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(71) Applicant: **Geo-Tech Barriere di de Vito Silvana**
61023 Macerata Feltria (PU) (IT)

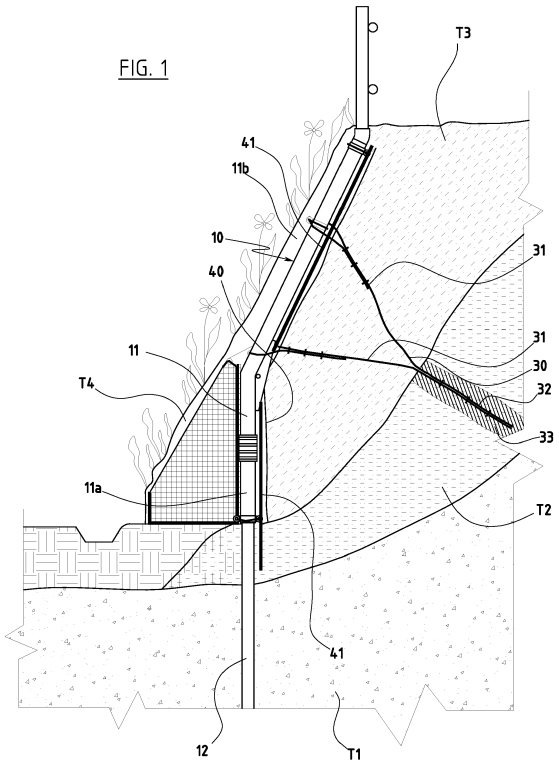
(72) Inventor: **ALOI, Aristodemo**
I-71121 Foggia (IT)

(74) Representative: **Corradini, Corrado et al**
Ing. C. Corradini & C. S.r.l.
Via Dante Alighieri 4
42121 Reggio Emilia (IT)

(54) **A MODULAR BARRIER FOR CONTAINING LANDSLIDE MASSES**

(57) The barrier comprises: a series of bearing posts (10), emerging from the ground, having a lower portion (12) planted in the ground, a plurality of longitudinal members (15) which run transversally of the posts (10) each having ends thereof constrained to two consecutive posts (10), constraining devices (20) which connect the longitudinal members (15) to the posts (10), each having a first hinge component (21) constrained to the respective post (10), and being free to oscillate with respect to the post (10) about the axis of the post (10), and a second hinge component (22) constrained to a longitudinal member (15) by means of a pin which enables the longitudinal member (15) to oscillate about an axis that is perpendicular to a plane defined by the two consecutive posts (10) which are connected to one another by the longitudinal member (15); a containing means (30), able to retain the landslide mass, placed against an uphill side of the longitudinal members (15), in turn retained by the posts (10) and by the longitudinal members (15).

FIG. 1



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Description

[0001] The present invention relates to a modular barrier for intercepting and containing landslide masses, such as terrains with debris, long slopes, more or less inclined, for stabilising slopes undergoing landslip, realising terracing, as well as bank protections and containing reliefs.

[0002] In the present state of the art, in relation to metal containing barriers of landslide masses along long inclined slopes, comprises simple prefabricated modules having a rectangular shape and predetermined measurements, to be rested on the ground, one by a side of another, so as to form a barrier. Each module is constrained to the ground by means of an iron plate, connected via a tube to the centre of the module, to be rested on the ground below the filler. The filler earth is in opposition to the plate so as to prevent the movement of the module. An example of these structures is illustrated in patent document EP1921210A1, where the illustrated module comprises a support frame constituted by metal tubes, to which a containing net is fixed. The frame is arranged inclined and supported on a strut or shank anchored to the ground, so as to form an inclined-T shape.

[0003] Though having some advantages, the known system however has some drawbacks that have not to date been obviated.

[0004] One of the main drawbacks lies in the fact that the known modules have a structure having non-modifiable shape and dimensions. They are in fact essentially characterised by a fixed rectangular shape and this means that when they are positioned on uneven, irregular ground they straddle and overlap one another or leave V-shaped spaces between one another. For this reason, they are not adaptable for the up-and-down nature of hillside slopes, as they constantly require the use of mechanical means for levelling terrains.

[0005] Further, these modules, by design choice, (they are without constraints to the ground, they simply rest on the ground) are without foundation posts which would be connected to the compact ground layer and would consolidate the positioning and alignment thereof. For this reason they are rested on the surface terrain, and are subject to the continuous settling movements to which these external layers are subjected and therefore washout, sinking and slipping, and to which they react by becoming unaligned, sliding and rotating on themselves, as they are constrained only at a central point. A further drawback lies in the fact that the known containing modules enable realising an extremely limited number of variants to the structure and the technical and aesthetic characteristics thereof, which are inevitably constrained by the fact that the modules are pre-mounted without leaving, to the persons fixing them in place, any possibility of adapting them to the never-repetitive requirements of slopes.

[0006] An aim of the invention is to realise a modular barrier having an unlimited length, able to be joined in any direction, made up of pre-constructed metal elements that be easily assembled to one another at the assembly site, with characteristics such as adaptability so as to enable a complete adaptation to any irregularity of the slope, whether morphological or directional.

