(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
31 August 2017 (31.08.2017)

WIPO | PCT

(10) International Publication Number
WO 2017/147626 A1

(51) International Patent Classification:
E21D 20/02 (2006.01)

(21) International Application Number:
PCT/ZA2017/000003

(22) International Filing Date:
23 February 2017 (23.02.2017)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2016/01214 23 February 2016 (23.02.2016) ZA

(71) Applicant: **NCM INNOVATIONS (PTY) LTD** [ZA/ZA]; 109 Adcock Ingram Avenue, Aeroton, 1454 Johannesburg (ZA).

(72) Inventors: **CROMPTON, Brendan Robert**; c/o 109 Adcock Ingram Avenue, Aeroton, 1451 Johannesburg (ZA). **CAWOOD, Martin**; c/o 109 Adcock Ingram Avenue, Aeroton, 1451 Johannesburg (ZA). **CHAMBERLAIN, Iain**; c/o 109 Adcock Ingram Avenue, Aeroton, 1451 Johannesburg (ZA). **BLITTERSWIJK, Anneke**; c/o 109 Adcock Ingram Avenue, Aeroton, 1451 Johannesburg (ZA).

(74) Agents: **MCCALUM RADEMEYER AND FREIMOND** et al.; 390 Kent Avenue, Ferndale, 2194 Randburg (ZA).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(54) Title: RESIN PUMP FOR INTRODUCING RESIN INTO A ROCK ANCHOR

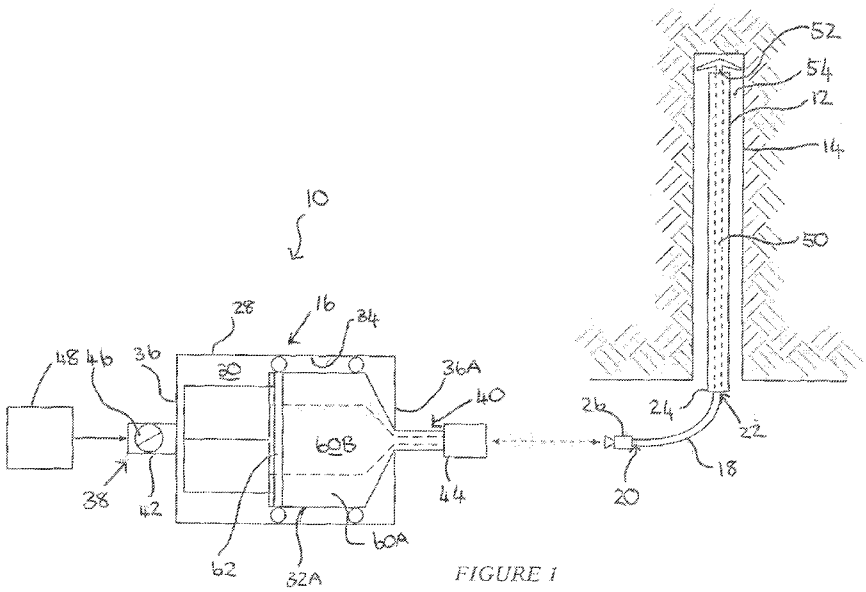

FIGURE 1

(57) Abstract: An adhesive pump (16) and a system for pumping a resin into a hollow rock anchor (12) wherein the adhesive pump includes a tubular housing (28) and a cartridge (32A) within the tubular housing having a leading end and an opposed trailing end, the leading end having an opening in fluid communication with the outlet A first compartment (60A) and a second compartment (60B) are defined within the cartridge, for respectively containing first and second components of an adhesive system. A pressing member (62) is positioned within the cartridge towards the trailing end and is caused to move, in response to fluid flowing into the tubular housing from the inlet (38), towards the leading end to force the second adhesive components from respective first and second compartments towards the outlet (40).

WO 2017/147626 A1

RESIN PUMP FOR INTRODUCING RESIN INTO A ROCK ANCHOR

BACKGROUND OF THE INVENTION

[0001] The invention relates to a resin pump and to a system for pumping a resin into a hollow rock anchor.

