



EUROPEAN PATENT APPLICATION

(43) Date of publication:
07.01.2015 Bulletin 2015/02

(51) Int Cl.:
E02D 5/80 (2006.01)

(21) Application number: **14172255.3**

(22) Date of filing: **13.06.2014**

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**
Designated Extension States:
BA ME

(72) Inventors:
• **Balconi, Gabriele**
20043 Arcore (Monza-Brianza) (IT)
• **Bruschi, Flavio**
20043 Arcore (Monza-Brianza) (IT)

(30) Priority: **03.07.2013 IT MI20131116**

(74) Representative: **Petruzziello, Aldo et al**
Racheli S.r.l.
Viale San Michele del Carso, 4
20144 Milano (IT)

(71) Applicant: **Sireg S.P.A.**
20043 Arcore (Monza-Brianza) (IT)

(54) **Sleeve valve fitted pipe in biodegradable bioplastic**

(57) A description is given of an injection pipe for the consolidation and stabilisation of the land, or for the impermeabilisation of the same, made in biodegradable bi-

oplastic deriving from the fermentation of sugars and/or with a base of fats/oils and/or with cellulose base.

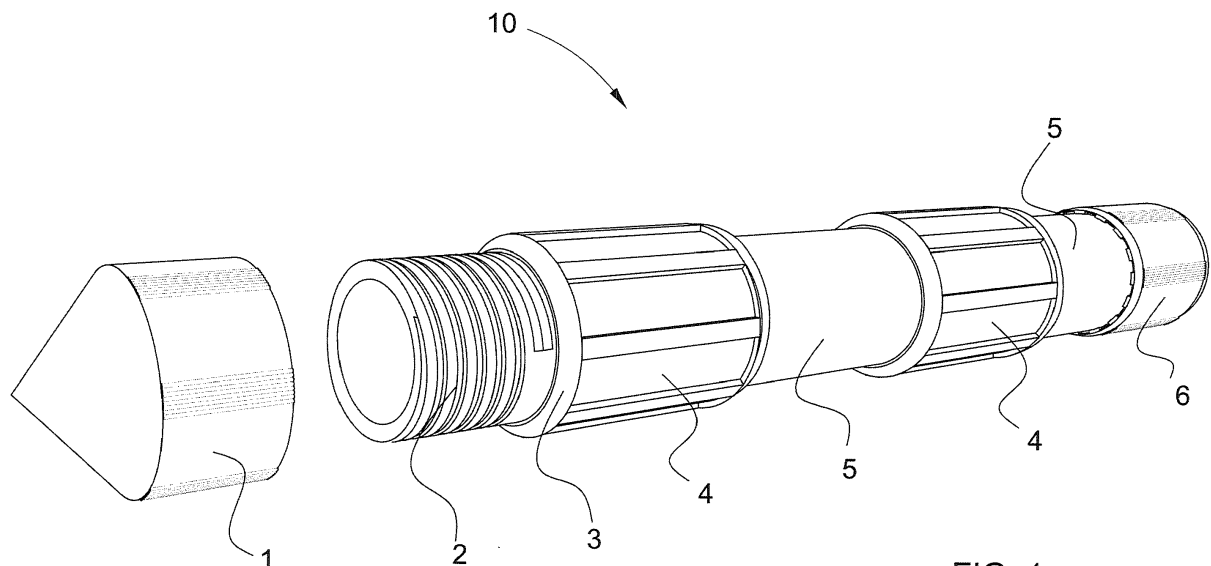


FIG. 1

Description

[0001] The present invention relates to a sleeve ("manchette") valve fitted pipe for the injection of cement/chemical mixtures suitable for the reinforcement of an excavation of a tunnel or for the reinforcement of land in order to prevent landslides or deformations of the land during the execution of tunnels or trenches, or suitable for altering the permeability of the land (impermeabilisation) or for the consolidation of foundations, or for the plugging of the pores of rock formations.