[0007] A second aim is to form a very sturdy structure that can resist landslip movement of the unstable surface strata. It is in fact solidly constrained to the ground in several points by bearing tie posts cemented into the compact part of the substrate, by-passing the unstable stratus, so as to not be subject to the continuing alterations. A further aim is to realise a barrier having many accessories and mounting alternatives able to vary the assembly thereof for an optimal specialisation in relation to the various tasks for which it can be used, such as for example internally containing a slipping ground or protecting, with the external side thereof, riverbanks from water erosion.

[0008] A further aim is to realise a barrier which when viewed is perfectly camouflaged, such as a simple grassy slope, as it can be externally equipped with geomats and containers for vegetation for terrains which, once planted, enable complete camouflaging.

[0009] These and other aims are attained by the present invention as it is characterised in the claims.

[0010] The invention will be described in detail in the following with the aid of the appended figure which illustrate an embodiment thereof, by way of non-exclusive example.

Figure 1 is a section view of the barrier.

Figure 2 is a perspective view of the barrier, without the terrain containing cages for camouflaging the barrier.

Figure 3A is a front schematic view of an embodiment of the barrier (with straight posts) applied to an irregular slope.

Figure 3B is a plan view of figure 3A.

Figure 4 is a perspective and larger-dimension view of the constraining device 20 of figure 2.

Figure 5 illustrates a hinge joint which constrains the lower portion and the upper portion of the bearing post 10 together, in an application on steep slopes.

[0011] The barrier of the example comprises a series of bearing posts 10, emerging from the ground, having a lower portion planted in the ground.

[0012] Each post 10 comprises a lower portion 12 which is planted in the ground and an upper portion 11 emerging from the ground.

[0013] The upper portion 11 can have one or more portions, the axis of which is inclined with respect to the lower portion 12, as illustrated in figures 1 and 2, or can have a single straight axis along a lower portion and along the upper portion (straight post).

[0014] In particular, in the embodiment illustrated in figures 1 and 2, the upper portion 11 has a first portion 11 a, being a lower portion, that is coaxial with the lower

portion 12; a portion 11 b located superiorly of the first portion 11 a, has instead an inclined axis with respect to the lower portion 12, In particular so as to be more or less parallel to the inclination of the inclined flank of the hill, where the barrier is planted.

[0015] In many cases, the posts 10 are arranged along the application slope with the lower portion 12 inserted in the ground in a substantially vertical position. The barrier further comprises a plurality of longitudinal members 15 which run transversally of the posts 10 each having ends thereof constrained to two consecutive posts 10. In a preferred embodiment, the longitudinal members 15 are conformed so as to be arranged with an orientation substantially parallel to the surface of the ground in which the barrier is planted. The longitudinal members 15 are preferably arranged along the height of the posts 10, in a distributed array on the basis of the loads which will bear down on the barrier.

[0016] The constraint between each end of longitudinal member 15 and the respective post 10 is made by constraining devices 20, each of which comprises a first hinge component 21 constrained to the respective post, and being free to oscillate with respect to the post about the axis of the post, and a second hinge component 22 constrained to a longitudinal member 15 which enables the longitudinal member 15 to oscillate about an axis that is perpendicular to a plane defined by the two consecutive posts 10 which are connected to one another by the longitudinal member 15.

[0017] Pairs (two in the figures) of devices 20 are included in the intermediate posts 10 positioned along the ground extension of the barrier, where each pair comprises two devices 20 flanked to one another and acting on the same point of the post, constraining two different longitudinal members 15. According to the embodiment illustrated in the figures (in particular figure 4), the first hinge component 21 of the constraining device 20 comprises a double ring 23 (as illustrated in figure 4) or a single ring, which jointingly surrounds the external surface of the post 10 with freedom to slide about it, fixed to an end of a flat body 22 which defines the second hinge component. The second hinge component 22 comprises, at the other end thereof, a slot 25 with which it is constrained to an end 16 of a longitudinal member by means of a bolt 26 which functions as a pin with ability to oscillate.

[0018] In particular, the longitudinal member 15 has a body with an H-shaped section (or another advantageous shape) which at the ends 16 takes on a suitably flat shape with which it is connected to the flat body 22 by means of the bolt 26. The flat body 22 can take on angularly different positions about the axis of the post 10, and with it the longitudinal member 15 constrained to the body 22; at the same time the longitudinal member 15 can assume angularly different positions with respect to the body 22 about the axis of the bolt 26, in the plane defined by the two posts 10 to which it is constrained, in other words the plane in which the barrier extends.

[0019] In greater detail, in a preferred embodiment (illustrated in figure 4), the longitudinal member 15 has an H-shaped section which comprises two wings 151 and an intermediate core 152 and at each end thereof comprises two plates 161, which define the end 16 of the beam 15; the two plates 161 are welded to the wings 151 forming an extension thereof and near one another up to embracing, on the two sides, the flat body 22, to which they are constrained by the bolt 26.

[0020] The wings 151 and the plates 161 are arranged geometrically on the plane (vertical or inclined) defined by two consecutive posts 10, while the core 152 is perpendicular to this plane.

