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(54) **DYNAMIC BARRIER AGAINST ROCKFALLS WITH AN IMPACT ABSORBING DEVICE**

DYNAMISCHE BARRIERE GEGEN STEINSCHLAG MIT EINER STOSSDÄMPFUNGSVORRICHTUNG

BARRIÈRE DYNAMIQUES CONTRE LES CHUTES DE PIERRES AVEC D'UN DISPOSITIF D'ABSORPTION D'IMPACT

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(56) References cited:
CN-U- 205 908 105
KR-A- 20120 083 874
US-A- 600 964
US-A- 4 518 953
US-A1- 2010 327 244

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Description

Technical Field

[0001] The invention relates to an a dynamic barrier against rockfalls comprising an impact absorbing device and to a slope protection system with such an impact absorbing device in a dynamic barrier against rockfalls.

Background Art

[0002] Dynamic barriers against rockfalls are in general not designed to absorb high energies caused by e.g. large rocks falling. Therefore, energy absorbing devices are added to the screen or fence system. Kinetic and potential energy released by rockfall must be transformed in deformation, fracture, or heat caused by friction of elements of the impact absorbing devices.

[0003] Efficient impact absorbing devices must meet high demands.

[0004] Impact absorbing devices must first assure continuity of the screen or fence and thus prevent the screen or fence to be broken in two or more parts.

[0005] Secondly, impact absorbing devices must be able to absorb various levels of energy, since it is not known in advance how big the impact may be.

[0006] A third requirement is that the impact absorbing devices must be resistant to severe weather conditions. They should be resistant to corrosion, continue working under humid conditions or under varying temperatures.

[0007] A last and fourth requirement is that the impact absorbing devices must have a long life time since they are in general installed and used on locations that are not easy to reach.

[0008] Patent application KR-A-20150031259 discloses an impact absorbing mechanism where a rope is encircling a tube. Upon impact the released energy is transformed into deformation energy of the tube and in heat due to friction between the rope and the tube. The deformation of the tube is only locally in the region of the encircling rope.

[0009] Patent applications KR-A-20120083874 and KR-A-20110130077 disclose a rockfall protection fence. Upon impact the tension on the rope is transferred to a device with a tube shaped part that can deform to absorb the transferred impact energy. This impact absorbing device needs to be located on a post.

[0010] Patent application US-A-2010 0327244 discloses another rockfall protection fence. Rope members go through posts in opposite directions and energy absorbers are provided to hold the ends of the ropes in place. Absorbers included in this patent are friction-resistant type. When tensile force overcomes their friction resistance, ropes slide through the absorber. Posts does not deform, but act as a lock.

[0011] Utility model CN-U-205908105 discloses an electric power facility rail guard. The tension of the ropes is obtained by regularly screwing tightening nuts.

Disclosure of Invention

[0012] It is a general object of the invention to avoid the drawbacks of the prior art.

[0013] It is a particular object of the invention to provide an impact absorbing device that has various composing elements that can be designed either in number or in dimensions or in both to allow for absorption of different levels of impact energy.

[0014] It is another object of the invention to provide an impact absorbing device that allows transforming the impact energy in deformation energy and in heat energy caused by friction.

[0015] Yet another object of the invention to provide an impact absorbing device that can be installed at various locations in a dynamic barrier against rockfalls.

[0016] There is provided a dynamic barrier against rockfalls comprising an impact absorbing device, said impact absorbing device comprising at least one tube. This tube or these tubes have a wall that is provided with two holes at a first side and two holes at a second side.

[0017] The device further comprises a first rope and a second rope.

[0018] The first rope passes through the tube or tubes starting from a first hole at the first side and going to a first hole at the second side of a first tube, and so on until all tubes have been passed through. The first rope is provided at its one end with a first thickening element such as a sleeve that prevents the first rope from slipping back or being pulled back through the tube or tubes. The first thickening element is fixed to the first rope and unable to slide along the first rope.

[0019] The second rope passes through the tube or tubes starting from a second hole at the second side and going to a second hole at the first side of a first tube and so on until all tubes have been passed through. The second rope is provided at its one end with a second thickening element such as a sleeve that prevents the second rope from slipping back or being pulled back through the tube or tubes. The second thickening element is fixed to the second rope and unable to slide along the second rope.

[0020] As will be explained hereinafter, this impact absorbing device allows to transform impact energy into energy needed to deform the tube or tubes, into energy needed to plastically elongate both ropes and into heat energy caused by friction of the ropes in the holes and with the stiff elements.

