

FALL ARRESTER

Field of the Invention

5 The present invention relates broadly to a fall arrester.

Background to the Invention

Figure 1 illustrates a common rope access system used for descent of a user 1 where a descender device 2 engages a working rope 3 for controlled descent, and a fall
10 arrester 4 engages a backup rope 5. If the descender device 2 or other associated equipment fails, the fall arrester 4 automatically brakes on the backup rope 5 to arrest fall of the user 1. There are various fall arrester designs which can be generally categorised as either automatic hands-free followers or back-up manual devices.

15 In a typical automatic follower there is provided a housing having a hinged gate for enclosing the backup rope. The follower also includes a large cam and lever with a head of the lever coupled to a user's harness via a lanyard and carabiner-style snap hook. If the user falls the lever pivots the large cam which brakes the backup rope within the housing. This type of automatic follower suffers from an inherent design
20 fault in that the exposed lever in a panic grab can be gripped together with the backup rope to release the large cam without arresting the device.

In a typical manual device there is provided a primary cam for braking where the user's carabiner and lanyard is connected to a body of the device. The body includes
25 a pivoting cover plate which can be opened for locating the fall arrester on the backup rope. The manual device, on rapid descent of a user, rocks the housing relative to the primary cam for braking of the rope. The manual device also includes a secondary cam and lever which connects to the user's carabiner so that rocking of the housing is promoted by the secondary cam which frictionally engages the backup
30 rope. This style of manual device presents a dropped objects hazard in that it must be detached from the user's carabiner when attaching to the backup rope.

It is to be understood that any acknowledgement of prior art in this specification is not to be taken as an admission that this prior art forms part of the common general knowledge.

5 **Summary of the Invention**

According to a first aspect of the present invention there is provided a fall arrester comprising:

a body adapted to couple to a user via a coupling;

10 a lever including a primary cam, the lever pivotally coupled to the body and arranged to cooperate with the coupling whereby in operation descent of the user urges the coupling into contact with the lever which pivots to effect braking of rope passing through the fall arrester between the primary cam and the body.

15 Preferably the fall arrester also comprises an inertial cam pivotally coupled to the lever proximate the primary cam and configured on rapid descent of the user to pivot into contact with the rope to initiate pivotal movement of the lever for braking of the rope with the primary cam.

20 According to a second aspect of the invention there is provided a fall arrester comprising:

a body adapted to receive a rope;

a lever including a primary cam arranged to brake the rope on descent of the fall arrester, the lever pivotally coupled to the body;

25 a tow cam movably coupled to the body and configured to contact the lever to pivot it and release the primary cam from the rope to permit manual towing of the fall arrester along the rope during its descent.

30 Preferably the body includes a closed opening adapted to retain the coupling. More preferably the lever is positioned relative to the closed opening whereby ascent of the user provides contact of the coupling with the body to effect raising of the fall arrestor independent of the lever and the primary cam.

Preferably the fall arrester also comprises a secondary cam connected to the lever whereby gripping the rope and the coupling toward one another urges the rope into

contact with the secondary cam pivoting the lever to promote braking of the rope between the primary cam and the body. More preferably the secondary cam is pivotally connected to the lever and biased to maintain contact with the rope to hold the fall arrester at a required position along the rope. Even more preferably the fall
5 arrester further comprises a secondary cam lock connected to the lever and arranged to lock the secondary cam in a retracted position to permit sliding movement of the fall arrester in both directions along the rope.

Preferably the fall arrester additionally comprises a tow cam pivotally coupled to the
10 body to provide contact with the lever to pivot it and release the associated primary cam from the rope to permit manual towing of the fall arrester along the rope on its descent. More preferably the tow cam is configured relative to the lever to disengage from the lever to permit braking of the rope via the primary cam beyond a predetermined pivot angle of the tow cam. Even more preferably the tow cam
15 connects to a tow line which is manually pulled to pivot the tow cam to allow towing of the fall arrester. Still more preferably the tow line includes a mechanical fuse which breaks at a predetermined pull load wherein the tow cam is deactivated.

