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(54) **ROAD SAFETY BARRIER HAVING CONTROLLED DISPLACEMENT**

(57) A road safety barrier (10, 10') having controlled displacement comprising a plurality of elongated elements (12) sequentially arranged on a surface (20) of a supporting ground (22), said elongated elements (12) being configured to form a continuous wall, wherein on said elongated elements (12) at least one vertically developing through opening (14) is formed, inside which a braking post (16) is slidably arranged, which engages said through opening (14) of said elongated element (12) by an upper portion (16') of its length, while a lower portion (16") of the same braking post (16) is configured to be inserted in the supporting ground (22) such as to plough through said supporting ground (22) in case of a vehicle's collision.

FIG.1B

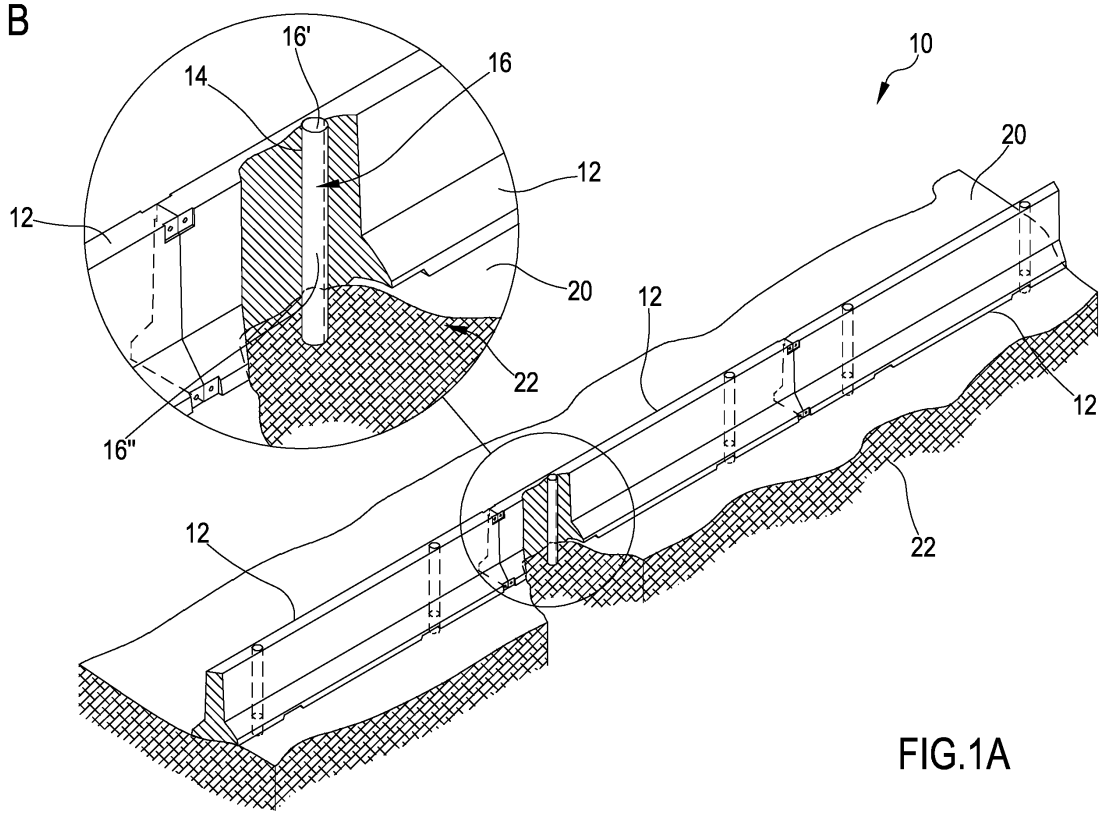

FIG.1A

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Description

[0001] The present invention relates to a road safety barrier having controlled displacement. More in particular, the present invention relates to a continuous road safety barrier having controlled inertial displacement as a result of a dynamic collision.

[0002] In the civil and road construction fields and in the road traffic safety field, the continuous safety barriers used as traffic divider for the directional split of a road or used as protection guard rails suitable for delimiting the roadway from the unpaved edges or the embankment of the roadway.

[0003] Said road safety barriers traditionally comprise elongated profiled elements or segments, typically made of concrete or other composite material, arranged in series along the direction of the road in order to form a continuous low wall barrier. These safety barriers also have a continuous vertical development, more often starting from the ground and gradually tapering up to a height generally ranging from about 80 up to 150 cm. Typical examples of these low-wall barriers are those of the *Jersey* barrier type, made in different shapes and types, with a double or simple slope of the vertical wall facing vehicular traffic, considered among the safest and most reliable barriers for vehicle protection as they allow to divert and re-direct a vehicle during a collision along the correct travel direction, often without considerable damage to people and without vehicular traffic interruption. Said safety barriers are also particularly safe for bikers which, in the event of a collision, are directly exposed to direct contact with the safety barriers. In fact, said barriers do not have discontinuous portions, undercuts, openings or parts of a structure such as posts and columns arranged along the direction of their longitudinal development, unlike other known types of metal safety barriers, made of deformable and assembled sections, which typically have only a continuous strip placed at a certain height from the roadway and therefore such as to cause considerable damage as a result of a collision. These known *Jersey* barrier-like continuous barriers are further advantageous as they do not require frequent maintenance, thus avoiding slowdowns and traffic interruptions which can in turn cause accidents.

[0004] These safety barriers can be placed on road supports consisting of natural road surfaces not covered by any paving or by road surfaces made of bituminous conglomerate or concrete. The static inertia of the barrier, intended as its ability to maintain its position upon a collision, depends on the mass of the elements that compose it and the sliding friction between the element itself and the type of road surface.

[0005] The safety barriers can also be weakly anchored to the roadway by means of deformable fastening elements or ones rigidly constrained to it, if they are arranged near road edges such as bridges, retaining walls or the like, for which it is necessary for the barrier to have limited freedom of movement or no freedom in the direction facing the void.