[0021] The posts 10 positioned in an intermediate position along the extension of the barrier are constrained with longitudinal members 15 arranged to the right and left thereof. In these cases pairs of devices 20 are included that are flanked to one another and acting on the same point of the post; figure 4 illustrates one of these pairs: two flat bodies 22a, and 22b are included, of which a double ring 23 (in particular 23a) is fixed to the body 22a and another double ring 23 (in particular 23b) is fixed to the body 22b; the two double rings are reciprocally intervalled and are free to oscillate with respect to the post 10 independently of one another, as are the flat bodies 22a and 22b. The rings 23a and 23b are coupled with the same post 10 while the flat body 22a located on the left is connected with a longitudinal member located on the left and the flat body 22b located on the right is connected with a longitudinal member located on the right.

[0022] In a preferred embodiment, illustrated in figure 1, the posts 10, or at least a part of the posts is constrained to the ground placed on the uphill side by means of cables 30 having an end 31 constrained to the emerging portion 11 of the post 10 and the other end 32 being inserted deeply in the ground and constrained thereto. In particular, the second end 32 is inserted in a hole 33 afforded in the ground and then filled with bonding mortar.

[0023] The lower portion 12 of the post 10 is preferably inserted in the ground with the axis thereof substantially vertical. The upper portion 11 of post can have an axis that entirely coincides with the axis of the lower portion 12 (straight post) or can have one or more portions the axis of which is inclined with respect to the axis of the lower portion 12.

[0024] In a preferred embodiment, the two portions 11 and 12 are constrained to one another by jointing insertion of the upper end of the lower portion 12 in the lower end of the upper portion 11, possibly by helical constraint.

[0025] In other cases, especially along a rather steep slope, it can be advantageous to insert the lower portion 12 in the ground, with a different inclination from the vertical, in particular with an inclination that is more or less perpendicular to the surface of the slope (with the aim of better reaching the more compact substrata of the ground), while at the same time the upper portion 11 has a vertical or nearly-vertical axis, or a further inclination, and is in any case inclined differently with respect to the lower portion 12.

[0026] In these cases, according to the embodiment illustrated in figure 5, the two portions 11 and 12 of the post 10 are constrained to one another by means of a hinge joint 14 which comprises a first body 141 which is made solid to the lower end of the upper portion 11 and a second body 142 which is made solid to the upper end of the lower portion 11, where the two bodies 141 and 142 are hinged to one another by a pin 147 having an axis that is transversal to the two portions 11 and 12 of the post.

[0027] In particular, the two bodies 141 and 142 each comprise a tubular portion, respectively 143 and 144, which is fixed to the respective portion of post by means of a respective threaded plug 145, 146, which tubular portions are constrained to one another by a bolt which defines the hinge pin 147.

[0028] The portions B of barrier defined by two consecutive posts 10 are delimited by a containing means 30, being a net (or the equivalent) able to retain the landslide mass, placed against an uphill side of the longitudinal members 15 and in turn retained by the posts 10 and by the longitudinal members 15. The containing means 30 can be constituted by a net (metal) having an indeterminate length, or by a series of adjacent and consecutive panels. Each portion B can be rectangular in shape (posts 10 positioned on the same plane) or can be a parallelogram (in the case of posts 10 positioned at different heights). In the case of the parallelogram, the barrier comprises a portion of containing net 40 for landslide masses, which runs from one post 10 to the other, and a plurality of metal bars 41 parallel to the posts 10, which function as a reinforcement of the net; the bars 41 and the net 40 are retained by the posts 10 and the longitudinal members 15, which are positioned uphill thereof. Some bars 41, positioned lower, are further planted in the ground with the lower end.

[0029] In the case of portions B of barrier having a rectangular shape, pre-prepared containing panels can be used having lengths that are equal to the distance between two posts; these panels are preferably made with a layer of electro-welded net fixed at the periphery thereof to a rigid rectangular frame which defines the perimeter of the panel, possibly already equipped with metal reinforcing bars.

[0030] In the case illustrated in figure 2, where the posts 10 are bent, for each space B between two posts, two containing panels are mounted suitable for connecting the two segments of different height of the two posts to one another.

[0031] In realising the barrier on the ground, the posts 10 are fixed at predetermined reciprocal distances, dictated by the length of the longitudinal members 15, in the various points of the slope where sliding masses of debris are to be contained; the posts can be arranged at different levels and, in plan view, entirely unaligned to one another.

[0032] The posts 10 can, advantageously, be arranged all parallel to one another, and in any case with the lower portion 12 planted in the ground with a vertical or nearly-vertical position. In other case, the lower portion 12 can be planted in the ground substantially perpendicularly to the surface of the slope, as illustrated in the foregoing with reference to figure 5.

[0033] The above-described possibilities the longitudinal members have to assume different angulations with respect to the posts 10 and in the vertical plane enable realising uninterrupted barriers which develop on irregular inclined planes and in different orientations, seen in plan view.

[0034] A schematic example of extension of the barrier is illustrated in figures 3A and 3B. In the vertical frontal elevation view of figure 3A, the barrier extends along ground-resting lines L1 - L4 which are differently inclined with respect to the horizontal line. The longitudinal members 15 run substantially parallel to these lines L forming different angles with respect to the posts 10 and are able to take on these different inclinations as they can oscillate about the axis of the bolts 26 with which they are constrained to the posts 10.