[0002] More particularly the present invention relates to a pipe as defined above provided with improved eco-compatibility since made with biodegradable bioplastics, hereinafter referred to also as DURVINIL BIO-SYSTEM.

[0003] Valve-fitted pipes are devices used for the selective injection of cement/chemical mixtures inside land or excavations for consolidating and stabilising the land during the execution of tunnels or trenches, thus preventing the same from sliding and/or deforming during the excavation. These cement/chemical mixtures can be injected inside the land or excavations, through the afore-said valve-fitted pipes, also for other different purposes such as for example in order to alter the permeability of the land, or for plugging the pores of rock formations.

[0004] As is known, in order to stabilise the land during these excavations, drillings are performed in which pipes are inserted for the purpose of distributing selectively a cement mortar inside and around the drilling.

[0005] In practice holes are formed in the land, in each one of which a valve-fitted pipe is inserted through which a first injection of cement mortar takes place for the formation of the external sheath, and subsequently a second selective and/or localised injection, valve by valve, takes place through the introduction into the valve-fitted pipe of double mechanical or hydraulic packers.

[0006] In the case wherein the pipe is provided with a single valve, injection can be carried out through the threaded end of the pipe.

[0007] Once the operation of injection has ended, said pipes can be removed (at times) but much more often they are left in the ground after having been broken up by the excavation machines.

[0008] Currently said pipes for injection are made of resistant thermoplastic materials (plastics) deriving from petroleum such as PE, PVC, PP, but at times also of steel. However the use of these materials is encountering several difficulties due to the high environmental impact that they cause.

[0009] In fact the steel pipes which are found to be difficult to break up and/or remove after use are very often abandoned in situ, thus violating local regulations which do not allow these elements to be abandoned in the ground.

[0010] Plastic pipes, which can instead be easily traversed by the excavation machines, have the disadvantage of being made of materials considered polluting since their abandoning in the ground, after breaking up,

entails a pollution of the same.

[0011] Moreover since also the spoil (i.e. the debris coming from works of excavation of tunnels, quarries and mines) containing said crushed pipes is considered polluting material, the possible reuse or recovery thereof is difficult in practice in light of current (and future) laws, therefore forcing disposal thereof with consequent considerable costs.

[0012] Moreover, due in fact to the high environmental impact of said pipes, they are used only in those areas considered accessible.

[0013] The patent EP 726383 describes a device for the reinforcement, the consolidation and the stabilisation of the land, made of non-biodegradable plastic material, particularly suitable for preventing landslides or deformations of the excavation front, in tunnels or trenches, comprising an injection pipe, conveniently fitted with a sleeve valve, to be inserted in a respective drilling in the ground, around which pipe a plurality of resistant reinforcement elements are arranged, mounted by means of centring spacers and held together by external sealing elements.

[0014] The object of the present invention is that of overcoming, at least in part, the disadvantages of the prior art by providing a pipe for the injection of cement/chemical mixtures for the reinforcement of excavations and/or land and also for altering the permeability of the land, or for the consolidation of foundations, or for the plugging of the pores of rock formations, which has substantially the same mechanical and resistance properties of known pipes, but which is provided with improved eco-compatibility.

[0015] These and other objects are achieved by a pipe for injection made of biodegradable plastic in accordance with the invention having the features listed in the annexed independent claim 1.

[0016] Advantageous embodiments of the invention are disclosed by the dependent claims.

[0017] An object of the present invention relates to a device suitable for being inserted in a respective drilling formed in the ground or in an excavation for the injection of cement mortar and/or chemical mixtures and the like, which is in the form of a sleeve ("manchette") valve pipe and comprises a cylindrical tubular body, with appropriately localised holes, having both the ends open and threaded, and moreover one or more sleeve valves for localised injections of said cement mortar and/or chemical mixtures.

