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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
10 December 2020 (10.12.2020)

WIPO | PCT

(10) International Publication Number
WO 2020/247987 A1

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

(21) International Application Number:
PCT/ZA2020/050028

(22) International Filing Date:
05 June 2020 (05.06.2020)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2019/02814 06 June 2019 (06.06.2019) ZA

(71) Applicant: **EPIROC HOLDINGS SOUTH AFRICA (PTY) LTD** [ZA/ZA]; 682 Innes Road, Jet Park, Boksburg, 1457 Johannesburg (ZA).

(72) Inventors: **PASTORINO, Paolo Ettore**; c/o 109 Adcock Ingram Avenue, Aeroton, 1457 Johannesburg (ZA). **DELPORT, Marco**; c/o 109 Adcock Ingram Avenue, Aeroton, 1457 Johannesburg (ZA).

(74) Agent: **TABERER ATTORNEYS**; 41 Waterloo Road, Wynberg, 7800 Cape Town (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, JO, 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, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, 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: NOZZLE FOR USE IN INTRODUCING A MULTI-COMPONENT ADHESIVE INTO A ROCK ANCHOR INSTALLATION

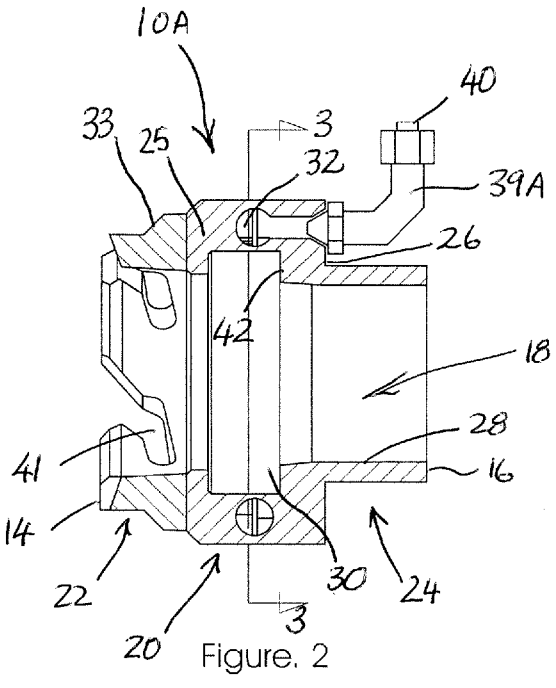

Figure. 2

(57) Abstract: The invention provides a resin delivery coupling member which includes a hollow body which includes a wall, an axially extending passage circumscribed by the wall that opens at a first end and an opposed second end, a circumferential resin distributing channel within the passage, a resin conduit in the wall which opens into the channel and at least one inlet port opening the resin conduit to an exterior of the body, wherein the passage is adapted to receive, from a first end, a trailing part of a rock anchor assembly installation which carries a docking element and to engage with the docking element in a position in which an inlet to the docking element is in sealingly fluid communication with the channel.

WO 2020/247987 A1

NOZZLE FOR USE IN INTRODUCING A MULTI-COMPONENT ADHESIVE INTO A ROCK ANCHOR INSTALLATION

FIELD OF THE INVENTION

[0001] The invention relates to a nozzle for use in introducing a multi-component adhesive into a rock anchor installation.

BACKGROUND OF INVENTION

[0002] In resin adhered rock anchor installations, a multi-component adhesive is used. Each component is pumped from an individual sources and brought together to mix at some stage during the introduction of the adhesive into and through a hollow rock anchor. At the point of mixing, the adhesive components will rapidly cure and harden.

[0003] Some of this cured or partially cured resin will remain within the supply conduits leading from the mixing stage. This often includes the passages and conduits within the nozzle itself, being the device, which connects to the rock anchor and fed by the adhesive component supply lines with the rock anchor.

[0004] To prevent this occlusion or partial occlusion of the conduits, and thereby to keep the conduits open to the supply of the adhesive resin to the rock anchor installation, a flushing medium is pumped after the resin components to flush residual mixed resin from at least the nozzle so that the nozzle can be re-used. However, even with flushing, some resin remains which accumulates over time to narrow and ultimately to close the conduits.

[0005] The invention at least partially solves the aforementioned problems.

SUMMARY OF INVENTION

[0006] Hereinafter, the term "resin" is used to refer to any adhesive system which includes at least two parts, an active part and an activating part.

[0007] The invention provides a resin delivery coupling member which includes a hollow body which includes a wall, an axially extending passage circumscribed by the wall that opens at a first end and an opposed second end, a circumferential resin distributing channel within the passage, a resin conduit in the wall which opens into the channel and at least one inlet port opening the resin conduit to an exterior of the body, wherein the passage is adapted to receive, from a first end, a trailing part of a rock anchor assembly installation which carries a docking element and to engage with the docking element in a position in which an inlet to the docking element is in sealingly fluid communication with the channel.

[0008] The resin coupling member may be a single-use or sacrificial component, made from a suitable plastics or composite material.

[0009] In this single-use embodiment, the member may include a static mixer which is contained within the conduit. The static mixer may be replaceable, wherein the wall may be adapted with a slot to receive the static mixer and wherein the static mixer may be adapted for removal from the conduit via the slot, when a replacement is needed.

[0010] The body may be formed with a plurality of inlet ports, each port adapted to receive a respective pre-mixed component of a resin system.

[0011] Each port may be adapted in a poke-yoke manner to allow engagement only to the resin component delivery hose which carries the correct component of the resin system.

[0012] The circumferential distributing channel may be formed on an inner wall surface of the channel.

[0013] Alternatively to the sacrificial embodiment, the resin coupling member may be reusable, made from a suitable metal.

[0014] The resin coupling member may include a removable annular element which is adapted with the circumferential distributing channel.

[0015] The removable annular element may be made of suitable flexible material. In one embodiment, the material may be non-stick to prevent post-mixed resin from sticking to the channel. In another, the removable annular element may be tubular, adapted with an air inlet to allow for inflation of the element.

[0016] The body may include an air passage formed through the wall which communicates with the air inlet of the removable annular element.

