

A Safety Apparatus

This invention relates to apparatus for raising and/or lowering loads to and from elevated heights. The invention relates particularly, but not exclusively, to a device which may be used to lower people safely from an elevated point, such as a skyscraper, in the case of a fire or other emergency.

Modern high-rise buildings are usually designed with many safety features, such as fire escapes and fire extinguishing systems. Unfortunately, if these safety features fail during an emergency, occupants in the buildings may become trapped. Stairways and elevators and other means of escape may often be disabled, perhaps by fire or structural damage to the building. In such life or death situations, it is a tragedy that occupants may have to choose between remaining in the building, or leaping from the building in the vain hope of surviving the fall. The chances of surviving a fall from a very tall skyscraper are negligible. The problem is especially critical in older high-rise buildings which may not have been designed with numerous safety features.

An object of the present invention is to provide an apparatus which is capable of allowing a load to descend safely from an elevated point, for example, from the outside of a tall building.

Summary of the Invention

According to the present invention, there is provided a safety apparatus adapted to retard the rate of descent of a load from an elevated point, said apparatus comprising:

- a first attachment means capable of being secured to the elevated point;
- a second attachment means capable of being secured to the load;
- a reel mechanism capable of dispensing a tether wound thereon; and,
- a retardation means capable of retarding the rate at which the tether is dispensed from the reel mechanism.

Preferably, the retardation means includes a torque reduction mechanism for reducing the torque of said reel mechanism and/or a hydraulic damping mechanism.

In another aspect the present invention provides safety apparatus adapted to retard the rate of descent of a load from an elevated point, said apparatus comprising:

- a first attachment means capable of being secured to the elevated point;

- a second attachment means capable of being secured to the load;

- a reel mechanism capable of dispensing a tether wound thereon; and,

- a retardation means capable of retarding the rate at which the tether is dispensed from the reel mechanism, said retardation means including a hydraulic damping mechanism providing a retarding effect on said reel mechanism, the retarding effect of said hydraulic damping mechanism being controlled in response to the rate of dispensing of said tether from said reel mechanism.

In one preferred embodiment the first attachment means is connected to one end of the tether and the second attachment means secures the reel mechanism to the load. In a second preferred embodiment the first attachment means secures the reel mechanism to the elevated point and the second attachment means secures one end of the tether to the load.

Preferably, the hydraulic damping mechanism includes a rotor which is mechanically coupled to said reel mechanism, said rotor being generally immersed in a hydraulic fluid chamber which enables the rotation of said rotor to be retarded, which in turn retards the rate of rotation of the reel mechanism.

Preferably, the rotor is provided with radially extending vanes.

Preferably, the hydraulic fluid chamber comprises internal surfaces which are provided with projections that are adapted to produce turbulence in said chamber as said rotor rotates.

Preferably, the projections of said internal surface are in the form of inwardly projecting fins or webs.

Preferably, the torque reduction mechanism includes a gear train, said gear train controlling the retarding effect of said hydraulic damping mechanism.

Preferably, the torque reduction mechanism includes a gear train

Preferably, the reel mechanism retractably dispenses said tether, such that said apparatus, in addition to descending, is also able to raise said load towards said elevated point by retracting said tether into said reel mechanism.

Preferably, the apparatus is provided with a motor adapted to motorise the retraction of said tether back into said reel mechanism.

Preferably, the apparatus is provided with a braking mechanism which enables a user of the apparatus to further retard or stop the rotation of said reel mechanism.

Preferably, the braking mechanism consists of a disc-braking mechanism.

Preferably, the tether is made of metallic cable or mono-filament plastics material capable of supporting said load.

Preferably, the apparatus includes a guiding mechanism for guiding said tether towards and away from said reel mechanism such that tangling of said tether within said reel mechanism is thereby minimised.

Preferably, the guiding mechanism is in the form of a eyelet-ring.

Preferably, the guiding mechanism is generally reciprocable along the length of the axis said reel mechanism.

In yet another aspect, the present invention provides a method of controlling the rate of decent of a load from an elevated point using an apparatus having a reel mechanism capable of dispensing a tether wound thereon, and a retardation means capable of retarding the rate at which the tether is dispensed from the reel mechanism, said method including:

securing the apparatus to the elevated point with a first attachment means;
securing the apparatus to the load with a second attachment means; and,
lowering the load from the elevated point by dispensing the tether from the
reel mechanism; whereby,
the retardation means retards that rate at which the tether dispenses from the
reel mechanism.