[0021] The tubes are preferably made of steel, aluminium or of another metallic alloy with a high level of deformation potential. These tubes or any of the rest of the parts can be made of neoprene, gum or other plastic material with similar properties. By selecting the proper tube material, by determining the number of tubes (one, two, three or more) and by designing the thickness of the tubes, one may obtain a large range of impact energy that can be absorbed.

[0022] In a preferable embodiment the first rope and the second rope are arranged substantially parallel to each other.

[0023] Most preferably, the first hole at the first side is positioned diametrically vis-à-vis the first hole at the second side. Similarly, the second hole at the first side is positioned preferably diametrically vis-à-vis the second hole at the second side.

[0024] The above design, namely parallel ropes and diametrically opposed holes, aims at obtaining the maximum possible deformation energy from the tubes.

[0025] The tube or tubes may have a circular cross-section, a rectangular cross-section or a rhombic cross-section.

[0026] Preferably the tubes do not have irregularities in the material that may cause weakening of the tubes and decrease in the deformation energy. More particularly, the tubes do not have welds.

[0027] The thickening element at the end of the ropes, e.g. a sleeve, a weld or a sling, may work together in combination with a stiff element. Stiff elements, e.g. stiff plates, are positioned between the first and/or the second thickenings and the at least one tube. The thickening at the rope end and the stiff element must work together such that after complete compression of the tube or tubes, the ropes still do not slip back through the tubes. The ropes must be blocked so that ultimately plastic elongation of the ropes can occur until fracture of the ropes. Fracture of the thickened rope ends is to be avoided. When an impact energy causes a tension force on the first and/or second rope, the first and/or said second thickenings transmit a compression force to the at least one tube and transform the impact energy into energy needed to deform the at least one tube by compression. The impact energy can also be partially transformed into energy needed to plastically elongate the ropes and into heat energy caused by friction of the ropes in the holes and with the possible stiff elements.

[0028] Generally, absorbing devices acting by friction are not regular in their behavior. Two devices with the same geometry and absorbing mechanism can have very different activation forces as well as different shape of the Force-displacement curve. This is related with the inaccuracy of (or difficulty on applying the same) the bolt pressure or small differences on the surface roughness. Energy absorbers acting by buckling have a more regular behavior all along their characteristic curve, excepting the activation energy that could also vary for the same tube profile. On the contrary and as an advantage of the present invention, the present invention does not have these problems. Experimental tests have been carried out with the same geometry according to the present invention, and Force-Displacement curves obtained are identical one to each other.

[0029] Furthermore, there is provided a slope protection system as a dynamic barrier against rockfalls that comprises an impact absorbing device according to the first aspect of the invention. The impact absorbing devices can be also used for mudflow barriers, debris barriers or snow barriers as different dynamic barriers for several applications.

[0030] The dynamic barrier may have several posts and nets, screens or fences positioned and installed between the posts at the dynamic barrier. Perimeter ropes are hanging the nets, screens or fences to the posts. Supporting ropes are connecting the posts to anchors in the ground. The impact absorbing device may be positioned on one or more of the perimeter ropes, or on one or more of the supporting ropes or on both types of ropes, thus giving flexibility to locate the impact absorbing device at the positions where the needs may be the highest.

Brief Description of Figures in the Drawings

[0031]

Figure 1 is a perspective view of an impact absorbing device of the dynamic barrier according to the invention;

Figure 2 is a perspective view of a tube used in an impact absorbing device of the dynamic barrier according to the invention;

Figure 3 is a perspective view of a preferable embodiment of the impact absorbing device of the dynamic barrier according to the invention;

Figure 4 is a schematic view of a dynamic barrier equipped with several impact absorbing devices according to the invention.

Mode(s) for Carrying Out the Invention

[0032] Figure 1 is a perspective view of an impact absorbing device 100 according to the invention. The device 100 has one tube 102. This tube 102 has a first hole 104 and a second hole 106 at a first side and a first hole 108 and a second hole 110 at a second side. A first rope 112 passes through the first hole 104 at the first side and through the first hole 108 at the second side. Further on, the first rope also passes through a solid stiff block 114. At its end, the first rope 112 is provided with a sleeve 116. The sleeve 116 transmits the force exercised on the first rope 112 to the solid stiff block 114. Due to the fact that the sleeve 116 has a larger diameter than the diameter in the hole of the solid stiff block 114, the stiff block 114 prevents the first rope 112 from slipping back. In the same way as the first rope 112, a second rope 118 passes through a hole in the stiff block 114 at the second side, through a second hole 110 at the second side, through a second hole 106 at the first side, and finally through a hole of a stiff block 120 at the first side. The second rope 118 ends with a sleeve 122.