[0017] The removable annular element may be made of a rigid material, for example a suitable rigid plastics material.

[0018] The removable annular element may include a helical partitioning wall which adapts the circumscribing distributing channel to a helical distribution channel.

[0019] The removable annular element may include may include a static mixer in at least a part of the helical distribution channel.

[0020] In this embodiment, the body may be formed with a plurality of inlet ports, each port adapted to receive a respective pre-mixed component of a resin system.

[0021] Each port may be adapted in a poke-yoke manner to allow engagement only to the resin component delivery hose which carries the correct component of the resin system.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] The invention is described with reference to the following drawings in which:

Figure 1 is a view from a back end of a nozzle in accordance with a first embodiment of the invention;

Figure 2 is a sectioned view of the nozzle through line 2 – 2 on Figure 1;

Figure 3 is a cross sectional view of the nozzle through line 3 – 3 on Figure 2;

Figure 4 is a view in plan of the nozzle of Figure 2;

Figure 5 is a side view of a nozzle in accordance with a second embodiment of the invention;

Figure 6 is a view in plan of a static mixer engageable to the nozzle of Figure 5;

Figure 7 is a partially sectioned isometric view of a nozzle in accordance with a third embodiment of the invention;

Figure 8 is a longitudinally sectioned exploded view of the nozzle of Figure 7;

Figure 9 is a partially sectioned exploded isometric view of the nozzle of Figure 8;

Figures 10 and 12 are each longitudinally sectioned views of a nozzle in accordance with a fourth embodiment of the invention;

Figures 11 and 13 are each partially sectioned isometric view of the nozzle of Figures 10 and 12 respectively;

Figure 14 is a partially sectioned isometric view of a nozzle in accordance with a fifth embodiment of the invention;

Figure 15 is a longitudinally sectioned exploded view of the nozzle of Figure 14;

Figure 16 is a partially sectioned exploded isometric view of the nozzle of Figure 15;

Figure 17 is a longitudinally sectioned exploded view of a nozzle in accordance with a sixth embodiment of the invention;

Figure 18 is a longitudinally sectioned view of the nozzle of Figure 17; and

Figure 18 is a series of longitudinally sectioned views of the nozzle of Figure 17 engaging with a rock anchor assembly.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0023] A first embodiment of the invention, a nozzle 10A, is described with reference to Figures 1 to 4.

[0024] The nozzle 10A includes a body 12 made of a low-cost disposable material such as a suitable rigid plastics material. The body extends, in an axial direction when in use, between a first end 14 and an opposed second end 16. The body is hollow, defining a substantially cylindrical passage 18 which extends between the

ends. The body has a diametrically larger mid-section 20 to a forward rock anchor assembly abutting section 22 and to a trailing section 24. A wall 25 of the body diametrically reduces, in a step, to the trailing section. The step provides a rear facing surface 26.

[0025] In an inner surface 28 of the wall 25, facing onto the cylindrical passage 18, a circular distributing channel 30 is formed. A circular or semi-circular conduit 32 is formed within the mid-section between an outer surface 33 of the wall and the channel 30. In this example, as shown in Figure 1, three inlets, respectively designated 34A, 34B, and 34C, are formed through the body from the rear facing wall 26 to open into the conduit 32. The conduit in turn spirals inwardly to join the channel at an outlet end 36. The conduit 32 contains a static mixer 38.

[0026] Each of the inlets can extend from the rear facing wall 26 as respective projecting inlet ports (only two are shown in Figure 4 for ease of illustration and designated 39A and 39B respectively). Each of the ports is connectable to a resin component delivery hose (not shown). Each port can be adapted, in a poke-yoke manner, with a specifically adapted or shaped boss 40 to allow attachment only to the resin component delivery hose which carries the correct component of the resin system so as to prevent the wrong component from being introduced to the nozzle 10A via the wrong inlet 34.

[0027] The forward rock anchor abutting section 22 is formed with a plurality of locking formations 41 which are adapted to receive complementary bayonets on a docking element, such as for example a barrel 62, which is engaged to a trailing end

of a rock anchor assembly 60 (see Figure 19, which illustrates this engagement with another embodiment of the invention), in twist lock engagement.

[0028] The forward section 22 does not have to be adapted with locking formations. It is also envisaged that the nozzle 10 will be held in a position during pumping of a resin by an applied axial force applied, for example, a rock bolting machine arm. The last embodiment shows this.

[0029] An example of the rock anchor assembly is described in a specification to PCT/ZA2016/000017, which specification is herein incorporated by reference.

[0030] The passage 18 provides a space through which the trailing end of the rock anchor assembly 60 passes in engagement.

[0031] The nozzle 10A is attachable to the barrel 62 so that a mixed resin can be delivered through the barrel and into a sleeve 64 (see Figure 19) surrounding a rock anchor 66. The barrel is partially received into the cylindrical passage 18 from the first end 14. The back end of the barrel seats and seals against a sealing surface 42 which radially inwardly extends into the passage 18 as a rim (see Figure 3).

[0032] By twisting the nozzle 10A relatively to the barrel 62, each locking formation 41 engages with a respective bayonet to lock the barrel to the nozzle. The barrel is positioned such that resin inlets in the barrel are in planar orientation with the circular distribution channel 30.

[0033] Resin components of a multi-component resin system, can be pumped from a respective source, through inlets 34A, 34B and 34C respectively, to mix in the static mixer containing conduit 32 and to empty into the channel 30 from outlet 36.

The post-mixed resin now flows into the barrel via its resin inlets. Back-flow of the resin is prevented by the seal provided against the sealing surface 42.

[0034] A second embodiment of the invention is described with reference to Figures 5 and 6. For ease of illustration, the inlet ports 39 are not shown.

[0035] This nozzle, designated 10B, is similar in all respects to the nozzle 10A, with the exception that it has a replaceable static mixer, designated 38B. This allows the nozzle to be re-used multiple times by replacing the static mixer when it gets occluded with hardened resin.

[0036] In describing this embodiment, and the embodiments that follow, like features bear like designations.

