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(54) **BRAKING ELEMENT FOR A SAFETY STRUCTURE AND BRAKING ASSEMBLY COMPRISING ONE OR MORE OF SAID BRAKING ELEMENTS**

(57) The invention relates to a braking element (11) for a safety structure and to a braking assembly (21) comprising one or more of said braking elements. Said braking element and said braking assembly can be particularly applied to the construction of rockfall safety structures, of the kind comprising a rockfall safety mesh (33). The braking element (11) according to the invention consists of an elongated body (13) provided with respective connecting points at its opposite ends for being connect-

ed at one side to a safety guard or mesh and at the other side to the ground, said body being arranged to pass from a non-deformed configuration to a deformed configuration when a tension is applied to said braking element. The braking assembly (21) according to the invention results from the combination of one or more braking elements (11), preferably from the combination of two or more braking elements (11) connected together in series and/or in parallel.

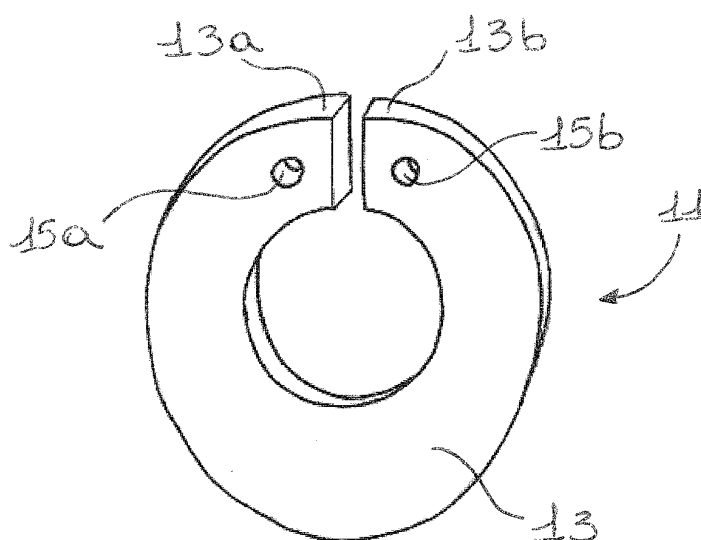


FIG. 1

Description

Technical Field

[0001] The invention relates to a braking element for a safety structure and to a braking assembly comprising one or more of said braking elements.

[0002] Said braking element and said braking assembly are suitable for being associated with a safety guard, such as a safety mesh, for forming a safety structure.

[0003] The invention can be applied to the construction of any safety structure that requires the dissipation of a large amount of energy or the limitation / containment of loads on the structures. Non-limiting examples of such structures include rockfall guards, debris-flow guards, consolidation structures, snow fences, and the like.

Prior Art

[0004] Using braking elements associated with a safety guard to absorb the kinetic energy of material impacting against the guard is known from the art.

[0005] In the case of application to rockfall safety structures, the use of said braking elements allows to absorb the kinetic energy of the landslide material deriving from subsidence of the ground, thus preventing the breakage of the safety mesh, and the consequent downward slipping of said landslide material, for example to dangerous areas, such as mountain roads or dwellings.

[0006] For the manufacturing of such braking elements the use of plastically deformable elements is known, which plastically deformable elements are fastened on one side to a support anchored to the ground and on the other side to the safety mesh or guard intended to stop the fall of the landslide material. These braking elements, thanks to their deformation, absorb the kinetic energy of the landslide material and thus prevent the damage - or even the breakage - of said safety mesh or guard. For example, these braking elements may have a helical profile, whereby the helical profile is straightened when subjected to a tension along the direction passing through the two fastening points for the connection to the ground and, respectively, to the safety mesh or guard.

[0007] An example of a known braking element of this kind is disclosed in WO 2014/075817. The braking element described in said document comprises a body provided with two diametrically opposite fastening points, one for the connection to a safety guard, and the other one for the anchoring to the ground. A predefined tearing line is provided on said body, which line is formed by a series of breaking points arranged according to a double spiral pattern, in which the two spirals extend in opposite directions and are converging towards the centre of said body. By applying a tension onto the two fastening points, tearing of said body along said predetermined breaking points is obtained, and, as a consequence, said body passes from the helical configuration to an extended configuration and the fastening points progressively move

away from each other, until reaching the maximum distance when said tearing has passed through all said breaking points. The kinetic energy of rocks, trees or other landslide material that are slipping onto said safety guard is converted into the energy required to obtain the aforementioned tearing.

[0008] The braking elements of the type described above are based on tearing along said breaking points to dissipate the kinetic energy of the landslide material; consequently, the deformation value of the braking element is strictly related to the fact that these breakages occur correctly and according to the pre-set theoretical values. In the event that these breakages, although theoretically controlled, do not correctly occur, the kinetic energy of the landslide material cannot be absorbed according to the desired parameters.

[0009] A first object of the invention is therefore to provide a braking element, which is deformable under the action of a tension applied thereto, which does not have the disadvantages of the prior art described above and which, more particularly, is not bound to the partial breakage, even controlled, of said braking element.

[0010] As the purpose of the braking elements is to absorb the kinetic energy of the landslide material, braking elements based on forms of energy dissipation other than tearing along predefined breaking points were also developed in the past. For example, other braking elements of a known type are based on friction to absorb the kinetic energy of the landslide material. In this case, the deformation value of the braking element is therefore dependent on the friction between its components.