[0018] Said cement mortar and/or chemical mixtures are suitable for the reinforcement, consolidation and stabilisation of land for preventing landslides or deformations of the excavation front in tunnels or trenches, or suitable for altering the permeability of the land, of earth dams and rises, or for the plugging of the pores of rock formations, particularly useful for the reinforcement of an excavation of a tunnel or for the reinforcement of land in order to prevent landslides or deformations of the land during the execution of tunnels or trenches, or for the consolidation of foundations.

[0019] Said device moreover provides a closure and guide element placed at the front end of the pipe, while at the rear end of said pipe a joining element is provided which can be screwed for the coupling with a second sleeve valve fitted pipe so as to form a device for injection also of high length by means of the joining of a plurality of sleeve valve fitted pipes which can be joined one to the other.

[0020] Said device is characterised in that it is fully made of heat-processable biodegradable bioplastic deriving from the fermentation of sugars and/or oils, preferably a biodegradable plastic chosen from among polyhydroxyalkanoates, polylactic acid, cellulose-based bioplastics or combinations thereof, more preferably made of a biodegradable bioplastic formed by a blend of polylactic acid with one or more polyhydroxyalkanoates.

[0021] This device can also provide composite profiles (resistant elements), for example made of fibreglass, when used for reinforcement.

[0022] Further features of the invention will be made clearer by the following detailed description, referred to a purely non-limiting example thereof, illustrated in the accompanying drawings in which:

Figure 1 is an axonometric partially exploded view of a valve-fitted pipe according to the invention;

Figure 2 is a cross-sectioned view of a section of the pipe of Fig. 1;

Figure 3 is an axonometric partially exploded view of a further embodiment of a device for injection according to the invention comprising moreover resistant profiles made of a composite material.

[0023] The valve-fitted pipe for injection of the present invention, denoted in Fig. 1 with reference numeral 10, is formed by a cylindrical tubular body 5, made in the required length, which has both ends 2 threaded.

[0024] Said pipe 5 is moreover provided with one or more sleeve ("manchette") valves 4, which as known allow, when they are stressed by a pressure inside the pipe 5, the performing of localised injections of the cement mixture (or chemical mixture according to the object of the injection) through the holes 11 (Fig. 2).

[0025] Each sleeve valve 4 is provided with two containment rings 3, opposite one to the other, which have the function of encouraging the release of the mortar in axial direction through the hole 11 of the valve rather than laterally and maintaining in position the valve for the subsequent injection cycles.

[0026] A conical cap or plug 1 is also provided, internally threaded, to be placed at the threaded front end 2 of the pipe 5 in order to facilitate the insertion of the pipe 5 inside the drilling, thus acting as guide.

[0027] Said threaded plug 1 is to be screwed on the threaded end 2 which is intended to represent the front end of said pipe 5.

[0028] On the threaded rear end 2, which is opposite that on which the threaded plug 1 is screwed, a joining

sleeve 6 is screwed, internally threaded, which has the purpose of allowing the coupling with another injection pipe 5 in order to be able to construct, in the place of the excavation, a continuous tubular reinforcement of the length corresponding to the drilling performed, also hundreds of metres, without having to resort to transporting heavy loads.

[0029] Once the reinforcement has been constructed and the first cement mortar injected, it will be possible, at a later time, to return to the interior of the pipe 5 with a shutter packer 21 (Fig. 2) to perform localised injections, injecting singly and locally through the valves 4.

[0030] All the elements forming the injection pipe 10 are characterised by being made of biodegradable and heat-processable bioplastic so as to be able to be left in the ground or in the excavation without any problem of environmental pollution. Any spoil will also be non-polluted.

[0031] "Bioplastics" here refer to plastics which derive from renewable raw materials or are biodegradable plastics or have both the properties.

[0032] "Biodegradable bioplastics" refer here to bioplastics which are also biodegradable, i.e. which can be decomposed biologically through the effect of natural micro-organisms (e.g. bacteria, fungi or algae) into simpler substances of the nature (in an anaerobic or aerobic environment, in certain conditions and with an acceptable rate), also including those biodegradable bioplastics which are not compostable.