[0033] Upon impact on a screen or fence that is attached to the impact absorbing device 100, the forces on the screen or fence will be translated in pulling forces on the first rope 112 and the second rope 118. The sleeves 114 and 140 will transform these pulling forces on the ropes 112, 118 into compressive forces on the stiff blocks 114, 120. As these stiff blocks 114, 120 are not immediately deformable, the tube 102 will start to deform plastically and absorb at least part of the impact energy. Simultaneously heat is generated between the ropes 112, 118 and the stiff blocks 114, 120 and between the ropes 112, 118 and the tube 102. Depending upon the amount of impact energy, the ropes 112, 118 may start to deform plastically and absorb also part of the impact energy.

[0034] Figure 2 is a perspective view of a further improvement of a tube 200 used in an impact absorbing device according to the invention. The tube 200 has a first hole 202 and a second hole 204 at a first side and a first hole 206 and a second hole 208 at a second side. Hole 202 is positioned diametrically vis-à-vis hole 206. Similarly, hole 204 is positioned diametrically vis-à-vis hole 208. The presence of the holes 202, 204, 206, 208 may weaken section A-A in the tube 200 to such an extent that deformation starts only in section A-A.

[0035] By selection of the proper material for the tube, by designing the outer diameter D and the thickness T, various levels of impact energy can be absorbed.

[0036] For a particular tube material, the energy absorbable by the tube could be doubled by increasing somewhat the diameter D and the thickness T.

[0037] Not only the dimensions of the tube may be varied, but also the number of tubes.

[0038] Figure 3 is a perspective view of a preferable embodiment of an impact absorbing device 300 according to the invention. The impact absorbing device 300 has two tubes 302 and 304. A first rope 306 passes through the two tubes 302, 304 and comprises a sleeve 308 at its one end at one side. This sleeve 308 has an external diameter that is larger than the hole through a stiff, solid plate 310 where the first rope 306 passes through. Similarly a second rope 312 passes through the tubes 302, 304 and ends with a sleeve 314 in contact with a stiff solid plate 316 at the other side.

[0039] Static tensile tests have been carried out separately on the ropes in order to measure the possible energy that can be absorbed by the ropes. This is done by recording a load displacement curve and by measuring the area under the curve.

[0040] Static compression tests have been carried out separately on the tubes in order to measure the energy that can be absorbed by the tubes themselves.

[0041] Finally some static tensile tests have been carried out on an impact absorbing device as shown in Figure 3. Test speed was set at the value that is recommended by the ETAG for static tests on energy dissipators.. The outer diameter D of the two tubes and the thickness T of the tubes determined The displacement of the tubes, the displacement of the ropes and the displacement of the clamps in the test that were all recorded

[0042] The static tensile tests carried out on the impact absorbing device gives a good estimate of the total energy absorbable. This total energy can be divided into three components:

- a first part absorbed by the plastic deformation of the tubes, this first part is determined by the static compression tests on the tubes individually;
- a second part absorbed by the plastic deformation of the ropes, this second part is determined by the tensile tests carried separately on the ropes;
- a third part absorbed friction between the ropes and the holes, mainly the holes of the stiff plates, this third part can be derived by subtracting the first part and the second part from the total energy .

[0043] Figure 4 is a schematic view of a dynamic barrier against rockfalls 400 comprising impact absorbing devices according to the invention .

[0044] A dynamic barrier against rockfalls 400 comprises a number of poles 402, 404, 406 between which fences, nets or screens 408, 410 are hung. These fences 408, 410 may preferably be chain link fences. The fences 408, 410 are stretched and attached to the poles 402, 404, 406 with the help of perimeter ropes 412, 414, 416 and 418. At the left side, supporting ropes 420, 422 attach the left most pole 402 to a support or anchor 424. At the left side, supporting ropes 426, 428 connect the right most pole 406 to a support or anchor 430. The poles in-between may also be connected or attached to a support. Since the invention impact absorbing devices do not need to be connected to a post, there is quite some freedom to position them in the dynamic barrier against rockfalls 400. Impact absorbing devices 434, 436 may be positioned on the upper perimeter ropes 412 and 414. Alternatively or additionally, impact absorbing devices 432, 438 may be positioned on the supporting ropes 420, 428.

