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(54) Injection anchor for tunnels and trenches

Injektionsanker für Tunnel und Gräben

Douille d'ancrage à injection pour les tunnels et les tranchées

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Description

[0001] The present invention relates to a device for consolidating and stabilizing ground, to preventing collapse or deformation of the ground during excavation of tunnels or trenches. A device having the features as set forth in the preamble portion of claim 1 is known for example from FR-A-2,101,916.

[0002] Excavation in tunnels and the like, especially in clay formations, often involves serious problems relating to the stability of the working face (breast) which, due to removal of the ground, loses some of its ability to withstand the stresses caused by advancement of the excavation.

[0003] As is known, in order to stabilize the ground during these excavations, boreholes are made on the face, in which tubes, normally of synthetic material, are inserted as reinforcement.

[0004] The boreholes are then filled with cement mortar, which acts as a binding and retaining element.

[0005] This procedure, though widely used, has not always proved effective, since it does not always permit a good uniform distribution of the cement mortar and it does not allow localized high-pressure injections to be carried out, which would allow consolidation and recompacting of the ground.

[0006] Furthermore, the small area of contact between the tube and the cement mortar and the low adhesion coefficient of the tube surface do not allow the resistance of the reinforcement to be transmitted completely to the ground, thus leaving it partly unused.

[0007] When working in restricted spaces or with boreholes whose length exceeds that of the tubular reinforcements that can be transported to the site, it is necessary to make joins in the reinforcement, by gluing for example, which is unlikely to allow the strength of the tube to be kept constant along the entire borehole.

[0008] The aim of the present invention is to overcome all the disadvantages listed above, providing a device for stabilizing the excavation or working face and preventing landslides or deformation of the ground in tunnels or trenches, which ensures that the reinforcement is highly resistant.

[0009] Another aim of the invention is to allow the high tensile strength of the reinforcement to be transmitted to the injection mixture even over very short lengths.

[0010] Yet another aim of the invention is to guarantee complete and uniform distribution of the cement mixture inside the borehole by means of a plastic tube, advantageously with valves.

[0011] Yet another aim of the invention is to guarantee the possibility of inserting reinforcements of any length, even in very small spaces and without transport problems, with no breaks or falls in the strength of the reinforcements along the entire borehole.

[0012] The device according to the invention presents the characteristics listed in the attached claims.

[0013] It comprises a plurality of strong elements, made from glass fibres impregnated with synthetic resins (fibreglass-reinforced plastic) mounted by means of centering spacers around a plastic injection tube, preferably a valved tube.

[0014] With such a device it is possible to exploit the known method of localized repeated injection of consolidating chemical or cement mixtures, by means of tubes with valves which, with pressures even higher than 100 bar, allow consolidation of the rock and also recompression of materials with low permeability using the claquage method.

[0015] The device is kept perfectly centered in the injection mixture by means of centering spacers; in this way the surfaces of the reinforcement, consisting of fiberglass-reinforced plastic straps, are completely surrounded by the cement, and a possible surface treatment of the straps with quartz sand allows a complete bond between reinforcement and injected mixture, thus allowing the reinforcement's strengthening capacity to be completely transmitted to the ground.

[0016] Lastly the strengthening elements of the device, that is the straps, can be rolled for transport, and the device itself can be assembled directly near the borehole, allowing continuous reinforcements to be made, without any break in strength, with a length of the order of a hundred metres.

[0017] Further characteristics of the invention will be made clearer by the detailed description that follows, referring to a purely exemplary, and therefore non-limiting, embodiment thereof, illustrated in the attached drawings, in which:

Figure 1 is an axonometric partially exploded view of a device according to the invention;

Figure 2 is a cross section taken along the line II-II of Figure 1;

Figure 3 is a longitudinal section diagrammatically illustrating how the device works inside a borehole, during injection;

Figure 4 is an enlargement of the detail indicated by A in Figure 3;

Figure 5 is a diagrammatic cross section showing a typical example of use of the device according to the invention for excavation of tunnels;

[0018] In Figure 5 an excavation front or working face 1 of a tunnel 2 being dug in ground 3 of any type is illustrated.

[0019] Structural elements 4 are inserted in the ground 3 and in the front 1, in order to consolidate the ground.