Preferably the fall arrester still also comprises an accelerator element pivotally
20 coupled to the body and adapted to engage the coupling to accelerate contact of the coupling with the lever for accelerated braking of the rope with the primary cam. More preferably the accelerator element is operatively coupled to a biasing member which urges the coupling to maintain contact with the lever.

Preferably the body includes a base body and a movable cover plate which in an
25 open position provides for attachment of the fall arrester to the rope. More preferably the body is configured with the cover plate in a closed position to substantially house at least the primary cam and the lever. Even more preferably the body includes an inverted cam movably mounted to the base body to only permit closure of the cover
30 plate into the closed position with the fall arrester correctly oriented relative to the rope to ensure braking on descent.

Preferably the fall arrester is integrally connected to the coupling. More preferably the coupling is in the form of a swivel connector.

Brief Description of the Figures

In order to achieve a better understanding of the nature of the present invention preferred embodiments of a fall arrester will now be described, by way of example
5 only, with reference to the accompanying drawings in which:

Figure 1 is a schematic illustration of a common rope access system including a fall arrester;

10 **Figure 2** is a perspective view of a fall arrester of an embodiment of the invention together with a coupling;

Figures 3A and 3B are perspective views of the fall arrester of figure 2 together with different length coupling arrangements;

Figures 4A and 4B are side elevational views of the fall arrester of figure 2 in closed and open configurations respectively;

15 **Figure 5** is a side elevational view of the fall arrester of the embodiment of figures 4A and 4B with the cover plate removed for clarity;

Figures 6A and 6B are side elevational views of the fall arrester of figure 5 shown in automatic and manual modes respectively;

20 **Figures 7A and 7B** are side elevational views of the fall arrester of figure 5 in the automatic mode;

Figures 8A and 8B are side elevational views of the fall arrester of figure 5 in the manual mode;

Figure 9 is a schematic illustration of the fall arrester of figure 5 shown in the case of a "panic grip";

25 **Figure 10** is a perspective view of the fall arrester of figure 5 in an inverted position.

Figures 11A and 11B are perspective views of a fall arrester of another embodiment of the invention shown with the cover plate removed for clarity;

Figures 12A and 12B are side elevational views of the fall arrester of figures 11A and 11B;

30 **Figure 13** is a cross-sectioned view of the fall arrester of figures 11A and 11B shown in the automatic mode braking the rope.

Detailed Description of the Preferred Embodiments

As best shown in figures 2 and 3A/3B there is a fall arrester 10 according to a preferred embodiment of the present invention which is coupled to a user's harness (not shown) via a coupling arrangement 6. In this embodiment the coupling arrangement 6 includes a coupling in the form of a swivel connector 7 connected integral with the fall arrester 10. The swivel connector 7 is connected to either a short or long lanyard 8 as shown in figures 3A and 3B, respectively. The lanyard 8 is at an opposite end connected to a carabiner 9 which detachably connects to a connection point defined by a D-ring (not shown) attached to the harness.

As best shown in figures 4A/B and 5 the fall arrester 10 is designed to be attached to a backup rope or safety line 12. The fall arrester 10 comprises a body 14, and a lever 16 pivotally coupled to the body 14. The lever 16 includes a primary cam 18 which in this embodiment is formed integral with the lever 16 which is arranged to co-operate with a coupling, an example of such a coupling being the coupling arrangement 6. In operation, descent of the user urges the coupling into contact with the lever 16 which pivots to effect braking of the safety line 12 between the body 14 and the primary cam 18.

The body 14 includes a base body 20 and a moveable cover plate 22 which in this example pivots about the base body 20. The base 14 includes a pivot axle 24 about which the cover plate 22 pivots. The pivot axle 24 also provides a pivotal mount to which the lever 16 is pivotally coupled. The base body 20 together with the cover plate 22 define a closed opening 26 designed to retain the coupling. The base body 20 and the cover plate 22 are slotted so that the opening 26 is maintained for connection to the coupling with the cover plate 22 both closed and open as illustrated in figures 4A and 4B respectively.