[0037] To allow for the replacement of the static mixer, 38B, an arcuate slot 44 is formed into the wall 25 of the nozzle body 12, from an outer surface 33, aligned in the circumferential direction. The arcuate slot opens the outer surface 33 to the conduit 32 within.

[0038] The static mixer 38B is shaped to complement the slot 44 so that the mixer can be inserted into the slot in a snap lock manner. Once fully inserted, an arcuate outer rib 46 of the mixer now forms part of the wall 25 of the body 12, once fully inserted, and seats flush with the outer surface 33. A mixer part 47 of the static mixer locates within the conduit 32.

[0039] Figures 7 to 9 illustrate a third embodiment; nozzle 10C. This embodiment differs from the preceding in that the nozzle of these embodiment adapted for multi-use, with a body 12 made of a durable material such as suitable metal.

[0040] To prevent the resin hardening problem, the nozzle 10C is provided with a replaceable seal 48. The seal is a replaceable, crushable, soft, non-stick sealing element which is removed after each use of the nozzle, and replaced with a new seal.

[0041] The nozzle 10C does not have multiple inlets like the earlier embodiments. It has a single inlet 34 and associated inlet port 39 which introduces a pre-mixed resin to an interior of the nozzle. The circular distribution channel 30 into which the resin is introduced is not part of the nozzle body 12 itself, but rather part of the seal 48.

[0042] The circular distribution channel 30 is provided between opposed, spaced circular bands, a back-sealing band and a forward sealing band, respectively designated 50A and 50B. It is against the back-sealing band 50A, structurally analogous to the sealing surface of the earlier embodiments that a back end of the barrel seals in engagement of the nozzle to barrel.

[0043] To facilitate easy removal and replacement of the seal 48, the nozzle is provided with a back plate 52 which is complementary in size and shape to fit within the cylindrical passage 18, into the trailing section 24, from the second end 16. The back-plate screws into place with a forward end providing a rim 42 against which the back-sealing band 50A of the seal abuts.

[0044] The fourth embodiment, designated 10D, is illustrated in Figures 10 to 13. This nozzle 10D has, like the nozzle 10C, a replaceable seal 48. However, unlike with earlier embodiment, the seal 48 of this embodiment is inflatable, after the passage of resin, to break off any resin stuck to the seal. Once the resin is broken up, it is easy to remove with flushing.

[0045] To achieve this inflation, the nozzle 10D is provided with a second inlet port 54, diametrically opposed to the resin inlet port 34 and the seal is provided with air inlet passage 55. Air is introduced through this port, into the seal via the passage, to inflate the seal from a deflated configuration as illustrated in Figure 10 and 11, to an expanded configuration as illustrated in Figures 12 and 13.

[0046] In the fifth embodiment, nozzle 10E has similarities to nozzle 10C in that it includes a replaceable, non-inflatable seal 48. This embodiment is illustrated in Figures 14 to 16. However, the nozzle 10E differs in that it is formed with a helical distributing channel 30, with cross-sections of the helical channel longitudinally separated by a partitioning wall 54 following a helical course on a base wall 57 of the seal. At least a part of the spiral distributing channel contains an integrally formed static mixer 38.

[0047] The resin components can be introduced separately and simultaneously via inlet ports 39A and 39B (depending upon the resin system or the need to flush with a flushing medium, a third port which is not shown can be provided) into the distributing channel where, following the helical channel, each component will be channelled through the static mixer to be mixed before exiting the channel at an outlet 36 and entering resin inlets of an attached barrel.

[0048] This embodiment, too, can make use of the poke-yoke principal with regards to the individual resin components input connections to prevent the possibility of cross-contamination of the components and any flushing medium that is subsequently introduced. Here again refer to Figure 4.

[0049] A final embodiment, nozzle 10F, is illustrated in Figures 17 and 18.

[0050] As with nozzle 10E, this embodiment has a disposable seal / mixing unit 48. However, this embodiment differs in that, upon completion of the resin component ingress to a rock anchor assembly 60, the nozzle is removed from engagement with a barrel 62, leaving behind the mixing seal unit which remains engaged with the barrel (see Figure 19).

[0051] The seal unit 48 engages with the cylindrical passage 18 and is press fitted therein and held behind an inwardly projecting lip 64 circumscribing the passage at the first end 14 so as not to fall out.

[0052] Such an embodiment is useful in a mechanised system, with no need to flush the sacrificial seal. The remaining seal now provides a visual indication that resin has been introduced into the particular bolt installation.

[0053] The arrangement of the ports in the seal separate the individual input resin components, of the resin system, to their respective sides. Mixing of the resin components thereby only occurs within the seal/mixing unit 48.

[0054] Resin components A and B are kept separate from each other, thus negating the need to flush mixed resin or excess resin from the nozzle.

CLAIMS

1. A resin delivery coupling member which includes a hollow body which includes a wall, an axially extending passage circumscribed by the wall that opens at a first end and an opposed second end, a circumferential resin distributing channel within the passage, a resin conduit in the wall which opens into the channel and at least one inlet port opening the resin conduit to an exterior of the body, wherein the passage is adapted to receive, from a first end, a trailing part of a rock anchor assembly installation which carries a docking element and to engage with the docking element in a position in which an inlet to the docking element is in fluid communication with the channel.

2. A resin delivery coupling member according to claim 1 which includes a static mixer which is contained within the conduit.

3. A resin delivery coupling member according to claim 2 wherein the static mixer is removable from, and insertable into, the conduit.

4. A resin delivery coupling member according to claim 3 wherein the wall of the body is formed with a slot which opens into the conduit and which is adapted to allow the insertion and removal of the static mixer.

5. A resin delivery coupling member according to anyone of claims 1 to 4 wherein the body includes a plurality of inlet ports.

6. A resin delivery coupling member according to claim 5 wherein each port is adapted in a poke-yoke manner to allow engagement only to the resin component delivery hose which carries the correct component of the resin system.

7. A resin delivery coupling member according to anyone of claims 1 to 6 wherein the circumferential distributing channel is formed on an inner wall surface of the channel.