[0011] A drawback of this type of braking elements is the difficulty in guaranteeing reliable and constant performances over time. By the way, this difficulty is increased by the fact that said braking elements are associated with safety structures which are mounted outdoors and exposed to weather and atmospheric agents. For example, in the event that over time infiltrations of liquids inside the braking elements or any deteriorations of their components take place, a variation in the friction coefficients between the different components could probably occur, which would result in a consequent variation in the deformation value of said braking elements and a possible loss of the capability of correctly absorbing the kinetic energy of the landslide material.

[0012] Another object of the invention is therefore to provide a braking element, the deformation value of which is independent from the friction between its components.

[0013] In general, in the known braking elements, the deformation value is strictly related to their dimensional characteristics and to the used materials. As a result, in order to obtain different deformation values it is necessary to change the material used for manufacturing the braking element or to modify the dimensions or the spatial arrangement of said braking element.

[0014] This implies that, in the case in which it is envisaged to manufacture a braking element arranged to

absorb of a wide range of kinetic energy values, said braking element shall be oversized, with considerable space requirement and obvious economic expenditure.

[0015] Another object of the invention is to provide a braking element, the deformation value of which is not strictly related to the dimensional characteristics and materials of said braking element.

[0016] A further object of the invention is to provide a braking assembly, made by the combination of one or more braking elements, preferably of two or more braking elements, which is suitable for absorbing of a wide range of kinetic energy values.

[0017] These and other objects are achieved by a braking element for a safety structure and a braking assembly comprising one or more of said braking elements as claimed in the appended claims.

Summary of the Invention

[0018] The braking element according to the invention consists of an elongated body provided with respective connecting points at its opposite ends for the connection to a safety guard or mesh on one side and to the ground on the other side, wherein said body is arranged for passing from a non-deformed configuration to a deformed configuration. In said non-deformed configuration, the body has an annular profile, in which the two opposite ends of said body face each other. In said deformed configuration, the body has an extended profile with its two opposite ends far from each other. The non-deformed configuration is the configuration in which the braking element is installed. The deformed configuration is the configuration after a tension, generated for example by the fall of landslide material against said safety mesh or guard, has been applied to the braking element.

[0019] Advantageously, the deformation value of the braking element according to the invention is not dependent on the tearing of predetermined breaking points nor on friction. As a consequence, said braking element is reliable and its performances remain reliable over time.

[0020] In a preferred embodiment of the invention, the body is provided with a plurality of connecting through-holes which are positioned at different locations at each of its opposite ends. Thanks to this arrangement, it is possible to select the desired connecting through-hole each time, thus modifying the deformation value for the same size and material of the braking element.

[0021] The present invention also relates to a braking assembly formed by the combination of two or more braking elements according to the invention connected to each other.

[0022] The possibility of combining several braking elements allows to vary the overall deformation value of the braking assembly and to make the invention applicable to a wide range of different situations in which different deformation values are required.

[0023] It is to be noted, in this respect, that the known braking elements described above would not be suitable

for being combined to obtain a braking assembly.

[0024] Firstly, these known braking elements have been designed as single units, so that the combination of said single units would be difficult, if not impossible in some instances, and would entail considerable space requirement.

[0025] Secondly, even if it were possible to combine said known braking elements together, it would not be possible to guarantee a uniform distribution of the involved tensions.

[0026] The braking assembly according to the invention can be obtained by combining the braking elements according to the invention according to different arrangements, among which:

- connection in series, in which said braking elements are sequentially arranged and connected to each other by means of a connecting element, for example a screw or a peg, at a respective end;
- connection in parallel, in which said braking elements are arranged side by side to each other and connected to each other by connecting elements, for example screws or pegs, at both respective ends.

[0027] Advantageously, more complex embodiments of the braking assembly according to the invention may be obtained by combining connections in series and connections in parallel of said braking elements.

Brief Description of the Drawings

[0028] Some preferred embodiments of the invention will be described by way of non-limiting examples with reference to the accompanying drawings in which:

- Fig. 1 shows a braking element according to the invention in a non-deformed configuration;
- Fig. 2 shows the braking element of Fig. 1 in a deformed configuration;
- Fig. 3 shows a braking assembly according to a first embodiment;
- Fig. 4 shows a braking assembly according to a second embodiment;
- Fig. 5 shows a braking assembly according to a third embodiment;
- Fig. 6 shows a braking assembly according to a fourth embodiment;
- Fig. 7 shows a braking assembly according to a fifth embodiment;
- Fig. 8 schematically shows a safety structure incorporating a plurality of braking assemblies according to the embodiment of Fig. 3.

Description of some Preferred Embodiments of the Invention

[0029] With reference initially to Figs. 1 and 2, a preferred embodiment of the braking element for safety

structure according to the invention is shown. The braking element has been indicated as a whole by reference numeral 11.

[0030] The braking element 11 comprises an elongated body 13 with two opposite ends 13a, 13b. Said opposite ends 13a, 13b are free and not in any way bound to each other and/or to an intermediate portion of the body 13.

[0031] Respective connecting through-holes 15a, 15b, at least one per side, are provided on said body 13, in the vicinity of each opposite end 13a, 13b. A first connecting through-hole 15a is intended for connecting, either directly or indirectly, the braking element to a safety mesh or guard, while the opposite connecting through-hole 15b is intended for anchoring, either directly or indirectly, the braking element to the ground.