[0002] It is known to introduce into a hollow rock anchor a two part adhesive system which, when the two parts contact and mix, harden to set the rock bolt within a rock hole that it is inserted within.

[0003] An example of such a resin system is described in WO2012/013968. To introduce the resin system into a hollow rock anchor, an injection system such as that described in WO2010/031132 can be used.

[0004] A problem with the systems described in the publications aforementioned is that each part of the two part resin system originates from its own source. Each part then needs to be separately, yet synchronously, pumped from the respective source along respective fluid conduits to meet at an injection system that would then introduce the two parts to the anchor.

[0005] To do this, each source requires a pump and the rate of pumping from each source requires co-ordination to ensure the correct mix ratio of each part of the resin system.

[0006] The injection system would need to keep the parts separate in respective passageways as each part flows there-through to prevent the parts mixing and hardening within the injection system. However, once the parts leave the system and flow into an interior of the rock anchor, they come into mixing contact. With mixing of

the parts comes the propensity to react and harden. If the hardening of the resin parts occurs in a space within the rock anchor in advance of a nozzle of the injector system, there is the risk that the injector system will adhere to the rock anchor.

[0007] The invention at least partially addresses the aforementioned problems.

SUMMARY OF INVENTION

[0008] Hereinafter the terms rock anchor and rock bolt are used interchangeably to describe a device which has an elongate body and which is inserted into a hole drilled into a rock face to stabilize the rock to prevent collapse or rock fall.

[0009] Hereinafter, "adhesive", or "resin" refers to a system which includes at least one low viscosity liquid adhesive component which is free-flowing before activation and which after activation, sets of hardens. An "adhesive component" bears corresponding meaning. The terms "adhesive" and "resin" are used interchangeably.

[0010] The invention provides an adhesive pump which includes:

a tubular housing which has an inlet and an outlet;

a cartridge in the tubular housing with a leading end and an opposed trailing end, the leading end having an opening in fluid communication with the outlet;

a first compartment and a second compartment defined within the cartridge, for respectively containing a first component and a second component of an adhesive system;

a pressing member positioned within the cartridge towards the trailing end; and

wherein the pressing member is caused to move, in response to fluid flowing into the tubular housing from the inlet, towards the leading end to force the first and second adhesive components from respective first and second compartments towards the outlet.

[0011] Preferably the inlet and the outlet are defined through a first end and an opposed second end respectively.

[0012] The pressing member may be slidingly and sealingly engaged with inner walls of the cartridge.

[0013] The cartridge may be made of a rigid plastics material.

[0014] The cartridge may be complementarily dimensioned to snugly fit within the housing. Preferably, the cartridge is sealingly fitted within the housing.

[0015] The inlet may be outwardly adapted to engage with a conduit end of a hydraulic fluid delivery system.

[0016] The inlet may include a valve.

[0017] The outlet may be outwardly adapted to engage with a rock anchor resin input conduit.

[0018] The cartridge may include an elongate tube which fits within the housing in co-axial extension and which defines the first compartment and whereby the second compartment is defined by a space between the cartridge and the tube.

[0019] In one embodiment, a wall of the tube may be adapted to axially compress in a controlled manner about predefined annular zones, when a force is applied at one end, to extrude its adhesive content.

[0020] Preferably, the tube is made of a suitable flexible plastics material.

[0021] The tube may be a tubular bellows-type tube, its wall comprising of a plurality of corrugated annular sections, each one of these sections defining an annular zone about which the tube is adapted to axially compress.

[0022] In another embodiment the pressing member may include a bladed formation.

[0023] In this embodiment the tube may be made of a rigid plastics material.