The base body 20 includes a retaining button 28 which retains the cover plate 22 in the closed position of figure 4A. The retaining button 28 is depressed to release the cover plate 22 and allow it to pivot about the pivot axle 24 into its open position as shown in figure 4B. In operation, ascent of the user releases the coupling from the lever 16 and the coupling contacts the body 14 about the opening 26 to effect raising of the fall arrester 10 independent of the lever 16 and the primary cam 18. As best

illustrated in figure 5, the primary cam 18 under the influence of gravity pivots away from the safety line 12 for relatively free movement of the fall arrester 10 along the safety line 12. In this embodiment the lever 16 and primary cam 18 are otherwise not actively biased.

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The fall arrester 10 further comprises an accelerator element 30 pivotally coupled to the base body 20. The accelerator element 30 is biased via a biasing member in the form of a torsion spring (not shown) in a clockwise direction as viewed in figure 5 to maintain contact with the coupling. This means that on rapid descent of a user the coupling is forced by the accelerator element 30 into contact with the lever 16 to initiate braking of the safety line 12 with the primary cam 18. The accelerator element 30 thus avoids a situation where the fall arrester 10 accelerates at the same rate as the user without the coupling contacting the lever 16 to effect braking via the primary cam 18.

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The fall arrester 10 also comprises a secondary cam 32 connected to the lever 16. The secondary cam 32 is designed so that gripping the safety line 12 and the coupling toward one another forces the safety line 12 into contact with the secondary cam 32. This contact with the secondary cam 32 pivots the lever 16 in a clockwise direction as shown in figure 6B to promote braking of the safety line 12 between the primary cam 18 and the body 16. The secondary cam 32 in this embodiment is pivotally connected to the lever 16 to permit operation of the fall arrester 10 in either an automatic or manual mode as shown in figures 6A and 6B respectively.

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The fall arrester 10 further comprises a secondary cam lock 34 mounted on the lever 16 and designed to retain the secondary cam 32 in a fixed and retracted position in the automatic mode. The secondary cam lock 34 is depressed to release the secondary cam 32 which is biased to pivot outwardly of the lever 16 into frictional engagement with the safety line 12 in the manual mode.

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In the automatic mode as shown in figure 7A the fall arrester 10 is free to slide or float in both upward and downward directions along the safety line 12. In moving upwardly along the safety line 12 the coupling lifts the body 14 of the arrester 10 without influencing pivoting of the lever 16 which under the influence of gravity pivots in an

anti-clockwise direction moving the primary cam 18 away from the safety line 12. The fall arrester 10 similarly travels downwardly along the safety line 12 without gripping the safety line 12. In travelling in both directions the secondary cam 32 is retracted clear of the safety line 12. In rapid descent the fall arrester 10 is activated wherein
5 the accelerator element 30 pushes the coupling into contact with the lever 16 to rotate the primary cam 18 in a clockwise direction to effect accelerated braking of the safety line 12 with the primary cam 18.

In the manual mode as illustrated in figures 8A and 8B the secondary cam 32 is
10 biased toward the safety line 12 by releasing or depressing the secondary cam lock 34. The secondary cam 32 thus maintains frictional engagement with the safety line 12 pivoting the lever 16 in a clockwise direction to press cam 18 against the safety line 12. This means that the fall arrester 10 is held stationary or parked at a required position along the safety line 12. The secondary cam 32 thus forces the primary cam
15 18 to lightly brake the safety line 12 to effectively park the fall arrester 10 at a required height. If the user rapidly descends or falls the coupling contacts the lever 16 pivoting the primary cam 18 to brake the safety line 12 against the body 14.