[0032] In a particularly preferred embodiment of the braking element 11, the body 13 has a plurality of connecting through-holes 15a, 15b arranged at each end 13a, 13b of said body, at different distances from the respective end.

[0033] The provision of a plurality of differently positioned connecting through-holes 15a, 15b at each end of the body 13 of the braking element 11 allows to connect said braking element to said safety mesh or guard and to anchor said braking element to the ground at different distances from the ends 13a, 13b of the body 13 and consequently provides for the possibility of obtaining different deformation values as a function of the selected connecting through-hole. Therefore, with the same size and material of the braking element 11, the deformation value of the braking element can be advantageously modified according to the specific requirements of each application.

[0034] In the shown embodiment, the cross-section of the body 13 of the braking element 11 is larger at the central region around the middle point and decreases going from said middle point towards the ends. However, in an alternative embodiment the body of the braking element 11 could also have a constant cross-section.

[0035] In the shown embodiment, the body 13 of the braking element 11 has a substantially rectangular cross-section. The body of the braking element 11 could also have a cross-section of a different shape.

[0036] Preferably, the body 13 of the braking element 11 is made of steel, more particularly of structural steel S235 - 275 - 355. However, other materials, such as for instance stainless steels, micro-alloyed steels, aluminium alloys, and other metals and metal alloys, can also be used. In general, it is preferable that the used material has a low elastic modulus and a high elongation at break.

[0037] Said braking element 11 can pass from a non-deformed configuration (Fig. 1) to a deformed configuration (Fig. 2).

[0038] When installing the safety structure, the braking element is arranged between the safety mesh or guard and the ground in said non-deformed configuration (Fig. 1): in said configuration, the body 13 of the braking ele-

ment 11 is bent on itself in an annular configuration and the opposite ends 13a, 13b face each other at a short distance from each other.

[0039] In case of material impacting against the safety mesh or guard (for example, in the case of application to rockfall structures, in case of slipping of landslide material against the safety mesh or guard), the kinetic energy of said material is transformed into deformation energy of the braking element 11, which passes from the non-deformed configuration to the deformed configuration (Fig. 2).

[0040] In the latter configuration, the body 13 of the braking element 11 is extended and the opposite ends 13a, 13b are at the maximum distance from each other.

[0041] As is evident from the comparison of Figs. 1 and 2, the dissipation of kinetic energy into deformation energy of the braking element and the consequent braking effect on the material impacting against the safety mesh or guard is independent of factors, such as tearing of predefined breaking points or friction between components of the braking element, which could entail margins of unreliability and unpredictability of the performance of the braking element itself.

[0042] Advantageously, the braking element 11 can be used for obtaining complex braking assemblies.

[0043] With reference now to Figs. 3 to 6, some preferred embodiments of a braking assembly 21 comprising a plurality of braking elements 11 for safety structure according to the invention are shown.

[0044] In general, said braking assembly 21 comprises one or more braking elements 11 and it is preferably obtained by the combination of two or more braking elements connected together. Said braking elements 11 may be connected in series and/or in parallel.

[0045] With reference to Fig. 3, in a preferred embodiment of said braking assembly 21, two or more braking elements (two in the example shown in Fig. 3) are connected in series: said braking elements 11, 11' are sequentially arranged and the bodies 13, 13' of said braking elements are connected to each other at a respective end 13a, 13'b by means of a connecting element 17, for example a screw or a peg, which passes through the respective connecting through-holes 15a, 15'b.

[0046] With reference to Fig. 4, in a different preferred embodiment of said braking assembly 21, two or more braking elements (two in the example shown in Fig. 4) are connected in parallel: said braking elements 11, 11' are arranged side by side to each other and the bodies 13, 13' of said braking elements are connected to each other at both respective ends 13a, 13'a and 13b, 13'b by connecting elements 17a, 17b, for example screws or pegs, which pass through the respective connecting through-holes 15a, 15'a and 15b, 15'b.

[0047] It is to be noted that in the case of a connection of braking elements in parallel, the connecting elements 17a, 17b preferably have side portions having a cross-section equal to or smaller than the cross-section of the connecting through-holes of said braking elements and

a middle portion having a cross section greater than the cross-section of said connecting through-holes, so as to ensure that the predetermined distance between the bodies of the different braking elements is maintained.

[0048] Connection in series and connection in parallel may be advantageously combined to obtain braking assemblies with more complex structures.

[0049] With reference to Fig. 5, a further preferred embodiment of the braking assembly 21 provides for the connection of three braking elements 11, 11', 11'', wherein two of said braking elements 11', 11'' are connected to each other in parallel and in turn, at one of their ends, they are connected in series to a third braking element 11.

[0050] In this case, preferably, the cross-section of the braking elements 11', 11'' connected in parallel is substantially equal to half the cross-section of the braking element 11 connected in series to said braking elements 11', 11'' and the distance between braking elements 11', 11'' connected in parallel is substantially equal to the thickness of the braking element 11 connected in series to said braking elements 11', 11'', so as to obtain a braking assembly 21 with a substantially symmetrical configuration.

[0051] With reference to Fig. 6, an alternative preferred embodiment of the braking assembly 21 provides for the connection of four braking elements 11, 11', 11'', 11''', wherein two of said braking elements 11', 11'' are connected in parallel and they are connected in series, at first ends thereof, to a third braking element 11 and, at second, opposite ends thereof, to a fourth braking element 11'''.

