

RACK

TECHNOLOGICAL FIELD

The presently disclosed subject matter relates to devices for carrying and releasing stores from a vehicle, in particular to ejector racks for carrying and releasing a store with respect to an air vehicle. The presently disclosed subject matter also relates to devices also for forcibly ejecting released stores from a vehicle, in particular to ejector racks for forcibly ejecting a released store with respect to an air vehicle.

BACKGROUND ART

References considered to be relevant as background to the presently disclosed subject matter include US 4,050,656.

Acknowledgement of the above references herein is not to be inferred as meaning that these are in any way relevant to the patentability of the presently disclosed subject matter.

BACKGROUND

Stores, such as for example bombs and missiles, are commonly carried by air vehicles, with a requirement to enable the stores to be released when required by the pilot or other aircrew. Conventionally, such carrying and release functions are provided by ejector racks, in which actuation thereof to release the stores is by ignition of gas cartridges.

By way of non-limiting example, US 4,050,656 discloses an ejector rack that is attachable to an aircraft and is for supporting and selectively releasing and/or ejecting a store that is carried internal of the aircraft, i.e., in a bomb bay. The store can be released from the ejector rack, and from the aircraft, in either of two ways, namely: by pushing on a manually operated release handle; or, by forced ejection, the only way used during flight of the aircraft. Forced ejection is achieved by sending an electrical impulse to either or both of two cartridges in the breech of the ejector rack, igniting the

cartridge(s). Gas is generated thereby; and, the resultant pressure that is built up in a gas system in the rack provides force that acts upon an unlocking piston, causing the piston to move out of its "locked" position. In turn, the moving piston provides a force on a slide, rotating a latch that allows the main linkage bellcrank to rotate and thus to open two hooks which are holding the store, thereby releasing the suspended store. Concurrently, gas pressure is manifolded to two sway brace ejection piston cylinders, and the ejection pistons therein are forcefully extended, causing positive and forcible ejection of the store by the ejection pistons.

GENERAL DESCRIPTION

According to a first aspect of the presently disclosed subject matter, there is provided an ejector rack for releasably supporting a store, the store having at least one lug for enabling removable engagement of the store with respect to the ejector rack, the ejector rack comprising:

- a housing, including:

- a lug engaging and releasing mechanism configured for selectively and releasably engaging the lug, and movable between a lug engaging position and a lug releasing position;

- a locking and unlocking mechanism actuatable between a locking position, for reversibly locking said lug engaging and releasing mechanism in said lug engaging position, and an unlocking position, for enabling the lug engaging and releasing mechanism to adopt said lug releasing position;

- an actuation system for reversibly actuating said locking and unlocking mechanism;

- wherein the locking and unlocking mechanism is configured, in operation of the ejector rack, for supporting part of a load applied by the store via the lug to the lug engaging and releasing mechanism in said lug engaging position.

For example, said part of the load is about 50% $\pm$ 10% of the load.

For example, in the lug engaging position the lug engaging and releasing mechanism is in load bearing contact with the locking and unlocking mechanism.

Additionally or alternatively, for example, in the locking position said locking and unlocking mechanism are geometrically locked via the load.

Additionally or alternatively, for example, said lug engaging and releasing mechanism comprises a first kinematic chain, comprising a stressed link pivotably connected to a hook element via a first pin, wherein the stressed link is further pivotably mounted to said housing at a fixed first pivot axis, and the hook element is pivotably mounted to the housing at a fixed second pivot axis. For example, said hook element comprises a C- or U-shaped engagement portion, configured for engaging said lug when pivoted about the second pivot axis to an engagement position, and for disengaging from the lug when pivoted away from the engagement position to a released position, the hook element further comprising an extension having a first abutment surface and a second abutment surface generally inclined to one another, and joined together via a rounded lateral edge, the extension projecting in a direction towards the locking and unlocking mechanism. Additionally or alternatively, for example, said stressed link comprises a free end at said first pin, said free end being reciprocally displaceable in a radial direction with respect to said first pivot axis, and wherein said stressed link is pre-stressed to bias said free end in a direction towards said first pivot axis. Additionally or alternatively, for example, said first kinematic chain operates to provide a first stable position and a second stable position, different from said first stable position, wherein in each one of said first stable position and said second stable position are such as to minimize a potential energy of said stressed link, and in which said first pin is at a respective maximum distance from an imaginary line joining said first pivot axis to said second pivot axis. For example, in said first stable position said first pin is on one side of said imaginary line, and said hook element is pivoted to the engagement position, enabling engagement of the lug, and wherein in the second stable position said first pin is side of said imaginary line and said hook element is pivoted in an opposed direction to the release position, enabling release of the lug if previously engaged thereto.

Additionally or alternatively, for example, said locking and unlocking mechanism is configured to function as a toggle mechanism, wherein a relatively small

force applied thereto maintains said locking and unlocking mechanism at the locked position while concurrently enabling a much larger force corresponding to said load to be resisted by said locking and unlocking mechanism.

Additionally or alternatively, for example, said locking and unlocking mechanism comprises a second kinematic chain comprising: a first link pivotably connected to an anvil via a second pin and pivotably connected to a second link via a third pin, wherein said anvil pivotably is mounted to said housing at a fixed third pivot axis, and said second link is pivotably mounted to said housing at a fixed fourth pivot axis, and wherein said anvil is pre-stressed to provide said small force. Additionally or alternatively, for example, said anvil is pre-stressed by a torsion spring to provide said small force. Additionally or alternatively, for example, the second kinematic chain comprises a roller freely rotatable about said third pin, and wherein said roller is in abutting contact alternately with said first abutment surface or said second abutment surface. For example, in said locking position, said engagement portion is in said engagement position, said roller is in abutting contact with said first abutting surface and in load bearing contact therewith, and capable of supporting said part of the load applied by the store via the lug, and wherein said anvil is prestressed to urge said second kinematic chain towards and about a physical stop provided in the casing, in said locking position.

Additionally or alternatively, for example, a remainder of said load is supported at said first pin. For example, a remainder of said load is symmetrically supported at said first pin and at said roller. For example, in said unlocking position, said anvil is selectively pivoted about said third pivot axis such that said second kinematic chain is urged away from said physical stop, sufficiently for the second kinematic chain to adopt a position that is not capable of supporting said part of the load applied by the store via the lug, enabling said roller to come into abutting contact with said second abutting surface while concurrently said engagement portion pivots to said release position, allowing release of the lug if previously engaged therein. For example, applying a pivoting force to said engagement portion by a lug to pivot the engagement portion to the engagement position automatically results in the second kinematic chain adopting the locking position.

