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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
17 December 2020 (17.12.2020)

WIPO | PCT

(10) International Publication Number
WO 2020/249869 A1

(51) International Patent Classification:
B08B 7/00 (2006.01) *F42D 3/00* (2006.01)

(21) International Application Number:
PCT/FI2020/050415

(22) International Filing Date:
12 June 2020 (12.06.2020)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
20195501 12 June 2019 (12.06.2019) FI

(71) Applicant: **LASSILA & TIKANOJA OYJ** [FI/FI]; Valimotie 27, 00380 Helsinki (FI).

(72) Inventor: **HONKASALO, Hannu**; Haanpääntie 4 as. 1, 40270 Palokka (FI).

(74) Agent: **HEINONEN & CO, ATTORNEYS-AT-LAW, LTD**; Fabianinkatu 29 B, 00100 Helsinki (FI).

(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))*

(54) **Title:** DEVICE AND METHOD FOR CLEANING WITH EXPLOSIVE MATERIAL

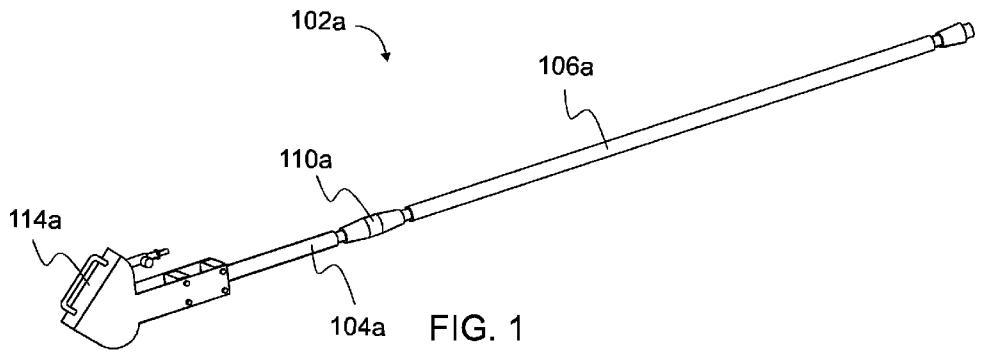

FIG. 1

(57) **Abstract:** The present invention relates to a device (200) for cleaning with explosive material, the device comprising a lance (102a, 102b, 102c), a control unit (230), a breakable part (238) comprising explosive material, cooling means for cooling the explosive material and/or a detonator (240). The invention relates to a related method.

WO 2020/249869 A1

DEVICE AND METHOD FOR CLEANING WITH EXPLOSIVE MATERIAL

FIELD OF THE INVENTION

Generally the present invention relates to cleaning devices. In particular, the present invention pertains to cleaning devices using explosive material.

BACKGROUND

A variety of methods and devices are used today for cleaning different industrial applications. For example, air cannons (also known as air blasters) and different sootblowers (e.g. air, steam, water) are known today for cleaning silos, bins and other large volume structures where dirt is built up and where it is difficult to reach by mechanical means.

Many of the solutions used today are fixed solutions that are installed to the target. These solutions may be difficult to move to another target. Even if it is possible, often it may require additional manpower and the process may be slow and cumbersome.

Further, devices using explosive material for cleaning industrial applications are known today. Cleaning with explosive material may be beneficial in targets where the dirt is hard to remove.

One problem with the solutions today is that the targets to be cleaned have a high temperature and therefore the devices used for cleaning are exposed to heat. The explosive material and/or triggering means must therefore be protected and/or cooled with suitable means. The means used today have some drawbacks and the explosive material and/or triggering means may therefore be exposed to too much heat before reaching the target to be cleaned. This may lead to premature explosion.

Another problem with many of the devices utilizing explosive material today is that the cleaning process may be rather slow. Recharging the explosion may be

slow and therefore the process for cleaning an industrial application may take a long time.

SUMMARY OF THE INVENTION

The objective is to at least alleviate the problems described hereinabove not satisfactorily solved by the known arrangements, and to provide a feasible device and method for cleaning with explosive material. One objective is to provide means for cooling the explosive material and/or detonator. Another objective is to speed up the cleaning process by providing a device where the change of explosive material is fast and convenient.

The aforesaid objectives are achieved by the embodiments of a device and/or method in accordance with the present invention.

The aforesaid objectives are achieved according to the present invention as claimed in claim 1.

The aforesaid objectives are achieved according to the present invention as claimed in claim 13.

Accordingly, in one aspect of the present invention a device for cleaning with explosive material comprises

-a lance comprising
    -a number of lance pipes,
    -a first connection for cooling means in a first end of the lance such that a coolant is supplied through the lance pipes,
    -an inlet channel for an electric cable, the inlet channel guiding the electric cable through the lance pipes,
    -a sleeve connector in a second end of the lance for connecting a breakable part to the lance,

-a control unit comprising
    -an inlet for the cooling means,
    -an outlet for connecting the cooling means to the first connection of the lance,

-an explosion trigger,

-an electric cable arranged in connection with the explosion trigger and a detonator,

-a detonator arranged to the breakable part next to explosive material,

-a breakable part comprising explosive material, and

-cooling means for cooling the explosive material and/or detonator.

In one embodiment the device comprises a second connection for cooling means in the first end of the lance such that a coolant is supplied at least partially through the lance pipes.

In one embodiment the device comprises an additional cooling pipe arranged between the first end of the lance and a second point of the lance for transferring the coolant closer to the second end of the lance.