[0052] Advantageously, by arranging the pair of braking elements 11', 11'' connected in parallel between the two individual braking elements 11, 11''' connected in series, it is possible to minimize the overall space requirement of the obtained braking assembly 21 in the non-deformed configuration.

[0053] It is to be noted that, for the same geometric arrangement of the braking elements of the kind shown in Fig. 6, it is possible to provide for two functionally different configurations for the braking assembly 21. Indeed, in a first configuration it is possible to provide that the braking elements 11', 11'' are simply arranged in parallel, but separated from each other and individually connected to the braking elements 11, 11''', while in a second configuration it is possible to provide that the braking elements 11', 11'' are rigidly connected in parallel to each other and further connected to the further braking elements 11, 11''', said two configurations having - the geometric arrangement being the same - different performances.

[0054] Also in this case, preferably, the cross-section of the braking elements connected in parallel is substantially equal to half the cross-section of the braking elements connected in series and the distance between the braking elements connected in parallel is substantially equal to the thickness of the braking elements 11 connected in series, so as to obtain a braking assembly 21

having a substantially symmetrical configuration.

[0055] With reference to Fig. 7, another preferred embodiment of the braking assembly 21 is shown, which can be considered as a variant of the embodiment of Fig. 4. Also in the embodiment of Fig. 7, two or more braking elements 11, 11' are arranged side by side to each other and the bodies 13, 13' of said braking elements are provided with connecting through-holes 15a, 15'a and 15b, 15'b at the respective ends 13a, 13'a and 13b, 13'b. In this embodiment, the braking elements 11, 11' are not simply arranged side by side to each other, but they are joined to each other by means of a joining element 19, which is sandwiched between them and extends over a given length from the central portion of said braking elements towards their ends.

[0056] Advantageously, in this embodiment the performances of the braking assembly could be modulated by acting not only upon the characteristics (number, sizes, materials, and so on) of the braking elements 11, 11', but also upon the selection of the characteristics of the joining element (extension, materials, and so on).

[0057] In this way, the overall braking effect of the braking assembly according to the invention can be modulated over a wide range of different values, which can be selected each time according to the specific requirements of each application.

[0058] More particularly, the possibility of obtaining a braking assembly by selecting each time the number of the braking elements and their arrangement (connection in series and/or in parallel) allows to obtain, for each application, the braking structure with the optimal features in terms of amount of loads that can be contained and/or amount of energy that can be dissipated and of the corresponding elongation of the braking elements.

[0059] On the basis of the (non-limiting) examples of Figs. 3 - 6, it will be evident to the person skilled in the art that the number of different possible combinations - hence of different resulting braking assemblies - is very high.

[0060] With reference now to Fig. 8, an example of application of a plurality of braking assemblies 21 according to the invention to a safety structure 31 comprising a safety guard 33, in particular in the form of a rockfall safety mesh 33, is shown.

[0061] Said safety mesh 33 is made of metal wire in order to be capable of bearing and containing the fall of landslide material. Respective supporting poles 35 are provided at the two opposite sides of said safety mesh 33. These supporting poles 35 are anchored to the ground, for example through cement basements, and serve as a support for said safety mesh 33, so as to maintain it in position and prevent it from being dragged downwards by the landslide material. These supporting poles 35 are made of steel so as to have a very high deformation value and withstand the possible fall of said landslide material directly onto them rather than onto the safety mesh 33. Load-bearing ropes 37 may be either inserted in said safety mesh 33 or tied around said supporting

poles 35. More particularly, load-bearing ropes 37 may be inserted in the safety mesh 33 at its lower edge, adjacent to the ground, and at its upper edge, and inserted in said supporting poles 35 by means of appropriate hooks positioned at the lower portion and at the upper portion of said supporting poles; load-bearing ropes 37 can also be wound around said supporting poles 35, without passing through the safety mesh 33.

[0062] As schematically shown in Fig. 8, the load-bearing ropes 37 are not directly anchored to the ground, but on the contrary they are connected at their free ends to respective braking assemblies 21 according to the invention, which are in turn anchored to the ground. Said load-bearing ropes 37 are made of metal cables for avoiding breakage under deformation when said landslide material falls.

[0063] In the case of load-bearing ropes passing through the safety mesh 33, the free ends of said ropes are on opposite sides of the safety structure 31 and are connected to respective braking assemblies. Instead, in the case of the load-bearing ropes wound around the supporting poles 35, the free ends of said ropes are on the same side of the safety structure 31 and they may be connected either separately to respective braking assemblies or to a single, common braking assembly.

[0064] In any case, the free end of each rope 37 is bound to a braking assembly 21 at the connecting through-hole of an end braking element of the braking assembly; on the opposite side of the braking assembly, the connecting through-hole of the other end braking element of the braking assembly is anchored to the ground.

[0065] In the example of Fig. 8, all the shown braking assemblies 21 consist of a pair of braking elements connected in series (see Fig. 3). However, it will be evident to the person skilled in the art that braking assemblies with different configurations may be used at different locations of the safety structure 31 according to the specific requirements.

[0066] It is also evident that the fall of landslide material against the safety mesh 33 causes the generation of a tension on said safety mesh 33 and on the supporting poles 35, which tension is transferred through the load-bearing ropes 37 to the braking assemblies 21, which become deformed and consequently absorb the kinetic energy of the aforementioned landslide material.

[0067] Therefore, the braking element and the braking assembly according to the invention allow to effectively achieve the objects set forth above.

