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Hede et al.

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[45] **Date of Patent: *Sep. 7, 1999**

[54] **ENERGY ABSORBING DEVICE FOR USE WITH A SAFETY LANYARD AND SYSTEM INCLUDING THE DEVICE**

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[73] Assignee: **Zedel**, Crolles, France

[*] Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

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[22] Filed: **Mar. 21, 1996**

[30] **Foreign Application Priority Data**

Mar. 27, 1995 [FR] France 95 03778

[51] **Int. Cl.**[6] **A62B 35/00**

[52] **U.S. Cl.** **182/5**; 182/191; 188/65.4

[58] **Field of Search** 182/5, 6, 191–193; 188/65.4

[56] **References Cited**

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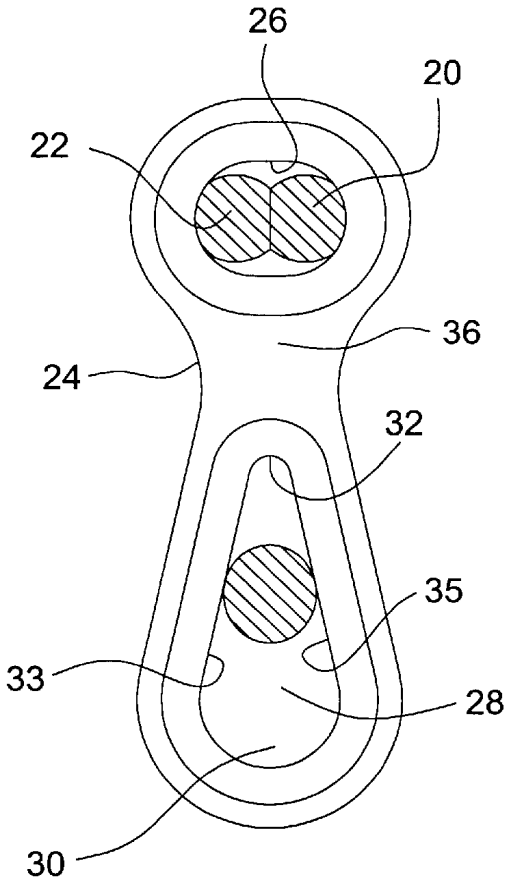
Attorney, Agent, or Firm—Oliff & Berridge, PLC

[57] **ABSTRACT**

An energy absorbing device for a safety device with a rope, comprises a metal body equipped with a first orifice of ellipsoidal shape allowing two strands of rope to cross without clearance, and a second reverse V-shaped orifice of decreasing cross-section in the direction of the first orifice. The second orifice has a portion of reduced width of a smaller dimension than the diameter of the rope, and two convergent edges for centering the rope when the turn is tightened during sliding. The lanyard may be used for rock-climbing, or for working at heights.