List of Reference Numbers

[0045]

100	first embodiment of an impact absorbing device
102	tube
104	first hole at first side
106	second hole at first side
108	first hole at second side
110	second hole at second side
112	first rope
114	first stiff cylindrical element
116	sleeve for first rope
118	second rope
120	second stiff cylindrical element
122	sleeve for second rope
200	tube
202	first hole at first side
204	second hole at first side
206	first hole at second side
208	second hole at second side
300	second embodiment of impact absorbing device
302	first tube
304	second tube
306	first rope
308	sleeve for first rope
310	first stiff plate
312	second rope
314	sleeve for second rope
316	second stiff plate
400	dynamic barrier against rockfalls
402- 404 -406	pole
408 - 410	fence
412 - 414 - 416 - 418	perimeter rope
420 - 422	supporting rope
424	support
426 -428	supporting rope
430	support
432 - 434 - 436 - 438	energy absorbing device

Claims

1. A dynamic barrier against rockfalls comprising an impact absorbing device (100),

said device comprising at least one tube (102),
said at least one tube having a wall that is provided with two holes at a first side (104, 106) and two holes at a second side (108, 110),
said device further comprising a first rope (112) and a second rope (118),
said first rope (112) passing through said at least one tube (102) starting from a first hole at the first side (104) and going to a first hole at the second side (108),
said first rope (112) being provided at its one end with a first thickening (116) that prevents said first rope from slipping back through said at least one tube (102),
said second rope (118) passing through said at least one tube (102) starting from a second hole at the second

side (110) and going to a second hole at the first side (106),
said second rope (118) being provided at its one end with a second thickening (122) that prevents said second rope from slipping back through said at least one tube,
Characterized in that
said first thickening element is fixed to said first rope and unable to slide along said first rope,
said second thickening element is fixed to said second rope and unable to slide along said second rope.

2. A dynamic barrier against rockfalls according to claim 1,
wherein said first thickening element (116) and said second thickening (122) element are a sleeve, a weld or a sling.

3. A dynamic barrier against rockfalls according to claim 1 or 2,
wherein said first rope (112) and said second rope (118) are substantially parallel to each other.

4. A dynamic barrier against rockfalls according to any one of the preceding claims,
wherein the first hole at the first side (202) is positioned diametrically versus the first hole at the second side (206) and wherein the second hole at the first side (204) is positioned diametrically versus the second hole at the second side (208).

5. A dynamic barrier against rockfalls according to any one of the preceding claims,
said device comprising two or more tubes (302, 304)

6. A dynamic barrier against rockfalls according to any one of the preceding claims,
wherein said at least one tube has a circular cross-section.

7. A dynamic barrier against rockfalls according to any one of claims 1 to 5,
wherein said at least one tube has a rectangular cross-section.

8. A dynamic barrier against rockfalls according to any one of the preceding claims,
wherein said tube has no welds.

9. A dynamic barrier against rockfalls according to any one of the preceding claims,
wherein stiff plates (310, 316) are positioned between said first and/or second thickenings (308, 314) and said at least one tube (302, 304).

10. A dynamic barrier against rockfalls according to any one of the preceding claims further comprising:

- posts,
- nets positioned between said posts,
- perimeter ropes hanging said nets between said posts,
- supporting ropes connecting said posts to the anchors in the ground

, wherein at least one impact absorbing device is positioned on one said perimeter ropes or on said supporting ropes.

Patentansprüche

1. Dynamische Sperre gegen Steinschlag, umfassend eine stoßdämpfende Vorrichtung (100),

wobei die Vorrichtung mindestens ein Rohr (102) umfasst,
wobei das mindestens eine Rohr eine Wand hat, die mit zwei Löchern an einer ersten Seite (104, 106) und zwei Löchern an einer zweiten Seite (108, 110) versehen ist,
wobei die Vorrichtung ferner ein erstes Seil (112) und ein zweites Seil (118) umfasst,
wobei das erste Seil (112) durch das mindestens eine Rohr (102) geht, ausgehend von einem ersten Loch an der ersten Seite (104) und weiter zu einem ersten Loch an der zweiten Seite (108),
wobei das erste Seil (112) an seinem einen Ende mit einer ersten Verdickung (116) versehen ist, die verhindert, dass das erste Seil durch das mindestens eine Rohr (102) zurückrutscht,
wobei das zweite Seil (118) durch das mindestens eine Rohr (102) geht, ausgehend von einem zweiten Loch an der zweiten Seite (110) und weiter zu einem zweiten Loch an der ersten Seite (106),