In one embodiment the coolant supplied through the first connection is compressed air, and wherein the coolant supplied through the second connection is water.

In one embodiment the device comprises a nozzle for creating water spray of the cooling water.

In one embodiment the device comprises at least two lance pipes, wherein the lance pipes are connected to each other with quick couplings.

In one embodiment the cooling means are connected to the first end of the lance with quick couplings.

In one embodiment the breakable part is a cardboard sleeve.

In one embodiment the electric cable comprises quick couplers in the second end of the electric cable for quick connection of the detonator wirings.

In one embodiment the breakable part is covered with a fire retardant cover for protecting the explosive material and/or electric detonator.

In one embodiment the explosive material is an F- or K-pipecharge.

In one embodiment the device comprises a hose reel with the electric cable, air pressure pipe and/or water pipe.

In one embodiment the control unit comprises ON/OFF valves and/or flow controllers for the air pressure and/or water.

In another aspect of the present invention, a method for cleaning with explosive material comprises

-placing a breakable part with explosive material and a detonator to a lance,

-cooling the explosive material and/or detonator with air pressure by flowing the air pressure through the lance,

-moving the breakable part to the target area to be exploded, and

-triggering the explosion.

In one embodiment water spray is flown through the lance for cooling the explosive material and/or detonator.

In one embodiment the water is supplied through an additional cooling pipe closer to the second end of the lance before the water flows through the lance.

The utility of the present invention follows from a plurality of factors depending on each particular embodiment. Some embodiments of the present invention may allow effective cleaning in the target area with the explosion of the explosive material. Some embodiments may provide suitable means for cooling the explosive material and/or detonator. Some embodiments may speed up the cleaning process by providing a device where the change of explosive material is fast and convenient.

The expression “a number of” refers herein to any positive integer starting from one (1), e.g. to one, two, or three.

The expression “a plurality of” refers herein to any positive integer starting from two (2), e.g. to two, three, or four.

Different embodiments of the present invention are disclosed in the dependent claims.

BRIEF DESCRIPTION OF THE RELATED DRAWINGS

Next the invention is described in more detail with reference to the appended drawings in which

Fig. 1 illustrates a first embodiment of a lance of the device for cleaning with explosive material in accordance with the present invention.
Fig. 2 illustrates a second embodiment of a lance of the device for cleaning with explosive material in accordance with the present invention.
Fig. 3 illustrates a closer view of the handle part.
Fig. 4 illustrates a side view of the first end of the lance without a handle cover.
Fig. 5 illustrates a cross-section of the handle part.
Fig. 6 illustrates a connection of a cooling pipe and the lance.
Fig. 7 illustrates a cross-section of the connection of the cooling pipe and the lance.
Fig. 8 illustrates a third embodiment of the first end of the lance without a handle cover.
Fig. 9 illustrates an embodiment of the device for cleaning with explosive material.
Fig. 10 illustrates view of the front end of the control unit and the lance.
Fig. 11 illustrates an embodiment of a box of cardboard sleeves.
Fig. 12 illustrates an embodiment of a cardboard sleeve having a fire retardant cover.
Fig. 13 illustrates an embodiment of a blasting trigger.
Fig. 14 illustrates an embodiment of the second end of the lance with sleeve connector and electric cables.
Fig. 15 illustrates an embodiment of the second end of the lance and a detonator.
Fig. 16 illustrates an embodiment of the detonator being placed in the cardboard sleeve.
Fig 17 illustrates a flow diagram of an embodiment of a method in accordance with the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Referring to figures 1-2, the lance 102a, 102b comprises a number of lance pipes 104a-106a, 104b-108b, preferably stainless and acid-proof lance pipes. The length of the lance can be increased by connecting multiple lance pipes together. The lance pipes 104a-106a, 104b-108b are connected to each other with quick couplings 110a, 110b, 112b.

Referring also to figures 3-5, the first end of the lance 102a, 102b comprises a handle part 114a, 114b. The handle part 114 comprises a handle cover 116. The handle part 114 may comprise a safety button 117 so that the triggering of the explosion requires that the safety button is pressed down. This may require two users so that one presses the explosion trigger and the other presses the safety button in the handle part.

Additionally, the first end of the lance comprises a first connection 118 and a second connection 119 for cooling means. The cooling means may comprise compressed air and/or water. The air pressure may be arranged to the first connection 118 such that the air pressure flows through the lance. The cooling water may be arranged to the second connection 119. Preferably, a nozzle is arranged directly after the second connection 119 to create water spray for cooling. The first and second connections 118, 119 may be quick couplings.

Additionally, the first end of the lance comprises a third connection 120 for an additional cooling pipe 122. The third connection may also be a quick coupling. Referring also to figures 6-7, the additional cooling pipe 122 may be arranged from the handle part to any connecting section of the lance pipes. If the length of the lance has to be increased to create a relatively long lance, the additional cooling pipe may be utilized to transfer the coolant closer to the second end of the lance. The second end of the additional cooling pipe 122 is arranged to the connecting section of the two lance pipes 106b, 108b. The second end of the additional cooling pipe may comprise a second nozzle 124 for creating or increasing the water spray for cooling. Alternatively, the second nozzle 124 is the only nozzle in the pipe for creating water spray.