Drawings

In order that the invention might be more fully understood, preferred
embodiments of the invention will be described, by way of example only, with
reference to the accompanying drawings, in which:

Figure 1 is a schematic diagram of a safety apparatus constructed in
accordance with a preferred embodiment of the invention;

Figures 2a and 2b illustrate schematically how the safety apparatus of Figure
1 may be used to lower a person from an elevated height, either with the device
fastened to the person as illustrated in Figure 2a, or with the device fastened to a
point at the elevated height as illustrated in Figure 2b;

Figure 3 is a cross-sectional view of the embodiment of the safety apparatus
illustrated in Figure 1 without a tether wound about the spool;

Figure 4 is an exploded diagram which illustrates a number of the
components of the embodiment illustrated in Figures 1 and 3;

Figure 5a is a cross-sectional view of an embodiment of a rotor housed within
a reservoir filled with hydraulic fluid, as viewed along lines B-B in Figure 3;

Figure 5b is a perspective view of the rotor and housing as illustrated in
Figure 5a;

Figure 5c is a cross-sectional view of another embodiment of a rotor housed
within a reservoir filled with hydraulic fluid, with a rotor having straight vanes, and

Figure 5d is a perspective view of the rotor and housing as illustrated in Figure 5c;

Figure 5e is a cross-sectional view of a further embodiment of a rotor housed within a reservoir filled with hydraulic fluid, with a rotor having straight vanes and a housing having curved fins, and Figure 5f is a perspective view of the rotor and housing as illustrated in Figure 5e;

(The features illustrated in Figures 5a, 5c and 5e use the same reference numerals for the sake of clarity, and the use of the same reference numerals should not be taken to mean that the embodiments of Figures 5a, 5c and 5e are identical);

Figure 6 is an illustration of an embodiment which is provided with a mechanised motor to allow mechanised rotation of the spool; and

Figure 7 is an illustration of a sleeve or handgrip that a user of an embodiment of the safety apparatus may grasp in order to avoid "rope burns" to the hand.

The drawings are not necessarily drawn to scale, and are provided for the purpose of illustration only.

Preferred Embodiments

Referring to the drawings, Figure 1 is a schematic diagram of a safety apparatus constructed in accordance with an embodiment of the invention. The embodiment of the safety apparatus 10 consists of a tether in the form of a line which is wound around a reel mechanism. In the embodiment, the line is a length of strong metallic cable 20. A line made of metallic material has an advantage that it has a high degree of fire resistance. However, other materials such as monofilament line made of polymeric materials such as nylon, that can support a desired load, for example between 10 and 350 kg., may also be used. Line that is made of strong polymeric material may enable the safety apparatus to weigh less than one that uses metallic line.

The reel mechanism is preferably embodied as a rotatable spool 30. The

spool is designed to store a cable, and to dispense the cable during use. The beginning of the cable (not shown) is fastened securely to the core of the spool 30. In other embodiments, the beginning of the cable is fastened to other suitable points on the apparatus, to ensure that the cable will not detach from the apparatus when the cable unwinds fully.

The safety apparatus 10 is able to lower a load, such as a person, from an elevated point at a safe rate of descent, essentially by unwinding the cable 20 from the spool 30 at a rate which is controlled by the safety apparatus.

The end of the cable 20A may be provided with a first attachment means, such as a hook 20B, which may be used to fasten the end of the cable securely to a point at an elevated height. In this arrangement the safety apparatus 10 includes second attachment means to attach the apparatus 10 to the person, as in Figure 2a by the use of a safety belt or any other suitable safety harness.

Alternatively, Figure 2b illustrates an example where the reel mechanism of the safety apparatus 10 may be fastened at the elevated point via first attachment means, with the end of the cable secured to the person by second attachment means, perhaps by some form of safety harness, belt or the like. In either case, the person is able to use the safety apparatus to descend from the elevated point, as a result of the cable 20 being dispensed from the spool 30.

In a sense, the cable acts as an extendible coupling between the elevated point and the load. Using this terminology, the coupling between the load and the elevated point is able to extend as the cable is dispensed from the spool. The use of the word "extend" does not imply necessarily that the cable is elastic, (although a degree of elasticity may be present). The word is used to imply that the length of the connection between the load and the apparatus may be altered, as a direct result of the cable being dispensed from and/or retracted into the safety apparatus.