[0020] In particular the structural elements inserted in the excavation front 1 serve as reinforcements for consolidation and stabilization of the ground, so as to pre-

vent landslides or deformation of the ground during excavation of the tunnel.

[0021] According to an embodiment of the invention, the structural elements 4 for consolidation of the front 1 consist of a device comprising a tube 5 which in the figures is shown as a tube with valves around which a plurality of fiberglass straps 7 (three in the example) are positioned by means of centering spacers 6.

[0022] The centering spacers 6 are put on the tube 5, whilst the strong fiberglass straps 7 are fitted outside them and fixed to them by means of fastening elements 8 consisting, for example, of a metal band or a binding of fiberglass reinforced adhesive tape.

[0023] In the example shown, which is the preferred embodiment of the device, the tube 5 is provided with "manchette" valves 10 (i.e. valves comprising an elastic annular band around a perforated portion of the tube) which, as is known, when subjected to pressure within the tube 5, allow the injection mixture to escape through the holes 11 (see Figure 4), completely surrounding the straps 7 and completely filling the borehole 20 in which the device is inserted.

[0024] It will later be possible to return inside of the tube 5 with a packer 21 (Figure 4) to carry out localized injections 22, locally injecting the individual valves 10, thus eliminating any injection defects and, if necessary, consolidating the surrounding ground.

[0025] In the case of a tube without valves, a single uniform injection of cement mortar will be made, filling the borehole 20 and coming out of the open front end 23 of the tube 5. The cone-shaped cap 24 disposed at the front end of the tube 5 serves only as guide to facilitate insertion of the device 4 into the borehole 20, without obstructing the outlet end 23 of the tube.

[0026] The fiberglass straps 7, thanks to their shape, ensure a greater area of contact with the injection mixture 22 than would a tubular cross section with the same resistance section.

[0027] Furthermore, during construction a quartz sand coating is advantageously applied to the surface of said straps, making it possible to obtain a very high friction coefficient and a good chemical compatibility with the injection mixtures.

[0028] It is thus possible to transmit all the strength of the reinforcement to the ground, preventing landslides or ground settling, even with very limited anchoring lengths.

[0029] The device according to the invention also has the peculiarity of being able to be assembled easily near the borehole.

[0030] In this case, the fiberglass straps 7 can be rolled in the desired length with an external diameter of less than 2.30 metres, whilst the tubes 5, manufactured in the desired lengths, have threaded ends 30 and are complete with coupling sleeves 31, threaded on the inside.

[0031] Hence all the material can be easily transported near the borehole, though creating structural elements with lengths of the order of a hundred metres which do not have any decrease in strength along the entire borehole since a continuous reinforcement (created by the straps 7) can be used without additions or breaks.

[0032] Obviously the invention is not limited to the particular embodiment described above and illustrated in the attached drawings, but a number of changes can be made to the details, without departing from the scope of the invention itself which is defined by the claims that follow.

Claims

1. A device for reinforcement, consolidation and stabilization of the ground, to prevent landslides or deformations of the excavation front in tunnels or trenches, comprising an injection tube (5) for injecting cement mortar, said tube to be inserted in a respective borehole (20) in the ground (3), **characterized in that** it has a plurality of reinforcing elements (7) **in the form of continuous straps made of fiberglass, or aramidic fibre, or carbon fibre, or polyvinyl alcohol fibre or the like,** mounted by means of centering spacers (6) around said tube (5) and possibly held together by external fastening elements (8), **no means being provided for tensioning said reinforcing elements (7).**

2. A device according to claim 1, **characterized in that** said reinforcing elements (7) have their outer surface treated with a coating of quartz sand.

3. A device according to any one of the preceding claims, **characterized in that** said tube (5) has an open front end (23) where a cone-shaped guide cap (24) is provided.

4. A device according to any one of the previous claims, **characterized in that** said tube is a valved tube (5), provided with manchette valves for localized injections.

5. A device according to any one of the preceding claims, **characterized in that** said tube (5) is manufactured in elements that can be joined together by means of coupling sleeves (31) that can be screwed on terminal threads (30) of said tube elements.

6. A device according to any one of the preceding claims **characterized in that** said retaining elements (8) holding the reinforcing elements (7, 7') consist of metal bands, binding with fiberglass reinforced adhesive tape and the like.