The handle part 114 comprises an inlet channel 126 for an electric cable, preferably thermally protected silicone cable. The electric cable may be protected with a

cover pipe, preferably acid-proof cover pipe. The cover pipe may be welded to the lance pipe and arranged in the middle of the lance pipe. Excess cable may be collected in the handle part.

Referring to figure 8, in a third embodiment of the lance 102c, the first and second connection 118c, 119c unite in the lance. The electric cable 128c is arranged through the inlet channel 126c.

Referring also to figures 9-10, the device 200 for cleaning with explosive material comprises a lance 202, a control unit 230 and a hose reel 232.

The control unit 230 comprises quick couplers for connecting the water pipe, air pressure pipe and electric cable from the hose reel 232. Alternatively, the electric cable, air pressure pipe and/or water pipe is arranged directly from the control unit 230 to the lance. Additionally, the control unit 230 comprises quick couplers for the inlets for the water and/or air pressure. The water and/or air pressure may be arranged from a water and/or air pressure network. The control unit comprises manual ON/OFF valves and/or flow controllers for the air pressure and/or water. The control unit comprises an explosion trigger 234. The explosion trigger 234 may be an Orican Thor™ explosion trigger, for example. Additionally, the control unit may comprise a sound alarm for explosion.

The first end of the electric cable 228 comprises a quick coupler so that the lance may be detached from the hose reel 232. The hose reel 232 comprises quick couplers in the first and second end for the water pipe, air pressure pipe and the electric cable. The pipes and cable of the hose reel may be arranged in a cut resistant and thermally protected bag. The ends of the thermally protected bag may be tightened to the pipes and/or cable with heat shrink.

Electric power for the device 200 for cleaning with explosive material may be arranged with batteries. Alternatively, electric power may be arranged from an electricity network.

Referring also to figures 11-16, the second end of the lance 202 comprises a sleeve connector 236 for connecting a cardboard sleeve 238 or other breakable part to the lance 202. The cardboard sleeve 238 comprises explosive material for creating an explosion in the target area. The explosive material may be an F- or K-pipecharge, for example. The cardboard sleeve 238 is arranged to the sleeve connector 236 so

that an electric detonator 240 may be arranged next to the explosive material inside the cardboard sleeve. The wires of the electric detonator may be arranged inside the cardboard sleeve so that the explosive material does not slide inside the lance.

The first end of the electric cable 228 is arranged to the control unit in connection with the explosion trigger 234. The electric detonator 240 is arranged in the second end of the electric cable 228. The second end of the electric cable is arranged through the sleeve connector 236 so that the electric detonator 240 may be connected to the electric cable 228. The electric detonator 240 is then arranged inside the cardboard sleeve next to the explosive material. The electric cable 228 comprises quick couplers 242 such as Wago® couplings for quick connection of the detonator 240. The detonator 240 comprises a protective case or quick couplers 244 such as Wago® couplings for quick connection. The protective case 244 is detached from the detonator wirings such that the wirings may be arranged in the quick couplers 242 of the electric cable 228.

A fire retardant cover 246 may be arranged over the cardboard sleeve to protect the electric detonator and/or explosive material. The fire retardant cover may be a sleeve, sock or other fire retardant fabric, for example.

Figure 17 is a flow diagram of an embodiment of a method in accordance with the present invention.

At method start-up 302, preparatory actions may take place.

At 304, the breakable part such as a cardboard sleeve is placed on the sleeve connector.

At 306, the explosive material and/or a detonator are cooled with air pressure by flowing the air pressure and/or water at least partially through the lance. The step may additionally comprise cooling the explosive material and/or detonator with water spray that is flown through the lance. The water may be supplied through an additional cooling pipe closer to the second end of the lance before the water flows through the lance.

At, 308, the breakable part is moved to the target area to be blasted.

At, 310, the blast is triggered.

At 312, the method execution is ended.

Consequently, a skilled person may on the basis of this disclosure and general knowledge apply the provided teachings in order to implement the scope of the present invention as defined by the appended claims in each particular use case with necessary modifications, deletions, and additions.

Claims

1. Device (200) for cleaning with explosive material, **characterized** in that the device comprises

-a lance (102a), (102b), (102c) comprising
-a number of lance pipes (104a, 106a), (104b, 106b, 108b),
-a first connection (118) for cooling means (122) in a first end of the lance (102a), (102b), (102c) such that a coolant is supplied through the lance pipes (104a, 106a), (104b, 106b, 108b)
-an inlet channel (126), (126c) for an electric cable (128c), the inlet channel (126c) guiding the electric cable (128c) through the lance pipes (104a, 106a), (104b, 106b, 108b) ,
-a sleeve connector (236) in a second end of the lance (102a), (102b) (102c), (202) for connecting a breakable part to the lance (102a), (102b) (102c),

-a control unit (230) comprising
-an inlet for the cooling means (122) ,
-an outlet for connecting the cooling means (122) to the first connection (118) of the lance (102a), (102b), (102c),
-an explosion trigger (234),

-an electric cable (128c) arranged in connection with the explosion trigger (234) and a detonator (240),

-a detonator (240) arranged to the breakable part (238) next to explosive material,

-a breakable part (238) comprising explosive material, and

-cooling means (122) for cooling the explosive material and/or detonator (240), **and in that**

the device (200) comprises an additional cooling pipe (122) arranged between the first end of the lance and a second point of the lance for transferring the coolant closer to the second end of the lance (202).