[0024] In this embodiment, the bladed formation facilitates advance of the pressing member towards the leading end of the cartridge, in response to fluid flowing into the tubular housing from the inlet, to thereby force the first and second adhesive components from respective first and second compartments towards the outlet, by severing a wall of the tube, such that the components are kept fluidly separated until exit from the outlet

[0025] The invention extends to a system for introducing a two-part adhesive to a hollow rock anchor which system includes:

an adhesive pump as described above;

a connector tube which is engageable, at opposed first and second ends, to the outlet of the pump and the rock anchor respectively to provide a fluid conduit from the pump housing to an interior of the rock anchor; and

a static mixer engaged with the tube, interposed in the fluid conduit.

[0026] From another perspective, the invention provides a system for introducing a two-part adhesive to a hollow rock anchor which system includes:

a pump which includes a tubular body, which is internally adapted to contain, and to keep in fluid separation, a first and second part of the adhesive and which has an input end and an output end and which input end is adapted to engage with a source of a hydraulic fluid, and a drive means within the tubular body which is caused to advance towards the output end in response to the fluid flowing into the input end to thereby drive the first and the second adhesive parts separately towards the output end;

a connector tube which is engageable, at opposed first and second ends, to the output end of the pump body and the rock anchor respectively to provide a fluid conduit to the adhesive from the pump body to an interior of the rock anchor; and

a static mixer engaged with the tube, interposed in the fluid conduit to receive the first and the second parts of the adhesive and to cause the parts to mix before delivery to the rock anchor.

[0027] The drive means may be a piston, a plunger, a pressing member or the like.

[0028] Preferably, the static mixer is engaged with the tube at or towards its first end.

[0029] The output end of the tubular body may be adapted to releasably engage the first end of the connector tube.

[0030] The tube may be a flexible tube.

BRIEF DESCRIPTION OF THE DRAWINGS

[0031] The invention is further described by way of example with reference to the accompanying drawing in which:

Figure 1 diagrammatically illustrates a system for introducing a two-part adhesive to a hollow rock anchor in accordance with the invention;

Figure 2 diagrammatically illustrates a resin pump of the system of Figure 1;

Figure 3 is a cross section through line 3 – 3 of Figure 2;

Figure 4 is a partially sectioned perspective view of a pressing member of the resin pump.

DESCRIPTION OF PREFERRED EMBODIMENT

[0032] With reference to the accompanying Figures, the invention provides a pumping system 10 for introducing a two-part adhesive through a tubular rock anchor 12, into a rock hole 14 in which the rock anchor is placed.

[0033] The system 10 includes a resin pump 16 and a connector tube 18. The connector tube 18, made of a suitable plastics material, is flexible to accommodate a variety of positions at which the pump 16 engages with the tube.

[0034] The tube 18 has opposed first and second ends (20, 22), with the first end adapted to releasably engage the resin pump 16 and the second end engaged to a trailing end 24 of the rock anchor 12.

[0035] The tube includes a static mixer 26 at the first end 20 of the tube 18.

[0036] The resin pump 16 has a tubular housing 28 defining an internal volume 30 in which a resin cartridge 32 is located. The resin cartridge is complementarily

dimensioned to fit snugly within the volume, sealed against internal walls 34 of the housing 28.

[0037] The housing extends between an inlet 38 and an outlet 40 and is defined through the inlet end 36 and the outlet end 36A respectively with an inlet valve assembly and outlet nozzle (42, 44) respectively exteriorly projecting from the inlet and outlet. The inlet valve assembly includes a valve 46.

[0038] The inlet valve assembly is connectable to a conduit (shown as an arrow in Figure 1) leading from a hydraulic fluid source 48.

[0039] The outlet nozzle 44 is adapted to releasibly engage with the first end 20 of the connector tube 18. A dotted line with opposed directional arrows in Figure 1 serves to illustrate this releasable interconnectedness of the resin pump 16 with the connector tube 18.

[0040] It is anticipated, in a preferred embodiment, that the connector tube 18 is permanent or fixed feature of the rock anchor 12 and that the resin pump 16 is attached to the connector tube, actuated to extrude the two-part adhesive, which flows through the tube 18 into the rock anchor, along an internal bore 50, through an opening in a leading end 52 of the anchor, to flow into an annular space 54 between the anchor and the rock hole walls.