Additionally or alternatively, for example, said actuation system for reversibly actuating said locking and unlocking mechanism comprises a bellcrank pivotably mounted to said housing at a fixed fifth pivot axis, the bellcrank having a long arm and a short arm each extending radially away from said fifth pivot axis, said actuation system further comprising an actuator coupled to said long arm and configured for selectively reversibly pivoting said bellcrank about said fifth pivot axis to thereby reversibly move said short arm between a first position and a second position, to thereby reversibly actuate said locking and unlocking mechanism. For example, moving said short arm between said first position and said second position causes said anvil to pivot about said third pivot axis such that said second kinematic chain is urged away from said physical stop, sufficiently for the second kinematic chain to adopt a position that is not capable of supporting said part of the load applied by the store via the lug. Additionally or alternatively, for example, said actuation system comprises an electrically powered motor comprising a shaft turned thereby, and further comprising a shuttle pivotably mounted to said long arm and coupled to the shaft, such that rotation of the shaft in one or another direction causes displacement of the shuttle, resulting in pivoting of said bellcrank about said fifth pivot axis in one or another direction, respectively.

Additionally or alternatively, for example, the ejector rack is further for selectively ejecting forcibly the store therefrom, the ejector rack comprising an ejector system comprising at least one ejection module, each ejection module configured for storing elastic potential energy therein, and for utilizing the stored potential energy for forcibly ejecting the store when the store is released from the ejector rack. For example, each ejection module comprises a plunger element reciprocally movable with respect to a casing and comprising at least one elastic element therebetween, the plunger element being selectively retractable with respect to the casing to any one of a plurality of retracted positions up to a maximum retracted position, wherein at each said position the at least one elastic element is progressively compressed storing therein said potential energy. For example, said at least one elastic element comprises at least one helical spring.

According to the first aspect of the presently disclosed subject matter, there is also provided an ejector rack for releasably supporting a store, and includes a housing, having a lug engaging and releasing mechanism operative for selectively and releasably engaging the lug, and movable between a lug engaging position and a lug releasing position. The housing also includes a locking and unlocking mechanism actuatable between a locking position, for reversibly locking the lug engaging and releasing mechanism in the lug engaging position, and an unlocking position, for enabling the lug engaging and releasing mechanism to adopt the lug releasing position. The housing also includes an actuation system for reversibly actuating the locking and unlocking mechanism, which is operative for supporting part of a load applied by the store via the lug to the lug engaging and releasing mechanism in the lug engaging position.

According to a second aspect of the presently disclosed subject matter, there is provided an ejector rack for releasably supporting, and selectively ejecting forcibly, a store therefrom, the store having at least one lug for enabling removable engagement of the store with the ejector rack, the ejector rack comprising an ejector system comprising at least one ejection module, each ejection module configured for storing elastic potential energy therein, and for utilizing the stored potential energy for forcibly ejecting the store when the store is released from the ejector rack.

For example, each ejection module comprises a plunger element reciprocally movable with respect to a casing and comprising at least one elastic element therebetween, the plunger element being selectively retractable with respect to the casing to any one of a plurality of retracted positions up to a maximum retracted position, wherein at each said position the at least one elastic element is progressively compressed storing therein said potential energy. For example, said at least one elastic element comprises at least one helical spring.

According to the second aspect of the presently disclosed subject matter, there is also provided an ejector rack for ejector rack for releasably supporting, and selectively ejecting forcibly, a store therefrom, and includes an ejector system having at least one ejection module, operative for storing elastic potential energy therein and for utilizing the stored potential energy for forcibly ejecting the store when the store is released from the ejector rack.

According to a third aspect of the presently disclosed subject matter, there is provided an air vehicle comprising at least one ejector rack as defined according to the first aspect of the presently disclosed subject matter.

According to a fourth aspect of the presently disclosed subject matter, there is provided a method for releasably supporting a store, the store having at least one lug, the method comprising:

- (a) providing at least one ejector rack as defined according to the first aspect of the presently disclosed subject matter; and
- (b) engaging the lug with respect to the lug engaging and releasing mechanism to thereby urge the locking and unlocking mechanism to the locking position.

For example, the method further comprises:

- (c) selectively operating the actuation system to thereby actuate said locking and unlocking mechanism to enable the locking and unlocking mechanism to adopt the unlocking position, thereby enabling the lug engaging and releasing mechanism to release the lug therefrom.

Additionally or alternatively, for example, in step (b), a plurality of said ejection modules are in a pre-stressed condition and in abutment with the engaged stores.

For example, in step (c) said plurality of said ejection modules forcibly eject the stores from the ejector rack.

A feature of at least one example of the presently disclosed subject matter is that a relatively low powered electrical motor can be used for releasing a relatively large load.

Another feature at least one example of the presently disclosed subject matter is that such a suspension and release device can be provided at a small scale, for example for use with small air vehicles, for example some types of UAV's.

Another feature at least one example of the presently disclosed subject matter is that such a suspension and release device can obviate the necessity for the release to be driven by the ignition of gas cartridges.

Another feature at least one example of the presently disclosed subject matter is that the suspension and release device uses the actual weight of the stores being supported thereby, together with a geometrical lock, to maintain the stores engaged.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to better understand the subject matter that is disclosed herein and to exemplify how it may be carried out in practice, examples will now be described, by way of non-limiting example only, with reference to the accompanying drawings, in which:

Fig. 1 shows in front/bottom/side isometric view a suspension and release device according to a first example of the presently disclosed subject matter.

Fig. 2 shows in front/bottom/side isometric view the example of Fig. 1 with a side panel removed.

Fig. 3 shows in transverse cross-sectional view the example of Fig. 1, taken along section J-J in Fig. 1.

Fig. 4 shows in partial side view the example of Fig. 2, in the engaged position.

Fig. 5 shows in partial side view the example of Fig. 2, in the released position.

Fig. 6 shows in transverse cross-sectional view an ejection module according to a first example of the presently disclosed subject matter.

Fig. 7(a) shows in front isometric view, and **Fig. 7(b)** shows in back isometric view, a tool useful with the example of the ejection module of Fig. 7.

Fig. 8 illustrates forces and moments acting on the example of Fig. 4.

DETAILED DESCRIPTION

Referring to Figs. 1 to 5 a suspension and release device according to a first example of the presently disclosed subject matter, generally designated **100**, comprises a lug release system **300** and an ejector system **500**.

In the Figures, the directional designations "Fore", "Aft", "Side", "Up" and "Down" are shown, together with an arrow for each designation, to facilitate comprehension. Referring to an orthogonal axes system (x-y-z), the fore and aft directions are parallel to a longitudinal axis "x"; the side directions are parallel to the lateral axis "z"; the up and down directions are parallel to the vertical axis "y". However, it is to be noted that the above directional designations are for ease of comprehension and are not necessarily limiting.