2. The device (200) of claim 1, **comprising** a second connection for cooling means (122) in the first end of the lance such that a coolant is supplied at least partially through the lance pipes (104a, 106a), (104b, 106b, 108b).

3. The device (200) of any preceding claim, **wherein** the coolant supplied through the first connection is compressed air, and wherein the coolant supplied through the second connection is water.

4. The device (200) of any preceding claim, **comprising** a nozzle (124) for creating water spray of the cooling water.

5. The device (200) of any preceding claim, **comprising** at least two lance pipes (104a, 106a), (104b, 106b, 108b), wherein the lance pipes (104a, 106a), (104b, 106b, 108b) are connected to each other with quick couplings.

6. The device (200) of any preceding claim, **wherein** the cooling means are connected to the first end of the lance with quick couplings.

7. The device (200) of any preceding claim, **wherein** the breakable part (238) is a cardboard sleeve (238).

8. The device (200) of any preceding claim, **wherein** the electric cable (128c), (228) comprises quick couplers (242) in the second end of the electric cable (128c), (228) for quick connection of the detonator wirings.

9. The device (200) of any preceding claim, **wherein** the breakable part (238) is covered with a fire retardant cover for protecting the explosive material and/or detonator (240).

10. The device (200) of any preceding claim, **wherein** the explosive material is an F- or K-pipecharge.

11. The device (200) of any preceding claim, **comprising** a hose reel (232) with the electric cable (128c), (228), air pressure pipe and/or water pipe.

12. The device (200) of any preceding claim, **wherein** the control unit (230) comprises ON/OFF valves and/or flow controllers for the air pressure and/or water.

13. A method for cleaning with explosive material by a device (200) according to anyone of the claims 1 to 12, the method **comprising**

-placing (304) a breakable part (238) with explosive material and a detonator (240) to a lance (102a), (102b), (102c) (202) ,

-cooling (306) the explosive material and/or detonator (240) with air pressure by flowing the air pressure through the lance (102a), (102b), (102c), (202),

-moving (308) the breakable part (238) to the target area to be exploded, and

-triggering (310) the explosion.

14. The method of claim 14, **wherein** water spray is flown through the lance (102a), (102b), (102c) (202) for cooling the explosive material and/or detonator (240).