5 Claims, 6 Drawing Sheets



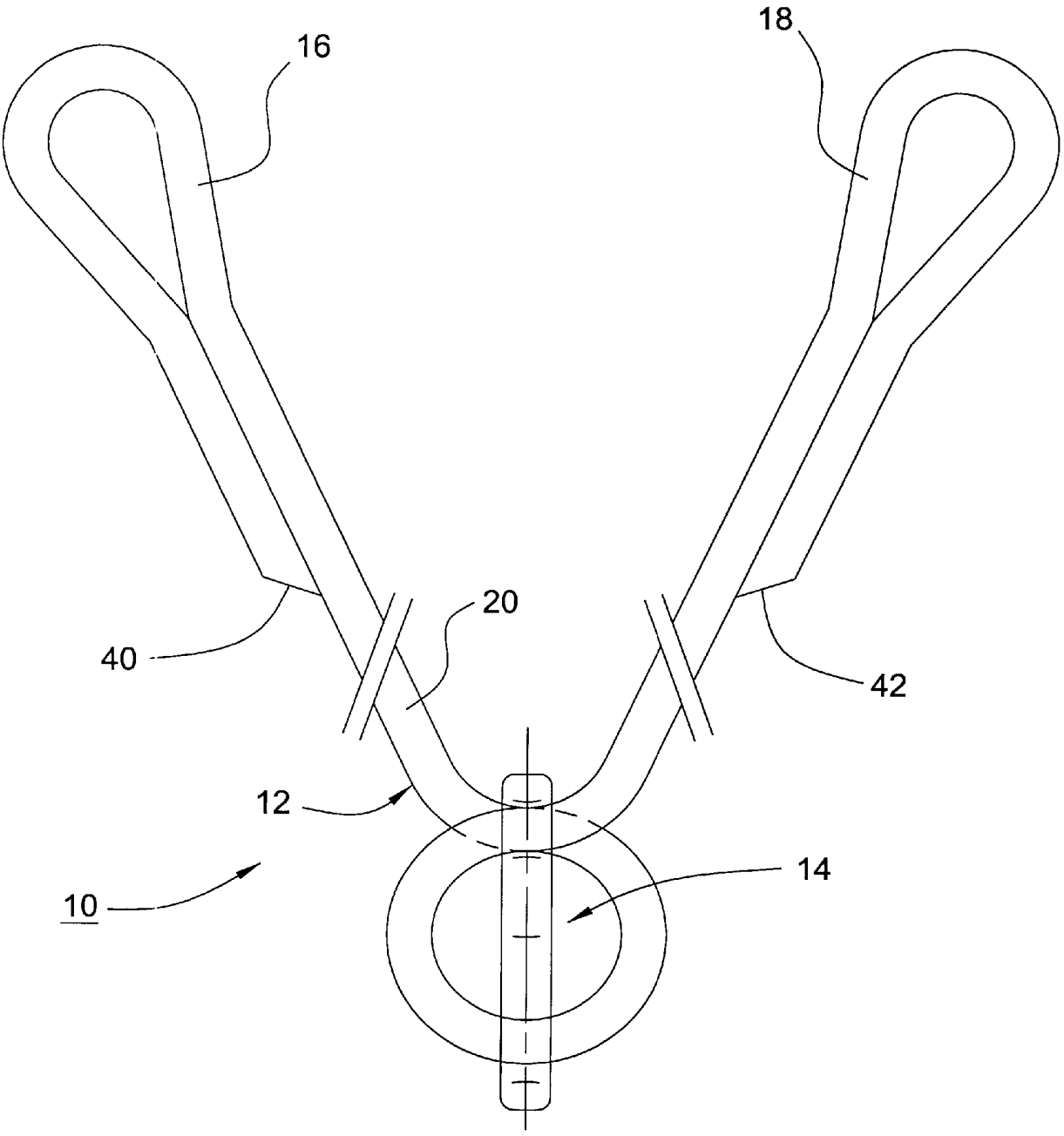


FIG. 1

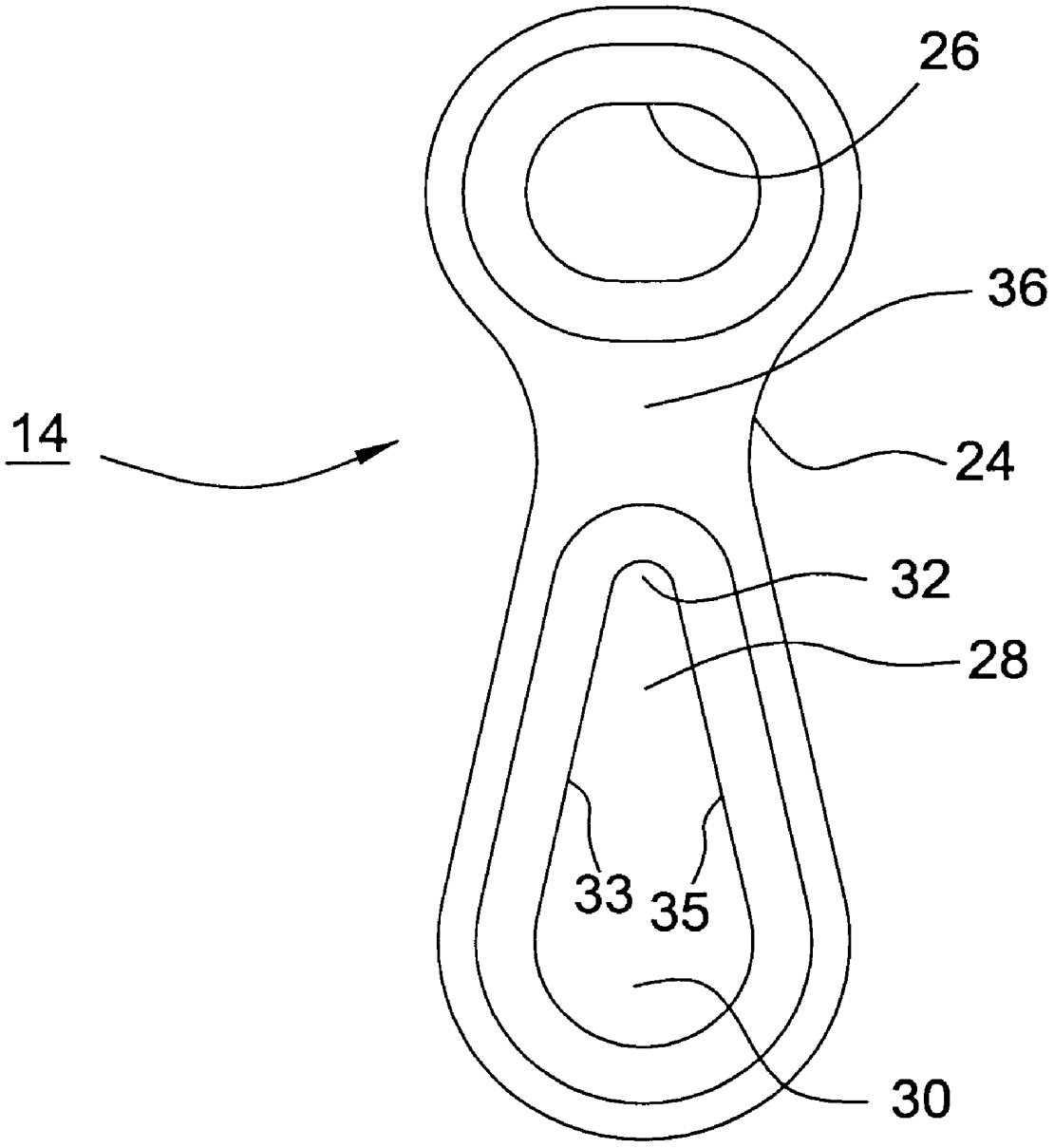