[0041] It is anticipated that the resin cartridge 32 of the resin pump 16 can come in many embodiments. What is common in all embodiments, is that the cartridge includes two compartments, respectively designated 60A and 60B, each of which contains a part or component of the two-part adhesive and a pressing member 62.

[0042] An embodiment 32A of the cartridge is illustrated diagrammatically in Figure 1 and in more detail in Figure 2.

[0043] The cartridge 32A includes a first tube 64 which is positioned co-axially within a second tube 66. The annular space between the first and the second tubes (64, 66) defines the first compartment 60A and a second compartment 60B is defined within the first tube 64. The compartments are divided by a partitioning wall being the wall constituting the first tube. Each compartment contains a discrete fluid part of a two part adhesive system.

[0044] A pressing member 62A is provided, initially located (i.e. before use of the resin pump), towards an end 68 of the cartridge 32A. The pressing member, as best illustrated in Figure 4, has a unitary body 70 comprising of a first cylindrical central part 72 and a second annular outer part 74. The first part and the second part are unitarily inter-linked by a blade formation comprising of three radially arranged blades, respectively designated 76A, 76B and 76C (see Figure 3).

[0045] The pressing member has a core 78 made of a suitable resilient plastics material, coated with an outer sealing layer 80 of a rubber-like material which is sufficiently strong yet flexible enough to provide adequate sealing. This sealing layer is moulded to provide a number of annular sealing ridges 82 (see Figure 4). The blades are not coated with the sealing layer and each presents a cutting edge to the partitioning wall.

[0046] The first part and second parts (72, 74) of the pressing member 62A are complementarily shaped and dimensioned to sealingly locate within the tube (compartment) 60B and the annular space (compartment) 60A respectively to

respectively seal off the compartments, from a trailing position as the pressing member 62A advances.

[0047] With fluid input into the volume 30, behind the pressing member 32A, through the inlet 38 by attaching the valve assembly 42 to the hydraulic fluid source 48, the pressing member is actuated to advance within the cartridge 32A. As the pressing member advances, the blades 76 cut into the partitioning wall of the tube 64 to enable further advance, whilst sealing engagement is maintained by the respective parts (74, 72) against the respective walls surfaces, to force the respective adhesive parts out of the respective compartment (60A, 60B) towards a leading end 78 of the cartridge 32A, without backflow.

[0048] The leading end 78 of the cartridge 32A is tapered towards the outlet nozzle 44, with each compartment 60 tapering accordingly, maintaining discrete passageways for the respective adhesive part, thus maintaining fluid separation until the adhesive parts exit the resin pump 16 at the nozzle 44, into the connection tube 18 and the proximally positioned static mixer 26.

CLAIMS

1. An adhesive pump which includes:

a tubular housing which has an inlet and an outlet;

a cartridge in the tubular housing with a leading end and an opposed trailing end, the leading end having an opening in fluid communication with the outlet;

a first compartment and a second compartment defined within the cartridge, for respectively containing a first component and a second component of an adhesive system;

a pressing member positioned within the cartridge towards the trailing end; and

wherein the pressing member is caused to move, in response to fluid flowing into the tubular housing from the inlet, towards the leading end to force the second adhesive components from respective first and second compartments towards the outlet.

2. An adhesive pump according to claim 1 wherein the inlet and the outlet are defined through a first end and an opposed second end respectively.

3. An adhesive pump according to claim 1 or 2 wherein the pressing member is slidingly and sealinlgy engaged with inner walls of the cartridge.

4. An adhesive pump according to anyone of claims 1 to 3 wherein the cartridge is made of a rigid plastics material.

5. An adhesive pump according to any one of claims 1 to 4 wherein the cartridge is complementarily dimensioned to snugly fit within the housing.

6. An adhesive pump according to claim 5 wherein the cartridge is sealing fitted within the housing.

7. An adhesive pump according to any one of claims 1 to 6 wherein the inlet is outwardly adapted to engage with a conduit end of a hydraulic fluid delivery system.