[0033] Some examples of biodegradable bioplastics which can be used in the present invention are those deriving from the fermentation of sugars and/or from fats/oils, in general vegetable ones, and/or with cellulose base, such as:

- Poly(lactic acid);
- Aliphatic biopolyesters such as the polyhydroxyalkanoates (PHA), in particular polyhydroxybutyrate (PHB), polyhydroxyvalerate (PHV), polyhydroxyalkanoate (PHH);
- Cellulose-based bioplastics.

[0034] The Applicant has found, by means of tests, that advantageously the device or injection pipe 10 can be made with a biodegradable bioplastic deriving from polyhydroxyalkanoate biopolyesters (deriving from sugar beet) and/or polylactic acid.

[0035] In fact the injection pipe made with that bioplastic (appropriately formulated with fillers) was found to be provided substantially with the same mechanical resistance (traction strength generally greater than or equal to 15 MPa) of a conventional pipe in PVC, with the same size.

[0036] Moreover the Applicant has also ascertained that other biodegradable bioplastics, such as for example those with a starch base, are not suitable for making an injection pipe having substantially the same mechanical properties of injection pipes in PVC, since they do not

guarantee a sufficient mechanical strength of finished pipe evaluated with the burst test (increase in internal pressure of the pipe filled until breakage to evaluate the maximum bearable pressure).

[0037] The biodegradable bioplastic used in the present invention can be advantageously a biodegradable blend of one or more biodegradable polyhydroxyalkanoates with polylactic acid, or a copolymer of lactic acid and one or more monomers forming said biodegradable polyhydroxyalkanoates, such as for example hydroxybutyrate, hydroxyvalerate and hydroxyhexanoate.

[0038] Said blend can be heat-processed, for example by means of injection moulding or extrusion, so as to form the valve-fitted pipe of the present invention. Biodegradability (or rate of biological degradation) of the bioplastic used in the present invention can be such as to fulfil the European standard EN13432 (Industrial Compostability), whose rate of biodegradability indicated in the law is ascertained and checked in scientifically repeatable conditions, in industrial composting plants with certain characteristics. Or said biodegradability can be such as to fulfil other standards, such as DIN V5900-02 (German standard), ASTM D 6400-99 (American standard), ISO 14021-99 (international standard) or for example those foreseen by the organisation AIB Vincotte, or by another organisation, without thereby departing from the scope of the present invention, provided that said biodegradable bioplastics have a rate of decomposition in anaerobic or aerobic environment much lower than that of conventional plastics deriving from fossil fuels.

[0039] The present injection device made of a biodegradable bioplastic can provide moreover, arranged around said pipe and connected thereto, a plurality of resistant elements (profiles) of reinforcement in fibreglass or, preferably, in biodegradable bioplastic, more preferably the same biodegradable bioplastic used for the pipe 5, which can be in the form of continuous strips (as illustrated in Fig. 3) or continuous rods or in another form.

[0040] Said strips 7 are made integral to said pipe 5 by means of the use of centring spacers 12 (preferably in biodegradable bioplastic, more preferably the same biodegradable bioplastic used for the pipe 5) which are disposed on the pipe 5 and locked to said strips 7 by means of fastening elements 13, placed at the exterior of said centring spacers 12.

[0041] Said fastening elements 13 can be constituted by a band made of a metal, a biodegradable bioplastic, or by a parcelling with adhesive tape reinforced with fibreglass, as described in the Italian patent no. 1275231, in the name of the Applicant, incorporated here in full for reference.

[0042] Said strips 7 are then covered, during construction, with quartz sand in order to obtain a very high coefficient of friction and good compatibility with the injection mixture: this entails an increased contact surface between the device and the cement mortar and in a greater coefficient of adherence of the surface of the device

to the drilling so as to allow the complete transfer of the value of resistance of the reinforcement (formed by various injection pipes) to the ground.

[0043] In the case of rods, they are held together by perimeter bands arranged externally to said rods, once said rods have been placed around the sleeve valve fitted device 10 of the present invention.

