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Device for progressively braking the fall of a load, and
life saving line equipped with said device

The invention concerns a device for braking the fall
of a load and in particular that of a person connected to
the device.

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There currently exist systems for braking and
stopping the fall of load, and in particular that of a
person, said systems consisting of a mobile part to which a
load is connected, said mobile part being engaged in a tube
10 under the effect of a sudden acceleration of this load. So
as to obtain braking, this tube has a lower cross section
than the cross section of the mobile part, so that the
latter, on being introduced into the tube, exerts a radial
pressure expressed by a widening of the section of the tube
15 over the length of the latter traversed by the mobile part.
This tube has a certain consistency and is dimensioned so
that its widening on a given length requires an effort
absorbing the energy provoked by the fall of the load and
thus resulting in stopping the fall.

20 This device is used specifically for life line
equipment comprising an approximately horizontal cable
fixed to the anchorage extremities and on which runs a
mobile anchorage to which a user exposed to the risk of
falling is connected by a rope. This equipment enables the
25 user to move on an approximately horizontal plane whilst
remaining constantly protected against the risk of falling.

The device described above is used in this type of
equipment by fixing a tube as indicated above on each of
the extremity anchorages onto which the horizontal cable is
30 fixed. Each extremity of the cable is passed into the
corresponding tube. A mobile part as mentioned above is
fixed to each of the extremities of the cable and to the
extremity of the corresponding tube outside the

installation so as to constitute a retention piece for the corresponding extremity of this cable. If the user falls, the cable constituting the life line is powerfully stressed downwards to the location where the mobile anchorage is situated, which powerfully stresses the extremities of the cable into the axis and towards the inside of the two tubes, thus driving each mobile part into the corresponding tube. Such a system is described in the European patent N° 0 605 538 and in the United States patent N° 5 458 221.

10 A system as described above has the drawback of having a progressively reduced braking effect which cannot be accurately predetermined. Moreover, said system requires a method for lubricating the surfaces in rubbing contact between the mobile part and the tube, this lubrication
15 being the object of the European patent N° 0 605 538 (or the United States patent N° 5 458 221). In addition, the use of this system in the event of a fall of the load damages the tube and consequently the device.

 The United States patent N° 5 174 421 describes a
20 shock absorber-damper for a motor vehicle seat. The device comprises a piston mounted so as to be able to slide in two opposing directions inside a tube made of a thermoplastic material packed in a fixed metal box guiding sliding of the piston rod having one extremity fixed to the vehicle
25 seat. The external diameter of the piston is larger than the internal diameter of the tube so that should an impact occur, the piston moves inside the tube by warping the wall of the tube and dissipating the energy due to the impact. Owing to its constitutive nature, the tube via elasticity
30 recovers its original diameter. In this device, which concerns a field of application completely different from that of the invention (absorption of impacts applied to a vehicle seat and not braking the fall of a user), the

mobile part is placed idle inside the ductile body and not outside the latter. Furthermore, the box ensuring fixing and packing of the thermoplastic ductile tube is a separate metal element, contrary to the device of the invention in
5 which the receiving element constitutes an elastic single piece fully participating in braking and damping of the fall of the load.

The purpose of the present invention is to eliminate
10 the above-mentioned drawbacks of known braking devices and to this effect concerns embodying a braking system for the fall of a load and in particular in a life line equipment and making it possible to improve progressiveness of the braking of the fall and to predetermine from this its
15 development and level without having to use a lubrication method and enabling the parts of the braking system to be recovered after it has functioned for their subsequent reuse. With this end in mind, according to the present invention, the device for braking the fall of a load and
20 more specifically of a person is of the type comprising a mobile part to which the load is connected, said mobile part penetrating and sliding under the effect of acceleration of said load into a longitudinal housing of a fixed receiving element whose initial internal diameter is
25 smaller than the width of the mobile part, so that the receiving element via its warping under the radial force of the mobile part absorbs the energy produced by the fall of the load and accordingly brakes this fall. It is characterized in that the receiving element is constituted
30 by a body which elastically warps under the radial force exerted by the mobile part so that progressiveness of the braking of the mobile part can be predetermined via the shape and dimensions of said element and that the latter

resumes its initial shape and aptitudes after the mobile part is removed, the receiving element forming a single piece element to be secured to on a receiving structure so that the entire elastic material of said part participates
5 via its elasticity in braking and damping the fall of the load.

Advantageously, the section of the elastic body of the receiving element transversal to the path of the mobile part becomes thicker in the direction of this path so as to
10 organize an increasing braking of the mobile part during its path via the reaction effect of the mass of material surrounding the longitudinal housing.