The fall arrester 10 as best illustrated in figures 8A and 8B also comprises a tow cam
20 36 pivotally coupled to the base body 20. The tow cam 36 is designed in the manual mode to tow the fall arrester 10 downwardly along the safety line 12. The tow cam 36 is configured to contact an underside surface 38 of the lever 16 to pivot the lever 16 in an anti-clockwise direction to release the associated primary cam 18 from the safety line 12. A tow line 40 is connected to the tow cam 36 so that when the tow line 40 is
25 pulled it pivots the tow cam 36 in the anti-clockwise direction. The tow cam 36 is actuated independent of the primary cam 18 via the tow line 40. The lever 16 at its underside surface 38 is shaped wherein the tow cam 36 beyond a predetermined pivot angle disengages from the lever 16. Up until the predetermined pivot angle, the tow cam 36 bears against the underlying surface 38 of the lever 16 to pivot the lever
30 16 and release the primary cam 18 from the safety line 12. The secondary cam 32 in the manual mode maintains frictional contact with the safety line 12 for smooth lowering of the fall arrester 10. The tow line 40 includes a mechanical fuse such as the breakaway cord 42 shown in figure 9. The breakaway cord 42 detaches from the

remainder of the tow line 40 at a predetermined pull load wherein the tow cam 36 is deactivated. The tow cam 36 is biased in a clockwise direction via torsion spring 43.

5 The body 14 of the fall arrester 10 of this embodiment houses the lever 16 and primary cam 18 together with the majority of the other moving components. The lever 16 is open-ended so that it is only effective in pivoting of the associated cam 18 on contact with the coupling in descent only. As illustrated in figure 9, this also means that in a "panic grip" the coupling or in this example the carabiner 43 does not contact the lever 16 and influence the primary cam 18. Rather, the secondary cam 32 in a
10 "panic grip" contacts the safety line 12 and pivots the lever 16 and the associated cam 18 into braking contact with the safety line 12. The carabiner 43 moves freely within the slotted opening 26 with the accelerator element 30 being pivoted away against its biasing force.

15 The fall arrester 10 as shown in figure 10 is configured so that it can be attached to the safety line 12 in a single orientation only wherein braking of the safety line 12 is effected on descent of the fall arrester 10. For this purpose the base body 20 is provided with an invert cam 44 which pivotally retracts with the fall arrester 10 oriented in the correct disposition. With the invert cam 44 retracted, the cover plate
20 22 is free to pivot across the base body 20 for retention with the button retainer 28. If the fall arrester 10 is incorrectly oriented relative to the safety line 12, the invert cam 44 extends from the base body 20 as shown in figure 10. This means the cover plate 22 is obstructed by the invert cam 44 not permitting full closure of the cover plate 22. This consequently alerts the user to incorrect orientation of the fall arrester 10.

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In order to further understand the invention, operation of the preferred fall arrester 10 involves the following steps:

1. In a safe environment, the fall arrester 10 which is integrally connected to a coupling is connected to a user's harness via a lanyard and carabiner;
- 30 2. The fall arrester 10 is opened by depressing the retainer button 28 and pivoting the cover plate 22 anti-clockwise to present an elongate passage for attaching or capturing the safety line 12;
3. The cover plate 22 is pivoted in a clockwise direction for closure about the safety line 12;

4. The user descends a working rope using a conventional descender device and relies upon the fall arrester 10, typically in the automatic mode, to function as a backup safety device;
5. The user having descended to a required working height can elect to park the fall arrester 10 in a manual mode at a required height along the safety line 12;
6. The user can tow the fall arrester 10 in the manual mode sliding it downwardly along the safety line 12 using the tow line 40 and associated tow cam 36.

10 In the event of a fall or rapid descent, the fall arrester 10 in either its automatic or manual mode brakes or locks against the safety line 12 to arrest descent of the user. If the tow line 40 is being used with the breakaway cord 42, the breakaway cord 42 will detach from the remainder of the tow line 40 and the tow cam 36 will be deactivated.