An advantage of having the apparatus secured to the elevated point, rather than to the person, is that the apparatus may be used conveniently by a number of people in turn. The apparatus would be secured to the elevated point, so that after one person has used the apparatus, it is merely necessary to retract the cable 20 back onto the spool 30 to enable the apparatus to be ready for reuse by another

person.

Alternatively, in the case where the apparatus is to be used by a number of people in turn, the apparatus may be attached to each person, but some means of returning the safety apparatus back up to the elevated point would then have to be incorporated into the design of the apparatus. A mechanised rewinding motor 110 shown in Figure 6 may be used to retract the cable onto the spool mechanically, which would have the effect of hoisting the apparatus back to the elevated point.

There are other instances where it would be advantageous to have the apparatus secured to the person, rather than the elevated point. For example, the apparatus may be embodied for use as part of the personal equipment of an emergency worker or even a soldier. When the emergency worker or soldier has used the apparatus to descend from a height, the line or cable may be unfastened from the point from which the person has descended. Since the safety apparatus, in such an embodiment, would be used solely by that one person, there would be no need to return the apparatus back to the elevated point. It is proposed that such an apparatus may become part of the personal kit of soldiers in armed forces.

Such safety apparatus may also be used as a safety harness for workers who work at elevated heights, such as building construction workers. When construction workers use ropes fastened around their waists to act as safety harnesses, the workers may be injured during a fall. Although the rope may prevent the worker from falling all the way to the ground, the worker may still be hurt by the sudden jolt that occurs when the falling worker reaches the end of the tether. In the present embodiment, the safety apparatus would preferably allow the worker to descend safely all the way to the ground.

Referring to Figure 3, the spool 30 rotates about the central axis A-A of the safety apparatus 10. The spool 30 is positioned between two closed cylindrical housings 40, 50. The two cylindrical housings are connected by a circumferential arrangement of lattice bars 60. The cross-sectional diagram of Figure 3 indicates that the cylindrical housings 40, 50 are used to house various components which will be described hereinafter in greater detail.

The reel mechanism is provided with retardation means for retarding the rate

of its rotation. Retarding the rotation of the reel mechanism thus affects that rate at which the line is able to be dispensed from and/or retracted into the reel mechanism. In the embodiment in Figure 3, the spool 30 is provided with retardation means that makes use of a gear mechanism and a hydraulic damping system. The spool 30 is connected indirectly to a rotor 70, by means of a gear train (gears A, B1, B2, B3, B4, C) and shaft 80. In this embodiment, the rotor is in the form of a paddle wheel 70. The rotation of the paddle wheel 70 is retarded by a hydraulic drag caused by viscosity of hydraulic fluid within the housing 50.

The spool 30 is attached directly to gear 'A'. The spool 30 and gear 'A' rotate in unison. The spool 30 and gear 'A', however, are not rigidly connected to the main shaft 80, but are able to rotate freely about the main shaft because each is mounted on the main shaft by bearing such as roller bearings 85. For the sake of clarity in understanding Figure 3, it is noted that the spool 30 is not connected directly to the paddle wheel 70, and hence the spool and paddle wheel do not rotate in unison.

The spool is connected to the paddle wheel through a torque reducing gear train. Therefore, the resistance torque applied to the paddle wheel by the hydraulic drag, is magnified through the gearing to provide a more substantial resistance torque to the spool giving greater retardation of the rate of decent.

The paddle wheel 70 rotates at a higher angular velocity than the spool. This difference in rotation occurs because the spool 30 is connected to the paddle wheel 70 indirectly, via the gear train (gears A, B1, B2, B3, B4, C). The spool 30 is connected directly to gear 'A'. The rotation of gear 'A' drives gears B1 and B3 of the gear train. Gears B1 and B2 rotate in unison because they are either fixed together to rotate in unison on the same axle or they are fixed to the same rotatable axle. Similarly, gears B3 and B4 rotate in unison. Thus, gear 'C' is rotated by gears B2 and B4. In this manner, gear 'C' rotates at a greater rate than gear 'A' by virtue of the gear ratio of the gear train. Gear 'C' is connected, by the main shaft 80, directly to the paddle wheel 70. Thus, the paddle wheel 70 rotates at a greater speed than the spool, a consequence of which is that any increase in the speed at which the spool rotates corresponds to a much larger increase in the rotational speed of the paddle wheel. The drag exerted on the paddle wheel is proportional to the square of its angular velocity, and so any increase in the angular velocity of the paddle wheel results in a substantial increase in the resistive torque applied to it. This allows the