FIG. 2

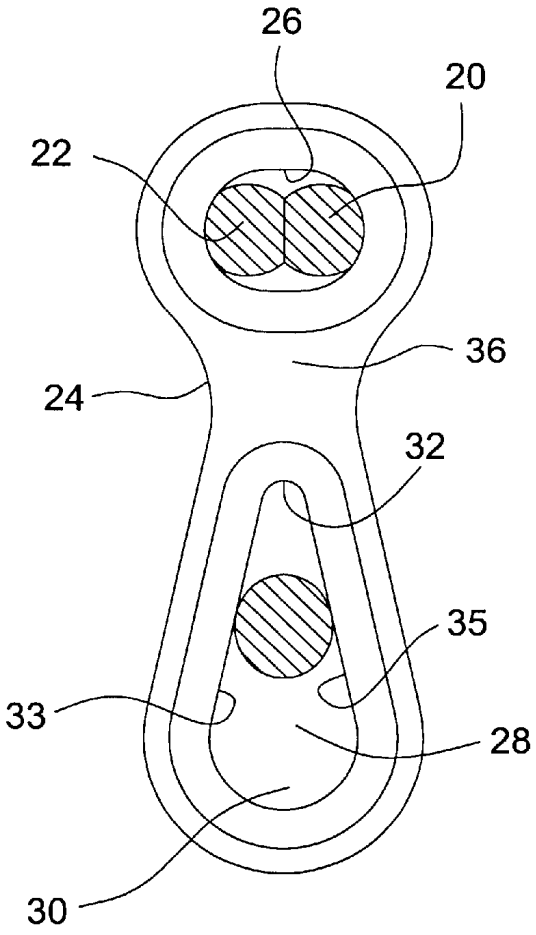


FIG. 4

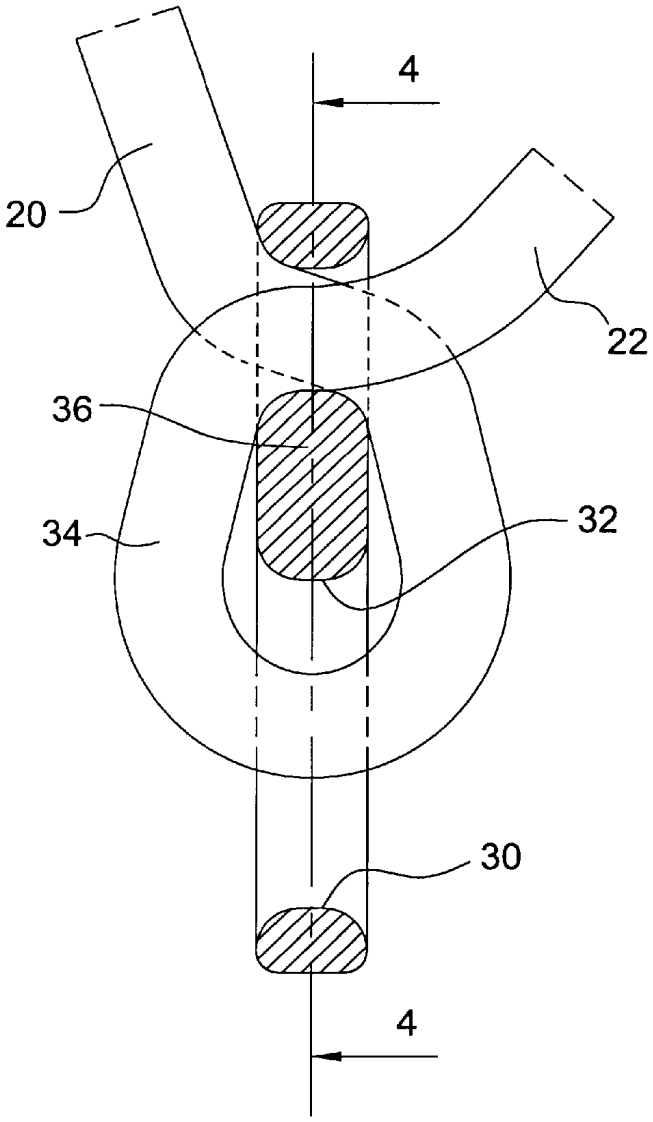