The suspension and release device **100** finds particular application in the form of an ejector rack (and is thus interchangeably referred to herein as an ejector rack, or as a stores ejector rack, or as a rack), for carrying a store, on or in an air vehicle. According to a first aspect of the presently disclosed subject matter, the suspension and release device **100** is configured for carrying the store in suspended configuration, and for selectively releasing the store from the air vehicle. According to a second aspect of the presently disclosed subject matter, the suspension and release device **100** is optionally configured forcibly ejecting the store away from the device **100** and thus away from the air vehicle.

For example, such a store can be a bomb, missile, rocket, external fuel tank, and so on, and an example thereof is illustrated in Fig. 3 and designated with the reference numeral **10**. The store **10** is in any case characterized in being equipped with at least one lug **15**, by which the store **10** is releasably engaged to and suspended from, i.e., with respect to, the device **100**. In this example, the store **10** has a single lug **15**, and thus the device **100** only requires a single lug release system **300**, as will become clearer herein. However, in alternative variations of this example, the store may instead have several lugs, and the suspension and release device can correspondingly comprise a similar number of lug release mechanisms **300**, for example.

Referring to Figs. 1 and 2 in particular, the device **100** comprises a housing **110**, including two parallel laterally spaced side plates (also referred to interchangeably herein as side walls or side panels) **120**, **130**, connected at the longitudinal ends **123**, **132** thereof

to end forward end block **140** and aft end block **150**, respectively to form a box-like structure. A bottom plate (not shown) can be provided between the lower edges of the two side plates **120**, **130**, having an opening in registry with hook element **320**, to enable a lug **15** of the store (not shown in Figs. 1 and 2) to be inserted from outside the device **100** into the space **Q** between the side plates **120**, **130** and engage vertically with hook element **320**.

The housing **110** accommodates lug release system **300**. Referring to Figs. 4 and 5, lug release system **300** comprises hook element **320** pivotably connected to stressed link **340**.

The hook element **320** is pivotably mounted between side plates **120**, **130** to allow pivoting thereof about lateral pivot axis **355**. The pivot axis **355** is fixed with respect to the housing **110**.

Hook element **320** comprises a C- or U-shaped engagement portion **322**, defined by lower arm **321**, base **323** and upper arm **325**, which together partially circumscribe a space **326**. The lower arm **321** is generally parallel to the upper arm **325**, and facing in a general aft direction, and pivot axis **355** is located proximal to the connection between the upper arm **325** and the base **323**. The upper arm **325** has an arm extension **330** that projects generally aft from upper arm **325**. The extension **330** comprises a first abutment surface **332** and a second abutment surface **334**, generally orthogonal to one another, and joined together via a rounded lateral edge **333**.

Hook element **320** further comprises an arm **335** of fixed length and extending generally forward, radially from the pivot axis **355**, at an acute angle θ with respect to the upper arm **325**. The free end **336** of arm **335** is pivotably connected to stressed link **340** at its free end **346** via pin **349**.

Stressed link **340** is pivotably mounted between side plates **120**, **130** to allow pivoting thereof about lateral pivot axis **345**, which is fixed with respect to the housing **110**. The free end **346** of the link **340** is reciprocally displaceable in a radial direction with respect to pivot axis **345**. Stressed link **340** is pre-stressed, comprising a pre-stressed helical spring **348** that biases the free end **346** in a direction towards pivot axis **345**.

In alternative variations of this example the helical spring **348** can be replaced with a two or more than two spring elements, in each case each spring element being for

example a helical spring or any other suitable spring capable of storing elastic potential energy when compressed.

Thus, a first kinematic chain **A** is provided by the stressed link **340** and the hook element **320**, having two stable relative positions that minimize the potential energy of the spring **348**, and in which the pin **349** is at a maximum distance from an imaginary line **L** joining the pivot axis **345** and the pivot axis **355**.

The first stable position is illustrated in Fig. 4, in which the pin **349** is below line **L**, and in which the hook element **320** is rotated counter clockwise to the closed or engaging position, enabling engagement of a lug.

The second stable position is illustrated in Fig. 5, in which the pin **349** is above line **L**, and in which the hook element **320** is rotated clockwise to the open or releasing position, enabling release of a lug previously engaged thereto.

The first kinematic chain **A** essentially thus operates as a lug engagement and release mechanism.

In the absence of external forces, the first kinematic chain **A** will adopt and remain at one of the two stable positions, until forced away from this stable position and past line **L** in proximity to the other stable position, wherein it will adopt and remain at the second stable position, and vice versa.

In order to load and engage a store, the first kinematic chain **A** must be in the second stable position shown in Fig. 5, allowing the lug to be vertically inserted into the bottom of housing **110** along vertical axis **LA**. As the lug (not shown in this figure) is thus inserted and pushes against the upper arm **325**, hook element **320** rotates in a counter clockwise direction about pivot axis **355** to the first stable position shown in Fig. 4, causing the lower arm **321** to enter into the lug and come into load supporting contact therewith, the lug being accommodated in space **326**.

The lug release system **300** further comprises a second kinematic chain **B**, defined by anvil **360**, first link **370** and second link **375**. The second kinematic chain **B** operates as a locking and unlocking mechanism for the first kinematic chain **A**.

Anvil **360** is pivotably mounted between side plates **120**, **130** to allow pivoting thereof about lateral pivot axis **365**, which is fixed with respect to the housing **110**. The free end **366** of the anvil **360** projects in a general aft direction, generally radially from the pivot axis **365**. The anvil **360** further comprises arm **363**, fixed thereto and projecting radially away from pivot axis **365** in a direction generally opposed to that of free end **366**, and arm **363** is freely pivoted to one end of first link **370** at pin **371**. The other end of first link **370** is freely pivoted to free end **374** of second link **375** at pin **372**. In turn, second link **375** is pivotably mounted between side plates **120**, **130** to allow pivoting thereof about lateral pivot axis **377**, which is fixed with respect to the housing **110**. A roller **379** is freely rotatable about pin **372** (i.e. about a lateral axis defined at pin **372**), and in operation of the device **100**, the roller **379** is in abutting contact alternately with first abutment surface **332** or second abutment surface **334**.

The anvil **360** further comprises a torsion spring **369**, having one end abutting a mechanical stop **368** in housing **110**, and another end looped over free end **366**. Torsion spring **369** biases free end **366** in a downward direction when in the position illustrated in Fig. 4, when the anvil **360** is pivoted in a clockwise direction until the arm **363** abuts mechanical stop **364**, wherein the free end **366** and the arm **363** are in a general horizontal disposition. At this position, the kinematic chain **B** compels second link **375** to adopt a generally orthogonal orientation with respect to second link **375**, which is generally aligned with arm **363**.