[0006] The fixed barriers, like the low wall type, contrariwise fall into the typology of traditional static structures as they are essentially defined by masonry works, typically in concrete, provided with foundations and rigidly stabilized and with no chance of movement to the road surface or directly formed on the structure or deck, e.g. of a bridge.

[0007] It is known from the experience and experimentation of the applicant in the field, that these barriers have an improved shock behaviour if they are allowed a certain freedom of movement of the consecutive elongated elements forming the barrier itself. This movement must be such as to allow the safety barrier to accelerate overcoming its static inertia, in order to be able to absorb the energy of collision with the vehicle moving at a limited distance and at the same time allowing the correction of the vehicle trajectory by re-conveying it in the direction of the road. In this case the vehicle retains most of its kinetic energy while the barrier absorbs part of its energy only during the change of direction. Moreover, a certain amount of displacement reduces the risk, during a collision, of a possible overturning or roll over of the vehicle above the barrier itself.

[0008] These known road safety barriers and their operation, however, have drawbacks and limitations of use.

[0009] An important limitation and drawback related to continuous safety barriers which simply rest on the road surface is due to the fact that the consecutive elongated element(s), affected by a collision, can move considerably, particularly in the case of high-energy collisions with high-speed or high-mass vehicles, an uneasy condition due to the usually limited or not available space on the edges of roadways. Even if said road safety barriers are used as central traffic dividers, too large a movement of the elongated elements of the barrier would cause disruption and accidents even in the part of the road designated for traffic in the opposite direction.

[0010] Said drawback is also present for safety barriers which are weakly anchored to the road surface by means of deformable and yielding elements, where in the event of high-energy potential collisions, and upon the failure of the anchors, the barrier is no longer contained and is free to move.

[0011] An important drawback, however, of the fixed or low wall-type barriers, rigidly stabilized to the road surface, is that of having no freedom of movement and therefore having a very low energy absorption capacity during the collision with the vehicle, causing an extreme deceleration of the same vehicle in the event of high-speed collisions or with a high angle of attack and such as to favour the overtaking of the vehicle, or roll over.

[0012] Therefore, while on the one hand a road safety barrier is sought to be able to have a certain freedom of movement following a collision, on the other hand a security barrier is sought to have not too much freedom of contained and limited movement, such as to not generate potentially dangerous situations.

[0013] The object of the present invention is to overcome the above-mentioned operating drawbacks and limitations.

[0014] More particularly, the object of the present invention is to provide a road safety barrier having controlled displacement, capable of having contained displacement within a limited space.

[0015] A further object of the present invention is to provide a road safety barrier having controlled displacement suitable to have a foreseeable and quantifiable displacement, comparable with the behaviour obtained through experimental tests in real test fields with compacted grounds having various resistances.

[0016] A further object of the present invention is to provide users with a road safety barrier which having controlled displacement able to be advantageously disposed on the edges of road surfaces facing the void as detected, retaining walls, decks and suspended structures of bridges without danger of leakage from the protection road surface.

[0017] Another object of the present invention is to provide users with a road safety barrier having controlled displacement, capable of being arranged either as a central traffic divider without danger of invasion of the track opposed to that of the collision, or as a road side protective element or guard rail.

[0018] A further object of the present invention is to provide a road safety barrier having controlled displacement able to guarantee a high level of resistance and reliability over time, such as to be produced easily and inexpensively.

[0019] These and other objects are achieved by the road safety barrier having controlled displacement in accordance with the independent claim.

[0020] The constructive and functional characteristics of the road safety barrier having controlled displacement, object of the present invention, can be better understood from the following detailed description, in which reference is made to the attached drawings which represent some preferred and non-limiting embodiments, wherein:

Figure 1A is an axonometric and partially sectioned schematic representation of the road safety barrier having controlled displacement, object of the present invention, arranged on the surface of a generic road support;

Figure 1B is a detailed axonometric schematic representation of Figure 1A;

Figure 2A is a cross-sectional schematic representation of the road safety barrier having controlled displacement, object of the present invention, placed on a natural ground surface;

Figure 2B is a cross-sectional schematic representation of a variation of the road safety barrier having controlled displacement, object of the present invention, arranged on a surface made of conglomerate material;

Figure 2C is a longitudinal section schematic representation of the road safety barrier having controlled displacement of Figures 2A and 2B;

Figure 3A is a cross-sectional schematic representation of a further embodiment of the road safety barrier having controlled displacement of Figure 2A arranged as a side barrier or guard rail;

Figure 3B is a cross-sectional schematic representation of a further embodiment of the road safety barrier having controlled displacement of Figure 2B arranged as a side barrier or guard rail;

Figure 4A is a schematic representation of a longitudinal section the road safety barrier having controlled displacement of Figure 3A;

Figure 4B is a schematic representation of a longitudinal section of the road safety barrier having controlled displacement of Figure 3B;

Figure 5A is a cross-sectional schematic representation of the road safety barrier having controlled displacement, arranged on a ground surface, in a further embodiment for high-energy collisions;

Figure 5B is a cross-sectional schematic representation of a variation of the road safety barrier having controlled displacement, object of the present invention, arranged on a surface made of conglomerate material in a further embodiment for high-energy collisions;

Figure 5C is a longitudinal section schematic representation of the road safety barrier having controlled displacement in the embodiment for high-energy collisions;

Figure 6 is an exemplary schematic representation of some cross sections of safety barriers of the Jersey barrier type, with a different shape.