weight of the load to accelerate the paddle wheel to a given speed where the torque applied to the spool by the load equals the torque exerted on the paddle wheel, but any further acceleration of the paddle wheel requires significantly more load to be applied. This provides that the rate of decent is effectively limited to a maximum value for a given load, and because the resistive torque increases with the square of the paddle wheel velocity, the maximum rate of decent for a much larger load will only be marginally higher than for the first given load.

In the present embodiment, it has been found that a gear ratios in the range of 1:9 to 1:20 for the gears 'A' and 'C', provides an adequate configuration for an apparatus that is intended to lower a person from an elevated height. These gear ratios are, of course, dependent on the other parameters of the embodiment, such as the size of the paddle wheel and the parameters of the hydraulics, which will be described later. Hence, these gear ratios are provided by way of example only, and the invention is not restricted to these ratios. Every embodiment of this invention may require some form of experimentation to achieve a balance of the different parameters of the various components.

Furthermore, the actual design configuration of the gear train is not critical to the invention in its broadest aspect. Any number of conventional designs for gear trains may be used, since the prime purpose of the gear train is to reduce the torque of the paddle wheel relative to the spool. Different arrangements of gear trains may be used to reduce the size of the apparatus.

Another feature that is not critical to the invention in its broadest aspect is the arrangement of the reel mechanism with respect to the components of the retardation means. In the illustrated embodiment, the spool is positioned in between the gear train and the paddle wheel. This arrangement allows the gear train and the paddle wheel to provide a weighted balance on either side of the spool, so that in use the axis of the spool may maintain a relatively horizontal orientation. However, the spool need not be positioned in between the gear train and the paddle wheel. The invention also embraces configurations where the axis of the spool is used in a vertical orientation, and in such a configuration the spool may be positioned to one side of the gear train and rotor.

The hydraulic damping system may consist of a paddle wheel 70 rotating

within an enclosed reservoir located within one of the cylindrical housings 50. The reservoir 50 is filled with hydraulic fluid, and is provided with a sealable opening (not shown) for draining and filling the reservoir with hydraulic fluid.

The cylindrical housing of the reservoir 50 may be made of metal. The components of the housing may be welded together to provide the greatest durability, especially when the hydraulic fluid becomes pressurised due to expansion in hot environments, for example when the housing is close to flames. The components of the housing may also be moulded, sealed with O-rings, or held together with bolts and screws. The ultimate choice of construction depends on the environment in which the safety apparatus is intended to be used, and the invention in its broadest aspect is not limited to any of the foregoing methods of construction.

Since an important use of the apparatus of the embodiment is for assisting people to escape from fires, it is preferred that the external components of the apparatus be constructed of fireproof materials, such as metal. For this same reason, the line should preferably also be made of fireproof material. Alternatively, the components of the housing may be made of other rigid material, such as strong plastic material, particularly when the safety device is not expected to be used in fires.

Referring to Figures 5a and 5b, the paddle wheel 70 has a number of vanes 75 which radiate from the shaft of the paddle wheel 70. Preferably, there should be at least two vanes 75, arranged symmetrically about the shaft 80. The vanes 75 of the paddle wheel 70 are connected directly to the main shaft 80, which in turn is connected indirectly, by the gear train, to the spool 30. Hence, when the spool 30 is rotated as a result of the cable 20 being withdrawn from the spool, the resistance of the hydraulic fluid on the paddle wheel 70, retards the overall rotation of the spool.

Referring to Figure 5a, the inner circumferential surface of the reservoir 50 is provided with projections which extend into the flow path of the hydraulic fluid. In the present embodiment, the projections may be in the form of protruding radial fins 90. The projections may also be in the form of webbing that extends between internal surfaces of the hydraulic fluid chamber. The actual shape and configuration of the projections are not critical, provided that the projections are able to extend into the flow path of the hydraulic fluid to discourage laminar flow of the hydraulic fluid

around the circumferential margins of the reservoir.