At this position, corresponding to the first stable position of the first kinematic chain **A**, the roller **379** is in abutting contact with first abutment surface **332**. Furthermore, the weight of the store as channeled by the lug and acting along axis **LA**, is supported at two points, each on either side of axis **LA** – at pivot axis **355** and at roller **379**, providing a stable configuration.

The force **R3** applied by abutment surface **332** on roller **379** (by virtue of the weight **M** of the store acting on arm **321**) would try to urge pin **371** in an upward direction to collapse the second kinematic chain **B** and drive roller **379** away from axis **LA**. In fact, and as seen in Fig. 4, the centre of pin **371** is vertically displaced upwards by a displacement **S** with respect to pivot axis **365** by virtue of this force **R3**, but further upward displacement is prevented by mechanical stop **364**.

Thus, mechanical stop **364** effectively locks the first kinematic chain **A** and the second kinematic chain **B** together, mechanically, in a geometrical lock, when in the position shown in Fig. 4. At the same time, undesired motion of the pin **371** in a downward direction to collapse the second kinematic chain **B** and thereby drive roller **379** away from axis **LA** is prevented by the biasing of torsion spring **369**. For example, such undesired motion may arise from sudden knocks or vibration.

In this position, the first kinematic chain **A** is stably locked with respect to the second kinematic chain **B** in a load bearing and engaged configuration with the lug, until anvil **360** is rotated in a counter clockwise direction. This is enabled by selective operation of actuator mechanism **C**, via bellcrank **380**.

Actuator mechanism **C**, which is also comprised in lug release system **300**, comprises actuator **390** operatively coupled to the bellcrank **380**.

Bellcrank **380** is pivotably mounted between side plates **120, 130** to allow pivoting thereof about lateral pivot axis **387**, which is fixed with respect to the housing **110**. Bellcrank **380** comprises a long arm **382** radially extending therefrom in a generally vertical direction, and the free end **381** of long arm **382** is pivotably coupled to shuttle **393** about a lateral pivot axis. Bellcrank **380** further comprises a short arm **384** radially extending therefrom in a direction generally opposed to the long arm **382** and disposed with respect thereto at an obtuse angle in this example. The free end **383** of short arm **384** comprises a roller **385**, which faces free end **366** in the closed position illustrated in Fig. 4.

The actuator **390** comprises a motor **392** having opposite longitudinal ends, **398, 399**. The actuator **390** further comprises a shaft **394** rotatable by the motor **392** about a longitudinal axis **395**, and connected to the motor **392** at aft end **398** of the motor **392**. The actuator **390** is pivotably mounted between side plates **120, 130** to allow pivoting thereof about lateral pivot axis **387**, which is fixed with respect to the housing **110**. In particular, motor **392** is pivotably mounted to the housing **110** at a forward end **399** of the motor **392** via pin **391**. In this example, the motor **392** is an electrical motor.

Shuttle **393** is mounted to the shaft **394**, and is configured for reciprocally translating along longitudinal axis **395** alternately in a fore or aft direction, responsive to the motor turning in a clockwise or anticlockwise direction, respectively (or vice versa). In

this example, the shaft **394** is formed with an external helical thread, while the shuttle **393** comprises a longitudinal bore **397** to allow sliding motion of the shaft **394** therethrough, and further includes at least one engagement pin (not shown) radially projecting towards the longitudinal axis **395** from the cylindrical inner surface of the bore **397**. The engagement pin is engaged in the helical thread and thus as the shaft rotates about longitudinal axis **395** in a clockwise or counter clockwise direction, the engagement pin, together with the shuttle **393** moves correspondingly forward or aft (or vice versa).

In alternative variations of this example, the actuator can instead comprise a piston housing replacing motor **392**, and a piston rod reciprocally movable along longitudinal axis **395** with respect to the piston housing, via an opening at an aft end of the piston housing; piston housing is pivotably mounted to the housing at a forward end of the piston housing. In such an example, the piston rod is driven by any suitable driving mechanism, for example a linear (electric) motor, a hydraulic mechanism, a pneumatic mechanism, and so on. In such a case, the shuttle **393** is fixed to the piston rod, and is reciprocally translated along longitudinal axis **395** in a fore or aft direction, responsive to the piston being moved out of or into the piston housing.

The lug release system **300** is configured for displacing the shuttle **393** between a forward position **P1** and an aft position **P2**. In the forward position **P1** shown in Fig. 4, roller **385** faces free end **366** and can actually be in contact therewith or spaced therefrom by a small clearance. However, at position **P1**, no force or no significant force is applied by the roller **385** onto free end **366**.

On the other hand, as the shuttle **393** is displaced from forward position **P1** to aft position **P2**, responsive to operation of the motor **392**, the bellcrank **380** is pivoted in a clockwise direction. The short arm **384** is moved towards the anvil **360**, and a significant force **R8** (Fig. 5) is now applied by the roller **385** onto the free end **366**, the force being in or having a force component in the general upward direction. In turn, this force or force component induces a moment **M2** (Fig. 8) onto the anvil **360** about pivot axis **365**, causing the anvil **360** together with arm **363** to rotate in a counter clockwise direction about pivot axis **365**. This counter clockwise rotation of arm **363** in turn pushes pin **371** downwards and away from mechanical stop **364**. When the centre of pin **371** is pushed below the level of pivot axis **365**, the second kinematic chain **B** become unlocked, and force **R3** acting on

roller **379** pushes roller **379** away from axis **LA**. Concurrent with this movement, the first kinematic chain **A** also becomes unlocked, and the hook element **320** can now rotate in a clockwise direction about pivot axis **355**, since the weight **M** is no longer being effectively supported at the roller **379**. As this movement continues and second link **375** rotates in a clockwise direction about pivot axis **377**, the roller **379** moves along first abutment surface **332** and then, via edge **333**, onto the second abutment surface **334**; concurrently, as the hook element **320** continues to rotate the weight **M** overcomes the pre-stress of the spring **348** and allows the second stable position to be attained (Fig. 5). At this point the lower arm **321** is completely removed from the lug **15**, which is then released and is free to fall away from the device **100** by gravity, and/or is forcibly ejected by use of the ejection system **500**.

In the second stable position of the first kinematic chain **A**, the second kinematic chain **B** is locked in the position shown in Fig. 5, and cannot be operated in order to achieve the configuration of Fig. 4, except by inserting another lug along axis **LA** and pushing upper arm **325**, as already described above. While in the second, locked, position of Fig. 5 the torsion spring **369** is stressed, there is insufficient potential energy therein to cause the second kinematic chain **B** to become unlocked and urge the anvil **360** in a downward direction, due to the force applied to second kinematic chain **B** by the spring **348** and via the second abutment surface **334**. However, once the second kinematic chain **B** is unlocked (by engaging a lug) the torsion spring **369** urges the anvil **360** in a downward direction towards the position shown in Fig. 4, displacing pin **371** to spacing **S** and into abutment with mechanical stop **364**, and thereby again locking the first kinematic chain **A** and the second kinematic chain **B** together.