[0044] It should be noted that the pipe 5 with holes of the present invention, made in biodegradable bioplastic as defined above but without sleeve valves 4, can be advantageously used as is also as drainage pipe in order to collect the excess water and evacuate it.

[0045] In this type of specific application it is preferable, even if not binding, that the slotting of the drainage pipe 5 be greater with respect to that of the pipe for injection of cement/chemical mixtures.

[0046] Generally this slotting is preferably in the form of narrow slits adjacent one to the other and arranged in such a way as to cover most of the circumference of the pipe.

[0047] The present invention is not limited to the particular embodiments previously described and illustrated in the accompanying drawings, but numerous detailed changes may be made thereto, within the reach of the person skilled in the art, without thereby departing from the scope of the invention itself as defined in the appended claims.

Claims

1. Device (10) suitable for being inserted in a respective drilling formed in the ground or in an excavation for injecting cement mortar and/or chemical mixtures and the like suitable for the reinforcement, consolidation and stabilisation of the ground to prevent landslides or deformations of the excavation front in tunnels or trenches, or suitable for altering the permeability of the ground or of the excavation and the like, said device comprising a cylindrical tubular body (5) with holes, having both ends (2) open and threaded, and provided with one or more "manchette" valves (4) for localised injections of said cement mortar and/or chemical mixture and the like, said device (1) being **characterised in that** it is completely made of biodegradable bioplastic derived from the fermentation of sugars and/or from fats/oils, preferably vegetable ones, and/or with cellulose base.
2. Device (10) according to claim 1 wherein said biodegradable bioplastic is selected from one or more polyhydroxyalkanoates, polylactic acid, cellulose-based bioplastics, or combinations thereof.
3. Device (10) according to claim 1 or 2 wherein said biodegradable bioplastic is a blend of one or more polyhydroxyalkanoates and polylactic acid.

4. Device (10) according to any one of the preceding claims wherein a closure and guide element (1) is also provided, placed at the front end (2) of the cylindrical tubular body (5), said closure and guide element (1) being made of biodegradable bioplastic derived from the fermentation of sugars and/or oils. 5
5. Device (10) according to any one of the preceding claims wherein a joining element (6) is also provided, placed on the threaded rear end (2) of the cylindrical tubular body (5) for the coupling with a second device for injection (10), said joining element (6) being made in biodegradable bioplastic derived from the fermentation of sugars and/or from oils. 10 15
6. Device (10) according to any one of the preceding claims wherein there are also provided, arranged around said cylindrical tubular body (5), a plurality of reinforcement elements (7) mounted by means of centring spacers (12) around said cylindrical tubular body (5) and held together by external fastening elements (13). 20
7. Device (10) according to claim 6 wherein said plurality of reinforcement elements (7) and said centring spacers (12) are made of a biodegradable bioplastic derived from the fermentation of sugars and/or from oils. 25
8. Device (10) according to claim 6 or 7 wherein said reinforcement elements (7) are in the form of a continuous strip or continuous rod. 30
9. Pipe with holes (5) made of a biodegradable bioplastic as defined in the preceding claims 1-8 and without sleeve valves (4) suitable for water drainage in land, foundations and the like. 35