8. A resin delivery coupling member according to claim 1 which includes a removable annular element which is adapted with the circumferential distributing channel.

9. A resin delivery coupling member according to claim 8 wherein the removable annular element is made of suitable flexible non-stick material.

10. A resin delivery coupling member according to claim 8 wherein the removable annular element is tubular, adapted with an air inlet to allow for inflation of the element.

11. A resin delivery coupling member according to claim 10 wherein the body includes an air passage formed through the wall to communicate with the air inlet of the removable annular element.

12. A resin delivery coupling member according to claim 8 wherein the removable annular element is made of a rigid material.

13. A resin delivery coupling member according to claim 12 wherein the removable annular element includes a helical partitioning wall which adapts the circumscribing distributing channel to a helical distribution channel.

14. A resin delivery coupling member according to claim 13 wherein the removable annular element includes a static mixer in at least a part of the helical distribution channel.

15. A resin delivery coupling member according to anyone of claims 12 to 14 wherein the body has a plurality of inlet ports, each port adapted to receive a respective pre-mixed component of a resin system.

16. A resin delivery coupling member according to claim 15 wherein each port may be adapted in a poke-yoke manner to allow engagement only to the resin component delivery hose which carries the correct component of the resin system.

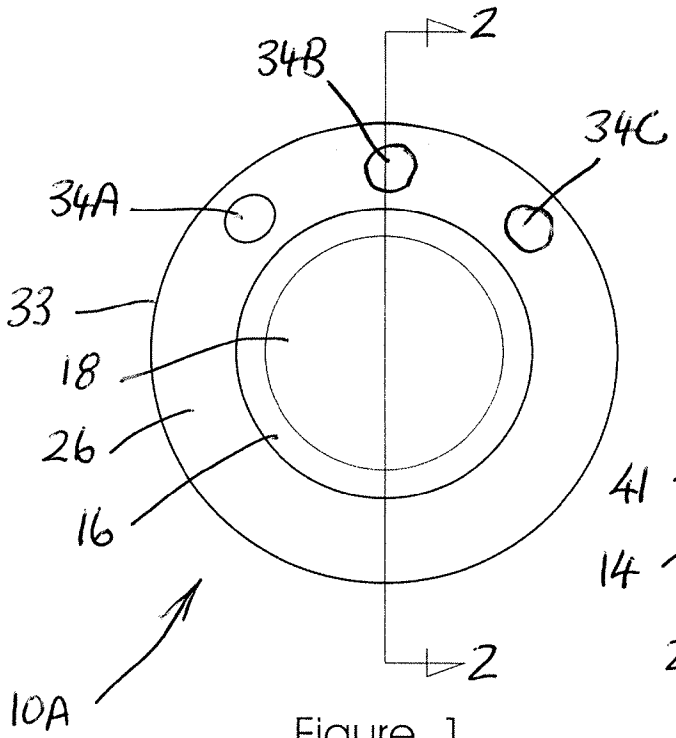

Figure. 1

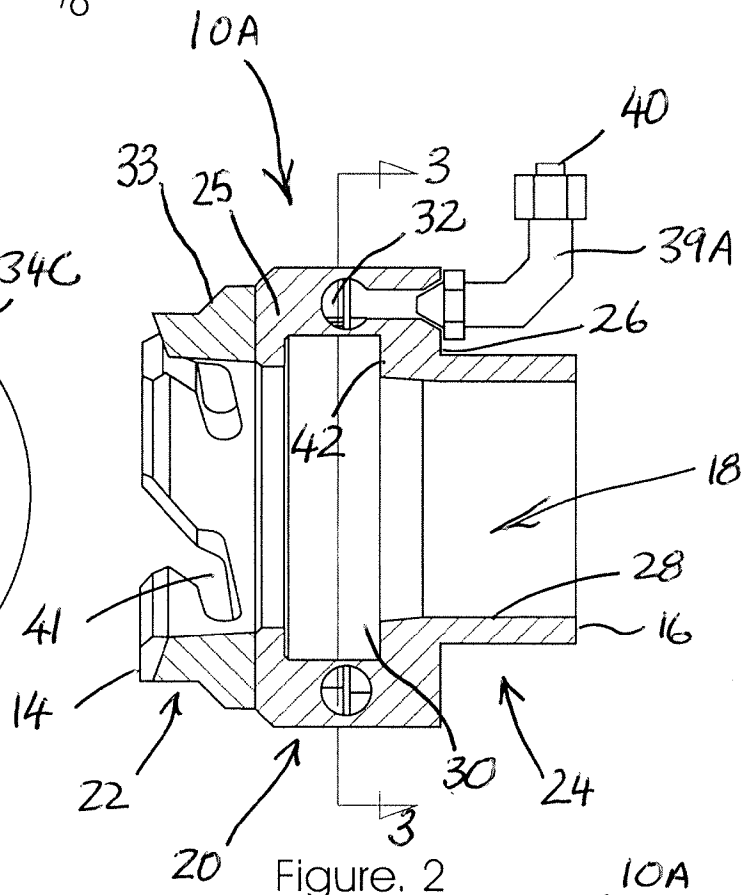

Figure. 2

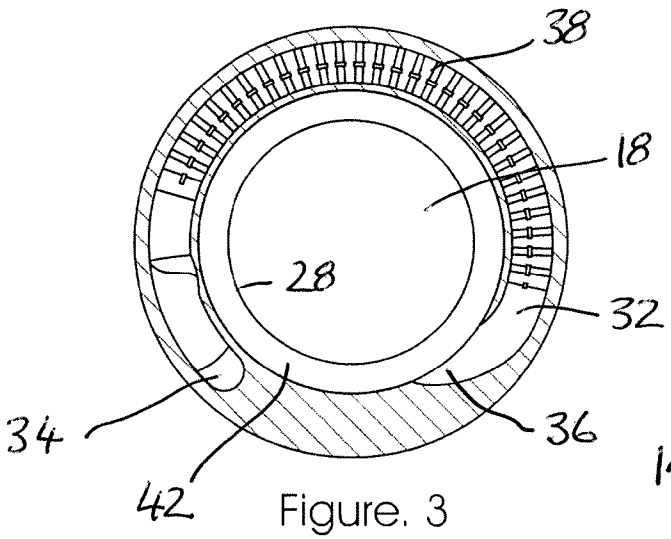

Figure. 3

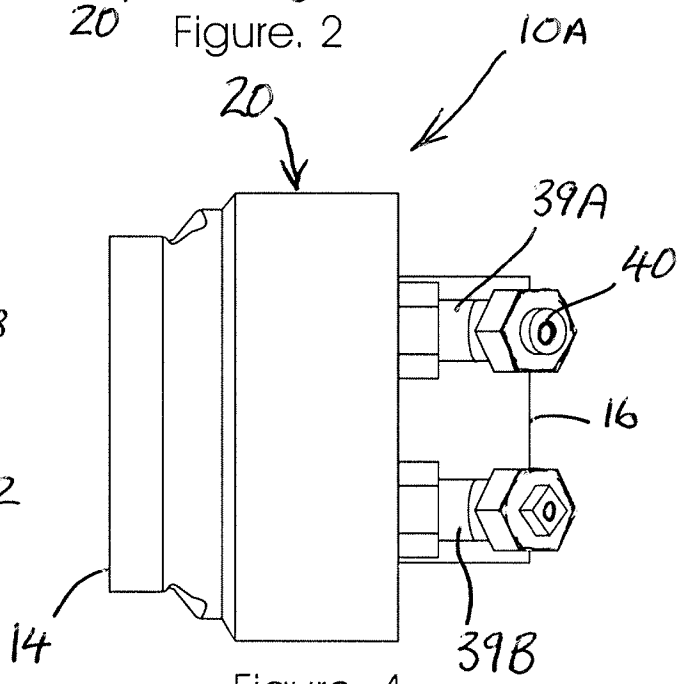