Patentansprüche

1. Vorrichtung für die Erdarmierung, -befestigung und -stabilisation, die zur Verhinderung von Erdrutschen oder Verformungen an der Vortriebsstelle in Tunnels oder Straßeneinschnittausgrabungen geeignet ist, die ein Einspritzrohr (5) für Zementmörtel umfaßt, das in eine entsprechend in das Erdreich (3) ausgeführte Bohrung (20) einzusetzen ist, dadurch gekenzeichnet, daß sie eine Vielzahl von Armierungselementen (7) in Form von durchgehenden Gurten aus Fiberglas, oder Aramidfaser, oder Kohlefaser bezw. Polyvinylalkoholfaser o.ä. aufweist, die mit Hilfe von Zentrierdistanzstücken (6) um das genannte Rohr (5) montiert und möglichst von Außenbefestigungselementen (8) zusammengehalten sind, wobei keine Elemente zur Spannung der genannten Armierungselemente (7) vorgesehen sind.

2. Vorrichtung nach Patentanspruch 1, **dadurch gekennzeichnet, daß** die besagten Armierungselemente (7) eine Außenoberfläche haben, die mit einer Quarzsandverkleidung behandelt ist.

3. Vorrichtung nach irgendeiner der vorherigen Patenansprüche, **dadurch gekennzeichnet, daß** das besagte Rohr (5) am vorderen Ende (23) geöffnet ist und einschließlich mit einer kegelförmigen Führungsventilkappe (24) ausgestattet ist.

4. Vorrichtung nach irgendeiner der vorherigen Patentansprüche, **dadurch gekennzeichnet, daß** das besagte Rohr (5) ein mit einem Ventil versehenes Rohr ist, das mit Muffenventile für lokalisierte Einspritzungen ausgestattet ist.

5. Vorrichtung nach irgendeiner der vorherigen Patentansprüche, **dadurch gekennzeichnet, daß** das besagte Rohr (5) aus untereinander zusammenfügbaren Elementen (31) hergestellt ist, die durch Verbindungsmuffen (31) auf Endgewinden (30), der besagten Rohrelemente, anschraubbar sind.

6. Vorrichtung nach irgendeiner der vorherigen Patentansprüche, **dadurch gekennzeichnet, daß** die besagten Dichtungselemente (8) der Armierungselemente (7,7') aus Metallfacetten, aus mit Glasfasern verstärkte Klebbandverbänden und ähnliches bestehen.

Revendications

1. Dispositif destiné à la réalisation d'une armature, à la consolidation et à la stabilisation du terrain permettant d'empêcher tout éboulement ou déformation du front de fouilles dans des galeries ou de fouilles en tranchées, comprenant un tube d'injection (5) pour injecter le mortier de ciment, ledit tube devant être introduit dans un orifice correspondant (20) réalisé dans le terrain (3), **caractérisé par le fait qu'**il prévoit plusieurs éléments d'armature (7) ayant la forme de plats continus réalisés en fibres de verre ou en fibres aramides ou en fibres de carbone ou en fibres de polyvinyle-alcool ou encore dans des matériaux analogues, montés à l'aide d'entretoises de centrage (6) autour dudit tube (5) et maintenus autant que possible assemblés par des éléments de fixation extérieurs (8), aucun dispositif n'étant prévu pour tendre lesdits éléments d'armature (7).

2. Dispositif selon la revendication 1, **caractérisé par le fait que** la surface extérieure des éléments de l'armature (7) est traitée à l'aide d'un revêtement de sable de quartz.

3. Dispositif selon une revendication quelconque des précédentes, **caractérisé par le fait que** l'extrémité antérieure (23) du dit tube (5) est ouverte et **par le fait que** celui-ci est muni d'un chapeau conique de guide (24).

4. Dispositif selon une revendication quelconque des précédentes, **caractérisé par le fait que** ledit tube (5) est un tube avec des vannes, muni de vannes à manchettes pour des injections localisées.

5. Dispositif selon une revendication quelconque des précédentes, **caractérisé par le fait que** ledit tube (5) est formé d'éléments qui peuvent être raccordés les uns aux autres à l'aide de manchons de jonction (31) pouvant être vissés sur des filetages terminaux (30) des dits éléments du tube.