wobei das zweite Seil (118) an seinem einen Ende mit einer zweiten Verdickung (122) versehen ist, die verhindert, dass das zweite Seil durch das mindestens eine Rohr zurückrutscht,
dadurch gekennzeichnet, dass
das erste Verdickungselement an dem ersten Seil festgelegt ist und nicht entlang des ersten Seils gleiten kann, das zweite Verdickungselement an dem zweiten Seil festgelegt ist und nicht entlang des zweiten Seils gleiten kann.

2. Dynamische Sperre gegen Steinschlag nach Anspruch 1,
wobei das erste Verdickungselement (116) und das zweite Verdickungselement (122) eine Hülse, eine Verschweißung oder eine Schlinge sind.

3. Dynamische Sperre gegen Steinschlag nach Anspruch 1 oder 2,
wobei das erste Seil (112) und das zweite Seil (118) im Wesentlichen parallel zueinander sind.

4. Dynamische Sperre gegen Steinschlag nach einem der vorhergehenden Ansprüche,
wobei das erste Loch an der ersten Seite (202) dem ersten Loch an der zweiten Seite (206) diametral gegenüber positioniert ist und wobei das zweite Loch an der ersten Seite (204) dem zweiten Loch an der zweiten Seite (208) diametral gegenüber positioniert ist.

5. Dynamische Sperre gegen Steinschlag nach einem der vorhergehenden Ansprüche,
wobei die Vorrichtung zwei oder mehr Rohre (302, 304) umfasst.

6. Dynamische Sperre gegen Steinschlag nach einem der vorhergehenden Ansprüche,
wobei das mindestens eine Rohr einen kreisförmigen Querschnitt hat.

7. Dynamische Sperre gegen Steinschlag nach einem der Ansprüche 1 bis 5, wobei das mindestens eine Rohr einen rechteckigen Querschnitt hat.

8. Dynamische Sperre gegen Steinschlag nach einem der vorhergehenden Ansprüche,
wobei das Rohr keine Verschweißungen hat.

9. Dynamische Sperre gegen Steinschlag nach einem der vorhergehenden Ansprüche,
wobei steife Platten (310, 316) zwischen der ersten und/oder zweiten Verdickung (308, 314) und dem mindestens einen Rohr (302, 304) positioniert sind.

10. Dynamische Sperre gegen Steinschlag nach einem der vorhergehenden Ansprüche, ferner umfassend:

- Pfosten,
- zwischen den Pfosten positionierte Netze,
- Begrenzungsseile, an denen die Netze zwischen den Pfosten aufgehängt sind,
- Stützseile, die die Pfosten mit den Ankern im Boden verbinden,

wobei mindestens stoßdämpfende Vorrichtung an einem der Begrenzungsseile oder an den Stützseilen positioniert ist.

Revendications

1. Barrière dynamique contre les chutes de pierres comprenant un dispositif d'absorption des chocs (100),

ledit dispositif comprenant au moins un tube (102),
ledit au moins un tube ayant une paroi qui est munie de deux trous sur un premier côté (104, 106) et de deux trous sur un second côté (108, 110),
ledit dispositif comprenant en outre un premier câble (112) et un second câble (118),
ledit premier câble (112) passant à travers ledit au moins un tube (102) en commençant par un premier trou sur le premier côté (104) et en allant jusqu'à un premier trou sur le second côté (108),
ledit premier câble (112) étant muni à son extrémité d'un premier épaississement (116) qui empêche ledit premier câble de glisser à travers ledit au moins un tube (102),

ledit second câble (118) passant à travers ledit au moins un tube (102) en commençant par un second trou sur le second côté (110) et allant jusqu'à un second trou sur le premier côté (106),
ledit second câble (118) étant muni à son extrémité d'un second épaississement (122) qui empêche ledit second câble de glisser à travers ledit au moins un tube,
caractérisée en ce que
ledit premier élément d'épaississement est fixé audit premier câble et ne peut pas glisser le long dudit premier câble,
ledit second élément d'épaississement est fixé audit second câble et ne peut pas glisser le long dudit second câble.