FIG. 3

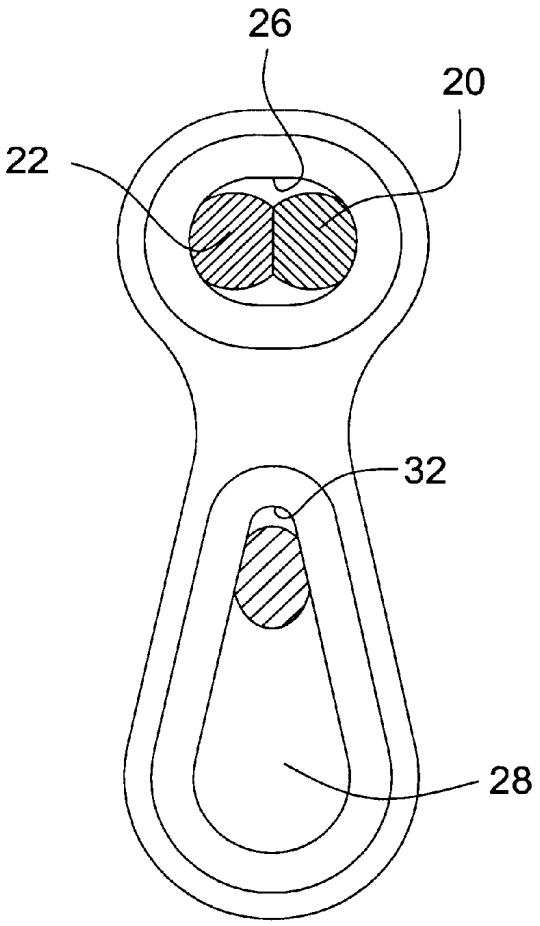
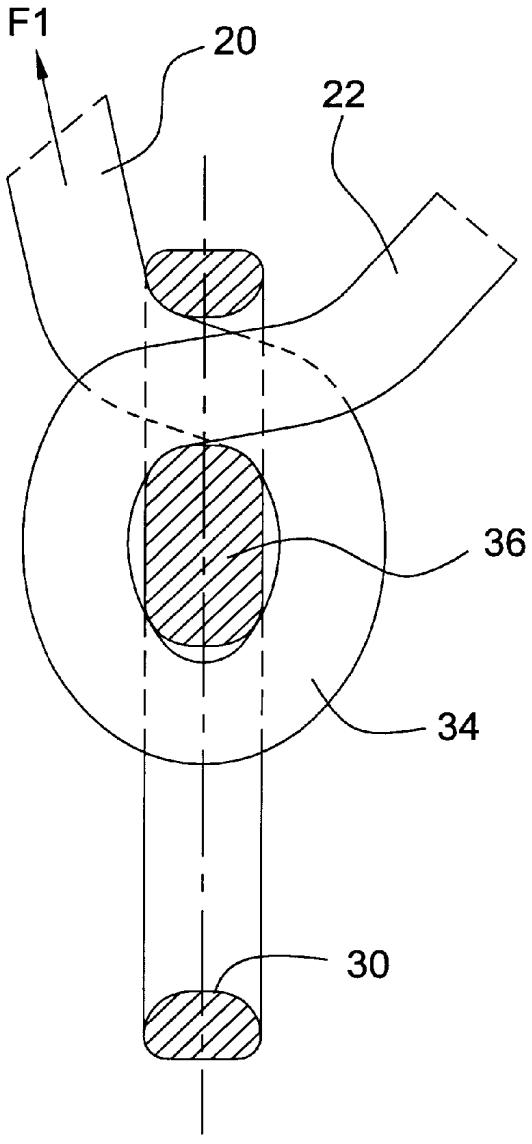