Figure. 4

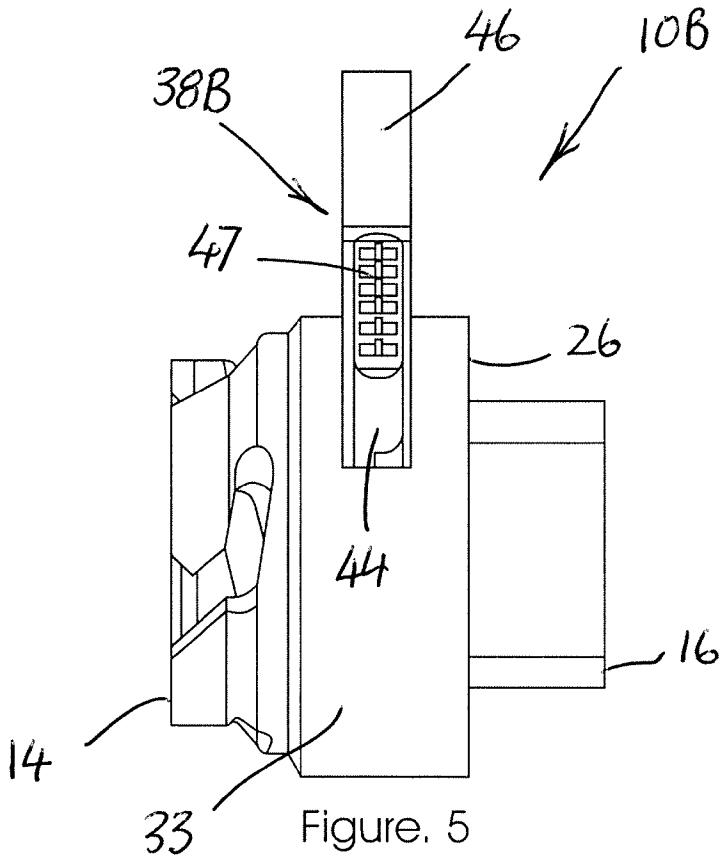

Figure. 5

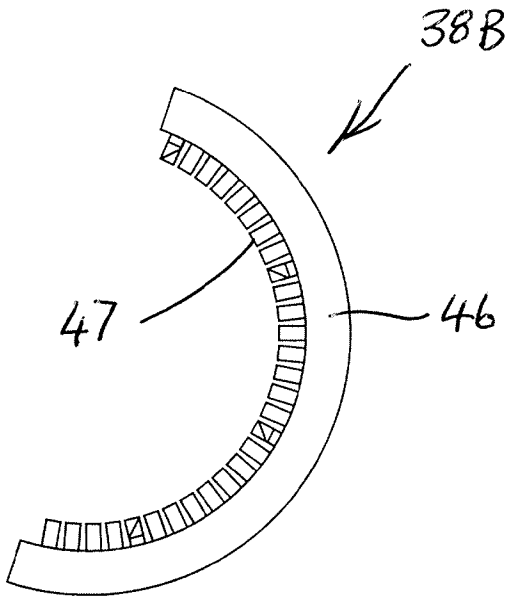

Figure. 6

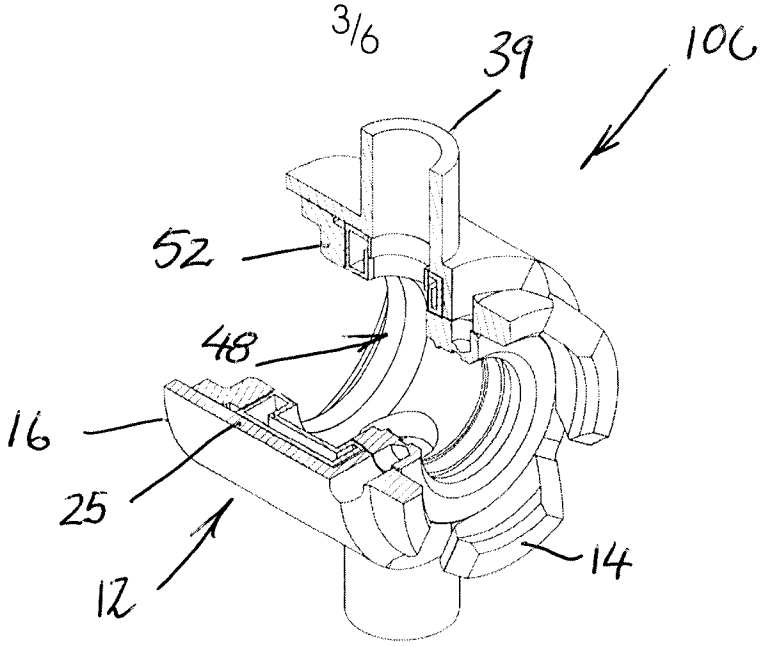

Figure. 7

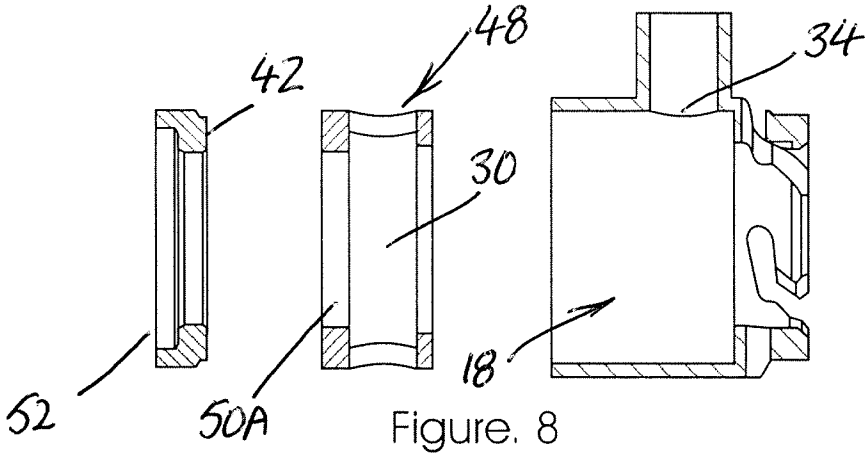

Figure. 8

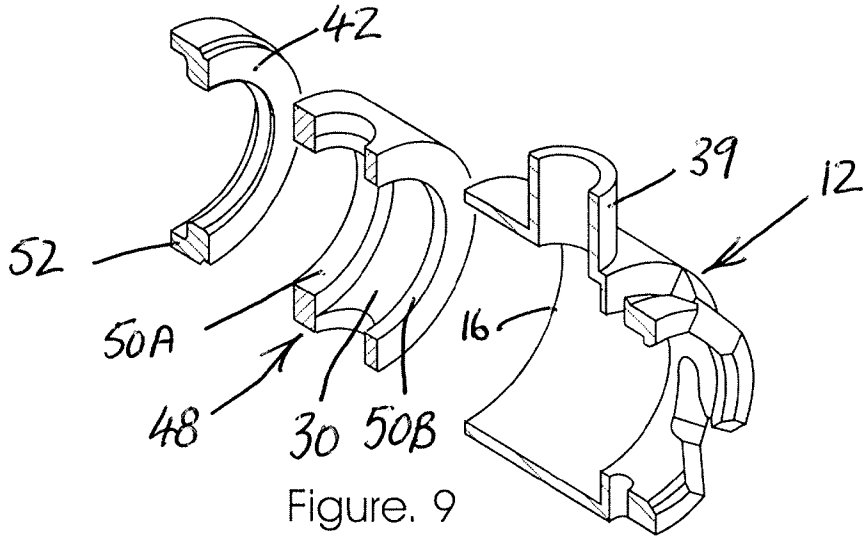

Figure. 9

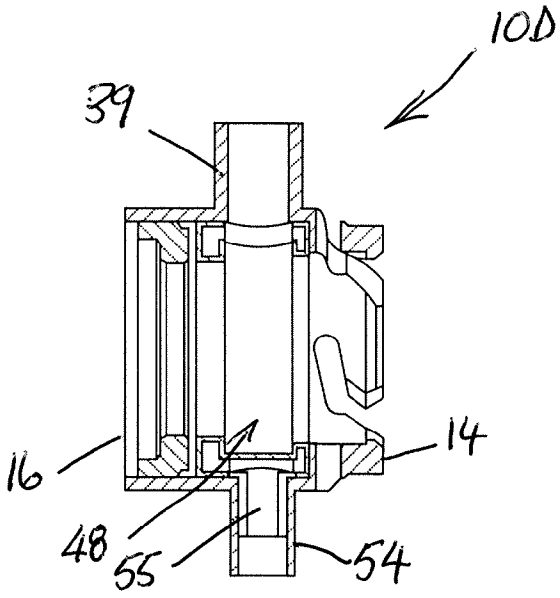

Figure. 10

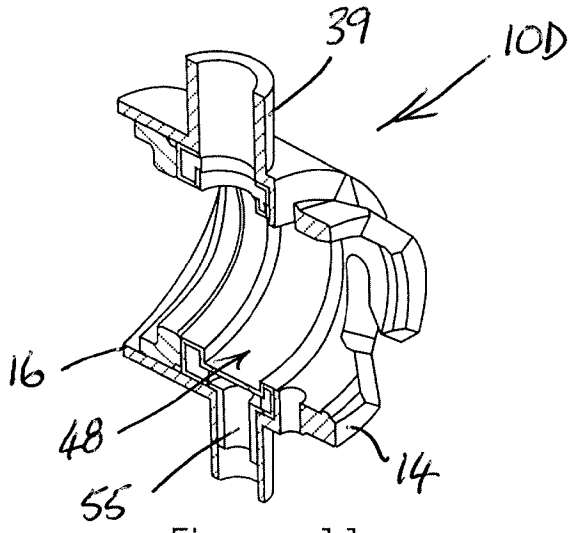

Figure. 11

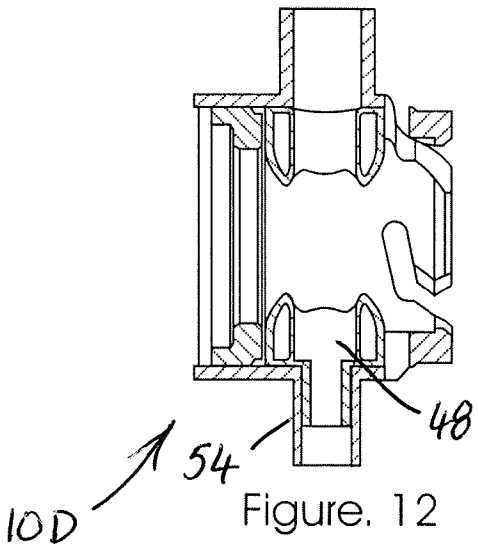

Figure. 12

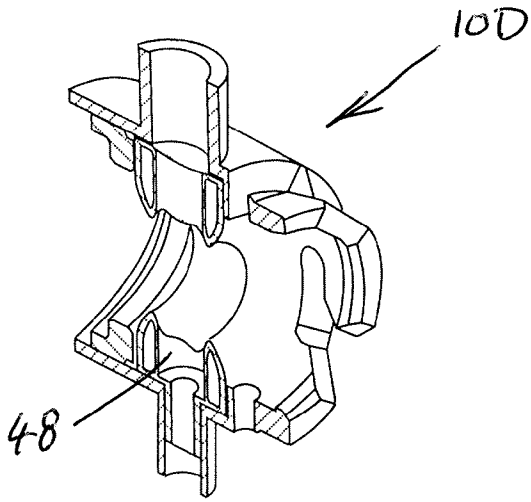

Figure. 13

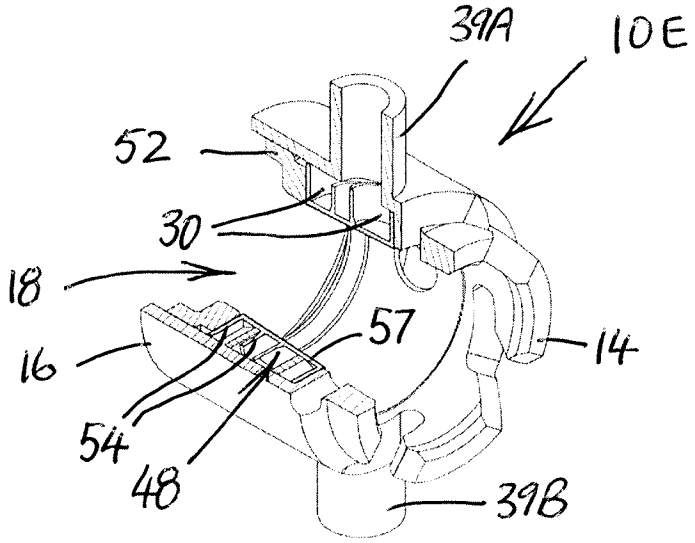

Figure. 14

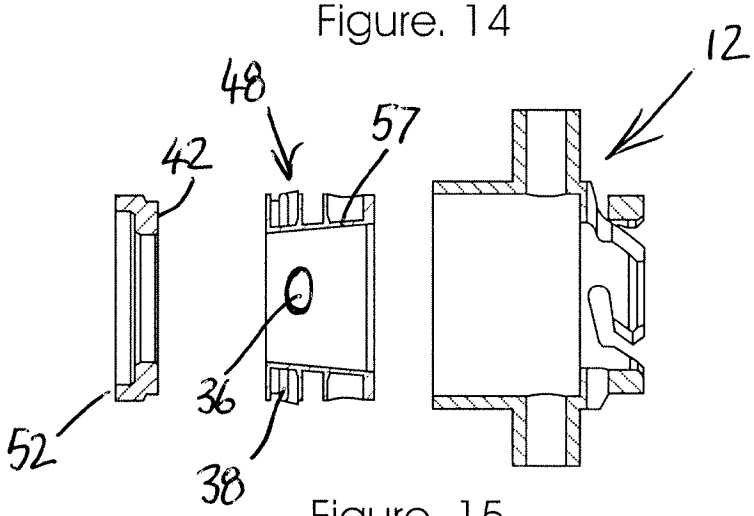

Figure. 15

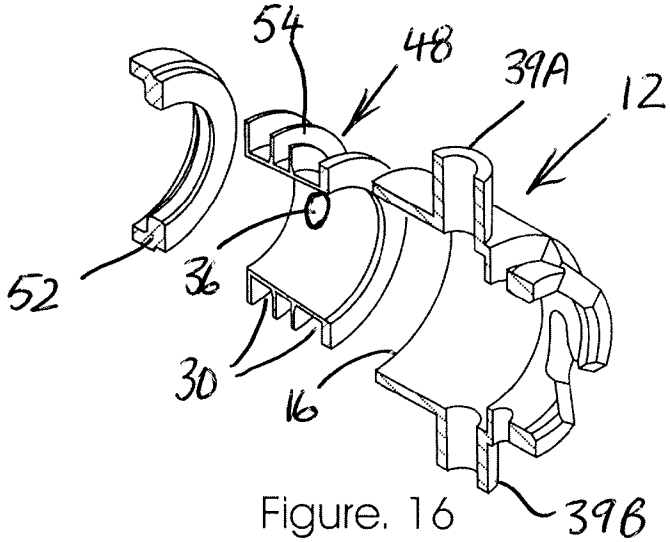

Figure. 16

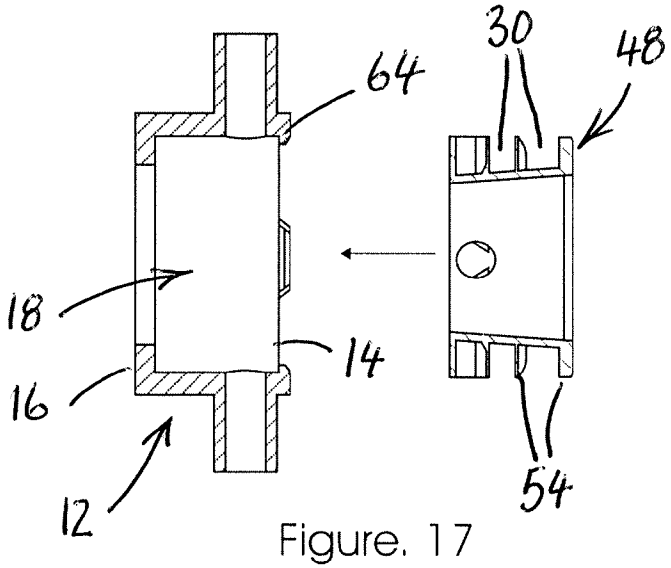

Figure. 17

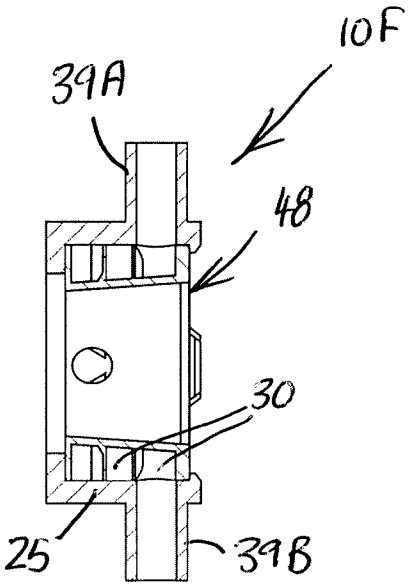

Figure. 18

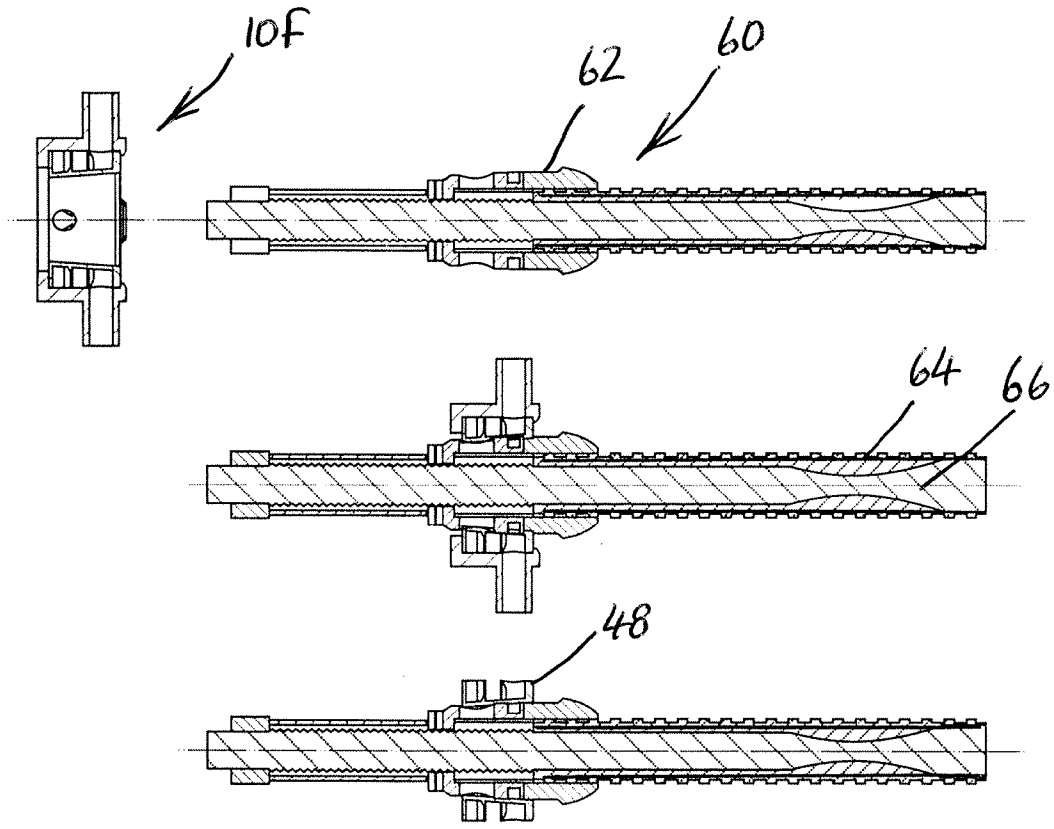

Figure. 19

INTERNATIONAL SEARCH REPORT

International application No
PCT/ZA2020/050028