8. An adhesive pump according to claim 7 wherein the inlet includes a valve.

9. An adhesive pump according to any one of claims 1 to 8 wherein the outlet is outwardly adapted to engage with a rock anchor resin input conduit.

10. An adhesive pump according to any one of claims 1 to 9 wherein the cartridge includes an elongate tube which fits within the housing in co-axial extension and which defines a first compartment and whereby the second compartment is defined by a space between the cartridge and the tube.

11. An adhesive pump according to claim 10 wherein a wall of the tube is adapted to axially compress in a controlled manner about predefined annular zones, when force is applied at one end, to extrude its adhesive content.

12. An adhesive pump according claim 11 wherein the tube is a tubular bellows-type tube, its wall comprising of a plurality of corrugated annular sections, each one of these sections defining an annular zone about which the tube is adapted to axially compress.

13. An adhesive pump according to claim 11 or 12 wherein the tube is made of a suitable flexible plastics material.

14. An adhesive pump according to claim 10 wherein the tube is made from a rigid plastics material.

15. An adhesive pump according to claim 14 wherein the pressing member includes a bladed formation.

16. An adhesive pump according to claim 15 wherein the bladed formation facilitates advance of the pressing member towards the leading end of the cartridge, in response to fluid flowing into the tubular housing from the inlet, to thereby force the first and second adhesive components from respective first and second compartments towards the outlet, by severing a wall of the tube, such that the components are kept fully separated until exit from the outlet.

17. A system for introducing a two-part adhesive to a hollow rock anchor which system includes:

an adhesive pump according to any one of claims 1 to 16;

a connector tube which is engageable, at opposed first and second ends, to the outlet of a pump and the rock anchor respectively to provide a fluid conduit from the pump housing to an interior of the rock anchor; and

a static mixer engaged with the tube, interposed in the fluid conduit.

18. A system for introducing a two-part adhesive to a hollow rock anchor which systems includes:

a pump which includes a tubular body, which is internally adapted to contain, and keep in fluid separation, a first and a second part of the adhesive and which has an input end and an output end and which input end is adapted to engage with a source of a hydraulic fluid, and a drive means within the tubular body which is caused to advance towards the output end in response to the fluid flowing into the input end to thereby drive the first and second adhesive parts separately towards the output end;

a connector tube which is engageable, at opposed first and second ends, to the output end of the pump body and the rock anchor respectively to provide a fluid conduit to the adhesive from the pump body to an interior of the rock anchor; and

a static mixer engaged with the tube, interposed in the fluid conduit to receive the first and second parts of the adhesive and to cause the parts to mix before delivery to the rock anchor.

19. A system according to claim 18 wherein the drive means is chosen from a piston, a plunger or a pressing member.

20. A system according to claim 18 wherein the static mixer is engaged with the tube at or towards its first end.

21. A system according to any one of claims 17 to 20 wherein the output end of the tubular body is adapted to releasably engage the first end of the connector tube.