[0021] With particular reference to Figure 1, the road safety barrier having controlled displacement, referred in the figures with the numeral reference 10, comprises a plurality of elongated elements 12 preferably, but not limited to, of the Jersey barrier type, indicatively in the form or cross-sections indicated in Figure 6, consecutively arranged on the surface 20 of a supporting ground 22 and configured to form a continuous wall, preferably without any interruption. With particular reference also to Figures 2A and 2B, the elements can be shaped differently in such a way as to generally define a wider section at the base and gradually tapered up to the upper end. Said elongated elements 12 are typically joined together at the respective contact ends by means of fastening elements 50. Said elongated elements 12 are preferably made of concrete, also reinforced, or other composite material having high mass. With reference to Figures 2A, 2B and 2C, on said elongated elements 12 at least one vertically developed through opening 14 is formed with respect to the section of the elongated element 12. In the preferred embodiments, with particular reference to Figure 2C, on each elongated element 12 two through openings 14 are preferably formed, arranged near the ends of each elongated element 12. With particular reference

now to Figures 2A and 2B, in each of said through openings 14 a braking post 16 is inserted, engaging said through opening 14 of said elongated element 12 with an upper portion 16' of its length while a lower portion 16", of the same braking post 16, is configured to be inserted in the supporting ground 22 below the surface 20.

[0022] Said braking post 16 is preferably, but not limited thereto, defined by a profiled element made of a metal material having a high mechanical resilience and with an open or closed external conformation or shaping, capable of being realized in various alternative forms suitable for facilitating or not the groove of the ground. In various possible embodiments said braking post 16 can be any tubular element or element made of solid material having a circular, polygonal or mixtilinear cross-section. The outer surface of the upper portion 16' said braking post 16 is advantageously coupled to the inner surface of said through opening 14 of the elongated element 12, in order to uniformly distribute the forces between the surfaces in contact with said elongated element 12 with said braking post 16. The cross-section of said braking post 16 is determined as a function of the supporting ground 22 in which the lower portion 16" of the braking post 16 is inserted.

[0023] Said braking post 16 is configured to be inserted in the supporting ground 22, below the surface 20, for a variable depth corresponding to its lower portion 16" which may have variable length depending on the material of which the supporting ground 22 is constituted or of the type of collisions to which the barrier must resist. The same post can also advantageously be inserted into suitable preformed holes, not shown, in the supporting ground 22.

[0024] The size of the cross-section and the external shaping of said braking post 16, as well as the depth size of the lower portion 16", configured to be inserted in the supporting ground 22 below the surface 20, determine the capacity of said braking post 16 to plough and dig through said supporting ground in the event of a collision, thereby dissipating the absorbed energy into the ground. Said post may have a cross-section and an orientation of its lower portion with conformations suitable for ploughing or digging through it more or less easily, in preferential directions.

[0025] Referring again to Figures 1A to 2C, and also to Figures 3A and 3B, said supporting ground 22, configured to be ploughed through by said braking post 16, may simply comprise more or less thickened ground, which may also comprise binding elements. In an alternative embodiment said supporting ground can comprise a bituminous conglomerate with a variable sand content determining the its cohesion level and its resistance to be ploughed through by the braking post 16.

[0026] With particular reference now to Figures 2C, 4B and 5C, said supporting ground 22, can comprise a strip of continuous material above which the safety barrier 10 is arranged and in which said braking posts 16 are inserted.

[0027] In an alternative embodiment, with particular reference to Figures 3A, 4A and 5A, the supporting ground 22 configured to be ploughed through, can be arranged in a discontinuous manner at the braking posts 16 within ground volumes 24. Said ground volumes 24 may have dimensions and shape calculated by means of experimental tests on test tracks and may comprise and be contained in metal cages 24' suitably filled with material and arranged as a substitute for the natural supporting ground of the road, in such a way to reproduce the behaviour of the experimental tests with the same real test grounds. A description of said containment metal cages is found in Italian patent application No. 102015000078451.

[0028] This alternative embodiment allows to use a supporting ground having known and tested features also on road surfaces which have a non-uniform or unsuitable ground to be excavated, such as concrete.

[0029] In a further embodiment, with particular reference to Figures 5A to 5C, the safety barrier 10' having controlled displacement comprises a braking post 18 with an upper end 16' extending externally beyond the upper end of the respective elongated element 12. Said upper end 16' of said braking post 16 is configured to be connected and stabilized by means of known fastening means with one or more connecting transverse bars 18 connecting several braking posts 16 in order to create a single supporting structure having greater height supporting the elongated elements 12.

[0030] The present invention also intends to provide a kit for road safety barrier (10, 10') having controlled displacement comprising at least one elongated element 12 and at least one braking post 16, suitable for replacing damaged or worn elements.

[0031] From the description of the road safety barrier having controlled displacement 10, 10' which is the object of the present invention, the operation described below can be seen.

[0032] With reference again to Figures 1A to 2C, the road safety barrier having controlled displacement 10 is configured to be disposed on any type of yielding and partially cohesive supporting ground 22. The elongated elements 12 are supported on the surface 20 of said supporting ground 22. The braking posts 16 are slidably inserted into the through opening 14 of the elongated elements 12 until they come into contact with the surfaces 20 and are forcibly inserted into the supporting ground 22 or arranged into the preformed holes in the same supporting ground 22, such that the lower portion 16" of the braking post 16 is surrounded by material of the supporting ground 22.

[0033] In the event of impact or collision with a vehicle, the kinetic energy absorbed by the elongated elements 12 is transferred to the braking post 16 and dissipated in the supporting ground 22 by means of the controlled ploughing action performed by the braking post 16 itself in the supporting ground 22 by means of its lower portion

16". Therefore, the kinetic energy of the vehicle is not completely absorbed by the elongated elements 12, by which it would be dissipated with the displacement of the elongated elements 12 of an amount proportional to the collision energy, but dissipated and consumed in the ploughing work of the supporting ground 22 by the braking posts 16. This ploughing work limits and controls the lateral displacement of the elongated elements 12 during the time interval in which the contact with the vehicle takes place and to the extent in which the displacement is necessary for conveying the vehicle along the road direction.