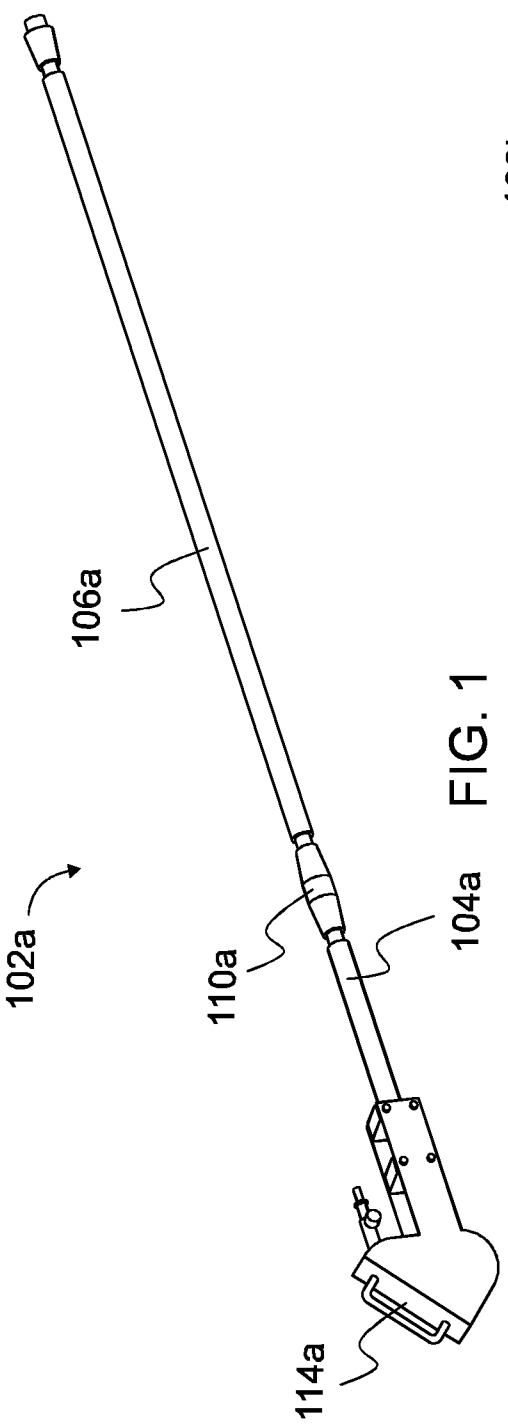
102a
106a
110a
104a
114a

FIG. 1

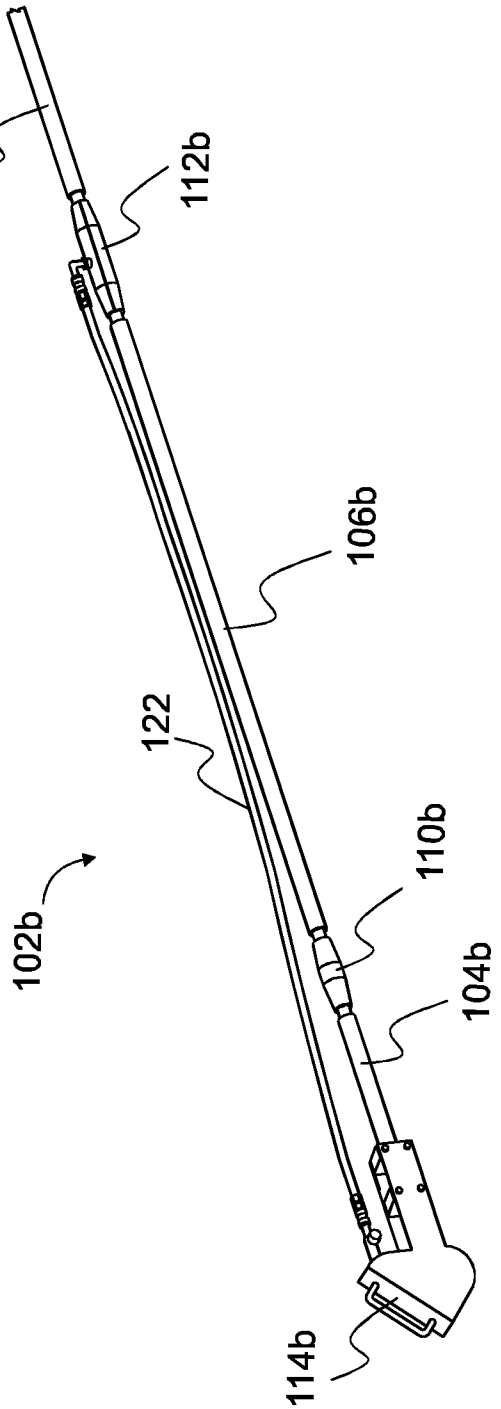
108b
112b
106b
122
102b
110b
104b
114b

FIG. 2

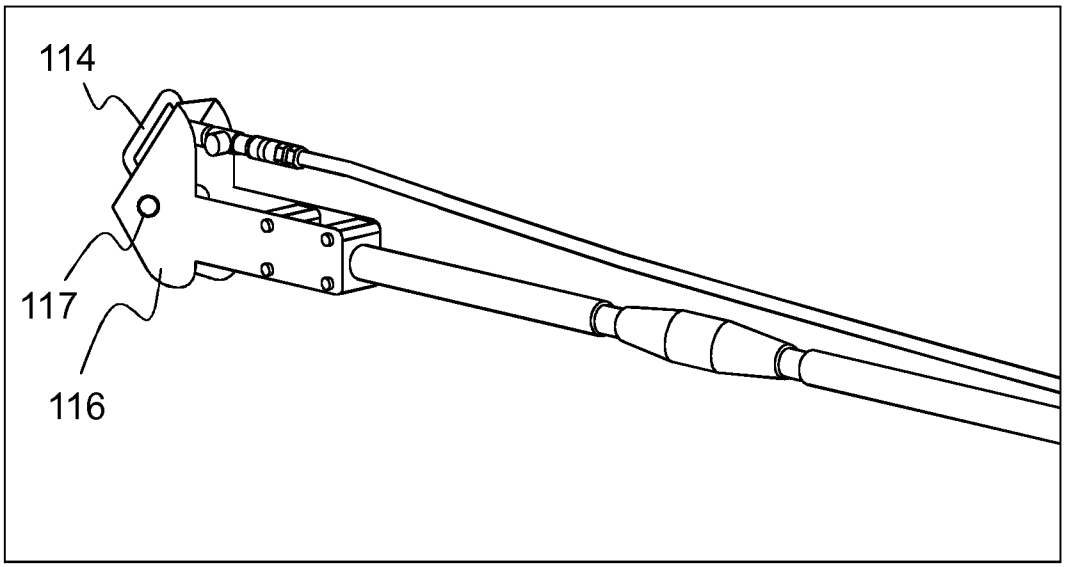