15 Figures 11 to 13 show another embodiment of a fall arrester according to the present invention. The fall arrester 100 of this embodiment is essentially the same as the preceding embodiment except for the inclusion of an inertial cam 130. For ease of reference and in order to avoid repetition the fall arrester 100 is for corresponding components to the preceding embodiment shown or designated with an additional "0".
20 For example, the housing of this fall arrester 100 is designated as 140.

As best shown in figure 11A the inertial cam 130 is pivotally connected to the lever 160 at the primary cam 180. The inertial cam 130 pivots or swings about pivot pin 150 fixed to the lever 160 at the primary cam 180. The inertial cam 130 is configured
25 on rapid descent of a user to pivot into contact with the rope 120 as shown in figure 11B. The inertial cam 130 contacts the rope 120 and thus initiates pivotal movement of the lever 160 and the associated primary cam 180 for braking of the rope 120 with the primary cam 180. The inertial cam 130 can thus swing from a retracted position of figure 11A for normal operation of the fall arrester 100 to an extended position of
30 figure 11B for activation of the primary cam 180.

As shown in figures 12A and 12B the fall arrester 100 can operate in an automatic mode with the secondary cam 320 in a fixed and retracted position. In the automatic mode the fall arrester 100 is free to slide or float in both upward and downward

directions along the rope or safety line 120. In the event of rapid descent which may be associated with a panic grip, the inertial cam 130 as shown in figure 12B is swung outward of the primary cam 180 due to the inertia difference in the system. The inertial cam 130 includes teeth such as 170 designed to contact and pick up the rope 120 and thus initiate locking of the primary cam 180. In rapid descent the falling mass further activates the primary cam 180 for braking of the rope 120 to arrest the fall.

Figure 13 depicts the fall arrester 100 with the rope 120 braked following rapid descent. Inertial cam 130 has retracted into a rebate 190 in the lever 160 at the primary cam 180. The inertial cam 130 in this retracted position does not contact or damage the rope 120. The fall arrester 100 is otherwise constructed to operate in a similar manner to the preceding embodiment.

Now that several preferred embodiments of the present invention have been described it will be apparent to those skilled in the art that the fall arrester has at least the following advantages:

1. The fall arrester is retained on the coupling or carabiner and lanyard whilst being attached or detached from the safety line thus eliminating a drop hazard;
2. The fall arrester can be operated in either an automatic or manual mode and these modes can be switched whilst in operation with relative ease;
3. The fall arrester eliminates hazards associated with a "panic grip" by one or a combination of the following design features:
 - i. The body houses the lever and associated primary cam so that the lever cannot be grasped;
 - ii. The carabiner or other coupling is not retained by the lever but rather contacts or engages the lever on descent only;
 - iii. The secondary cam on contact with the safety line urges the primary cam into braking contact with the safety line;
 - iv. The primary cam may include an inertial cam which ensures braking of the rope;
4. The fall arrester can be safely towed via the tow cam which is activated independent of the primary braking cam;
5. The tow cam is designed to deactivate if over pulled by panic.

Those skilled in the art will appreciate that the invention described herein is susceptible to variation and modifications other than those specifically described. For example, the shape and configuration of the fall arrester and its associated components may vary from that described provided it functions in accordance with the essential characteristics of the invention. The fall arrester need not necessarily include the secondary cam in which case it would function in the automatic mode only. All such variations and modifications are to be considered within the scope of the present invention the nature of which is to be determined from the foregoing description.