[0034] The control and containment of the displacement of the road safety barrier 10, with particular reference to Figures 3A and 3B, allow the advantageous arrangement of the barrier itself in limited or overlooking spaces such as, e.g., raised or decked road edges of suspended structures such as bridges.

[0035] Furthermore, in order to have a calculable and uniform behaviour and displacement and to meet the safety requirements of the resistance classes imposed by the safety standards (e.g., European standards EN 1316'), the road safety barrier having controlled displacement 10 must be checked by experimental tests on real test fields with variable supporting ground compositions and dimensions. The composition characteristics of the various materials constituting the supporting ground 20, as well as the calculated dimensions, must be reproduced during the installation step of the road safety barrier 10.

[0036] With particular reference to Figures 2C and 4B, such reproduction is carried out, in a first embodiment, by placing a continuous strip of supporting ground 22 having tested composition and dimensions, along the direction where the road safety barrier 10 is located. In the alternative embodiment of Figures 3A and 4A, the supporting ground 22 is arranged in a discontinuous manner in volumes of material 24 located at the braking posts 16. These volumes of material 24 are obtained in the road surface and can be defined by metal cages 24' filled with ground, bituminous conglomerate or other material configured to be ploughed through in such a way as to have a behaviour of the road safety barrier 10 similar to that experienced in the tests.

[0037] In the alternative embodiment of Figures 5A to 5C, the road safety barrier having controlled displacement 10' defines a metal structure which connects the upper portions 16' of the braking posts 16 by means of the transverse bars 18 in order to form a barrier having a higher height and suitable to contain even heavy vehicles in the event of high-energy collisions, preventing them from overturning above the safety barrier 10'.

[0038] As it can be seen from the foregoing, the advantages achieved by the road safety barrier having controlled displacement of the present invention are evident.

[0039] The road safety barrier having controlled displacement, object of the present invention, is particularly advantageous because it allows its use in reduced spaces where its movement after a collision must be controlled and limited, at the same time dissipating the energy of the collision in an effective way.

[0040] The road safety barrier having controlled displacement is also particularly advantageous as it allows it to be arranged either as a traffic divider or as a side barrier or guardrail in areas overlooking the vacuum or on bridges also reducing the installation obstruction.

[0041] A further advantage of the road safety barrier having controlled displacement is to be able to reproduce the test conditions experimentally tested in any place.

[0042] A further advantage of the road safety barrier having controlled displacement is that it can be advantageously resistant to high-energy collisions and as an anti-overturning containment barrier.

[0043] Although the invention has been described above with particular reference to some preferred embodiments, given only by way of non-limiting example, numerous modifications and variations will be obvious to a person skilled in the art in the light of the above description. The present invention, therefore, intends to embrace all modifications and variations which fall within the spirit and in the protective scope of the following claims.

Claims

1. A road safety barrier (10, 10') having controlled displacement comprising a plurality of elongated elements (12) sequentially arranged on a surface (20) of a supporting ground (22), said elongated elements (12) being configured to form a continuous wall, **characterized in that** on said elongated elements (12) at least one vertically developing through opening (14) is obtained, inside which is slidably arranged a braking post (16) which engages said through opening (14) of said elongated element (12) by an upper portion (16') of its length, while a lower portion (16") of the same braking post (16) is configured to be inserted in the supporting ground (22) such to plough through said supporting ground (22) in case of a vehicle's collision

2. Road safety barrier (10, 10') according to claim 1, wherein said elongated element (12) defines a wide section at the base and gradually tapering to the upper end.

3. Road safety barrier (10, 10') according to claim 1, wherein said elongated element (12) is made of concrete.

4. Road safety barrier (10, 10') according to claim 1, wherein said braking post (16) is defined by a section bar element made of metal material having a high mechanical resilience.

5. Road safety barrier (10, 10') according to claim 1, wherein said supporting ground (22) comprises more or less thickened soil.

6. Road safety barrier (10, 10') according to claim 5, wherein said soil comprises binder elements.

7. Road safety barrier (10, 10') according to claim 1, wherein said supporting ground (22) comprises a bituminous mixture.

8. Road safety barrier (10, 10') according to claim 7, wherein said bituminous mixture comprises a variable contents of sand.

9. Road safety barrier (10, 10') according to claim 1, wherein said supporting ground (22) comprises a strip of continuous material above which the safety barrier (10, 10') is arranged.

10. Road safety barrier (10, 10') according to claim 1, wherein said supporting ground (22) comprises ground volumes (24) arranged in discontinuous manner at the braking posts (16).

11. Road safety barrier (10, 10') according to claim 10, wherein said ground volume (24) comprises metal cages (24') filled with material.

12. Road safety barrier (10, 10') according to claim 10, wherein said ground volumes (24) have dimensions calculated by means of experimental tests on test tracks.

13. Road safety barrier (10') according to claim 1, comprising a braking post (16) with an upper end (16') extending outside beyond the upper end of the respective elongated element (12), said upper end (16') being intended to be connected and stabilized by means of fastening means with one or more transverse bars (18) connecting several braking posts (16).