FIG. 6



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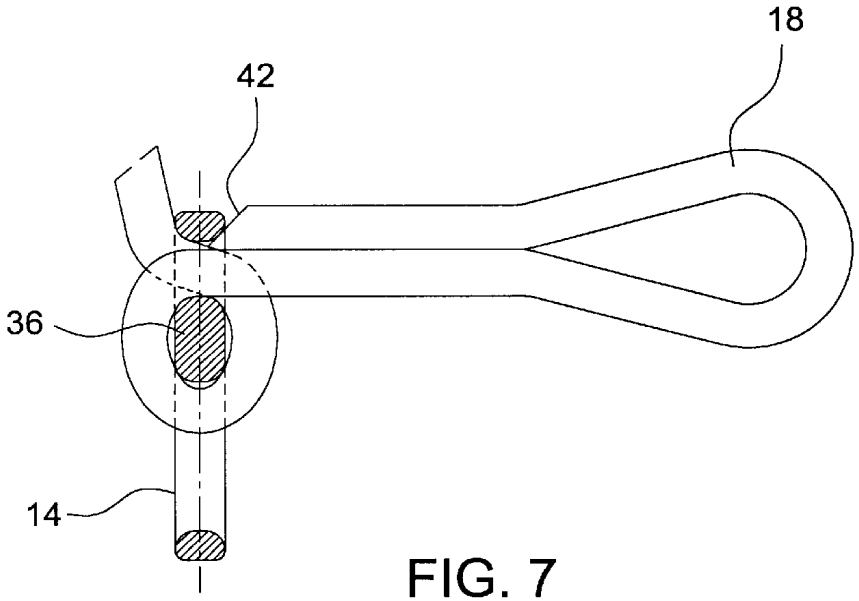