It is to be noted that once the short arm **384** has rotated sufficiently so that, via abutment with anvil **360** and rotation of arm **363**, the pin **371** is below the pivot axis **365**, there is no further need to apply force **R8** to the free end **366**, and further rotation of the anvil **360** and arm **363** is now compelled by force **R3** (Fig. 4). Accordingly, the bellcrank **380** can be pivoted back to the starting position of Fig. 4 as soon as pin **371** is below the pivot axis **365**, or shortly after. This is accomplished by actuating the motor **392**, which then turns shaft **394** in the opposite direction, thereby displacing shuttle **393** in a forward direction back to first position **P1**.

Operation of lug release system **300** to pivot back the bellcrank **380** is facilitated in this example by providing a first microswitch **MS1** and a second microswitch **MS2**, operatively coupled to the motor **392**, and a mechanical stop **386** provided on and carried by the long arm **382**.

The first microswitch **MS1** is configured for switching off the motor **392** when contacted by mechanical stop **386**, while the second microswitch **MS2** is configured for reversing the direction of rotation of the motor **392** when contacted by mechanical stop **386**.

Operation of the device to engage a store **10** is as follows. Starting with the first kinematic chain **A** and the second kinematic chain in the positions shown in Fig. 5, and the actuator mechanism **C** in the position shown in Fig. 4, a store **10** can be engaged by inserting the lug **15** thereof in an upward direction into device **100** along axis **LA**, and pushing upper arm **325**. This forces the first kinematic chain **A** into the first stable position illustrated in Fig. 4. Concurrently, and as the hook element **320** is rotated about pivot axis **355**, roller **379** contacts second abutment surface **334**, urged by torsion spring **369** acting on anvil **360**, until the pin **371** is in abutment with mechanical stop **364**, thereby locking the first kinematic chain **A** and the second kinematic chain in the positions shown in Fig. 4. At this position, the lug is engaged by hook element **320**, and in loading relationship with the first kinematic chain **A** and the second kinematic chain.

The device **100** optionally comprises a removable safety lock **310** (Figs. 1 and 2) that is selectively and releasably engageable with respect to the housing **110** for safety locking the first kinematic chain **A** and the second kinematic chain **B**. Safety lock **310** comprises a pin **311** that is insertable into housing **110** via opening **315** (Fig. 4), i.e., at a position that is disposed just below the position of pin **371** in the position shown in Fig. 4, and thus prevents downward motion of the pin **371**. Thus, when the safety latch **310** is in place engaged in opening **315**, any accidental unlocking of the second kinematic chain **B** is prevented until the safety lock **310** is removed.

Operation of the device to release a store **10** is as follows. Starting with the first kinematic chain **A**, the second kinematic chain **B**, and actuator mechanism **C** in the positions shown in Fig. 4, the engaged store **10** can be released by selectively activating the actuator mechanism **C**.

Initially, in the configuration shown in Fig. 4, the motor **392** is off until the actuator mechanism **C** is actuated by a user, for example using circuitry (not shown) that is activated when it is desired to operate the device **100** and allow the lug and stores to be released. Such actuation causes the motor to rotate shaft **394** in one rotational direction such as to displace the shuttle **393** towards the second position **P2**. Concurrently, bellcrank **380** is rotated in a clockwise direction, unlocking the first kinematic chain **A** and the second kinematic chain **B**, allowing hook element **320** to rotate in a clockwise direction to the position shown in Fig. 5, thereby releasing the lug and stores.

Once the shuttle **393** reaches position **P2**, the mechanical stop **386** activates the second microswitch **MS2**, which automatically reverses the rotational direction of the motor **392** (and thus of the shaft **394**), causing the shuttle **393** to become displaced again in a forward direction, and allowing the bellcrank **380** to adopt the position showing in Fig. 5 when the shuttle reaches position **P1**. However, at position **P1**, mechanical stop **386** activates the first microswitch **MS1**, which automatically shuts off the motor **392** and maintains the shuttle **393** at position **P1** until the next time the actuator mechanism **C** is selectively actuated by the user.

According to the first aspect of the presently disclosed subject matter, the lug release system **300** functions as a toggle mechanism, wherein a relatively small force applied by the motor **392** operates to release a much larger force supported by the hook element **320** (i.e., the weight **M** of the stores via the lug).

In particular, locking and unlocking mechanism is configured to function as a toggle mechanism, wherein a relatively small force applied thereto (in this example by the torsion spring) maintains it at the locked position while concurrently enabling a much larger force corresponding to the load or weight **M** of the stores to be resisted by the locking and unlocking mechanism. In particular, the locking and unlocking mechanism is configured to form a geometrical lock, when part of the weight **M** is supported thereby, the weight **M** actually maintaining the geometrical lock, constrained in this configuration by the weight **M** and by mechanical stop **364**. In other words, the locking and unlocking mechanism provides a geometrical lock in the locked configuration of Fig. 4.

Referring also to Fig. 8, and without being bound to theory, the geometrical lock provided by the locking and unlocking mechanism also enables a relatively large force

(e.g. the weight **M** of the stores **10**) to be supported by the locking and unlocking mechanism (via the hook element **320**), and enables a much smaller actuating force **F1** to unlock the locking and unlocking mechanism and thereby release the stores **10**.

As may be seen in Fig. 8, the weight **M** of the engaged stores **10** is supported via vertical reaction **R1** at pivot axis **355** and vertical reaction **R2** at pivot axis **372** (via roller **379**). Reactions **R1** and **R2** are approximately equal to one another, since the longitudinal spacings, **q1** and **q2** respectively, of these two axes with respect to vertical axis **LA** are approximately equal. Thus, the vertical reaction **R2** is about 50% of weight **M** (and in some examples $\pm 10\%$). (However, in alternative variations of this example the weight **M** can be asymmetrically supported: for example **R2** can have a value between 10% and 90% of **M**, or a value between 20% and 80% of **M**, or a value between 30% and 70% of **M**, or a value between 40% and 60% of **M**.)

The vertical reaction **R2** is a component of the total reaction **R3** provided radially at roller **379** through pivot axis **372**, and total reaction **R3** also resolves to a horizontal reaction **R4**. Reaction **R4** can be determined from the vertical reaction **R2** using the following expression:

$$\mathbf{R4} = \mathbf{R2} * \tan \theta$$

Angle θ is the angle between the total reaction **R3** and the vertical reaction **R2**, and in this example, angle θ is about 30° .