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

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	US 4 974 689 A (ISSAKAINEN ONNI [FI]) 4 December 1990 (1990-12-04) figures 1,2	1,5,7
X	CA 2 713 194 A1 (ISCHEBECK FRIEDRICH GMBH [DE]) 30 July 2009 (2009-07-30) figures 1,2,6,9	1,5,7
A	WO 2011/116918 A2 (HENNING KARIN [DE]; MOLITOR VOLKER [DE]) 29 September 2011 (2011-09-29) figures 2,12-17	1-5,7

☐ Further documents are listed in the continuation of Box C.

☒ 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
18 September 2020	16/11/2020

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

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ZA2020/050028

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-5, 7

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-5, 7

A resin delivery coupling member including a static mixer within a conduit in the wall of the housing

---

2. claim: 6

A resin delivery coupling member with inlet ports adapted on a poke-yoke manner

---

3. claims: 8-16

A resin delivery coupling member with a removable element adapted with the circumferential distributing channel

---

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/ZA2020/050028

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4974689 A	04-12-1990	AU 2478688 A	11-05-1989
		CA 1327351 C	01-03-1994
		DE 3838186 A1	24-05-1989
		FI 874966 A	12-05-1989
		FR 2623563 A1	26-05-1989
		US 4974689 A	04-12-1990
		US 5129470 A	14-07-1992
		ZA 888410 B	30-08-1989
CA 2713194 A1	30-07-2009	AU 2009207740 A1	30-07-2009
		CA 2713194 A1	30-07-2009
		CN 101925720 A	22-12-2010
		DE 102008006233 A1	30-07-2009
		WO 2009092632 A1	30-07-2009
		ZA 201004523 B	28-09-2011
WO 2011116918 A2	29-09-2011	DE 112011100977 A5	06-06-2013
		EP 2550431 A2	30-01-2013
		ES 2616632 T3	13-06-2017
		WO 2011116918 A2	29-09-2011