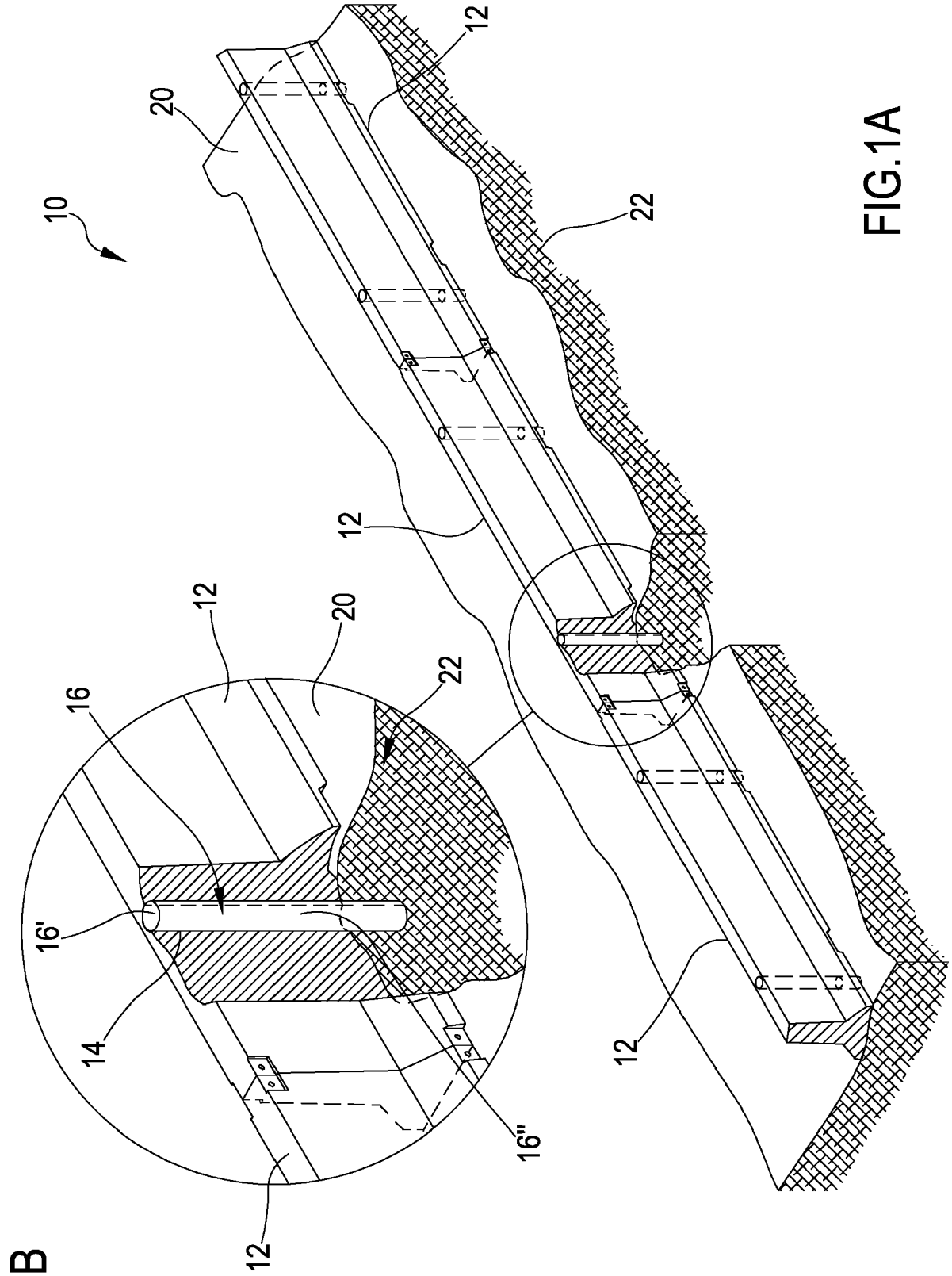

FIG.1A

FIG.1B

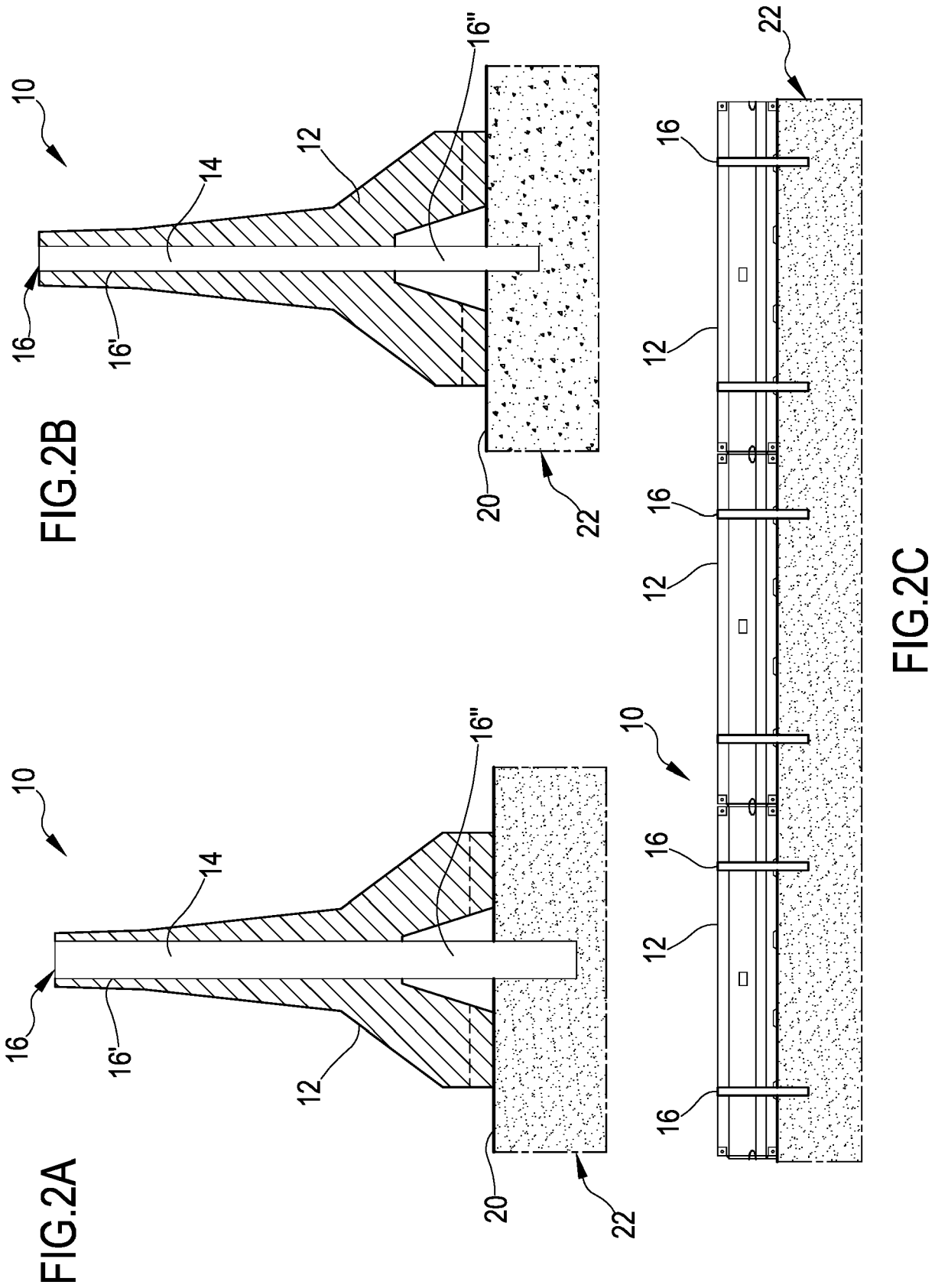

FIG.2A

FIG.2B

FIG.2C

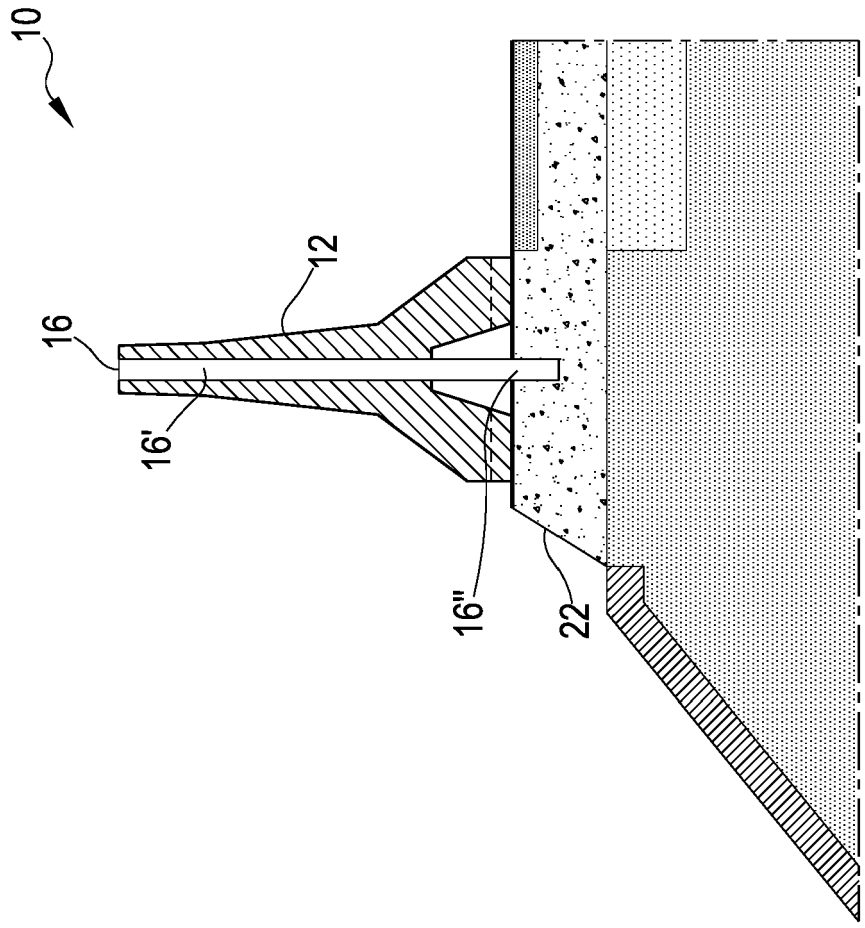

FIG.B

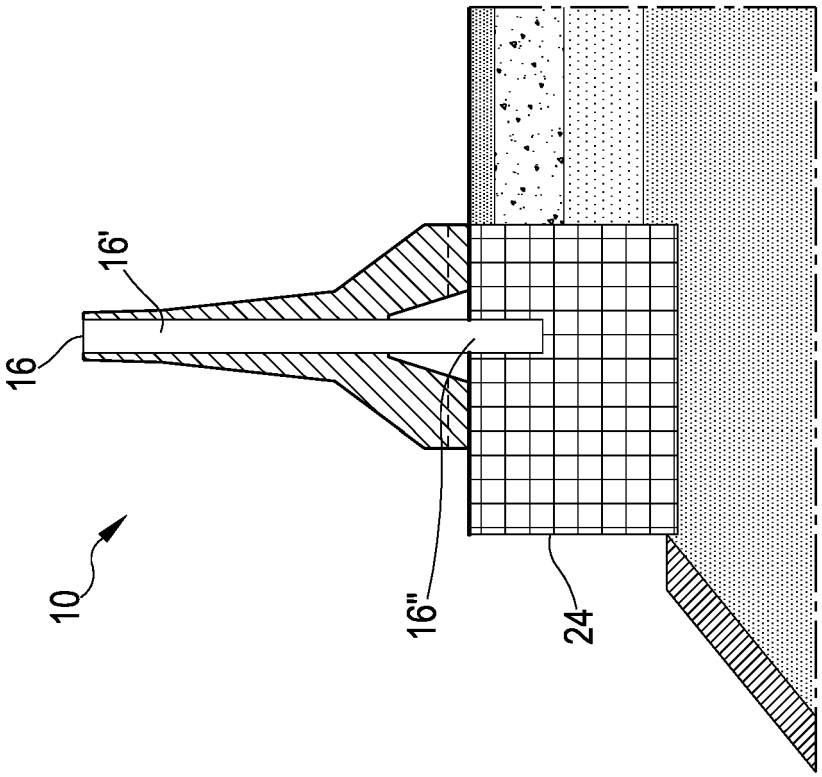

FIG.3A

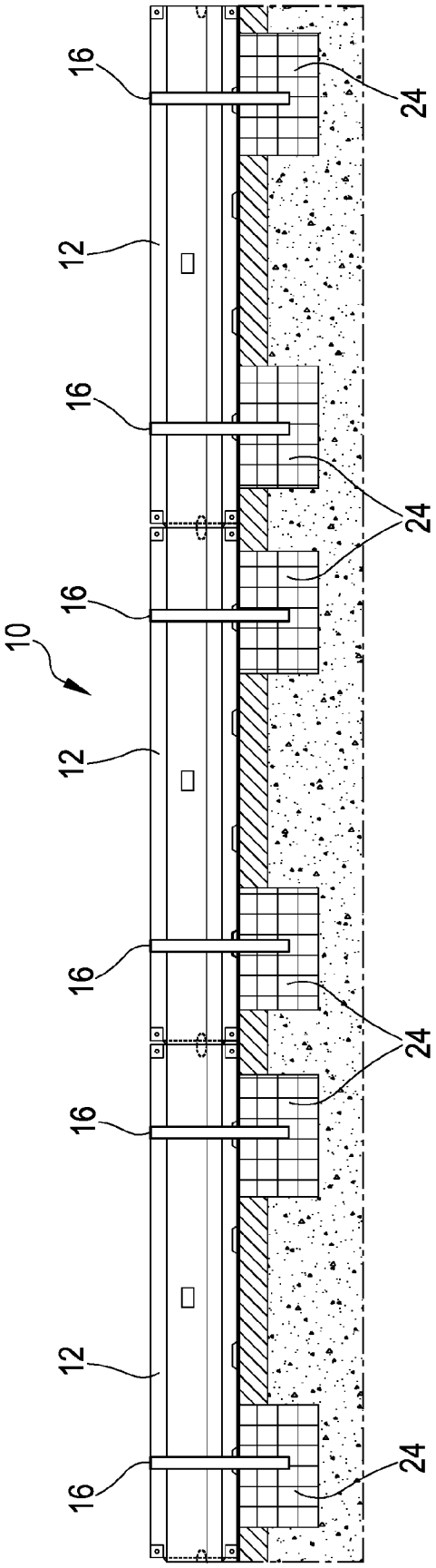

FIG.4A

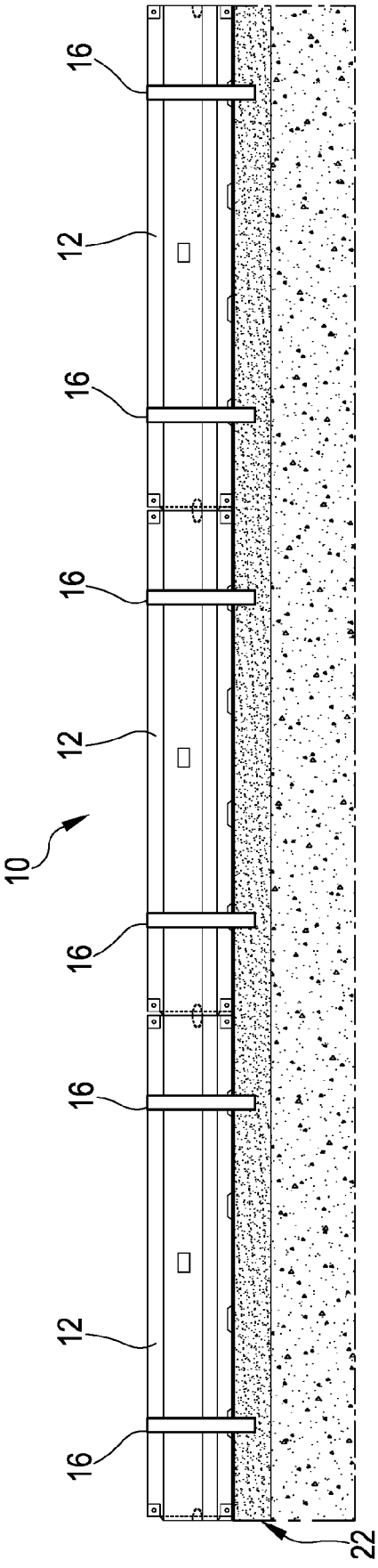

FIG.4B

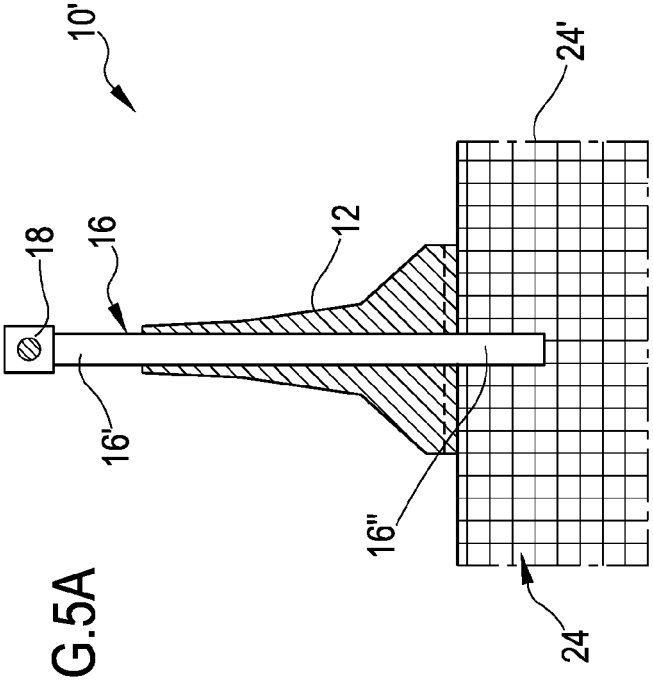

FIG.5A

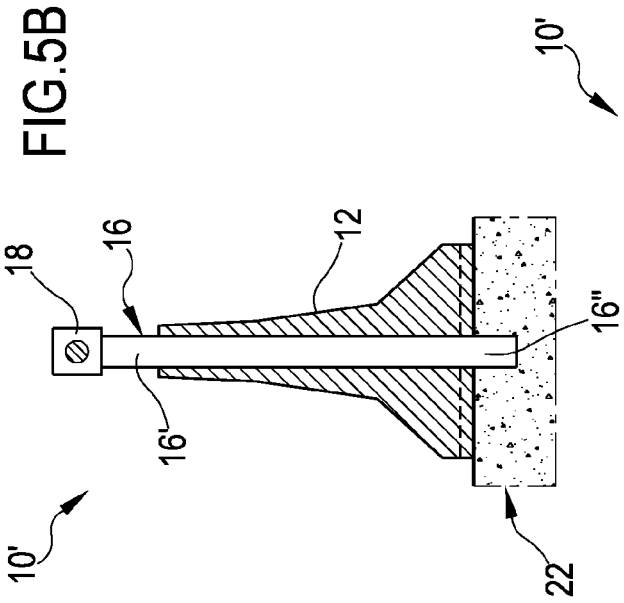