FIG. 7

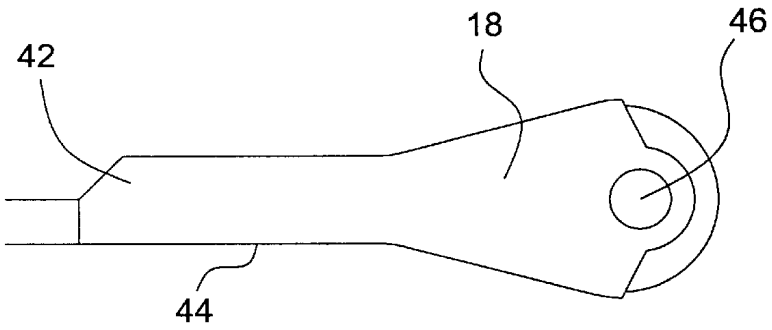

FIG. 8

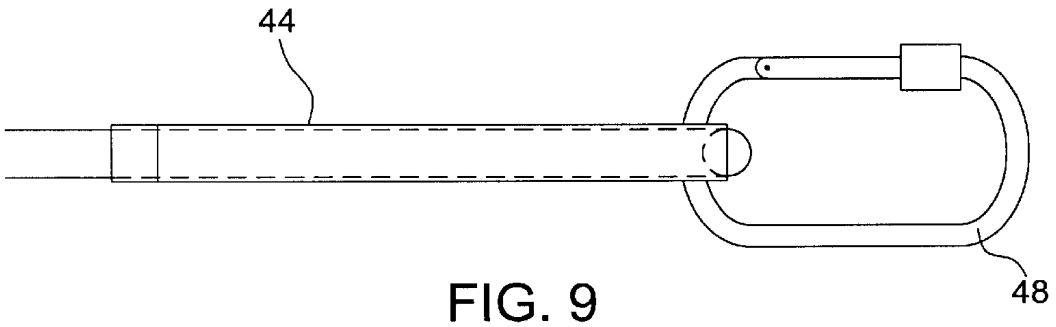

FIG. 9

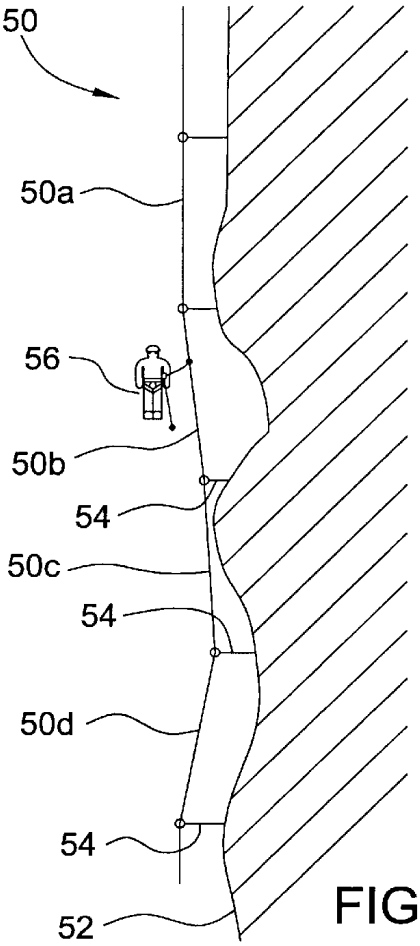

FIG. 10

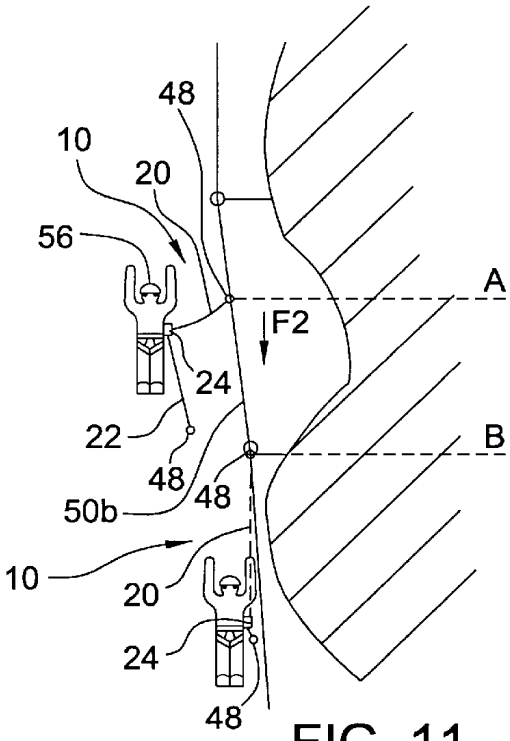

FIG. 11

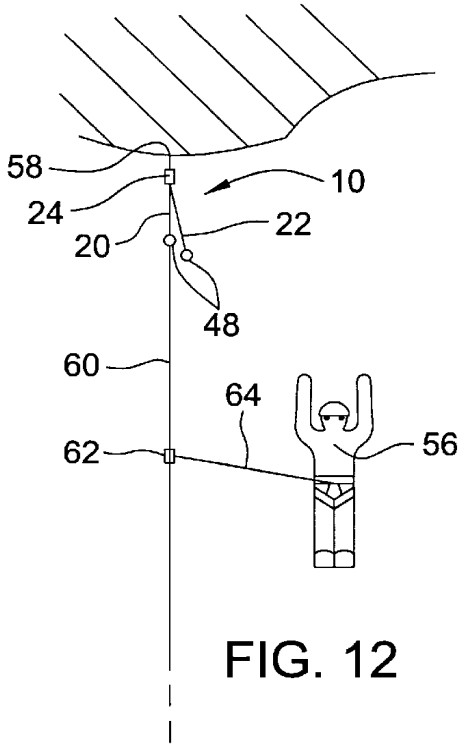

FIG. 12

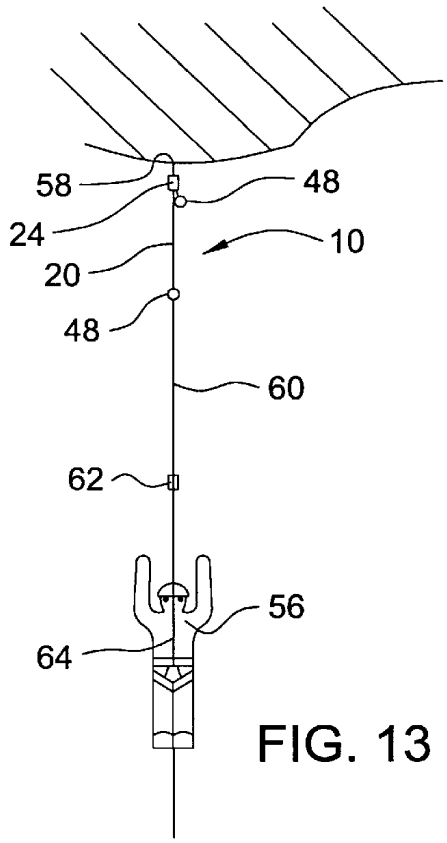

FIG. 13

ENERGY ABSORBING DEVICE FOR USE WITH A SAFETY LANYARD AND SYSTEM INCLUDING THE DEVICE

BACKGROUND OF THE INVENTION

The invention relates to an energy absorbing device associated to a safety lanyard, and comprising a body equipped with means for passing the rope to generate a securing force due to the friction of the rope when the latter slides on the body.