Thus, the volume and distribution of the elastically ductile material combined with the modulus of elasticity of
15 the latter make it possible to embody a predetermined and improved progressiveness of the braking effect according to a calculated function in keeping with the desired path of the mobile part inside the receiving element. In fact, the thickness of the elastic material surrounding the
20 longitudinal housing at the location where the mobile part is situated at a given moment of its passage inside this longitudinal housing determines a level of reaction to the radial force and thus a level of deceleration. By determining an increasing profile of the thickness of the
25 element around the longitudinal housing in the direction of movement of the mobile part under the effect of the load, a progressive deceleration is obtained according to a calculable function refined by successive adjustments during tests according to the behavior of all the
30 equipment.

So as to provide the device with more safety, the receiving element advantageously comprises a shoulder in its longitudinal bore providing a crash stop for movement

of the mobile part when the latter is stressed by the fall of the load.

According to a preferred embodiment of the invention, the element for receiving the mobile part is incorporated
5 so as to be a single piece inside the anchorage part retaining the extremity of the link to which the load is secured or connected. Thus, all this anchorage part forms the body of the receiving element and, via its elasticity, helps in damping the fall of the load. This embodiment also
10 has the advantage of reducing costs on account of the simplicity for producing the single piece element.

The embodiment study of the invention has shown that the polyurethane is a material particularly adapted to the function of the receiving element via its modulus of
15 elasticity and its resistance in relation to the energy to be absorbed in the applications provided. However, another suitable material could be selected for other applications.

So as to clearly understand the invention, there now
20 follows a non-restrictive example of a preferred embodiment with reference to the accompanying diagrammatic drawing on which :

Figure 1 is a partial perspective view of a life line according to the invention and showing in particular one
25 extremity anchorage and one intermediate anchorage of the latter ;

Figure 2 is a perspective view of an extremity anchorage of the life line of figure 1 ;

Figure 3 is a side view, partially shown as a
30 vertical section, of the extremity anchorage of figure 2, the mobile part equipping it being shown in the idle position ; and

Figure 4 is a view similar to figure 3, the mobile part being engaged in the housing of the receiving element of the extremity anchorage during its load braking function.

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With reference to the drawing, shown at 1 is an extremity anchorage of a life line including two approximately horizontal parallel cables 2 connected at one extremity to the anchorage 1 and, at their opposing
10 extremity, to an identical extremity anchorage (not shown on the drawing). Intermediate anchorages 12 are regularly spaced along the cables 2. Moving on the cables 2 is a known type of slide 3 forming a mobile anchorage to which a user can be linked by a head rope (not shown).

15 Shown on figures 2 to 4 and made up of a single piece of a molded polyurethane elastic material, the extremity anchorage 1 includes a base 4 to be fixed (for example by bolting) to a receiving structure such as a floor, ceiling or wall (not shown) and a receiving element 5 which extends
20 the base 4 at its upper extremity. The orientation of the receiving element 5 is approximately horizontal and the latter has two parallel bulging portions which are symmetrical with respect to a vertical median longitudinal plane.

25 Each bulging portion 6 comprises an axial longitudinal bore 7 for the passage of a cable 2 and is continued towards the rear by a longitudinal housing 8 having a larger diameter. A shoulder 9 connects the bore 7 and the housing 8.

30 Each cable 2 axially traverses the corresponding bulging portion 6 and, clamped onto its extremity projecting towards the rear outside the bulging portion 6, is a sleeve 10.

As shown on the drawing, the rear portion of each swelling 6 surrounding the longitudinal housing 8 has an active conical shape gradually narrowing from the front to the rear so that the thickness of the elastic material
5 surrounding the longitudinal housing 8 increases from the rear towards the front of the latter.

Situated at the rear extremity of the extremity anchorage 1, that is at the extremity opposite the one situated on the side of the life line, is a mobile part 11
10 for example having the shape of an olive traversed by a cable 2 and which has an outer diameter larger than the internal diameter of the corresponding longitudinal housing 8. The mobile part 11 is blocked by the sleeve 10 clamped onto the cable 2 against the open extremity of the housing
15 8.

Should the user connected by means of the mobile anchorage 3 to the life line accidentally fall, a traction towards the front is automatically applied to the portion of the cables 2 connected to the anchorage 1 under the
20 effect of acceleration of the load, thus provoking the penetration and sliding of each mobile part 11 inside the corresponding longitudinal housing 8. This movement of the mobile parts 11 inside the housings 8 results in warping of the elastic material of the conical portion of the bulging
25 portions 6 under the effect of the radial force of the mobile parts 11 and ensures the braking and immobilization of the mobile parts and thus that of the load connected to the cables 2, thus absorbing the energy produced by the fall of the load.