Thus, reaction **R4** is about 58% of **R2**, i.e. about 29% of weight **M**. Reaction **R4** provides a moment **M1** about pivot axis **365** that urges arm **363** against mechanical stop **364**, and moment **M1** can be determined from the expression:

$$\mathbf{M1} = \mathbf{R4} * \mathbf{S}$$

In order to unlock the locking and unlocking mechanism, and thus allow the hook element **320** to released the lug **15** with stores **10**, force **R8** is provided via bellcrank **380** and applied to anvil **366** to generate a counter moment **M2**, just greater than moment **M1**, but in the opposite direction.

Moment **M2** can be determined from the expression:

$$M2 = R8 * l_1$$

...where l_1 is the moment arm of force **R8** (at the tangential contact point between roller **385** and anvil **366**) from the pivot axis **365**.

Thus, a minimum value for force **R8** is determined from the expression:

$$R8 = R4 * (S/l_1)$$

Or,

$$R8 = 0.29M * (S/l_1)$$

For example, in one application, **S** is 0.8mm, while l_1 is about 15mm, and thus the ratio (S/l_1) is 0.0533, and thus **R8** is about 1.5% of the weight **M**.

In practice, **R8** needs to be even greater than this minimum value to also overcome the reaction to the unlocking moment **M2** provided by torsion spring **369**. In practice, torsion spring **369** provides a safety measure in preventing accidental unlocking of the locking and unlocking mechanism due to sudden knocks or vibrations, and thus does not need to develop large forces.

Force **R8** is in turn generated via moment **M3** corresponding to the actuating force **F1**, generated by the actuator and shuttle **393**, acting on bellcrank **380**, and the two forces, **F1**, **R8**, are related to one another by their respective moment arms l_2 and l_3 , respectively; thus:

$$F1 = R8 * (l_2/l_3)$$

Or,

$$F1 = 0.29M * (S/l_1) * (l_2/l_3)$$

In the above example, wherein ratio (S/l_1) is 0.0533, and for example the ratio (l_2/l_3) is about 2, the actuating force **F1** is less than 1% of the weight **M** supported by the hook element **320** (excluding the effect of torsion spring **369**).

It is also to be noted that once the force **R8** is applied to the anvil **366**, and this pivots over a small angular displacement about pivot axis **365** sufficient to diminish spacing **S** to zero, the locking and unlocking mechanism is no longer in geometrical lock.

Thus, force **R8** no longer needs to be applied to the anvil **366** by bellcrank **380**, which can immediately pivot back to the position shown in Fig. 4, and this is facilitated by operation of microswitches **MS1** and **MS2**. Instead, once the pin **371** is below the level of pivot axis **365**, the reaction **R4** produces a moment about pivot axis **365** that is in the opposite direction to moment **M1**, and thus the locking and unlocking mechanism is not able to provide reaction **R2** to support weight **M**. Accordingly, the moment provided by the weight **M** about pivot axis **355** drives the hook element **320** to pivot about pivot axis **355**, thereby opening and releasing the lug **15** and with it stores **10**.

Referring to Figs. 1, 2, and 3, the device **100** in this example further comprises two sway brace assemblies **900**. One sway brace assembly **900** is provided at a forward end of the device **100** and can be affixed to the forward end block **140**, while the other sway brace assembly **900** is provided at the aft end of the device **100** and can be affixed to aft end block **150**. The sway brace assemblies **900** can be used for controlling movement or vibration of the stores **10** when engaged by the device **100**, while not interfering with the engagement procedure or the release procedure of the stores with respect to the device **100**.

Each brace assembly **900** comprises a pair of lateral flanges **910**, each flange **910** carrying a sway brace **950** at each end thereof having an abutment end which in operation of the device is in abutting contact with the stores when the stores is engaged by the device **100**. In some applications of the device **100** one or more of the sway brace assemblies **900**, or at least one or more of the sway braces **950** can be omitted.

The device **100** can be operated absent the ejector system **500**, and thus allows the stores to drop away therefrom under the influence of gravity once released from the hook element.

According to a second aspect of the presently disclosed subject matter, the suspension and release device **100** is optionally configured for forcibly ejecting the store away from the device **100** and thus away from the air vehicle. Thus, alternatively, and optionally, the device **100** can be operated together with ejector system **500**, configured for forcibly ejecting the store away from the device **100** and thus away from the air vehicle, once the stores is released from the device **100**.

The ejector system **500** comprises at least one ejection module **600** configured for forcibly ejecting a store away from the device **100**. In particular, each ejection module **600** is configured for providing an ejection force generated via release of stored elastic potential energy.

In this example, the ejector system **500** comprises two ejection modules **600**, which are essentially identical to one another, and thus, only one shall be described herein. In alternative variations of this example, the ejector system **500** can instead comprise one or more than two ejection modules **600**. In this example each ejection module **600** is accommodated in one or the other of forward end block **140** or aft end block **150** (Figs. 1 and 2).

Referring to Figs. 6 in particular, a first example of ejection module **600** according to the second aspect of the presently disclosed subject matter, comprises a tubular housing **620**, extending along a longitudinal axis **601**. The tubular housing **620** is open at one longitudinal end **615** thereof and closed at a second longitudinal end **625** thereof. A guiding pin **630**, co-axial with longitudinal axis **601**, is fixed at the closed end **625** and extends therefrom and projects beyond the open end **615**. A plunger element **640** comprises a hollow shaft **650**, coaxial with guiding pin **630** and slidably mounted thereto, and an abutment element **660**. Abutment element **660** comprises a padded outer end **662**, an annular shoulder **668**, and annular lip **669**. Two concentric helical springs **672**, **674**, co-axial with longitudinal axis **601**, are abutting said shoulder **668** at one end thereof and said closed end **625** at the other end thereof.

In alternative variations of this example the pair concentric helical springs **672**, **674** can be replaced with a single spring element, or with more than two spring elements, in each case each spring element being for example a helical spring or any other suitable spring capable of storing elastic potential energy when compressed.

Tubular housing **620** comprises a flange **610** configured for affixing the ejection module **600** to the device **100**, in particular to one or the other of forward end block **140** or aft end block **150**.