6. Dispositif selon une revendication quelconque des précédentes, **caractérisé par le fait que** lesdits éléments de tenue (8) des éléments de l'armature (7, 7') sont constitués par des colliers métalliques et des bandages réalisés à l'aide d'un ruban adhésif renforcé par des fibres de verre et matériaux analogues.

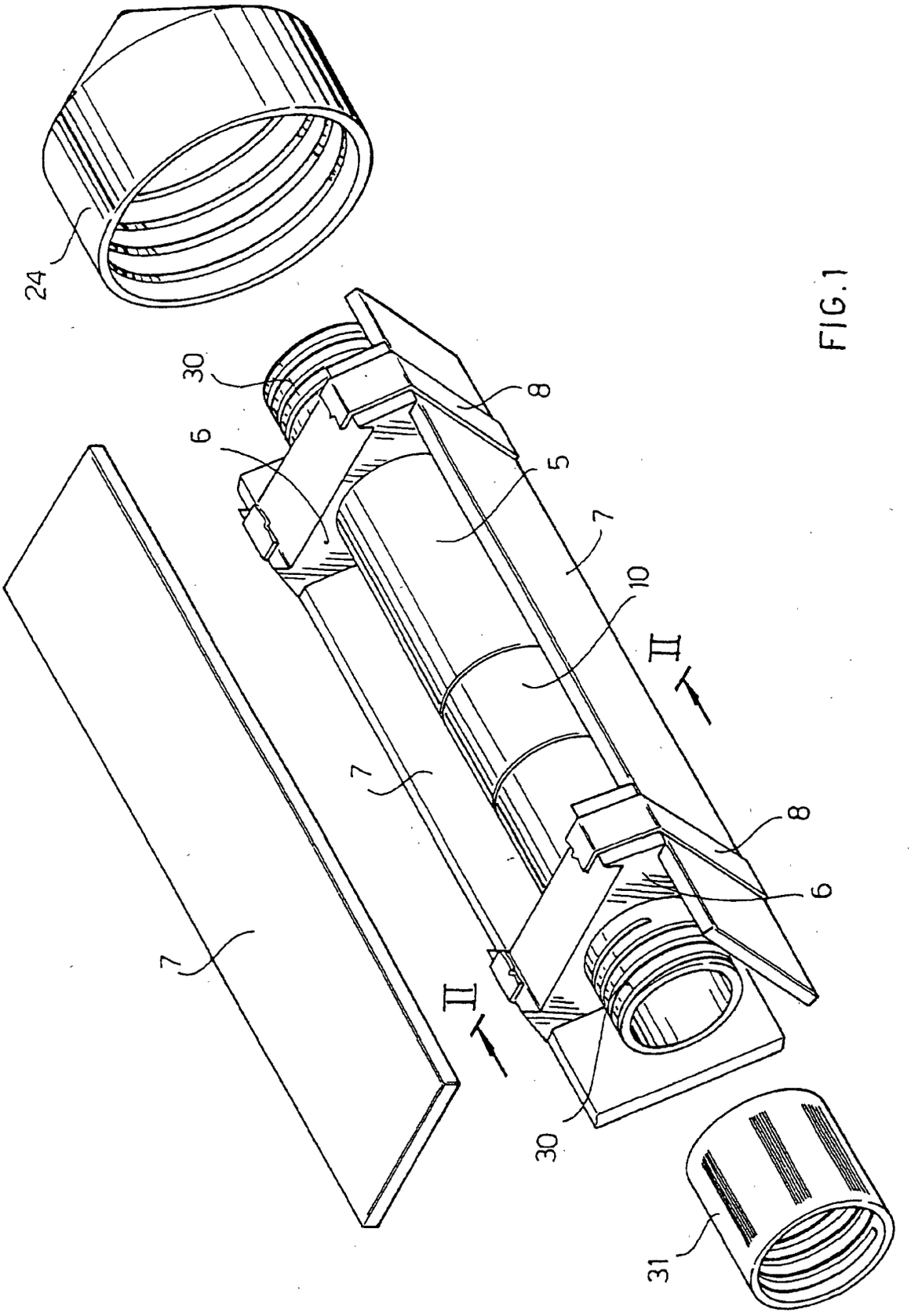

FIG.1