FIG.5B

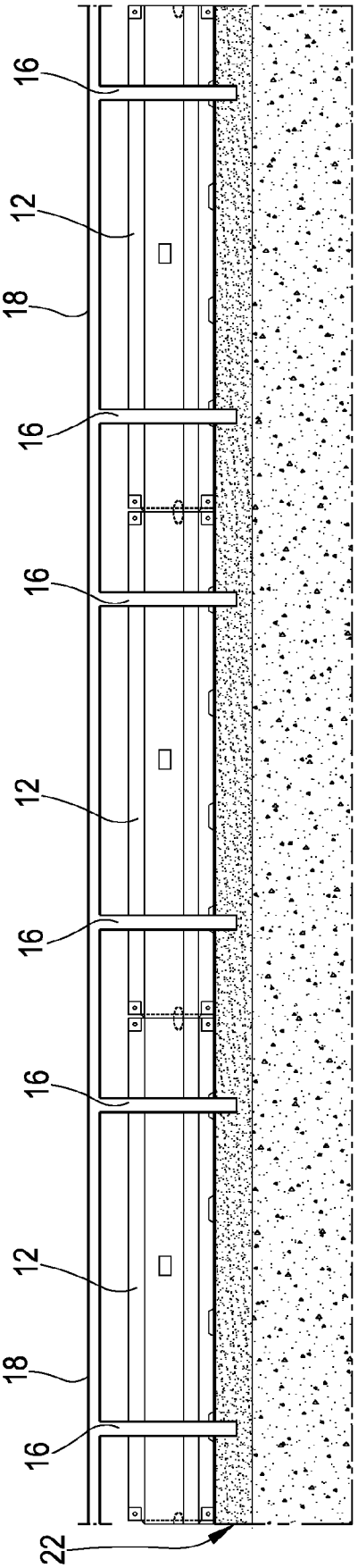

FIG.5C

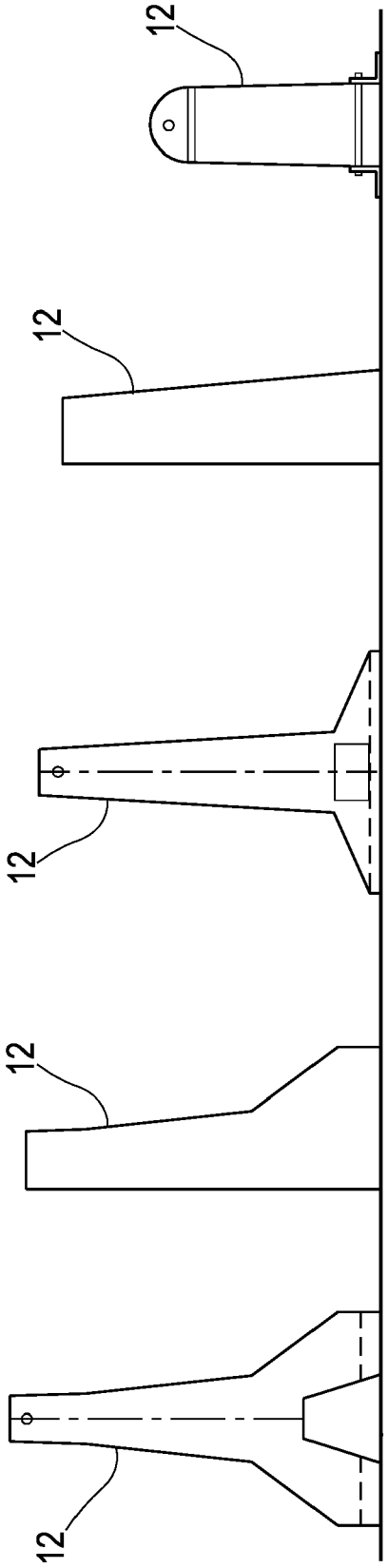

FIG.6

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EUROPEAN SEARCH REPORT

Application Number
EP 18 17 0339

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	FR 2 749 329 A1 (PLATTARD SA [FR]) 5 December 1997 (1997-12-05) * the whole document *	1-13	INV. E01F15/08
X	US 2004/076468 A1 (MCKAY MICHAEL DONALD [US] ET AL) 22 April 2004 (2004-04-22) * the whole document *	1-13	

TECHNICAL FIELDS SEARCHED (IPC)

E01F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	17 September 2018	Flores Hokkanen, P

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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E : earlier patent document, but published on, or after the filing date
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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17-09-2018

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR 2749329 A1	05-12-1997	NONE	
US 2004076468 A1	22-04-2004	NONE	

EPO FORM P0459

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

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Patent documents cited in the description

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