It has been observed that the fluid caught in the segments 90a in between the fins 90, hinder the flow of fluid around the reservoir. In the absence of some form of projections, such as the fins 90, laminar flow within the reservoir may be established and the paddle wheel 70 may rotate with an increasing rate of rotation. The presence of the fins creates turbulence which may tend to hinder the rotation of the paddle wheel 70. It is found that when the fins are present, the wheel, after experiencing an initial peak in the rate of rotation, subsequently maintains a relatively constant rate of rotation. Hence, the rate of descent may be relatively constant, without any significant acceleration occurring for much of the descent.

There should be a minimum amount of air in the hydraulic fluid reservoir. If the regions 90a around the projections or fins are filled with a significant amount of air, the abovementioned turbulent effect created by the fins may be absent.

In the embodiment of Figures 5a and 5b, the vanes 75 are shaped as spiral arms. The spiral shape of the vane is especially advantageous when the rotor is intended to rotate in one rotational direction. For example, the rotor in Figure 5a would ideally only rotate clockwise, as illustrated. The curve in the spiral arm of the vanes 75 may make it marginally more difficult for fluid to flow around the vane, which may increase the amount of turbulence in the reservoir chamber.

However, the vanes may also be straight, as illustrated in the embodiments in Figures 5c and 5d. Straight vanes may be preferable when the vane is intended to retard the rate of rotation of the shaft 80, in both instances where the shaft rotates clockwise or anti-clockwise. The shaft would have to be retarded when rotating clockwise and anti-clockwise in an embodiment of a safety device that is capable of ascending and descending.

In Figure 5e and 5f, the fins of this further embodiment are provided with curved surfaces. The shapes of the fins and vanes may be modified according to how much resistance to rotation is required. The amount of resistance that is contributed by the shape of the vanes and fins will depend on other design parameters, such as the desired rate of descent, and the viscosity of the hydraulic fluid, for example.

In one preferred embodiment, the hydraulic fluid used may be Shell Tellus Oil 37, although the invention is clearly not restricted to this grade and manufacture of hydraulic fluid.

Hence, in the embodiment, the gear train and the paddle wheel both act to retard the rotation of the spool. Therefore, changes in the parameters of the gear train will affect the parameters required for the hydraulic system, and vice versa. As an example, if a higher gear ratio is selected for the gear train, a lighter less viscous hydraulic fluid may be used. Increasing the gear ratio correspondingly increases the angular velocity of the paddle wheel for any given rotational speed of the spool. As described above, the drag on the paddle wheel is a function of the angular velocity squared and the viscosity of the hydraulic fluid. Therefore to achieve the required resistive torque on the paddle wheel when using a higher gear ratio a lighter grade of hydraulic fluid should be used.

Since the cable 20, in the present embodiment, is withdrawn from the spool in a direction perpendicular to the spool, the gears used in the present embodiment may be spur gears. Spur gears may be satisfactory because there is a minimal force in the axial direction. However, in other embodiments of the invention where the cable is withdrawn from the spool in a more axial direction, the use of bevel gears in the gear train would be recommended.

In a further embodiment, the safety apparatus may be provided with a braking mechanism which enables a user of the apparatus to further retard or stop the rotation of the reel mechanism. The braking mechanism may be in the form of a disc-braking mechanism, similar to that which is used on automotive disc-brakes. Other braking mechanisms, such as friction clamps, may be contemplated, so long as these mechanisms are able to substantially retard or stop the rotation of the reel, at the initiative of a user of the apparatus.

In addition to being used for lowering loads from elevated heights, other embodiments of the invention may be used to raise loads. However, the invention in its broadest aspect need not be capable of raising loads. In these embodiments, a gear mechanism may be used to facilitate the raising of loads. The gear train may be provided with a mechanism, such as a manual crank or motor, that operates the

gear train in such a manner as to rotate gear 'A' in order to rotate the spool 30, so as to cause the cable 20 to be retracted back onto the spool. The versatility of those embodiments which may be used for ascending and descending may lend itself to applications in emergency rescue work, in military applications, work on building construction sites, and possibly in mountaineering.

