [US]) 29 December 1992 (1992-12-29) figures 3,5 column 4, line 58 - column 5, line 2	1-4,6-9, 12
X	WO 2005/079922 A1 (KEYGUARD LTD [GB]; RENTON JULIAN [GB]; NOTT PETER [GB]) 1 September 2005 (2005-09-01) figures	1,3,4,8, 10,11
X	WO 03/047700 A1 (UNILINE SAFETY SYSTEMS LTD [GB]; LUKE SIMON [GB]; GRIFFITHS MARK [GB]) 12 June 2003 (2003-06-12) figures 5-8 figures	1,3-5,8, 10

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 May 2019	27/05/2019

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Andlauer, Dominique

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2019/050622

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
E	US 2019/118010 A1 (PATTON JUSTIN S [US] ET AL) 25 April 2019 (2019-04-25) figures ----	1-5, 8-10,12
X,P	US D 834 262 S1 (PATTON JUSTIN S [US] ET AL) 20 November 2018 (2018-11-20) figures ----	1-5, 8-10,12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB2019/050622

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

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

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

2. ☒ Claims Nos.: 13-74
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

see FURTHER INFORMATION sheet PCT/ISA/210

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

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

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

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

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

Remark on Protest

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

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

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 13-74

1 The application does not meet the requirements of Article 6 PCT, because the claim are not clear.

1.1 Although entity claims 1, 13, 18, 21, 36, 43, 48, 66, 74 have been drafted as separate independent claims, they appear to relate effectively to the same subject-matter and to differ from each other only with regard to the definition of the subject-matter for which protection is sought and/or in respect of the terminology used for the features of that subject-matter. The aforementioned claims therefore lack conciseness and as such do not meet the requirements of Article 6 PCT.

1.2 It seems claim 18 could be formulated as dependent on claim 13.

1.3 It seems claim 21 represents the independent claim with the broadest scope. As there are a large number of claims, they need to be arranged with the broadest claim first.

1.4 Claim 47 is dependent on claim 38, but follows claims 43-46 which are dependent on claim 43

1.5 Claim 70, dependent of claim 66, interchanges the housing of claim 66 with the housing singled out of the scope independent claim 43, rendering the scope and the the dependency of this claim unclear.

1.6 Claim 74, singles out the housing of the scope independent claim 42, rendering the dependency and the scope of this claim unclear.

1.7 The present application contains 74 claims, of which 9 are independent. There is no clear distinction between the independent claims because of overlapping scope. There are so many claims, and they are drafted and ordered in such a way that the claims as a whole are not in compliance with the provisions of clarity and conciseness of Article 6 PCT, as it is particularly burdensome for a skilled person to establish the subject-matter for which protection is sought.

1.8 There is a multitude of equally likely permutations of features providing as many fall-back positions, making it impossible to foresee to which subject-matter from the description and the claims are most likely to provided the basis for prosecution of the application.

1.9 The above clarity issues are such that a meaningful search cannot be carried out on the basis of the claims as filed.

1.10 A request for clarification was made to the applicant on the basis of points 1-1.8 above, to which the applicant answered requesting the search to be conducted in respect of independent claim 1 and claims dependent thereon.

1.11 The search was therefore limited to claims 1-12.

The applicant's attention is drawn to the fact that claims relating to

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guidelines C-IV, 7.2), should the problems which led to the Article 17(2) declaration be overcome.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/GB2019/050622

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5174410 A	29-12-1992	CA 2076695 A1	25-02-1994
		US 5174410 A	29-12-1992
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		WO 03047700 A1	12-06-2003
US 2019118010 A1	25-04-2019	NONE	
US D834262 S1	20-11-2018	----------	