[0035] At the same time, in the plan view of figure 3B, the barrier extends along lines M1 - M4 which are differently inclined to one another, forming different angles; the longitudinal members 15 run substantially parallel to these lines M forming different angles with respect to one another and are able to take on these different inclinations as the constraining devices 20 can oscillate about the axis of the posts 10 to which they are constrained.

[0036] As illustrated in figure 1, on the front side of the barrier (the side facing outwards) a container 50 is arranged, for each portion of barrier, positioned in the lower part, in particular made of electro-welded netting, able to contain earth T4 on which camouflaging vegetation is grown.

[0037] The container 50 is advantageously constrained to the posts 10 by means of cables 53; other containers can be advantageously included for camouflaging (not illustrated in the figures) positioned superiorly of the container 50, which are constrained to the posts by means of cables, which are made to pass through the holes 51 afforded in brackets 52 fixed to the posts.

[0038] In the example illustrated in figure 1, T1 denotes a layer of compact lower ground; and T2 denotes a layer of unstable ground positioned above the layer T1 and posteriorly of the barrier, which the barrier is intended to contain.

[0039] The barrier is made with the posts planted in the compact layer T1 at a distance from the layer T2; the volume between the layer T2 and the barrier is lastly filled with transported earth T3.

[0040] As described in the foregoing, the barrier is lastly tied using cables 30, cemented in holes 33 made uphill of the barrier at the position of each post 10 and having a length that is such as to appropriately penetrate into the compact layer T1.

[0041] In the case of relative low barriers (barriers with a straight post that are lower than 2 metres in height) the tie cables 30 might not be necessary, if it is only neces-

sary to construct low terracing. The tie cables in this case are necessary only if the terrain is liable to sliding.

[0042] Obviously numerous modifications of a practical-applicational nature can be made to the present invention without forsaking the scope of the inventive idea as claimed in the following.

Claims

1. A modular barrier for containing landslide masses along inclined slopes, comprising:

   - a series of bearing posts (10), emerging from the ground, having a lower portion (12) planted in the ground,
   - a plurality of longitudinal members (15) which run transversally of the posts (10) each having ends thereof constrained to two consecutive posts (10),
   - constraining devices (20) which connect the longitudinal members (15) to the posts (10), each having a first hinge component (21) constrained to the respective post (10), and being free to oscillate with respect to the post (10) about the axis of the post (10), and a second hinge component (22) constrained to a longitudinal member (15) by means of a pin which enables the longitudinal member (15) to oscillate about an axis that is perpendicular to a plane defined by the two consecutive posts (10) which are connected to one another by the longitudinal member (15);
   - a containing means (30), able to retain the landslide mass, placed against an uphill side of the longitudinal members (15), in turn retained by the posts (10) and by the longitudinal members (15).

2. The barrier of claim 1, wherein at least a part of the posts (10) is constrained to the ground placed on the uphill side by means of cables (30) having an end (31) constrained to the emerging portion of the post (10) and the other end (32) being inserted deeply in the ground and constrained thereto.

3. The barrier of claim 1, wherein the first hinge component (21) of the constraining device (20) comprises a ring (23), which jointingly surrounds the external surface of the post (10).

4. The barrier according to claim 3, wherein the second hinge component (22) of the constraining device (20) comprises a flat body (22) fixed at an end thereof to the ring (23) and having at another end thereof a slot (25) with which it is constrained to an end (16) of a longitudinal member (15) by means of a bolt (26) which functions as a pin with ability to oscillate.

5. The barrier of claim 1, wherein each post (10) comprises a lower portion (12) which is planted in the ground and an upper portion (11) emerging from the ground, where the two portions (11 and 12) are constrained to one another by jointing insertion of the upper end of the lower portion (12) in the lower end of the upper portion (11), possibly by helical constraint.

6. The barrier of claim 1, wherein each post (10) comprises a lower portion (12) which is planted in the ground and an upper portion (11) emerging from the ground, where the two portions (11 and 12) are constrained to one another by means of a hinge joint (14) which comprises a first body (141) which is made solid to the lower end of the upper portion (11) and a second body (142) which is made solid to the upper end of the lower portion (11), where the two bodies (141 and 142) are hinged to one another by a pin (147) having an axis that is transversal to the two portions (11 and 12) of the post.

7. The barrier of claim 1, wherein each post (10) comprises a lower portion (12) which is planted in the ground and an upper portion (11) emerging from the ground, where the lower portion (12) is inserted in the ground in a substantially vertical position, being perpendicular to the ground surface.

8. The barrier of claim 1, wherein each post comprises a lower portion (12) which is planted in the ground and an upper portion (11) emerging from the ground, where the upper portion (11) has one or more portions an axis of which is inclined with respect to the axis of the lower portion (12), in a more or less parallel way to the inclination of the ground where the barrier is planted.

9. The barrier of claim 1, **characterised in that** each portion of barrier defined by two consecutive posts (10) comprises a portion of containing net (40) and a plurality of metal bars (41) parallel to the posts (10), the lower portion of which is planted in the ground, for reinforcing the net (40), the bars (41) and the net (40) being retained by the posts (10) and by the longitudinal members (15), which are positioned downstream thereof.