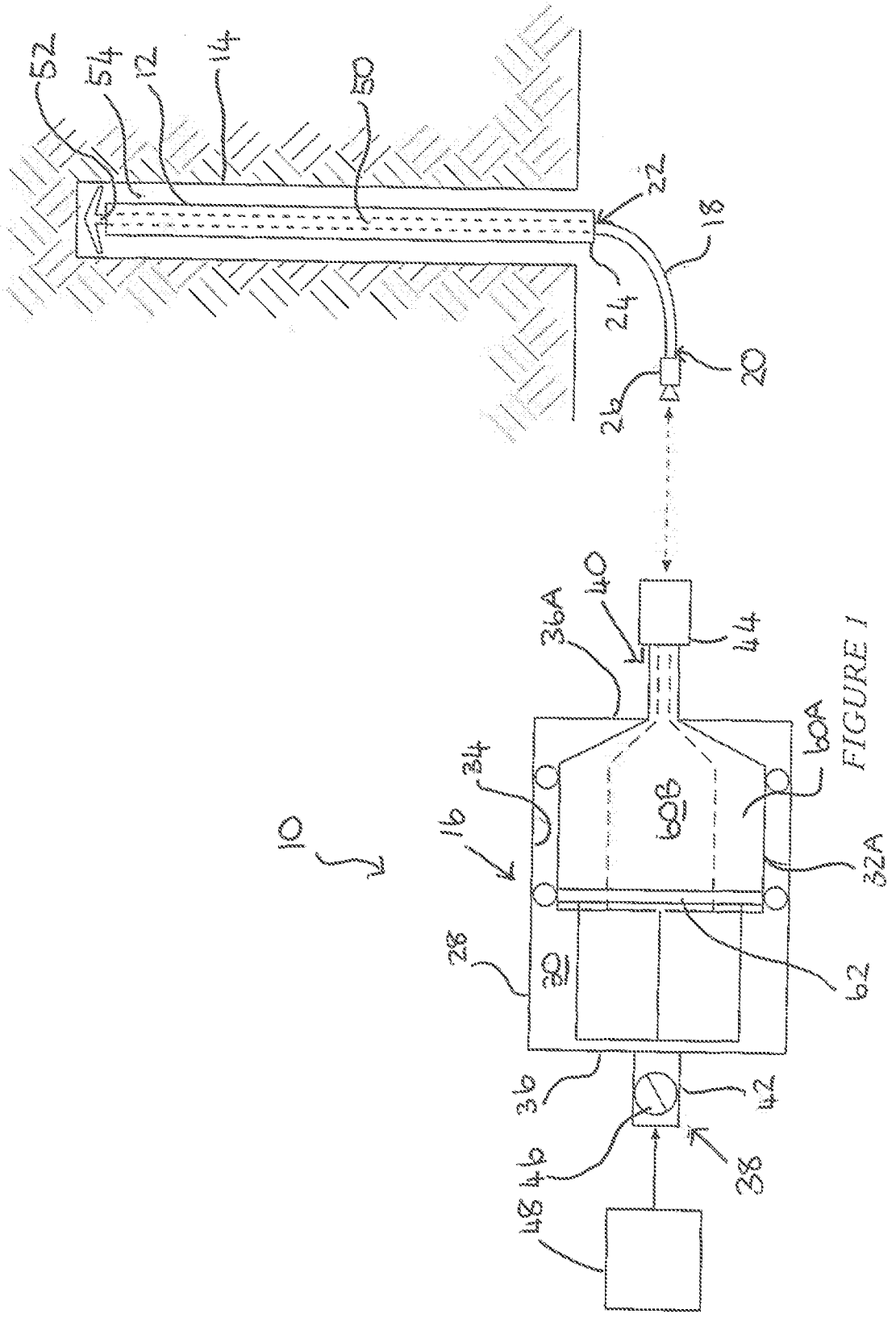
52
54
12
14
50
22
18
24
20
26
10
16
34
36A
40
44
60A
60B
32A
28
30
62
39
42
46
48
38