FIG. 3

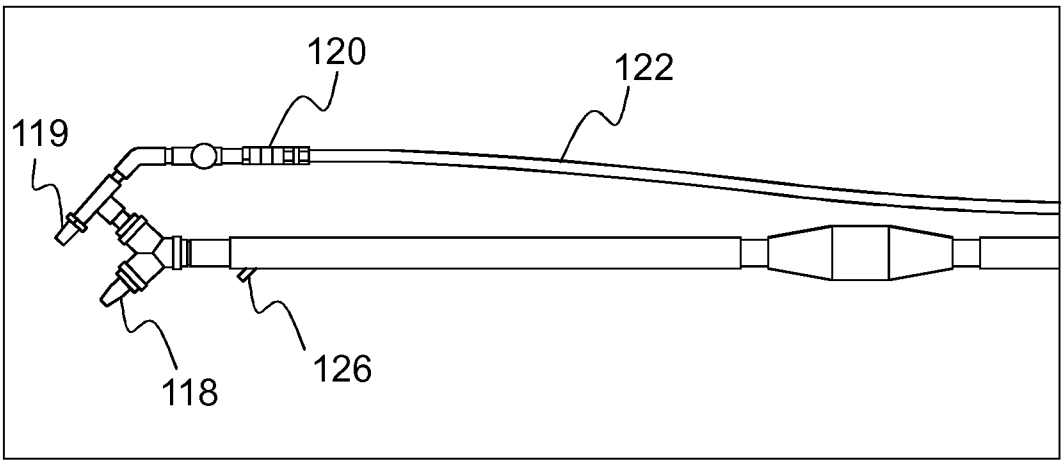

FIG. 4

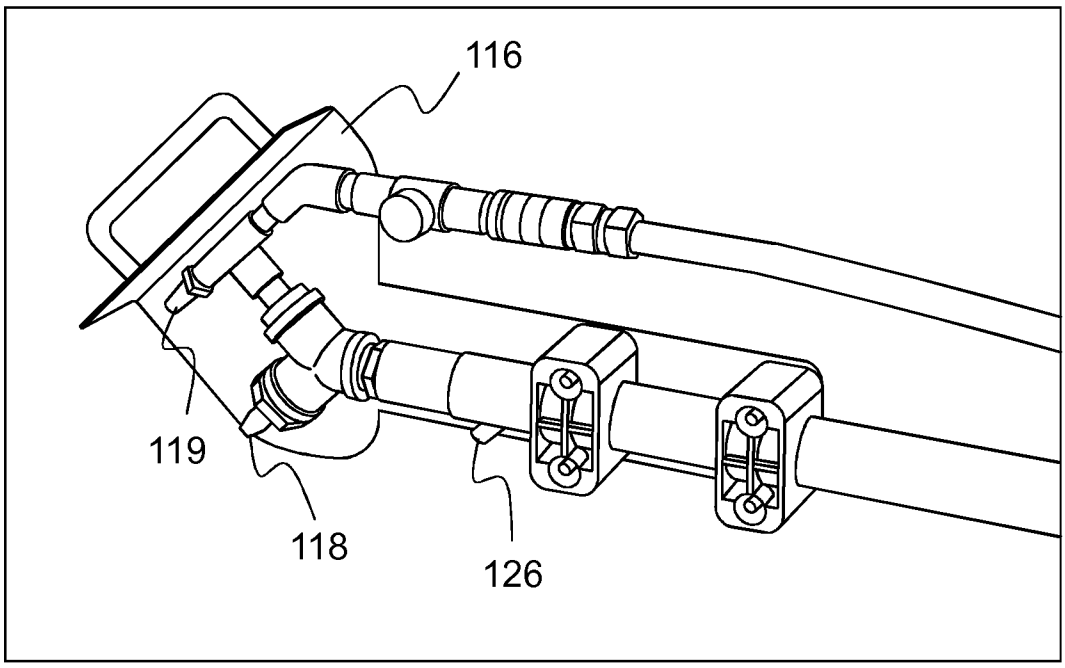

FIG. 5

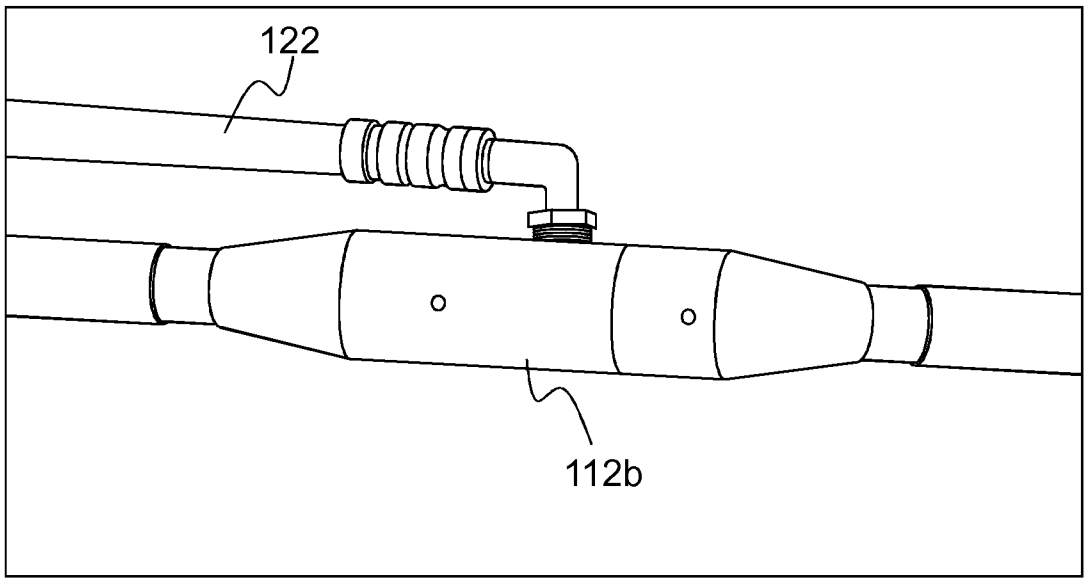

FIG. 6