The plunger element **640**, via the hollow shaft **650**, is slidable about guiding pin **630** and along longitudinal axis **601**, between an extended position and a retracted

position. In the extended position the abutment element **660** is at a maximum spacing from closed end **625**, and springs **672**, **674** are unstressed or have a minimum compressive stress. In the retracted position the abutment element **660** is at a minimum spacing from closed end **625**, and springs **672**, **674** are at maximum compressive stress, in which the springs **672**, **674** store elastic potential energy. The plunger element **640** can be pushed towards the closed end **625** to any one of a plurality of relative positions one with the other, at each position the elastic potential energy stored by springs **672**, **674** will be closer to that corresponding to the maximum compressive stress or the minimum compressive stress depending on whether the position is closer to the retracted position or the extended position. One or more holes **682** are provided on hollow shaft **650**, while a series of circumferential cutouts or channels **684** are provided in the guiding pin **630** and longitudinally spaced from one another. As the plunger element **640** is pushed towards the closed end **625** to any one of said plurality of relative positions, holes **682** become aligned with a corresponding one of the channels **684**, and a removable locking pin (not shown) can be inserted through the one or more holes **682** and the particular channels **684** in registry therewith to hold the plunger element **640** at this position. In operation of the device **100**, such a position corresponds to the abutment element **660** being in abutment with the outer surface of the stores **10** when the stores is engaged by the device **100**, for example as indicated in Figs. 3 and 5. While in this example, the tubular housing **620** and hollow shaft **650** are cylindrical, in alternative variations of this example the casing and hollow shaft can each have any other suitable cross-section.

Referring to Figs. 7(a) and 7(b), a retraction tool **900** can be employed to provide the desired retraction of the plunger element **640**.

Retraction tool **900** comprises a base **910** having a threaded bore **915** coupled to a leadscrew **950**. A pair of arms **920** are orthogonally joined to base **910** at one end thereof, and comprise hook projections **930** at another end thereof. In side view, each combination of hook projection **930**, arm **920** and base **930** has a C-like form. An abutment head **955** is provided at one end of the leadscrew **950**, between the base **910** and the hook projections **930**, while a turning handle **960** is provided at the other end of the leadscrew **950**. Turning the leadscrew **950** via the handle **960** in one direction advances the abutment head **955** towards hook projections **930**, while turning the handle **960** in the opposite direction distances the abutment head **955** from hook projections **930**. The two arms **920** are

laterally spaced at a spacing **W**, greater than the width **W'** of the housing **110** (see Fig. 1) but less than the width of the flanges **910**.

In use, the tool **900** can be engaged to the forward or aft end of the device **100**, such that the hook projections **930** are abutting the top of the corresponding flanges **910**, and the abutment head **955** is in contact with the respective abutment element **660**. The handle **960** is then turned to retract the plunger element **640**, and when the required relative position is reached with respect to the tubular housing **620**, a locking pin is inserted between the holes **682** and the particular channels **684** in registry therewith to hold the plunger element **640** at this position. The tool **900** can then be removed, and the operation repeated with the other ejection modules **600**. In this position, the ejection modules **600** are pre-stressed, wherein the respective springs **672**, **674** are compressed and storing elastic potential energy.

At this point the stores **100** can be engaged to the device **100** via the lug **15**, as already disclosed above. Once engaged, the locking pins can be removed, and the ejection modules **600** are maintained in their respective pre-stressed states since the stores is pressing against the respective abutment elements **660** by virtue of the engagement of the stores to the device **100**.

However, once the stores are released from the device **100** by disengagement of the lug **15** from the lug release system **300**, the stored elastic potential energy in the springs **372**, **374** urge the respective plunger elements **640** away from their respective casings **610** and thus forcibly eject the stores (onto which the plunger elements **640** abut) away from the device **100**.

It is to be noted that while the ejector system **500** and ejection module **600** have been described in the context of the example of device **100**, in alternative variations of this example, the ejector system **500** and ejection module **600** can instead be used with different types of suspension and release devices, for example conventional devices known per se in the art.

In the method claims that follow, alphanumeric characters and Roman numerals used to designate claim steps are provided for convenience only and do not imply any particular order of performing the steps.

Finally, it should be noted that the word “comprising” as used throughout the appended claims is to be interpreted to mean “including but not limited to”.

While there has been shown and disclosed examples in accordance with the presently disclosed subject matter, it will be appreciated that many changes may be made therein without departing from the spirit of the presently disclosed subject matter.

CLAIMS

1. An ejector rack for releasably supporting a store, the store having at least one lug for enabling removable engagement of the store with the ejector rack, the ejector rack comprising:

a housing, including:

a lug engaging and releasing mechanism configured for selectively and releasably engaging the lug, and movable between a lug engaging position and a lug releasing position, the lug engaging and releasing mechanism comprising a hook element, the hook element having an extension;

a locking and unlocking mechanism actuatable between a locking position, for reversibly locking said lug engaging and releasing mechanism in said lug engaging position, and an unlocking position, for enabling the lug engaging and releasing mechanism to adopt said lug releasing position, said locking and unlocking mechanism comprising a roller;

an actuation system for reversibly actuating said locking and unlocking mechanism;

wherein the locking and unlocking mechanism is configured, in operation of the ejector rack, for supporting part of a load applied by the store via the lug to the lug engaging and releasing mechanism in said lug engaging position, and

wherein in said locking position, said roller is in abutting contact with said extension and in load bearing contact therewith, and capable of supporting said part of the load applied by the store via the lug.

2. An ejector rack according to claim 1, wherein in the lug engaging position the lug engaging and releasing mechanism is in load bearing contact with the locking and unlocking mechanism.

3. An ejector rack according to claim 1 or claim 2, wherein in the locking position said locking and unlocking mechanism are geometrically locked via the load.

4. An ejector rack according to any one of claims 1 to 3, wherein said lug engaging and releasing mechanism comprises a first kinematic chain, comprising a stressed link pivotably connected to said hook element via a first pin, wherein the stressed link is further pivotably mounted to said housing at a fixed first pivot axis, and the hook element is pivotably mounted to the housing at a fixed second pivot axis.
5. An ejector rack according to claim 4, wherein said hook element comprises a C- or U-shaped engagement portion, configured for engaging said lug when pivoted about the second pivot axis to an engagement position, and for disengaging from the lug when pivoted away from the engagement position to a released position, the extension having a first abutment surface and a second abutment surface generally inclined to one another, and joined together via a rounded lateral edge, the extension projecting in a direction towards the locking and unlocking mechanism.
6. An ejector rack according to claim 4 or claim 5, wherein said stressed link comprises a free end at said first pin, said free end being reciprocally displaceable in a radial direction with respect to said first pivot axis, and wherein said stressed link is pre-stressed to bias said free end in a direction towards said first pivot axis.
7. An ejector rack according to any one of claims 4 to 6, wherein said first kinematic chain operates to provide a first stable position and a second stable position, different from said first stable position, wherein in each one of said first stable position and said second stable position are such as to minimize a potential energy of said stressed link, and in which said first pin is at a respective maximum distance from an imaginary line joining said first pivot axis to said second pivot axis.
8. An ejector rack according to claim 7, wherein in said first stable position said first pin is on one side of said imaginary line, and said hook element is pivoted to the engagement position, enabling engagement of the lug, and wherein in the second stable position said first pin is side of said imaginary line and said hook element is pivoted in an opposed direction to the release position, enabling release of the lug if previously engaged thereto.
9. An ejector rack according to any one of claims 1 to 8, wherein said locking and unlocking mechanism is configured to function as a toggle mechanism, wherein a relatively small force applied thereto maintains said locking and unlocking mechanism at the locked

position while concurrently enabling a much larger force corresponding to said load to be resisted by said locking and unlocking mechanism.