10. The barrier of claim 1, **characterised in that** each portion of barrier defined by two consecutive posts (10) comprises one or more pre-prepared panels of nets, where each panel comprises a rigid frame which defines a perimeter of the panel, a net filler and a series of bar reinforcements.

FIG. 1

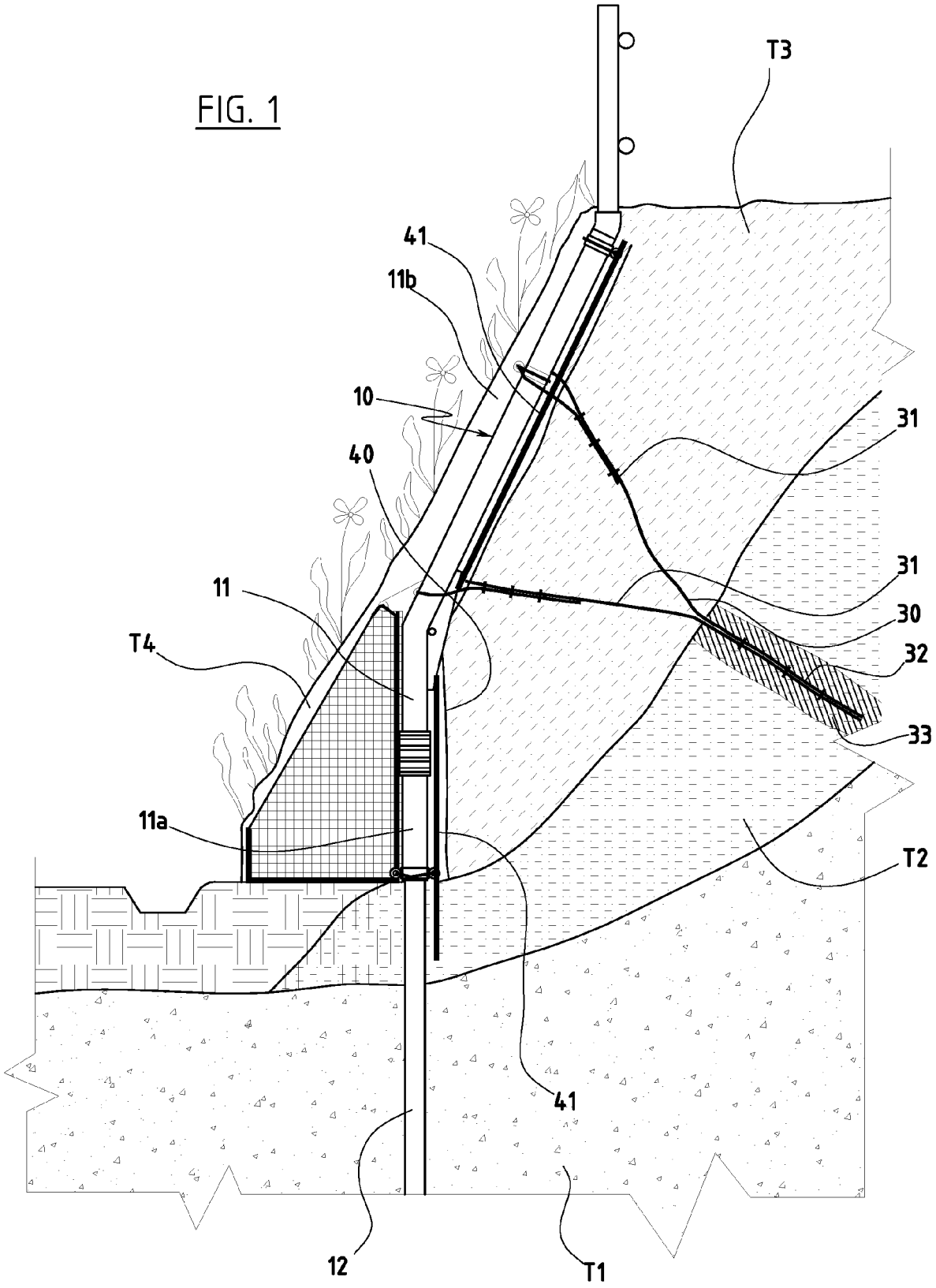
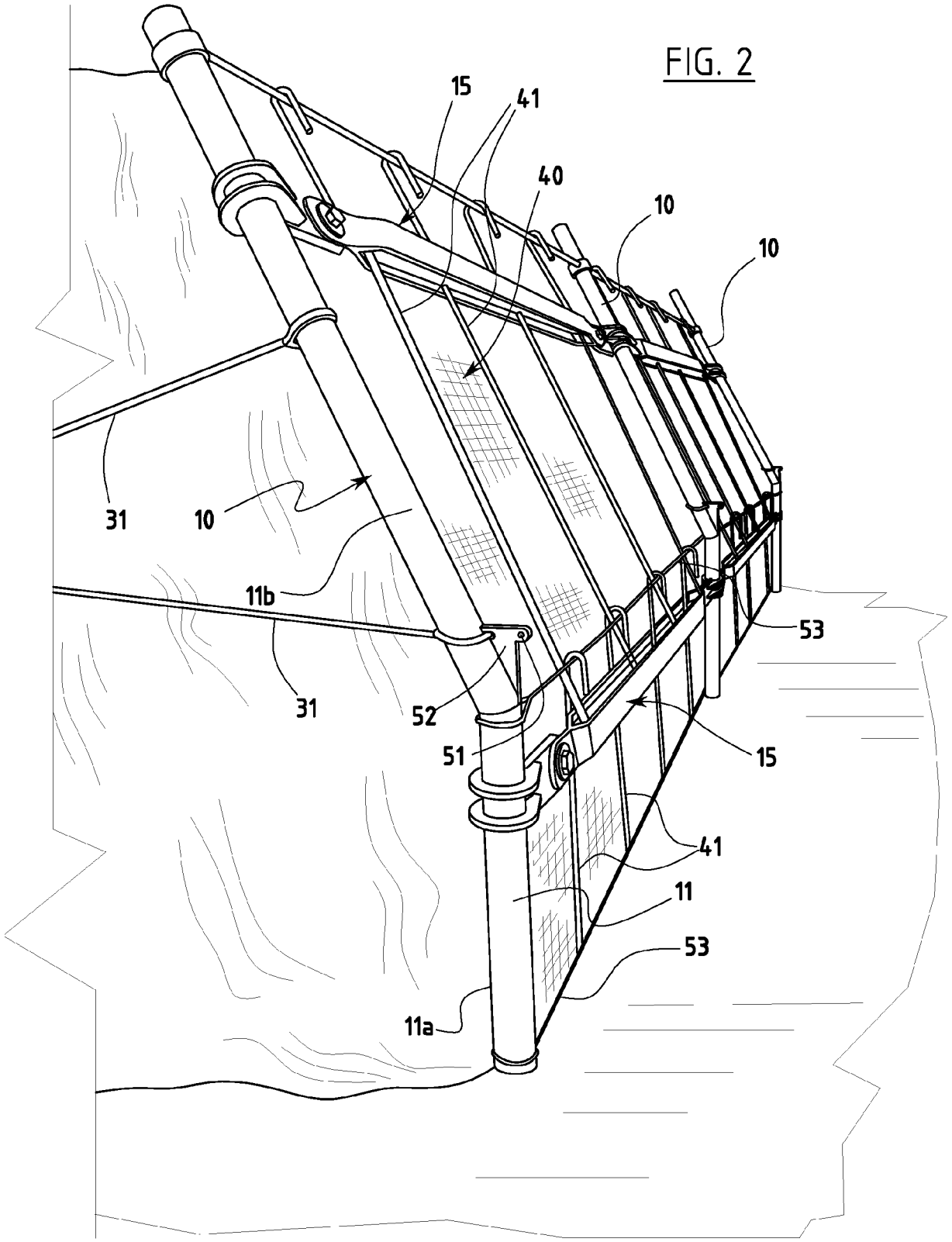