The main function of such a device consists in limiting the force exerted on the rope when stopping a mass in movement, notably in case of a climber falling. Known devices are generally formed by a simple metal plate drilled with several circular holes for passage of the rope, so as to form an interleaving of several elementary turns. The diameter of each hole corresponds appreciably to that of the rope. Fitting of the rope on the body of the device is complicated, as the rope has to be passed at least five or six times through the holes to achieve a sufficient securing force.

SUMMARY OF THE INVENTION

The object of the invention is to achieve a reliable energy absorbing device, notably for an easily operational safety lanyard, regardless of the mode of use on a fixed rope or a hand rail.

The energy absorbing device according to the invention is characterized in that the means for passing the rope of cylindrical cross-section comprise a first orifice allowing two strands of rope to cross without clearance, and a second reverse V-shaped orifice of decreasing cross-section in the direction of the first orifice, said second orifice having a portion of reduced width of a smaller dimension than the diameter of the rope, and two convergent edges for centering the rope when the turn is tightened during said sliding.

According to one feature of the invention, the first orifice presents an appreciably ellipsoidal configuration, and the greatest distance of the first orifice corresponds appreciably to twice the diameter of the rope.

The mid-axis of symmetry of the body passes through the bottom of the second orifice and through the centre of the first orifice.

The jamming effect of the safety rope in the V of the second orifice, and the crossing of the strands of rope in the first orifice enable optimum braking to be obtained with a single self-jamming turn.

According to a preferred embodiment, the energy absorbing device is integrated in a safety lanyard having two strands of rope, and two attachment loops. Each attachment loop comprises stop means coming into engagement against the body at the end of sliding travel of the rope.

BRIEF DESCRIPTION OF THE DRAWINGS

Other advantages and features will become more clearly apparent from the following description of an embodiment of the invention, given as a nonrestrictive example only and represented in the accompanying drawings, in which:

FIG. **1** is a schematic side view of a safety lanyard equipped with the energy absorbing device according to the invention;

FIG. **2** shows an elevational view on an enlarged scale of the energy absorbing device of FIG. **1**;

FIG. **3** represents a cross-sectional view of the energy absorbing device of FIG. **1**, before any tension is applied to the safety rope;

FIG. **4** is a cross-sectional view along the line **4**—**4** of FIG. **3**;

FIGS. **5** and **6** are identical views to FIGS. **3** and **4**, after a tension has been applied to the safety rope;

FIG. **7** is an identical view to FIG. **5**, and shows the lanyard at the end of sliding after a fraction of the falling energy has been absorbed;

FIG. **8** shows the end of an attachment loop associated to a protective sleeve;

FIG. **9** is a plan view of FIG. **8**, after a snap-hook has been fitted;

FIGS. **10** and **11** represent a first application of the safety lanyard to a hand rail, respectively before and during the climber's fall;

FIGS. **12** and **13** show a second application of the safety lanyard to a fixed rope, respectively before and after the climber's fall.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIG. **1**, a safety lanyard **10** for rock-climbing or pot-holing is formed by cooperation of a safety rope **12** of circular cross-section with an energy absorbing device designated by the general reference **14**.

Each end of the safety rope **12** comprises an attachment loop **16**, **18** arranged in the extension of an intermediate strand of rope **20**, **22** joined to the energy absorbing device **14**. Depending on the mode of use of the safety lanyard **10**, the energy absorbing device **14** can be attached to the user's harness or to a fixed securing part. The attachment loops **16**, **18** are secured alternatively to a securing plate or to a hand rail, formed for example by a cable secured to the rock.

Only one of the intermediate strands **20**, **22** is active, whereas the other one remains inactive. When the attachment loop **16** is fixed to the securing plate or to the hand rail, the strand of rope **20** is active whereas the attachment loop **18** falls freely downwards due to the effect of gravity. Reciprocally, the strand of rope **22** is in the active state when the attachment loop **18** is fixed to the securing plate or to the hand rail and the other attachment loop **16** is free.

With reference to FIGS. **2** to **4**, the energy absorbing device **14** comprises a metallic body **24** equipped with two orifices **26**, **28** for passage of the rope **12**. The first orifice **26** presents an appreciably ellipsoidal shape, allowing crossing of the two strands of rope **20**, **22**. The shortest distance measured vertically between the two parallel sides of the ellipse, is slightly greater than the diameter of the rope **12**.

The second orifice **28** comprises a reverse V-shaped configuration of decreasing cross-section in the direction of the first orifice **26**. The dimension of the widened portion **30** of the orifice **28** is appreciably greater than the diameter of the rope **12**, whereas the portion of reduced width **32** presents a wedge shape having a dimension half the size of the diameter of the safety rope **12**.