[0068] The embodiments as described and shown are not to be intended in any limiting sense and several variants and modifications within the reach of the person skilled in the art are possible and in any case fall within the scope of protection of the present invention as defined by the appended claims.

Claims

1. Braking element (11) for a safety structure (31), provided with an elongated body (13) which comprises two opposite ends (13a, 13b) and at least one connecting through-hole (15a, 15b) located in the vicinity of each of said ends (13a, 13b), **characterized in that** said ends (13a, 13b) of said body (13) are free and said body (13) can pass from a non-deformed configuration, in which said body (13) is bent on itself in an annular configuration and said ends (13a, 13b) face each other at a short distance from each other, to a deformed configuration, in which said body (13) is in an extended configuration and said ends (13a, 13b) are at their maximum distance from each other.
2. Braking element (11) according to claim 1, wherein a plurality of connecting through-holes are provided at each of said ends (13a, 13b), said through-holes being placed at different distances from the respective end of said body (13).
3. Braking element (11) according to claim 1, wherein the cross-section of said body (13) is larger at its central portion, about its middle point, and decreases going from said middle point towards said ends (13a, 13b).
4. Braking assembly (21) for a safety structure (31) **characterized in that** it comprises one or more braking elements (11, 11', 11'', 11'''), each of said braking elements being provided with an elongated body (13) which comprises two opposite ends (13a, 13b) and at least one connecting through-hole (15a, 15b) located in the vicinity of each of said ends (13a, 13b), wherein said ends (13a, 13b) of said body (13) are free and said body (13) can pass from a non-deformed configuration, in which said body (13) is bent on itself in an annular configuration and said ends (13a, 13b) face each other at a short distance from each other, to a deformed configuration, in which said body (13) is in an extended configuration and said ends (13a, 13b) are at their maximum distance from each other, and **in that** that said braking elements (11, 11', 11'', 11''') are connected to one another in series and/or in parallel by means of one or more connecting elements (17; 17a, 17b).
5. Braking assembly (21) according to claim 4, wherein said braking assembly (21) is made by two or more of said braking elements (11, 11') connected in series, said bodies (13, 13') of said braking elements being arranged sequentially to each other and connected to each other at a respective end (13a, 13'b) thereof by means of a connecting element (17).
6. Braking assembly (21) according to claim 4, wherein said braking assembly (21) is made by two or more

of said braking elements (11, 11') connected in parallel, said bodies (13, 13') of said braking elements being arranged side by side to each other and connected to each other at both respective ends (13a, 13'a, 13b, 13'b) thereof by means of connecting elements (17a, 17b). 5

7. Braking assembly (21) according to claim 4, wherein said braking assembly (21) is made by two or more of said braking elements (11', 11'') connected to each other in parallel and further connected in series, at one of their ends or at both their ends, to one or more of said braking elements (11; 11, 11''). 10
8. Braking assembly (21) according to claim 6, wherein said braking elements (11', 11'') connected to each other in parallel are joined to each other by means of a joining element (19) which is sandwiched between the bodies (13, 13') of said braking elements and extends over a given length from the central portion of said bodies towards their ends. 15 20
9. Braking assembly (21) according to claim 6, wherein said connecting elements (17a, 17b) are screws or pegs and have side portions having a cross-section which is equal to or smaller than the cross-section of said connecting through-holes (15a, 15'a, 15b, 15'b) of said braking elements and a middle portion having a cross-section which is larger than the cross-section of said connecting through-holes. 25 30
10. Safety structure (31) comprising a safety mesh or guard (33), supporting poles (35) arranged on opposite sides of said safety mesh or guard (33) and load-bearing ropes (37) for connecting said safety mesh or guard to said supporting poles and for anchoring said safety mesh or guard to the ground, **characterized in that** it comprises one or more braking assemblies (21) according to any of the claims 4 to 9, said braking assemblies (21) being interposed between an end of a respective load-bearing rope (37) and the ground. 35 40

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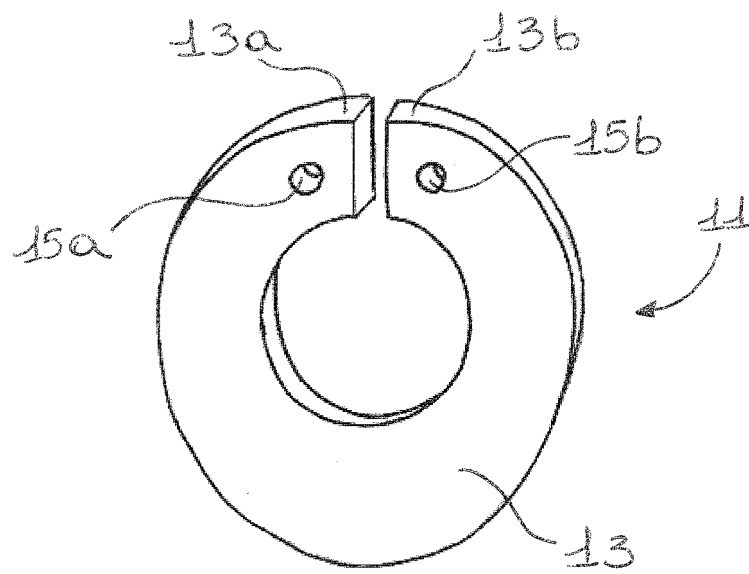