In safety apparatus that may be used for raising loads as shown in Figure 6, the apparatus may be provided with a drive motor 110 to drive shaft 80 and a first clutch mechanism 112 to disengage the paddle wheel 70 from the main shaft 80. The resistance of the paddle wheel may thus be nullified while the apparatus is being used to raise a load, and may be brought into effect only when the apparatus is being used to lower a load. To isolate the motor 110 from the drive shaft 80 when a load is being lowered, a second clutch mechanism 111 may be provided.

When the apparatus is to be used for transporting persons, steps may be taken to provide safety features wherever possible failure of the mechanical components might be anticipated. For example, it is preferable that the safety apparatus include a guiding mechanism for guiding the line towards and away from the reel mechanism, in order that tangling of the line within the reel mechanism may be minimised. Referring to Figure 1, the guiding mechanism may be in the form of an eyelet ring 45 through which the cable is able to pass. In further embodiments, the guiding mechanism may be designed to have linear motion. For example, the eyelet ring may be able to reciprocate along a track parallel to the axis of the spool 30, so that the guiding mechanism may move in tandem with the cable as it uncoils from various portions along the length of the spool.

Referring to Figure 7, the line may be provided with a handgrip or sleeve 100 which slides along the line. A user may grasp the handgrip in order to avoid sustaining "rope burns" to the hand.

The embodiment has been described in terms of raising and lowering people from an elevated height, because the invention is capable of addressing the very serious problem of rescuing people from endangered buildings. Therefore, the embodiments have been described in terms of a safety apparatus which is capable of handling loads of approximately 10 kg to 350 kg. However, the invention may be equally adapted for handling heavier loads, although some experimentation may be

required to ascertain the design parameters required for such heavier loads. It is recommended especially that experiments be performed to identify the maximum failure load of the particular configuration, especially when the apparatus is to be used for transporting people.

The retardation means for retarding the rate of rotation of said reel mechanism has been described in terms of a gear train and a hydraulic damping system, since this is considered to be the best mode of performing the invention. However, the invention is not limited to these types of mechanisms. Other mechanisms, such as a gyroscopic flywheel, rotating in opposition to the reel mechanism, may possibly be used to achieve the function of retarding the rate of rotation of the reel. Frictional clutches or brake pads may also be used, provided appropriate materials may be obtained to provide adequate frictional resistance for retarding the rate of rotation of the reel mechanism.

The embodiments have been described by way of example only, and modifications are possible within the spirit and scope of the appended claims.

**CLAIMS:**

1. A safety apparatus adapted to retard the rate of descent of a load from an elevated point using a tether, said apparatus comprising:
 - a first attachment means capable of being secured to the elevated point;
 - a second attachment means capable of being secured to the load;
 - a reel mechanism capable of dispensing the tether wound thereon;and,
 - a retardation means capable of retarding the rate at which the tether is dispensed from the reel mechanism.
2. A safety apparatus adapted to retard the rate of descent of a load from an elevated point using a tether, said apparatus comprising:
 - a first attachment means capable of being secured to the elevated point and to one end of the tether;
 - a reel mechanism capable of dispensing said tether wound thereon;
 - a second attachment means capable of securing said reel mechanism to the load; and,
 - a retardation means capable of retarding the rate at which the tether is dispensed from the reel mechanism.
3. A safety apparatus adapted to retard the rate of descent of a load from an elevated point using a tether, said apparatus comprising:
 - a reel mechanism capable of dispensing the tether wound thereon;
 - a first attachment means capable of securing the reel mechanism to the elevated point;
 - a second attachment means capable of securing one end of the tether to the load; and,
 - a retardation means capable of retarding the rate at which the tether is dispensed from the reel mechanism.
4. A safety apparatus according to any one of claims 1 to 3 wherein said retardation means includes a torque reduction mechanism for reducing the torque of

said reel mechanism.



5. A safety apparatus according to any one of claims 1 to 4 wherein said retardation means includes a hydraulic damping mechanism.

6. A safety apparatus adapted to retard the rate of descent of a load from an elevated point using a tether, said apparatus comprising:

a first attachment means capable of being secured to the elevated point;

a second attachment means capable of being secured to the load;

a reel mechanism capable of dispensing the tether wound thereon;

and,

a retardation means capable of retarding the rate at which the tether is dispensed from the reel mechanism, said retardation means including a hydraulic damping mechanism providing a retarding effect on said reel mechanism, the retarding effect of said hydraulic damping mechanism being controlled in response to the rate of dispensing of said tether from said reel mechanism.