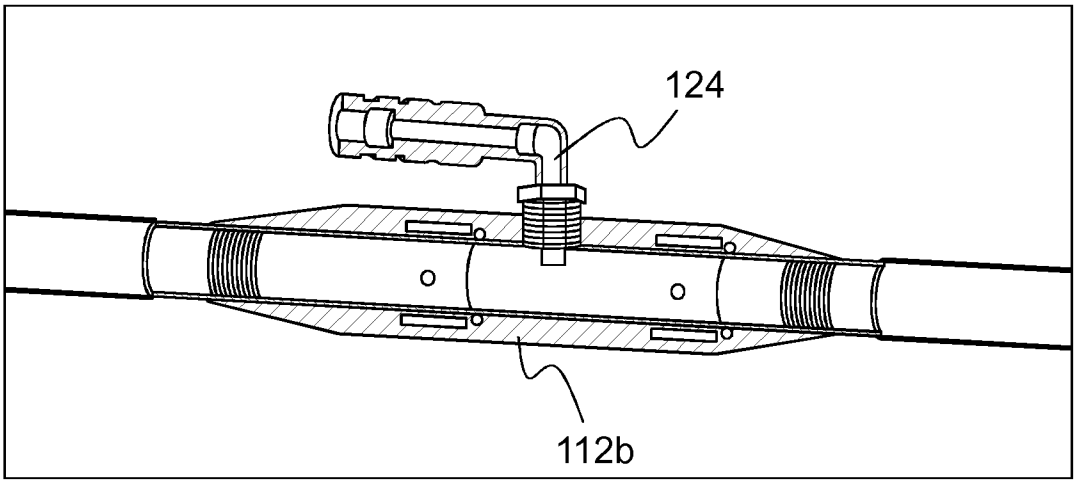

FIG. 7

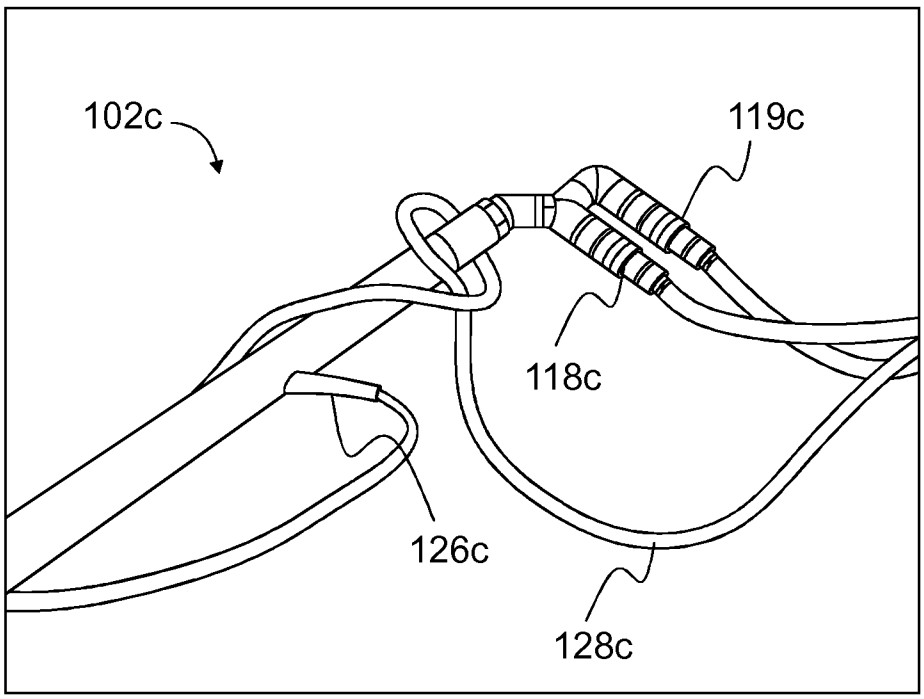

FIG. 8

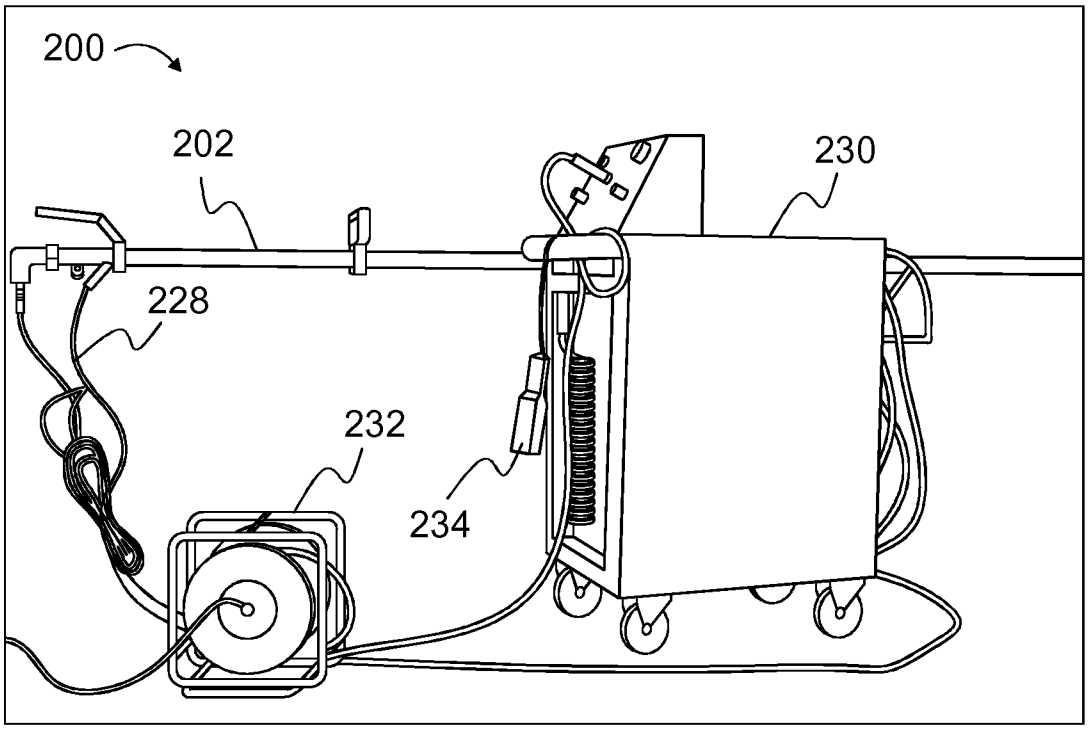

FIG. 9

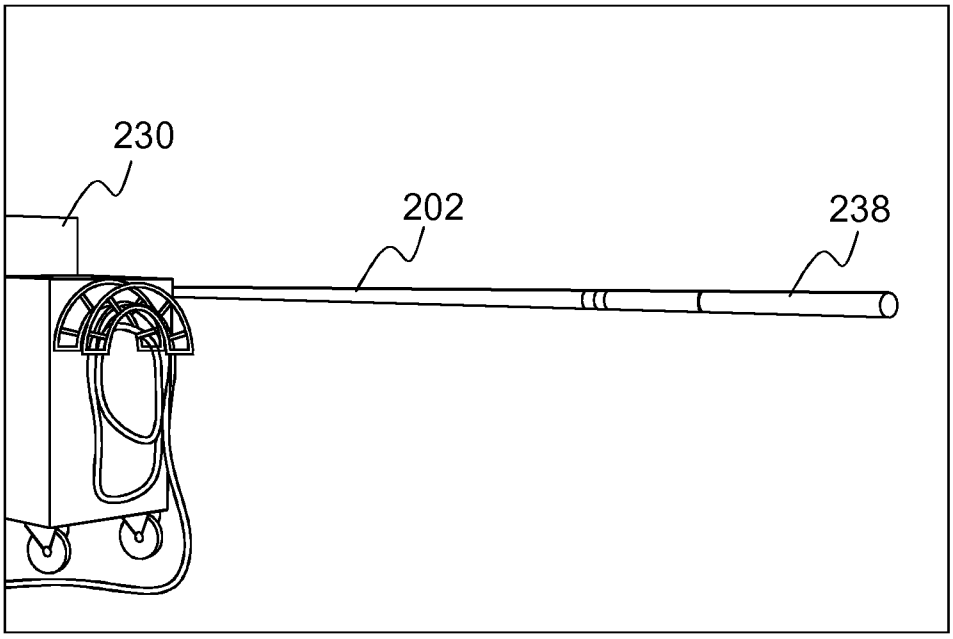

FIG. 10