FIGURE 1

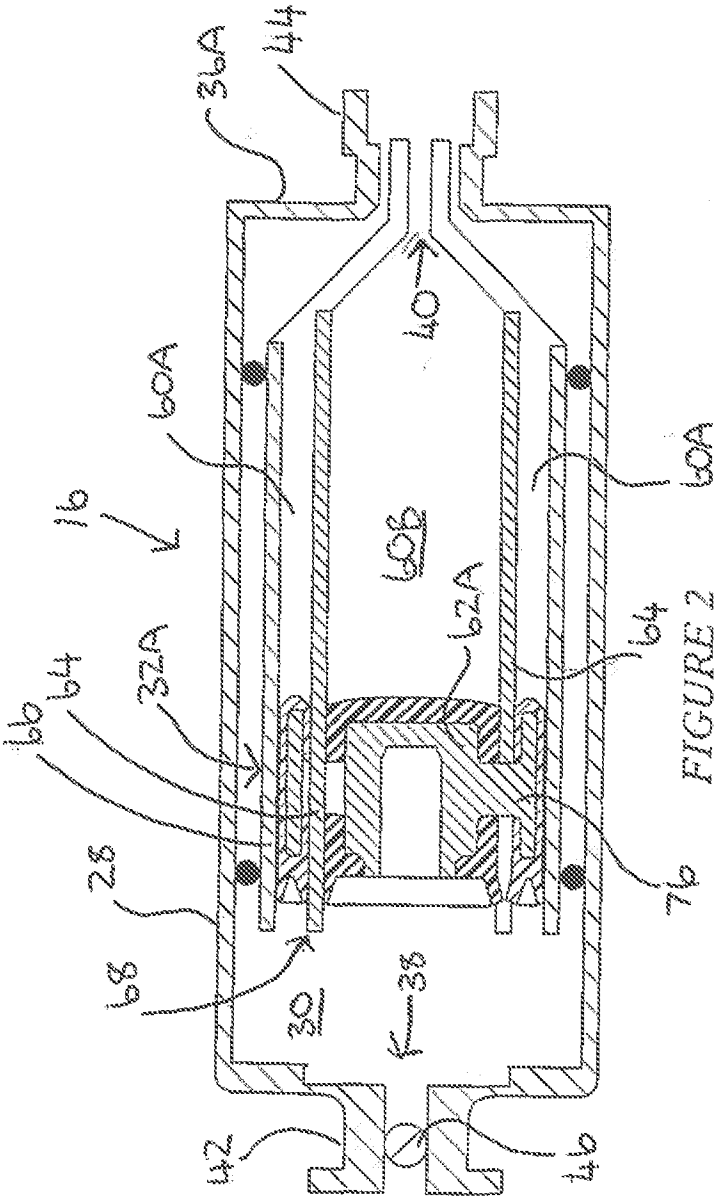

FIGURE 2

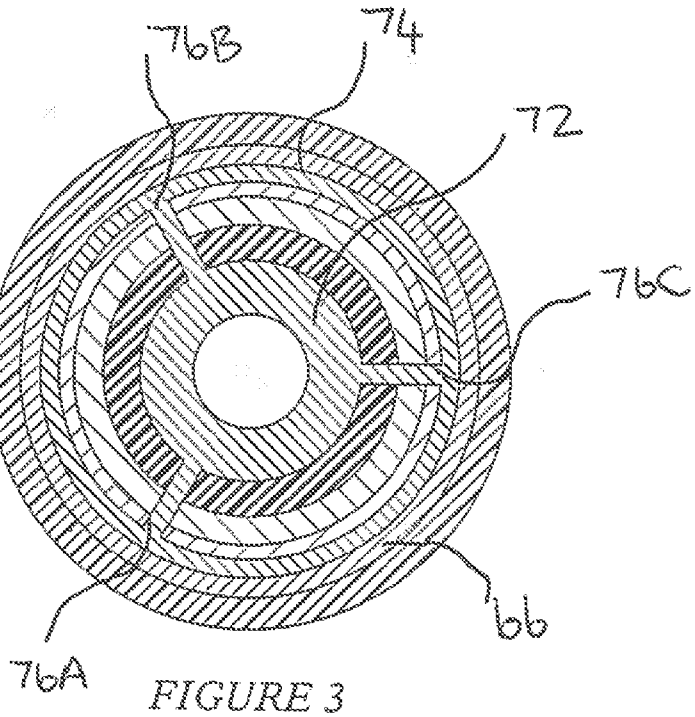

FIGURE 3

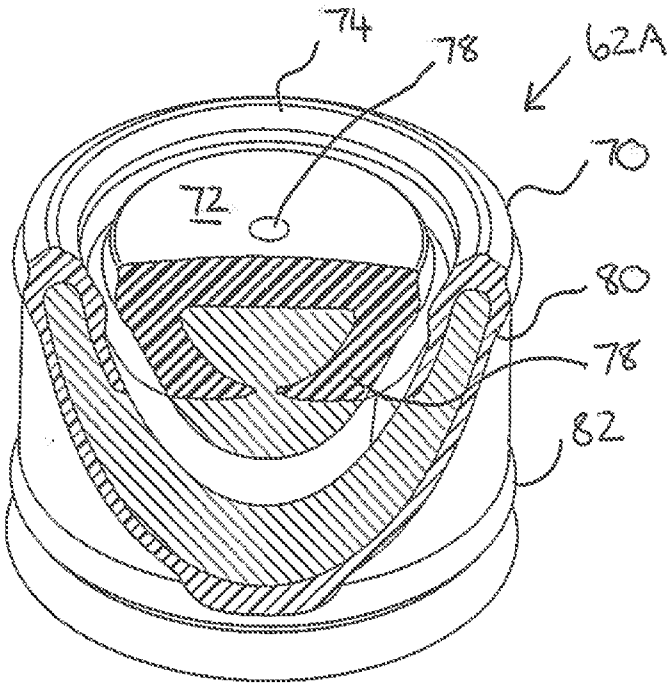

FIGURE 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/ZA2017/000003

A. CLASSIFICATION OF SUBJECT MATTER
INV. E21D20/02
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E21D B05C B65D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 2 532 832 A2 (GIDDICCA PTY LTD [ZA]) 12 December 2012 (2012-12-12) paragraph [0010] - paragraph [0019]; figures 1,3 paragraph [0022] - paragraph [0024] paragraph [0031] paragraph [0041] - paragraph [0043] -----	1-3, 5-13, 17-21
X	US 4 652 175 A (MAUTHE PETER [DE]) 24 March 1987 (1987-03-24) column 1, line 5 - line 10; figure 1 column 3, line 54 - line 60 -----	1-10, 14-21
X	US 5 647 510 A (KELLER WILHELM A [CH]) 15 July 1997 (1997-07-15) column 3, line 18 - line 39; figures 1,2, 5,6 -----	1-3,5-9
	-/--	

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
7 August 2017	16/08/2017

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Dantinne, Patrick

1

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/ZA2017/000003

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 634 524 B1 (HELMENSTEIN ACHIM [DE]) 21 October 2003 (2003-10-21) figures 1,2	1-3,5,6, 10-13