2. Barrière dynamique contre les chutes de pierres selon la revendication 1,
dans laquelle ledit premier élément d'épaississement (116) et ledit second élément d'épaississement (122) sont une gaine, une soudure ou une sangle.

3. Barrière dynamique contre les chutes de pierres selon la revendication 1 ou 2,
dans laquelle ledit premier câble (112) et ledit second câble (118) sont sensiblement parallèles l'un à l'autre.

4. Barrière dynamique contre les chutes de pierres selon l'une quelconque des revendications précédentes,
dans laquelle le premier trou sur le premier côté (202) est positionné de façon diamétrale par rapport au premier trou sur le second côté (206) et dans laquelle le second trou sur le premier côté (204) est positionné de façon diamétrale par rapport au second trou sur le second côté (208).

5. Barrière dynamique contre les chutes de pierres selon l'une quelconque des revendications précédentes,
ledit dispositif comprenant deux tubes ou plus (302, 304) .

6. Barrière dynamique contre les chutes de pierres selon l'une quelconque des revendications précédentes,
dans laquelle ledit au moins un tube a une section transversale circulaire.

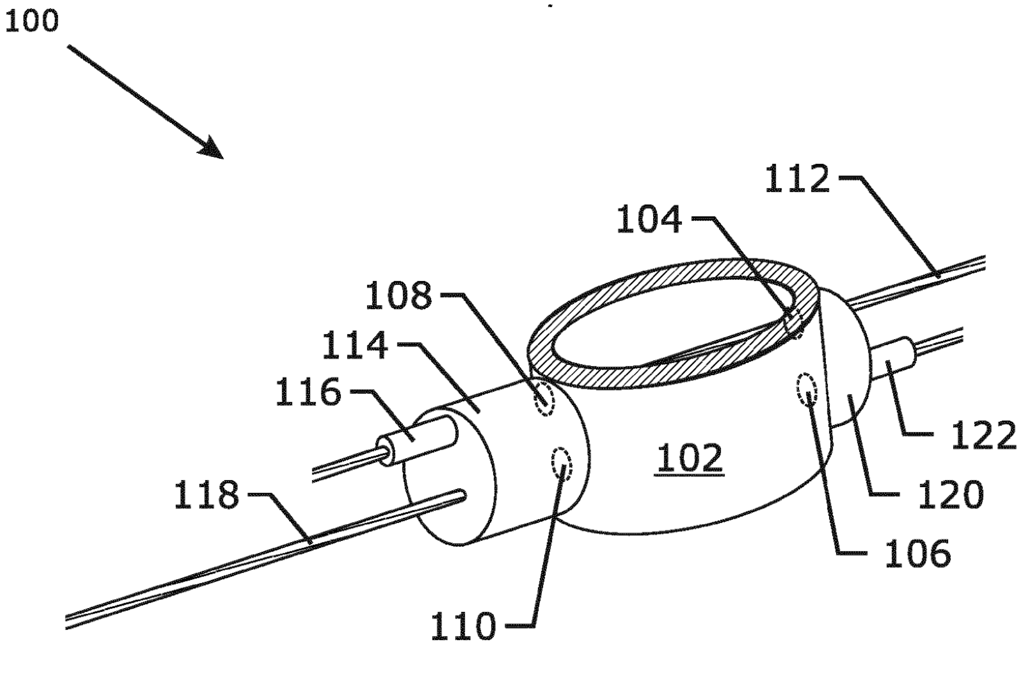
7. Barrière dynamique contre les chutes de pierres selon l'une quelconque des revendications 1 à 5, dans laquelle ledit au moins un tube a une section transversale rectangulaire.

8. Barrière dynamique contre les chutes de pierres selon l'une quelconque des revendications précédentes,
dans laquelle ledit tube n'a pas de soudure.

9. Barrière dynamique contre les chutes de pierres selon l'une quelconque des revendications précédentes,
dans laquelle des plaques rigides (310, 316) sont positionnées entre lesdits premier et/ou second épaississements (308, 314) et ledit au moins un tube (302, 304) .