Claims

1. A fall arrester comprising:
 - a body adapted to couple to a user via a coupling;
 - a lever including a primary cam, the lever pivotally coupled to the body
- 5 and arranged to cooperate with the coupling whereby in operation descent of the user urges the coupling into contact with the lever which pivots to effect braking of rope passing through the fall arrester between the primary cam and the body.
- 10 2. A fall arrester as defined in claim 1 also comprising an inertial cam pivotally coupled to the lever proximate the primary cam and configured on rapid descent of the user to pivot into contact with the rope to initiate pivotal movement of the lever for braking of the rope with the primary cam.
- 15 3. A fall arrester as defined in either of claims 1 or 2 also comprising a tow cam pivotally coupled to the body to provide contact with the lever to pivot it and release the associated primary cam from the rope to permit manual towing of the fall arrester along the rope on its descent.
- 20 4. A fall arrester as defined in claim 3 wherein the tow cam is configured relative to the lever to disengage from the lever to permit braking of the rope via the primary cam beyond a predetermined pivot angle of the tow cam.
- 25 5. A fall arrester as defined in either of claims 3 or 4 wherein the tow cam connects to a tow line which is manually pulled to pivot the tow cam to allow towing of the fall arrester.
6. A fall arrester as defined in claim 5 wherein the tow line includes a mechanical fuse which breaks at a predetermined pull load wherein the tow cam is
- 30 deactivated.
7. A fall arrester comprising:
 - a body adapted to receive a rope;
 - a lever including a primary cam arranged to brake the rope on descent
- 35 of the fall arrester, the lever pivotally coupled to the body;

a tow cam movably coupled to the body and configured to contact the lever to pivot it and release the primary cam from the rope to permit manual towing of the fall arrester along the rope during its descent.

- 5 8. A fall arrester as defined in claim 7 wherein the tow cam is configured relative to the lever to disengage from the lever to permit braking of the rope via the primary cam beyond a predetermined pivot angle of the tow cam.
- 10 9. A fall arrester as defined in either of claims 7 or 8 wherein the tow cam connects to a tow line which is manually pulled to pivot the tow cam to allow towing of the fall arrester.
- 15 10. A fall arrester as defined in claim 9 wherein the tow line includes a mechanical fuse which breaks at a predetermined pull load wherein the tow cam is deactivated.
11. A fall arrester as defined in any one of the preceding claims wherein the body includes a closed opening adapted to retain the coupling.
- 20 12. A fall arrester as defined in claim 11 wherein the lever is positioned relative to the closed opening whereby ascent of the user provides contact of the coupling with the body to effect raising of the fall arrestor independent of the lever and the primary cam.
- 25 13. A fall arrester as defined in any one of the preceding claims also comprising a secondary cam connected to the lever whereby gripping the rope and the coupling toward one another urges the rope into contact with the secondary cam pivoting the lever to promote braking of the rope between the primary cam and the body.
- 30 14. A fall arrester as defined in claim 13 wherein the secondary cam is pivotally connected to the lever and biased to maintain contact with the rope to hold the fall arrester at a required position along the rope.

15. A fall arrester as defined in either of claims 13 or 14 further comprising a secondary cam lock connected to the lever and arranged to lock the secondary cam in a retracted position to permit sliding movement of the fall arrester in both directions along the rope.

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16. A fall arrester as defined in any one of the preceding claims also comprising an accelerator element pivotally coupled to the body and adapted to engage the coupling to accelerate contact of the coupling with the lever for accelerated braking of the rope with the primary cam.

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17. A fall arrester as defined in claim 16 wherein the accelerator element is operatively coupled to a biasing member which urges the coupling to maintain contact with the lever.

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18. A fall arrester as defined in any one of the preceding claims wherein the body includes a base body and a movable cover plate which in an open position provides for attachment of the fall arrester to the rope.

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19. A fall arrester as defined in claim 18 wherein the body is configured with the cover plate in a closed position to substantially house at least the primary cam and the lever.

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20. A fall arrester as defined in either of claims 18 or 19 wherein the body includes an inverted cam movably mounted to the base body to only permit closure of the cover plate into the closed position with the fall arrester correctly oriented relative to the rope to ensure braking on descent.

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21. A fall arrester as defined in any one of the preceding claims wherein the fall arrester is integrally connected to the coupling.

22. A fall arrester as defined in any one of the preceding claims wherein the coupling is in the form of a swivel connector.