FIG. 1

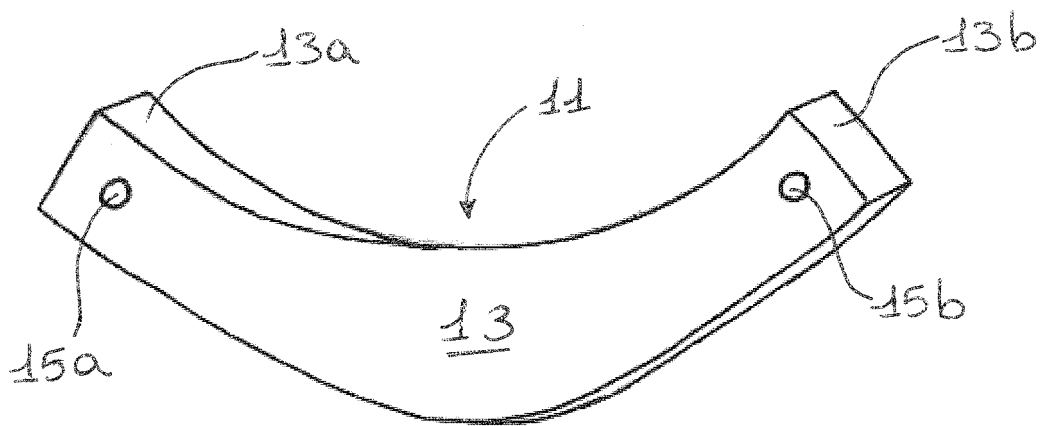


FIG. 2

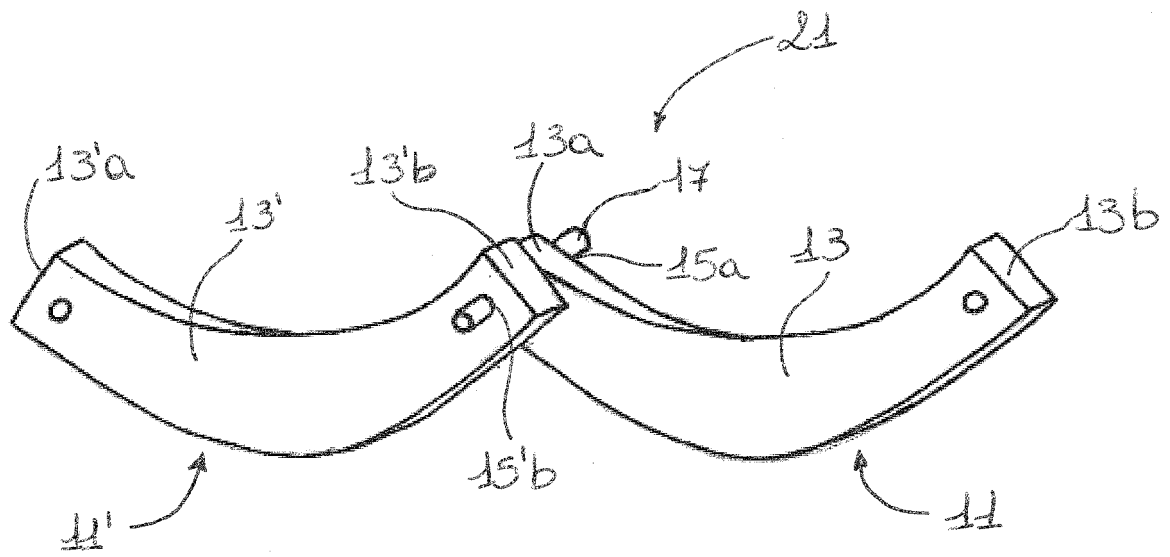


FIG. 3

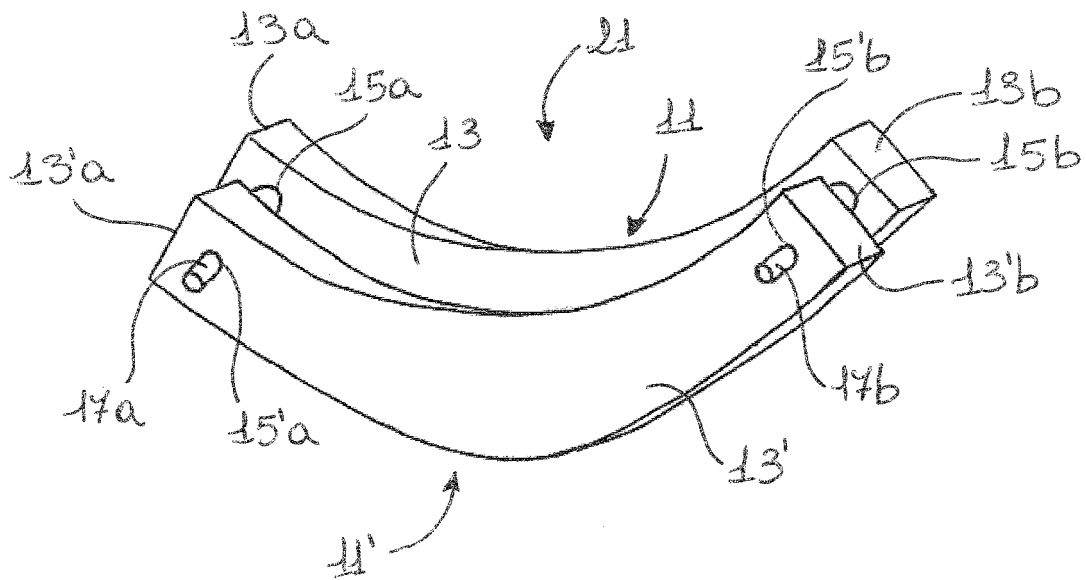


FIG. 4

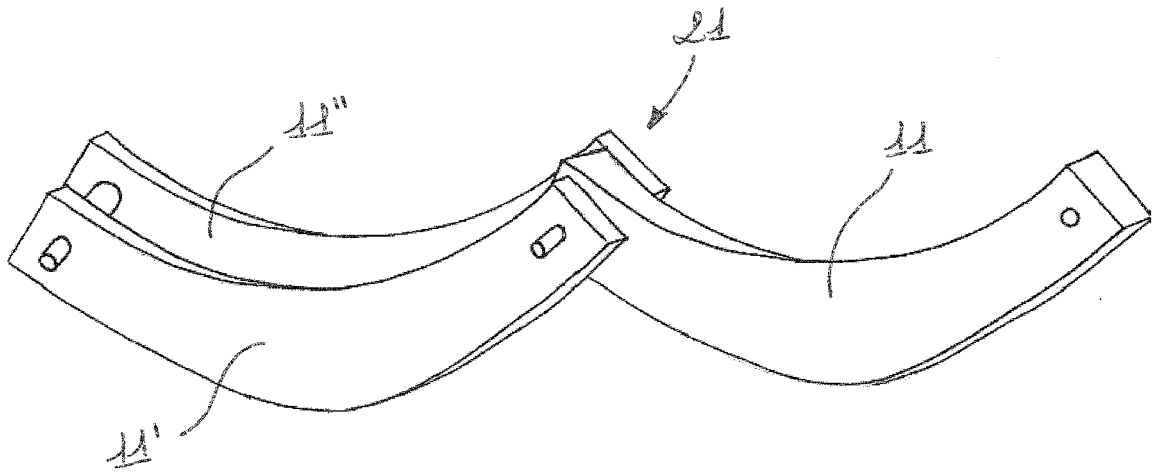


FIG. 5

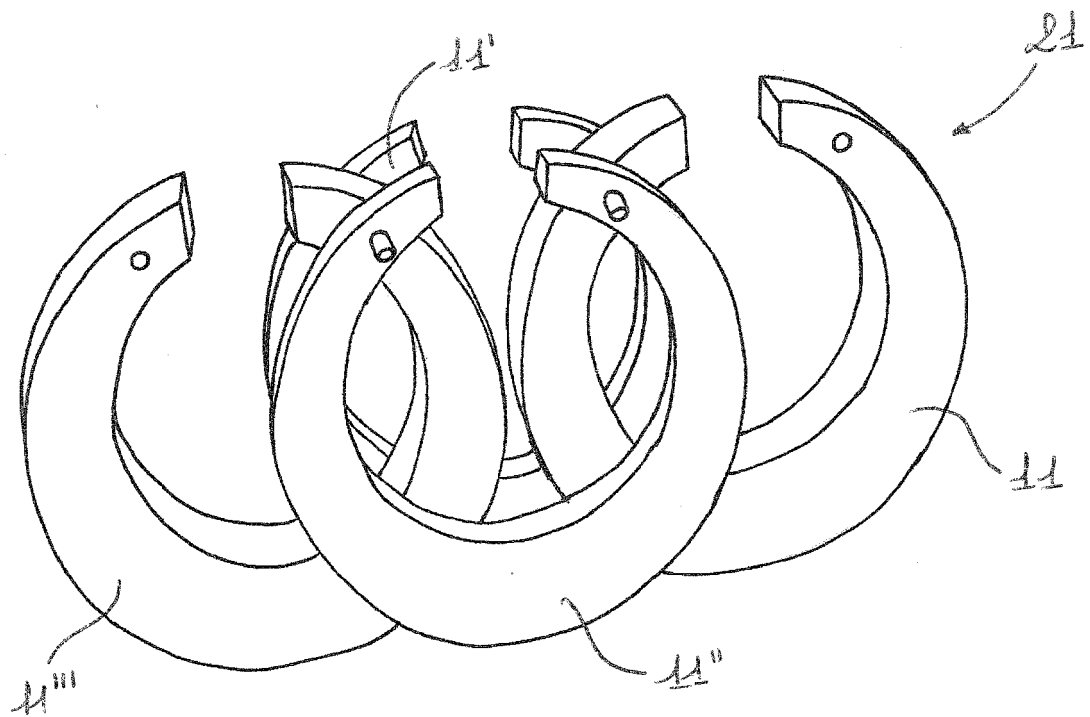


FIG. 6

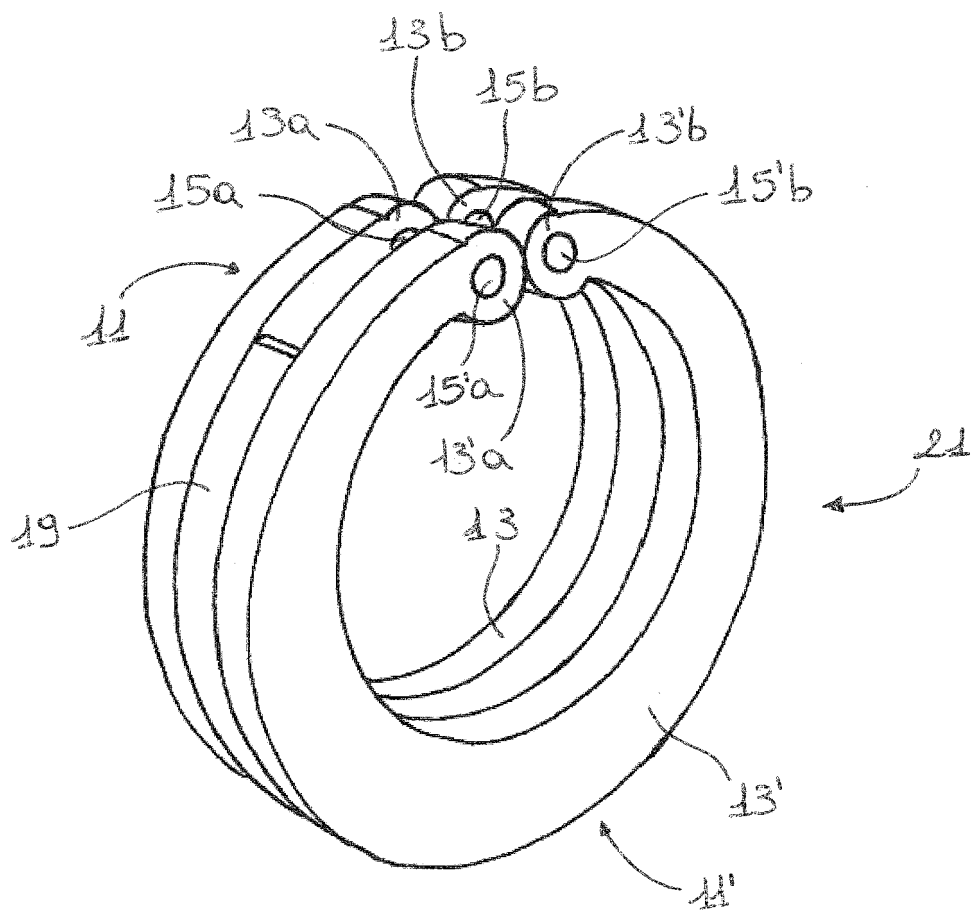


FIG. 7