10. Barrière dynamique contre les chutes de pierres selon l'une quelconque des revendications précédentes, comprenant en outre :

des montants,
des filets positionnés entre lesdits montants,
des câbles périphériques suspendant lesdits filets entre lesdits montants,
des câbles de support reliant lesdits montants aux ancres dans le sol, dans laquelle au moins un dispositif d'absorption des chocs est positionné sur l'un desdits câbles périphériques ou sur lesdits câbles de support.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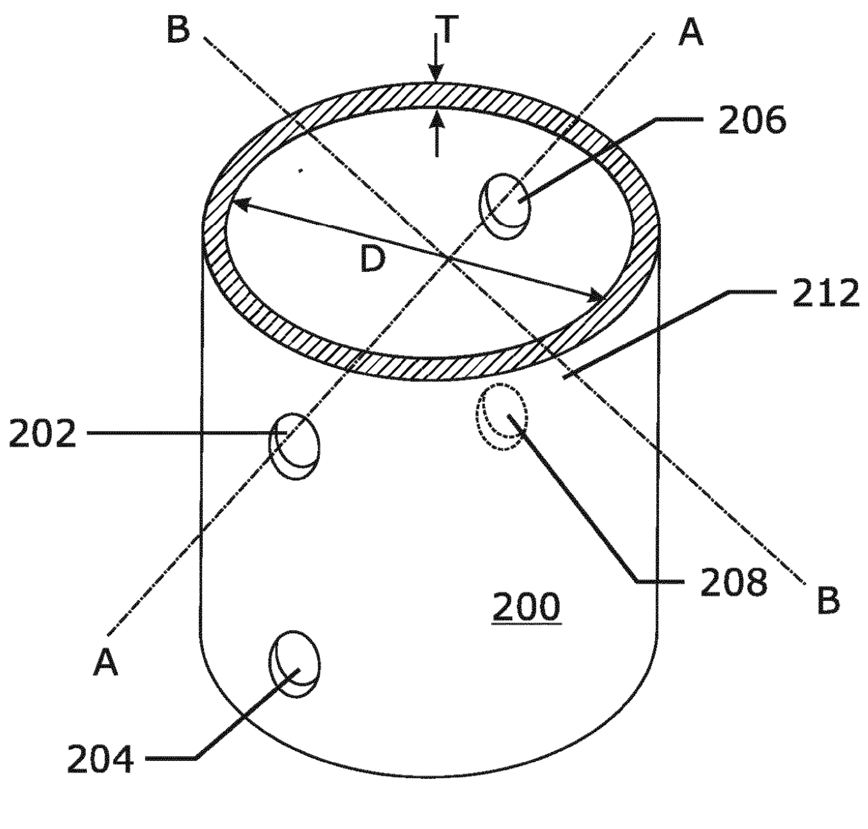
102
122
120
106
110

Fig. 1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D
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202
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204