A	RU 2 157 454 C2 (CHERNYKH NIKOLAJ GEORGIEVICH) 10 October 2000 (2000-10-10) abstract; figure 1	1-21

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/ZA2017/000003

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2532832 A2	12-12-2012	BR 112013031069 A2	01-03-2017
		CA 2777995 A1	08-12-2012
		EA 201270609 A1	30-04-2013
		EP 2532832 A2	12-12-2012
		PE 03212013 A1	18-03-2013
		US 2013004246 A1	03-01-2013
		US 2015192015 A1	09-07-2015
		WO 2012171044 A2	13-12-2012
		ZA 201203836 B	30-01-2013
		ZA 201208239 B	27-11-2013
US 4652175 A	24-03-1987	CH 666086 A5	30-06-1988
		DE 3401089 A1	18-07-1985
		FR 2558209 A1	19-07-1985
		JP H0449640 B2	12-08-1992
		JP S60159300 A	20-08-1985
		US 4652175 A	24-03-1987
US 5647510 A	15-07-1997	DE 69415293 D1	28-01-1999
		DE 69415293 T2	06-05-1999
		EP 0666823 A1	16-08-1995
		ES 2126768 T3	01-04-1999
		JP H08502712 A	26-03-1996
		US 5647510 A	15-07-1997
		WO 9505984 A2	02-03-1995
US 6634524 B1	21-10-2003	AU 7417800 A	17-04-2001
		CH 694457 A5	31-01-2005
		DE 19943877 A1	15-03-2001
		GB 2369863 A	12-06-2002
		US 6634524 B1	21-10-2003
		WO 0119700 A1	22-03-2001
RU 2157454 C2	10-10-2000	NONE	