40

45

50

55

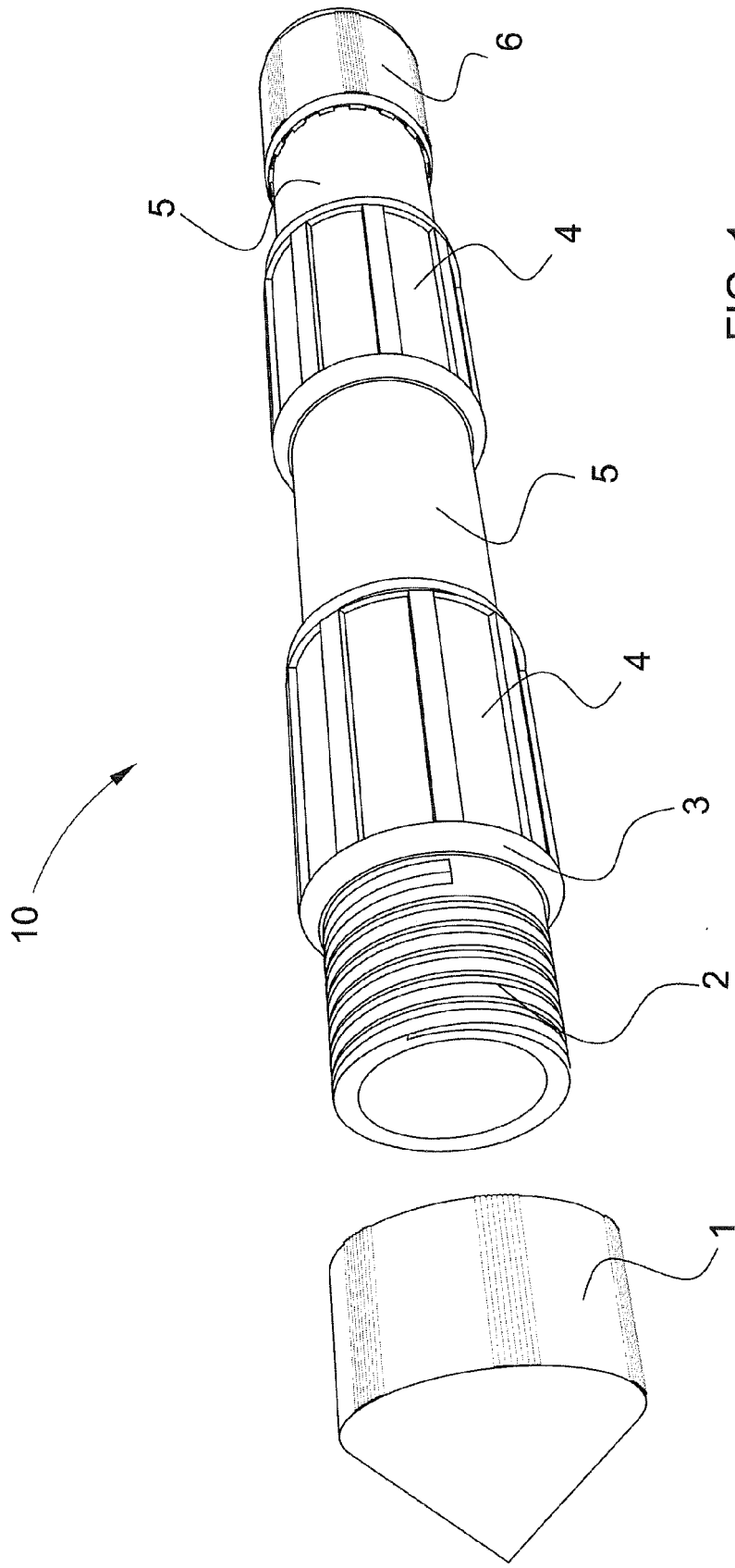
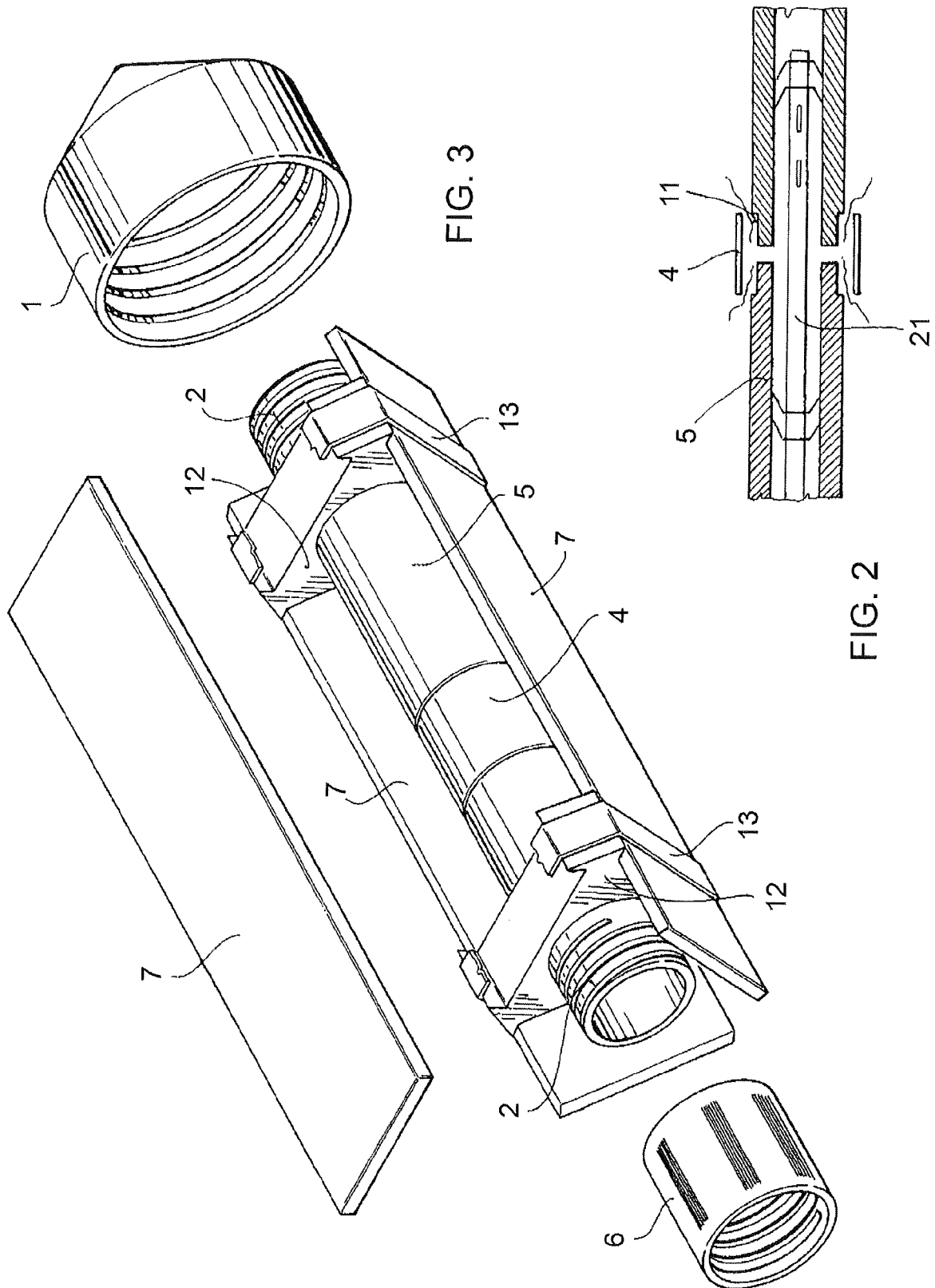


FIG. 1





EUROPEAN SEARCH REPORT

Application Number
EP 14 17 2255

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	EP 0 726 383 A1 (SIREG S P A SOCIETA ITALIANA D [IT] SIREG S P A SOC IT DI RICERCA [IT]) 14 August 1996 (1996-08-14) * the whole document * -----	1-9	INV. E02D5/80
			TECHNICAL FIELDS SEARCHED (IPC)
			E02D E21D
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 27 November 2014	Examiner Friedrich, Albert
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

EPO FORM 1503 03/82 (P04/C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 14 17 2255

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

27-11-2014

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0726383 A1	14-08-1996	AT 162593 T	15-02-1998
		DE 69600147 D1	26-02-1998
		DE 69600147 T2	02-07-1998
		EP 0726383 A1	14-08-1996
		IT MI950235 A1	09-08-1996

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 726383 A [0013]
- IT 1275231 [0041]