Fig. 2

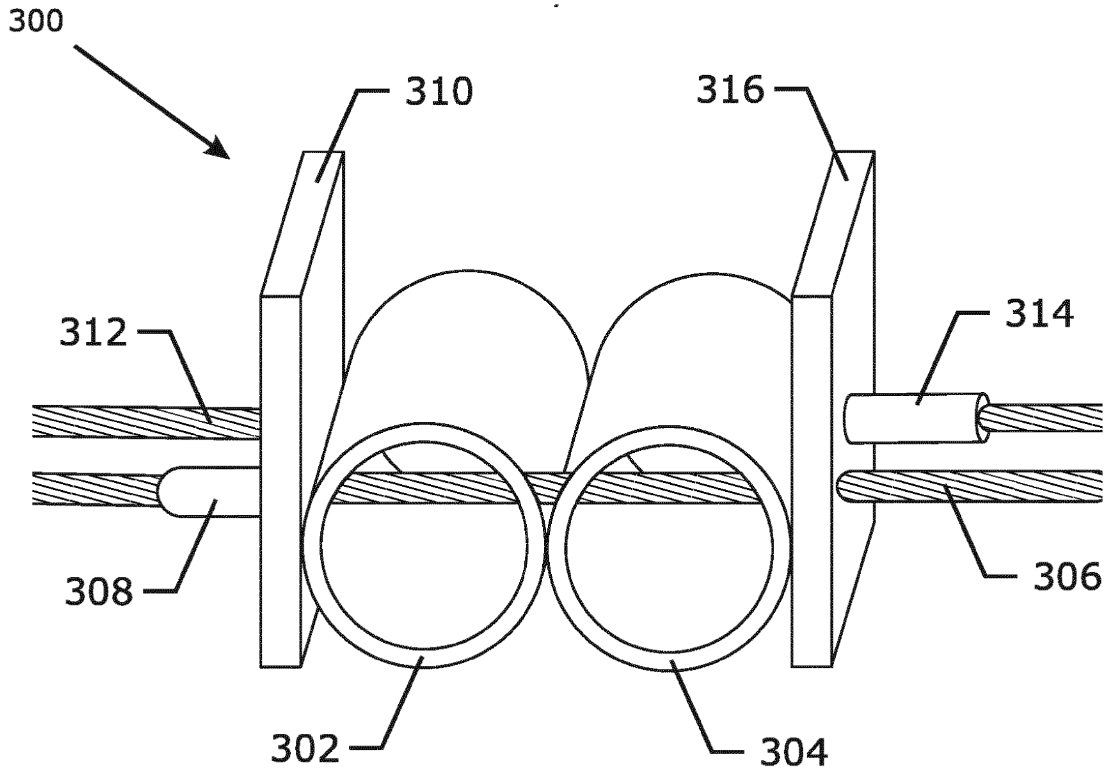
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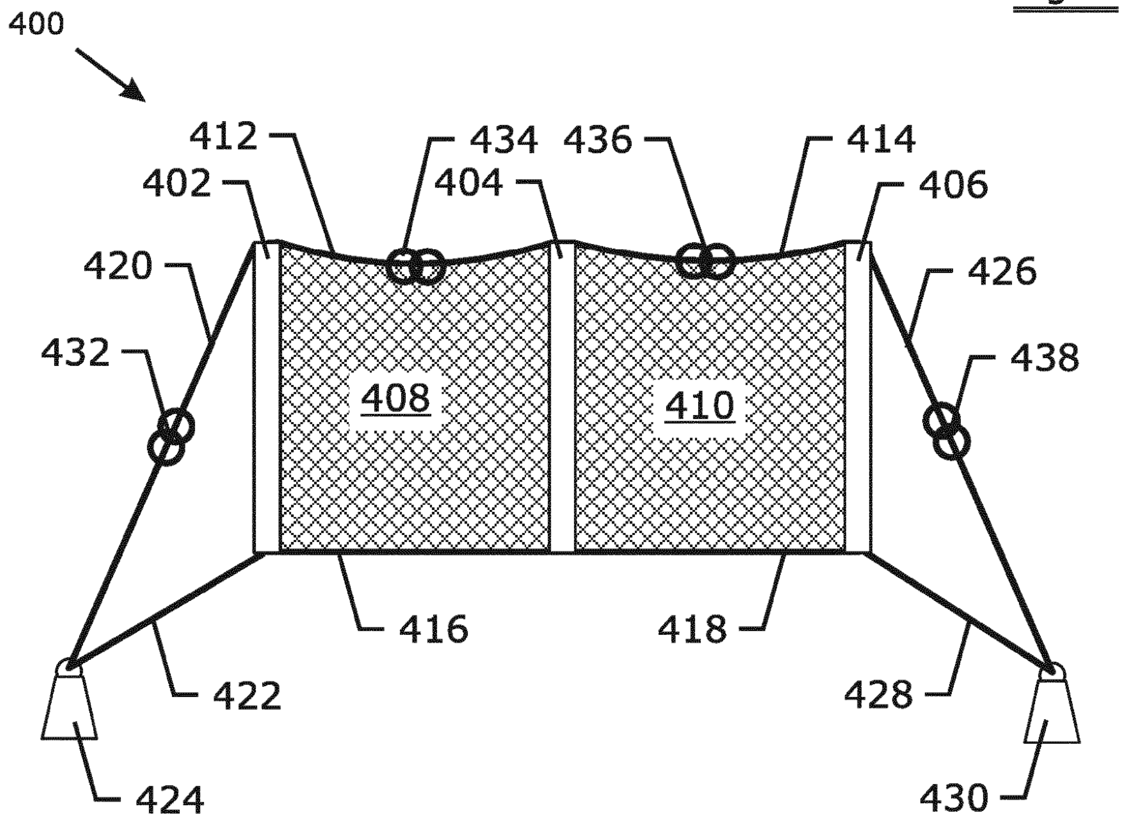
Fig. 3


400
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424
430

Fig. 4

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- KR 20150031259 A **[0008]**
- KR 20120083874 A **[0009]**
- KR 20110130077 A **[0009]**
- US 20100327244 A **[0010]**
- CN 205908105 U **[0011]**