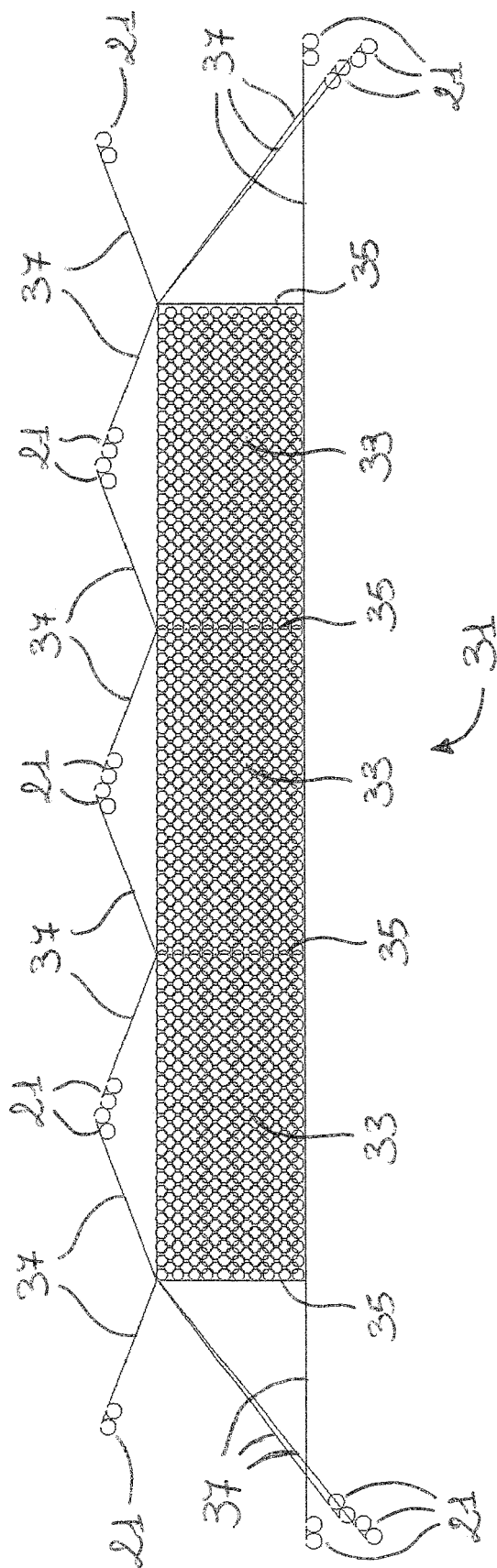


FIG. 8



EUROPEAN SEARCH REPORT

Application Number
EP 18 17 1715

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 2008/046446 A1 (CHRISTIAN DALLOZ HOLDING DEUTS [DE]; KRAUSS MARKUS [DE]) 24 April 2008 (2008-04-24) * paragraph [00320033]; figures *	1,3,4	INV. E01F7/04
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A	EP 1 469 130 A1 (AVT ANKER & VORSPANNTECHNIK AG [CH]) 20 October 2004 (2004-10-20) * figures *	1,4,10	
			TECHNICAL FIELDS SEARCHED (IPC)
			E01F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 29 August 2018	Examiner Stern, Claudio
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