The distance separating the convergent oblique edges **33**, **35** at the level of the intermediate part of the second orifice **28** corresponds appreciably to the diameter of the safety rope **12** (see FIG. **4**).

The rope **12** is in the shape of a closed turn **34** (FIG. **3**) when it is fitted in place via the orifices **26**, **28** of the energy absorbing device **14**. The two orifices **26**, **28** are separated from one another by a spacer **36** situated in the central part of the body **24**.

In FIGS. **5** and **6**, a moderate application of tension (arrow F1) on the active rope strand **20** causes progressive tight-

ening of the turn **34**, and engagement of the rope in the part of reduced width **32** at the bottom of the V of the second orifice **28**. In this position, jamming of the rope **12** in the energy absorbing device **14** generates a securing force due to the friction effect of the rope in the orifices **26**, **28**.

This results in a braking force which occurs up to a preset force threshold, so as to stop the fall or progression movement of the user without creating too great stresses for the whole of the safety chain formed by the rope, the securing plate and the harness.

In the case of a sudden tension being applied to the active rope strand **20**, for example when falling from a great height, the safety rope slides in the energy absorbing device **14**, but still exerting a braking force to absorb a part of the energy of the fall. When the loop **18** of the non-active rope strand **22** comes into engagement at the end of travel against the body **24** at the level of the first orifice **26**, and before the fall is finally stopped, the remaining energy is absorbed by the elasticity of the rope **12** (FIG. **7**).

Each attachment loop **16**, **18** is advantageously provided with stop means **40**, **42** in the form of ramps enabling wear to be prevented in case of sewn loops. These ramps can be arranged directly at the end of each loop **16**, **18** (FIGS. **1** and **7**), or be disposed on a protective sleeve **44** (FIGS. **8** and **9**), which is fitted to the attachment loop.

The sleeve **44** comprises a circular hole **46** opposite the ramp **42** to allow passage of a snap-hook **48** inside the attachment loop. The presence of the sleeve **44** protects each attachment loop **16**, **18** and at the same time serves the purpose of securing the snap-hook without any clearance.

FIGS. **10** and **11** show a first use of the safety lanyard **10** on a hand rail **50**, which is formed by several sections of cables **50***a*, **50***b*, **50***c*, **50***d*, fixed to the rock **52** by fixing brackets **54**. The body **24** of the energy absorbing device **14** is attached to the harness of the climber **56**, and the snap-hook **48** of the active strand **20** passes in the section of cable **50***b*. The other strand **22** of the safety rope **12** is inactive and hangs downwards due to gravity. Should the climber **56** fall, the snap-hook **48** moves down from level A in the direction of the arrow F2, and is stopped by the fixing bracket **54** at level B.

The strand of rope **20** is lengthened following sliding of the rope **12** in the orifices **26**, **28** of the energy absorbing device **14** (FIG. **11** in broken line). The sliding effect comes to an end when the ramp **42** of the inactive strand **22** comes up against the stop formed by the body **24**.

In FIGS. **12** and **13**, the body **24** of the safety lanyard **10** is secured to an up-hill securing point **58**, and the strand of rope **20** is attached to a rope **60**. The safety of the climber **56** is ensured by means of a jammer **62** cooperating with the abseiling rope **60**, and connected to the harness by a link cord **64**. The other strand of rope **22** is free and inactive. Should the climber **56** fall (FIG. **13**), a fraction of the energy is first absorbed by the safety lanyard **10**, and then by the elasticity of the abseiling rope **60**.

We claim:

1. An energy absorbing system, comprising:

a safety rope of cylindrical cross-section; and

an energy absorbing device including:

a body equipped with means for passing said rope to generate a securing force due to the friction of said rope when said rope slides on said body,

a first orifice arranged in said body through which two passes of said rope are inserted and cross without clearance within the first orifice, and

a second reverse V-shaped orifice of decreasing cross-section in the direction of said first orifice through which said rope passes, said second orifice having a portion of reduced width of a smaller dimension than a diameter of said rope, and

two convergent edges in said second orifice for centering said rope passing through said second orifice, when a turn of said rope is tightened during said sliding.

2. The energy absorbing system according to claim **1**, wherein each end of the safety rope is provided with an attachment loop joined to the body by an intermediate rope strand, wherein each attachment loop comprises stop means coming into engagement against the body at the end of sliding travel of the rope.

3. The energy absorbing system according to claim **2**, wherein the stop means are shaped as ramps cooperating with the body at the level of the first orifice.

4. The energy absorbing system according to claim **3**, wherein the ramps are situated on a protective sleeve made of plastic material fitted onto each attachment loop.

5. The energy absorbing system according to claim **4**, wherein the protective sleeve is provided with a hole for attaching a snap-hook through the attachment loop.

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