10. An ejector rack according to any one of claims 1 to 9, wherein said locking and unlocking mechanism comprises a second kinematic chain comprising: a first link pivotably connected to an anvil via a second pin and pivotably connected to a second link via a third pin, wherein said anvil pivotably is mounted to said housing at a fixed third pivot axis, and said second link is pivotably mounted to said housing at a fixed fourth pivot axis, and wherein said anvil is pre-stressed to provide said small force.

11. An ejector rack according to claim 9 or claim 10, wherein said anvil is pre-stressed by a torsion spring to provide said small force.

12. An ejector rack according to claim 10 or claim 11, wherein said roller freely rotatable about said third pin, and wherein said roller is in abutting contact alternately with said first abutment surface or said second abutment surface.

13. An ejector rack according to claim 12, wherein in said locking position, said engagement portion is in said engagement position, said roller is in abutting contact with said first abutting surface and in load bearing contact therewith, and capable of supporting said part of the load applied by the store via the lug, and wherein said anvil is prestressed to urge said second kinematic chain towards and abut a physical stop provided in the casing, in said locking position.

14. An ejector rack according to any one of claims 4 to 13, wherein a remainder of said load is supported at said first pin.

15. An ejector rack according to claim 14, wherein a remainder of said load is symmetrically supported at said first pin and at said roller.

16. An ejector rack according to any one of claims 13 to 15, wherein in said unlocking position, said anvil is selectively pivoted about said third pivot axis such that said second kinematic chain is urged away from said physical stop, sufficiently for the second kinematic chain to adopt a position that is not capable of supporting said part of the load applied by the store via the lug, enabling said roller to come into abutting contact with said

second abutting surface while concurrently said engagement portion pivots to said release position, allowing release of the lug if previously engaged therein.

17. An ejector rack according to claim 16, wherein applying a pivoting force to said engagement portion by a lug to pivot the engagement portion to the engagement position automatically results in the second kinematic chain adopting the locking position.

18. An ejector rack according to any one of claims 1 to 17, wherein said actuation system for reversibly actuating said locking and unlocking mechanism comprises a bellcrank pivotably mounted to said housing at a fixed fifth pivot axis, the bellcrank having a long arm and a short arm each extending radially away from said fifth pivot axis, said actuation system further comprising an actuator coupled to said long arm and configured for selectively reversibly pivoting said bellcrank about said fifth pivot axis to thereby reversibly move said short arm between a first position and a second position, to thereby reversibly actuate said locking and unlocking mechanism.

19. An ejector rack according to claim 18, wherein moving said short arm between said first position and said second position causes said anvil to pivot about said third pivot axis such that said second kinematic chain is urged away from said physical stop, sufficiently for the second kinematic chain to adopt a position that is not capable of supporting said part of the load applied by the store via the lug.

20. An ejector rack according to any one of claims 18 to 19, wherein said actuation system comprises an electrically powered motor comprising a shaft turned thereby, and further comprising a shuttle pivotably mounted to said long arm and coupled to the shaft, such that rotation of the shaft in one or another direction causes displacement of the shuttle, resulting in pivoting of said bellcrank about said fifth pivot axis in one or another direction, respectively.

21. An ejector rack according to any one of claims 1 to 20, further for selectively ejecting forcibly the store therefrom, the ejector rack comprising an ejector system comprising at least one ejection module, each ejection module configured for storing elastic potential energy therein, and for utilizing the stored potential energy for forcibly ejecting the store when the store is released from the ejector rack.

22. An ejector rack according to claim 21, each ejection module comprising:

a plunger element reciprocally movable with respect to a casing and comprising at least one elastic element therebetween, the plunger element being selectively retractable with respect to the casing to any one of a plurality of retracted positions up to a maximum retracted position, wherein at each said position the at least one elastic element is progressively compressed storing therein said potential energy.

23. An ejector rack according to claim 22, wherein said at least one elastic element comprises at least one helical spring.

24. An ejector rack for releasably supporting, and selectively ejecting forcibly, a store therefrom, the store having at least one lug for enabling removable engagement of the store with the ejector rack, the ejector rack comprising an ejector system comprising at least one ejection module, each ejection module configured for storing elastic potential energy therein, and for utilizing the stored potential energy for forcibly ejecting the store when the store is released from the ejector rack.

25. An ejector rack according to claim 24, each ejection module comprising:

a plunger element reciprocally movable with respect to a casing and comprising at least one elastic element therebetween, the plunger element being selectively retractable with respect to the casing to any one of a plurality of retracted positions up to a maximum retracted position, wherein at each said position the at least one elastic element is progressively compressed storing therein said potential energy.

26. An ejector rack according to claim 25, wherein said at least one elastic element comprises at least one helical spring.

27. An air vehicle comprising at least one ejector rack as defined in any one of claims 1 to 26.

28. A method for releasably supporting a store, the store having at least one lug, the method comprising:

(a) providing at least one ejector rack as defined in any one of claims 1 to 26;

and

(b) engaging the lug with respect to the lug engaging and releasing mechanism to thereby urge the locking and unlocking mechanism to the locking position.

29. A method according to claim 28, further comprising:

(c) selectively operating the actuation system to thereby actuate said locking and unlocking mechanism to enable the locking and unlocking mechanism to adopt the unlocking position, thereby enabling the lug engaging and releasing mechanism to release the lug therefrom.

30. A method according to any one of claims 26 and 27, wherein in step (b), a plurality of said ejection modules are in a pre-stressed condition and in abutment with the engaged stores.

31. A method according to claim 30, wherein in step (c) said plurality of said ejection modules forcibly eject the stores from the ejector rack.

32. An ejector rack for releasably supporting a store, the store having at least one lug for enabling removable engagement of the store with the ejector rack, the ejector rack comprising:

a housing, including:

a lug engaging and releasing mechanism configured for selectively and releasably engaging the lug, and movable between a lug engaging position and a lug releasing position;

a locking and unlocking mechanism actuatable between a locking position, for reversibly locking said lug engaging and releasing mechanism in said lug engaging position, and an unlocking position, for enabling the lug engaging and releasing mechanism to adopt said lug releasing position;

an actuation system for reversibly actuating said locking and unlocking mechanism;

wherein the locking and unlocking mechanism is configured, in operation of the ejector rack, for supporting part of a load applied by the store via the lug to the lug engaging and releasing mechanism in said lug engaging position.