30 The distribution of the elastic material constituting surrounding of the longitudinal housings 8 and in particular the conical shape of this surrounding makes it

possible to obtain a predetermined and improved progressiveness of the braking effect.

The presence of the shoulder 9 at the bottom of each longitudinal housing 8 increases safety by providing a
5 crash stop for movement of the corresponding mobile part 11 when the latter is stressed by the fall of the load.

The intermediate anchorages 12 intended for avoiding any excessive bending of the cables 2 during a fall are each made up of two parts (see figure 1), that is an upper
10 part 13 in metal or composite material (for example extruded aluminum or glass fiber composite) which allows easy passage of the slide 3 on the anchorage, and a polyurethane shaft 14 molded around the part 13. Should a fall occur, as for the extremity anchorage 1, a fraction of
15 the energy is dissipated by virtue of the material and the geometry of the anchorage, the shaft 14 bending via elastic deformation and resuming its initial shape after stoppage of the fall.

The preceding description has been given solely by
20 way of non-restrictive example and constructive additions of modifications could be made without departing from the context of the invention.

It shall be observed that the receiving element of the extremity anchorage has been described as being made of
25 polyurethane, a material which is particularly adapted to the function of this element owing to its modulus of elasticity and resistance in relation to the energy to be absorbed in the applications provided, but another appropriate material could be selected for another
30 application.

It shall also be noted that the receiving element may comprise several parallel longitudinal housings each co-

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operating with a mobile part, the various mobile parts being connected to separate loads or to a common load.



CLAIMS

1. Device for braking the fall of a load and more particularly of a person and comprising a mobile part (11) to which the load is connected penetrating and sliding under the effect of the acceleration of this load in the longitudinal housing (8) of a fixed receiving element whose initial internal diameter is less than the width of the mobile part (11) so that the receiving element (6) via its deformation under the radial force of the mobile part (11) absorbs the energy produced by the fall of the load and accordingly brakes this fall, characterized in that the receiving element (6) is made up of body able to elastically deform under the radial force exerted by the mobile part (11) so that the progressive braking of the mobile part (11) can be predetermined by the shape and dimensions of this element (6) and in that the latter resumes its initial shape and aptitudes after extraction of the mobile part (11), the receiving element (4,6) forming a single piece for being fixed on a receiving structure so that all the elastic material of this piece (4,6) participates via its elasticity in braking and damping the fall of the load.

2. Device according to claim 1, characterized in that the section of the elastic body of the receiving element (6) has, transversal to the path of the mobile part (11), an increasing thickness in the direction of this path so as to organize an increasing braking of the mobile part (11) during its path under the reaction effect of the mass of material surrounding the longitudinal housing (8).

3. Device according to claim 1 or 2, characterized in that the longitudinal housing (8) of the receiving element



(6) comprises a shoulder (9) limiting movement of the mobile part (11).

4. Device according to one of claims 1 to 3, characterized in that the receiving element (6) is
5 constituted, at least partially, of polyurethane so as to provide an elasticity adapted to the forces exerted and the desired progressiveness of braking in the applications according to the invention.

5. Life line to protect persons against falls and
10 including at least one approximately horizontal cable (2) fixed to two extremity anchorages (1) and along which runs a mobile anchorage (3) to which a user exposed to a risk of falling is connected by a head rope, intermediate anchorages (12) being placed at regular intervals along
15 said cable (2), characterized in that each extremity anchorage (1) includes a braking device according to one of claims 1 to 4, the mobile part (11) of the braking device being placed on the cable (2) at the extremity of the receiving element (5) opposite the one situated on the side
20 of the life line section on which the stressing of the load is exerted so as to constitute a retention point for the extremity of the life line and co-operate with the receiving element (5) for braking the fall.

6. Life line according to claim 5, characterized in
25 that each intermediate anchorage (12) includes an upper part (13) made of metal or composite material which is used to guide said cable (2) and a single piece shaft (14) made of an elastic material able to bend via elastic deformation should a fall occur and to resume its initial shape after
30 stoppage of the fall.

7. Life line according to claim 5 or 6 including several parallel cables (2), characterized in that the receiving element (5) of each extremity anchorage (1)



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comprises a corresponding number of parallel longitudinal housings (8) each co-operating with a mobile part (11), the various mobile parts (11) being connected to separate loads or to a common load.