FIG. 2



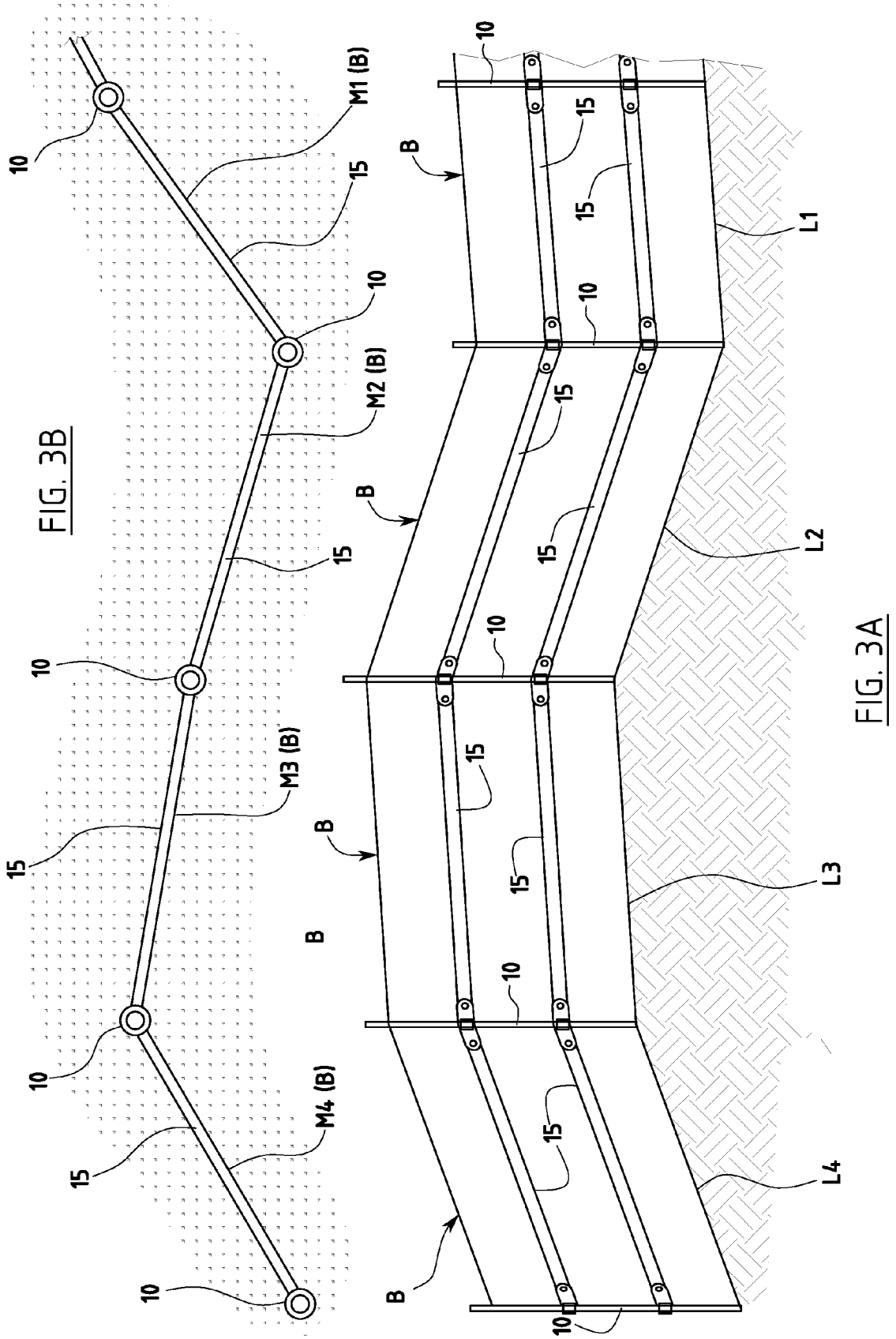

10
M1 (B)
15
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M2 (B)
15
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M3 (B)
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M4 (B)
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B