7. A safety apparatus adapted to retard the rate of descent of a load from an elevated point using a tether, said apparatus comprising:

a first attachment means capable of being secured to the elevated point and to one end of the tether;

a reel mechanism capable of dispensing said tether wound thereon;

a second attachment means capable of securing said reel mechanism to the load; and,

a retardation means capable of retarding the rate at which the tether is dispensed from the reel mechanism, said retardation means including a hydraulic damping mechanism providing a retarding effect on said reel mechanism, the retarding effect of said hydraulic damping mechanism being controlled in response to the rate of dispensing of said tether from said reel mechanism.

8. A safety apparatus adapted to retard the rate of descent of a load from an



elevated point using a tether, said apparatus comprising:

- a reel mechanism capable of dispensing the tether wound thereon;
- a first attachment means capable of securing the reel mechanism to the elevated point;
- a second attachment means capable of securing one end of the tether to the load; and,
- a retardation means capable of retarding the rate at which the tether is dispensed from the reel mechanism, said retardation means including a hydraulic damping mechanism providing a retarding effect on said reel mechanism, the retarding effect of said hydraulic damping mechanism being controlled in response to the rate of dispensing of said tether from said reel mechanism.

9. A safety apparatus according to any one of claims 6 to 8 wherein said hydraulic damping mechanism includes a rotor which is mechanically coupled to said reel mechanism, said rotor being generally immersed in a hydraulic fluid chamber which enables the rotation of said rotor to be retarded, which in turn retards the rate of rotation of the reel mechanism.

10. A safety apparatus according to claim 9 wherein said rotor is provided with radially extending vanes.

11. A safety apparatus according to either of claims 9 or 10, wherein said hydraulic fluid chamber comprises internal surfaces which are provided with projections that are adapted to produce turbulence in said chamber as said rotor rotates.

12. A safety apparatus according to claim 11 wherein said projections of said internal surface are in the form of inwardly projecting fins or webs.

13. A safety apparatus according to any one of claims 6 to 8 wherein said torque reduction mechanism includes a gear train, said gear train controlling the retarding

effect of said hydraulic damping mechanism.



14. A safety apparatus according to any one of claims 4, 5, 9, 10, 11 or 12 wherein said torque reduction mechanism includes a gear train

15. A safety apparatus according to any one of the preceding claims wherein said reel mechanism retractably dispenses said tether, such that said apparatus, in addition to descending, is also able to raise said load towards said elevated point by retracting said tether into said reel mechanism.

16. A safety apparatus according to claim 15 wherein said apparatus is provided with a motor adapted to motorise the retraction of said tether back into said reel mechanism.

17. A safety apparatus according to any one of the preceding claims wherein said apparatus is provided with a braking mechanism which enables a user of the apparatus to further retard or stop the rotation of said reel mechanism.

18. A safety apparatus according to claim 17 wherein said braking mechanism consists of a disc-braking mechanism.

19. A safety apparatus according to any one of the preceding claims wherein said tether is made of metallic cable.

20. A safety apparatus according to any one of claims 1 to 18 wherein said tether is made of mono-filament plastics material capable of supporting said load.

21. A safety apparatus according to any one of the preceding claims



wherein said apparatus includes a guiding mechanism for guiding said tether towards and away from said reel mechanism such that tangling of said tether within said reel mechanism is thereby minimised.

22. A safety apparatus according to claim 21 wherein said guiding mechanism is in the form of a eyelet-ring.

23. A safety apparatus according to claim 22 wherein said guiding mechanism is generally reciprocable axially along said reel mechanism.

24. A method of controlling the rate of decent of a load from an elevated point using an apparatus having a reel mechanism capable of dispensing a tether wound thereon, and a retardation means capable of retarding the rate at which the tether is dispensed from the reel mechanism, said method including:

- securing the apparatus to the elevated point with a first attachment means;
- securing the apparatus to the load with a second attachment means; and,
- lowering the load from the elevated point by dispensing the tether from the reel mechanism; whereby,

the retardation means retards that rate at which the tether dispenses from the reel mechanism.

25. A method according to claim 24 wherein said retardation means includes a torque reduction mechanism for reducing the torque of said reel mechanism.

26. A method according to either of claims 24 or 25 wherein said retardation means includes a hydraulic damping mechanism.