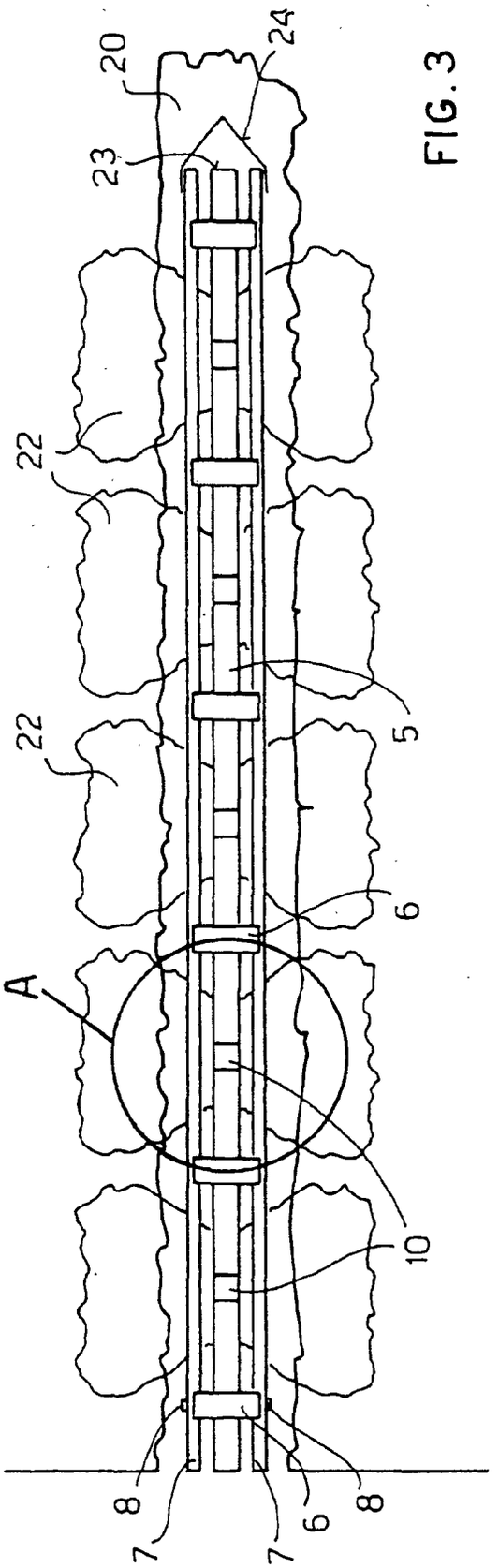

FIG. 3

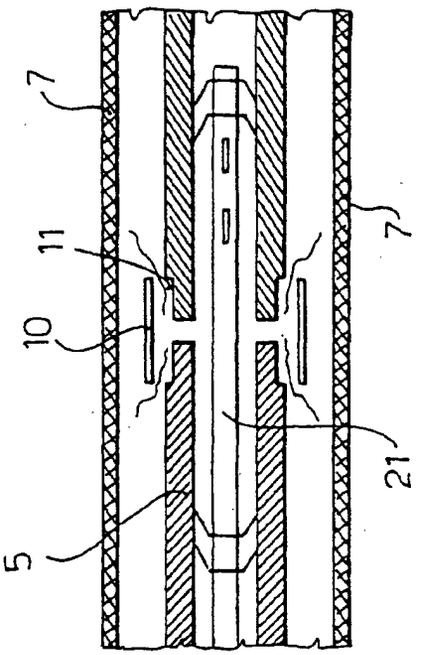

FIG.4

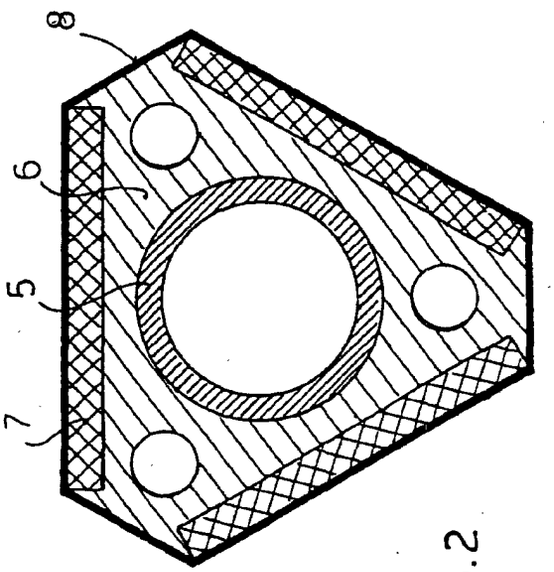

FIG.2

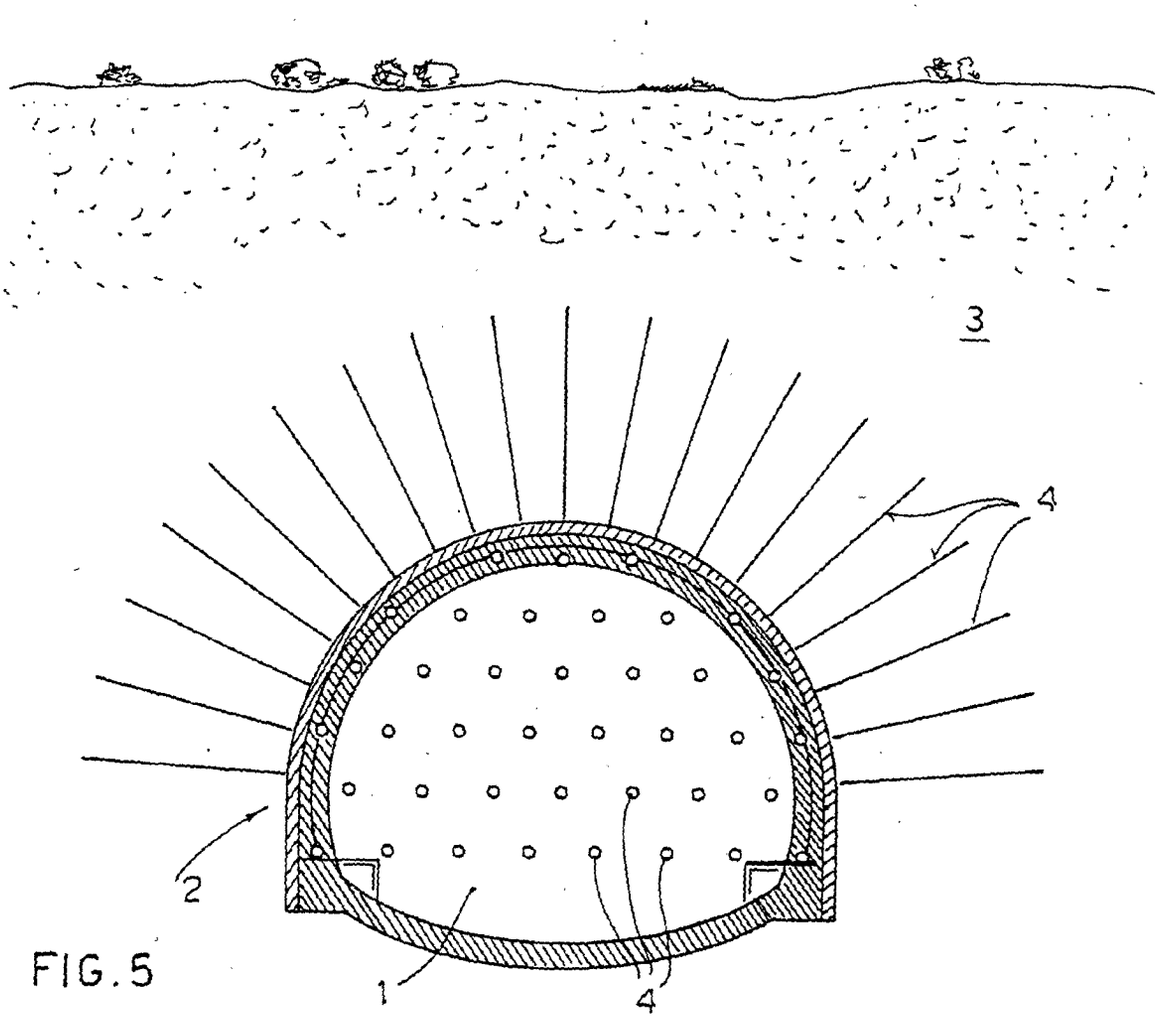

FIG.5