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L1
L2
L3
L4

FIG. 3B

FIG. 3A

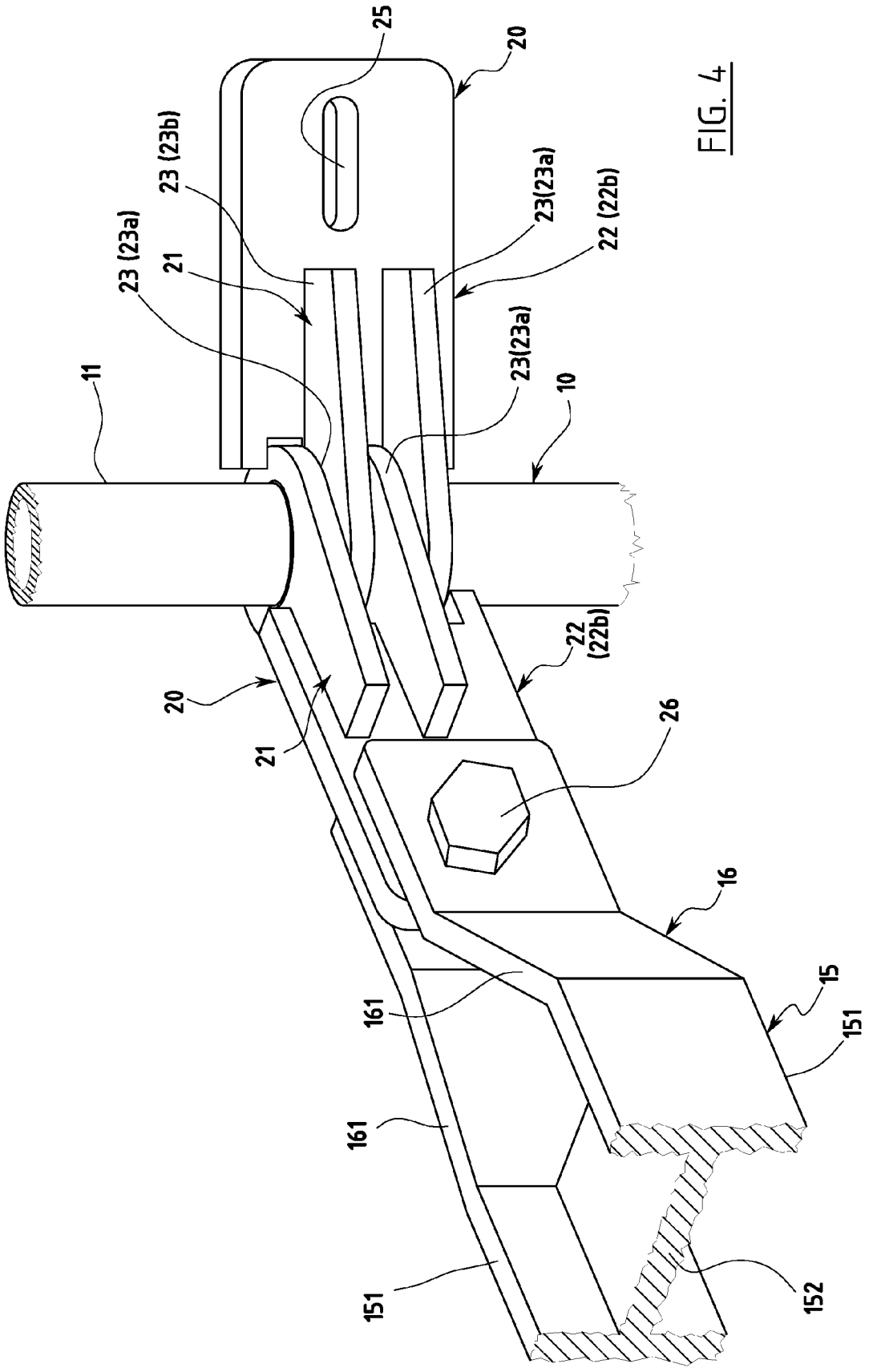

25
20
23 (23b)
23(23a)
22 (22b)
23 (23a)
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(22b)
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161
151
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152

FIG. 4

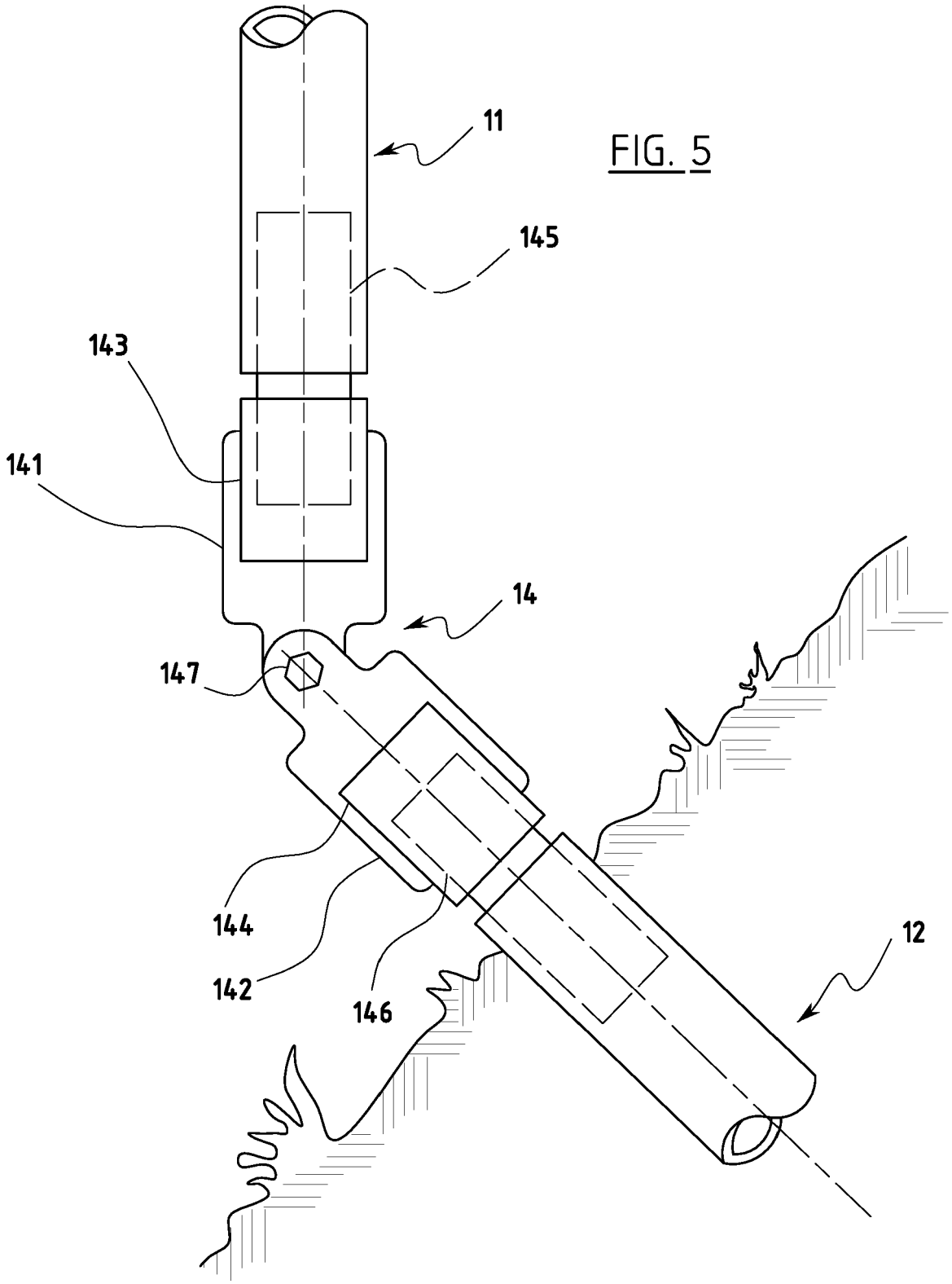


FIG. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 16 18 3351

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	FR 2 414 586 A1 (IND ENTREPRISE [FR]) 10 August 1979 (1979-08-10) * the whole document *	1-10	INV. E02D29/02 E02D5/80
A	US 5 299 781 A (BARRETT ROBERT K [US] ET AL) 5 April 1994 (1994-04-05) * the whole document *	1-10	

TECHNICAL FIELDS SEARCHED (IPC)

E02D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	11 October 2016	Geiger, Harald

CATEGORY OF CITED DOCUMENTS

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11-10-2016

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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