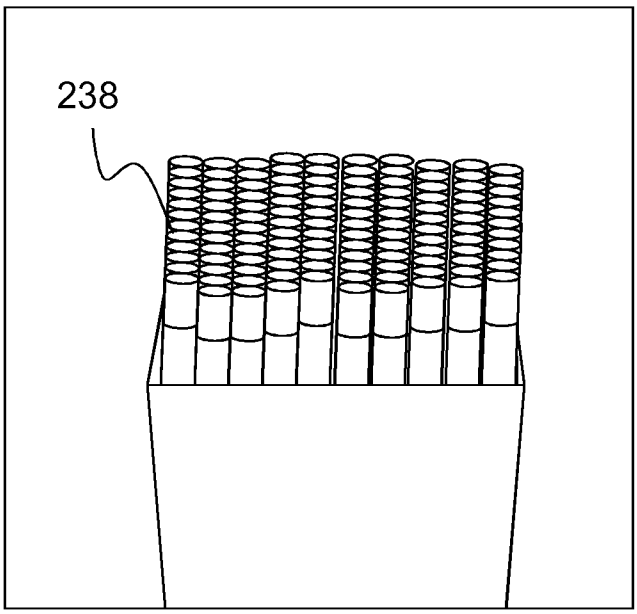

FIG. 11

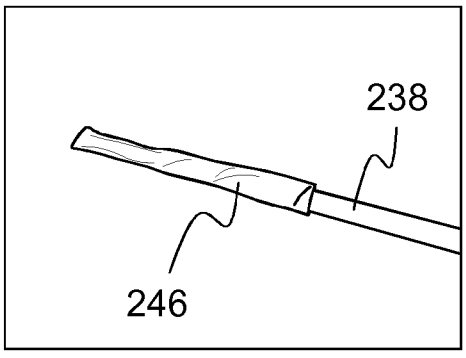

FIG. 12

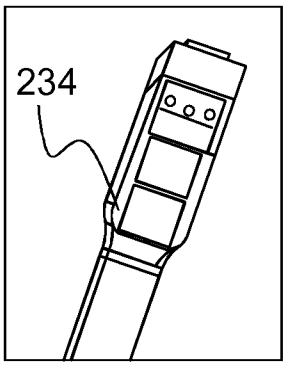

FIG. 13

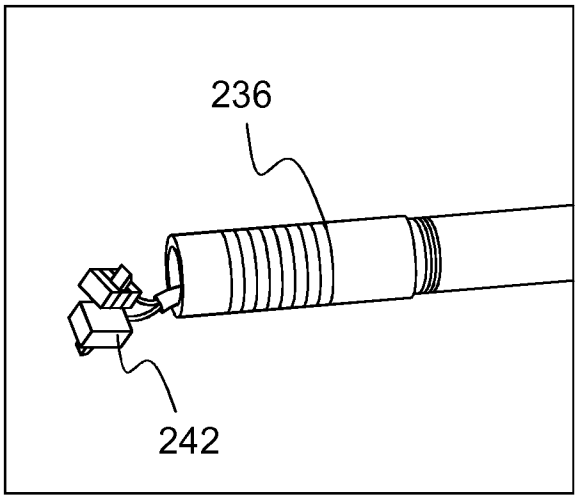

FIG. 14

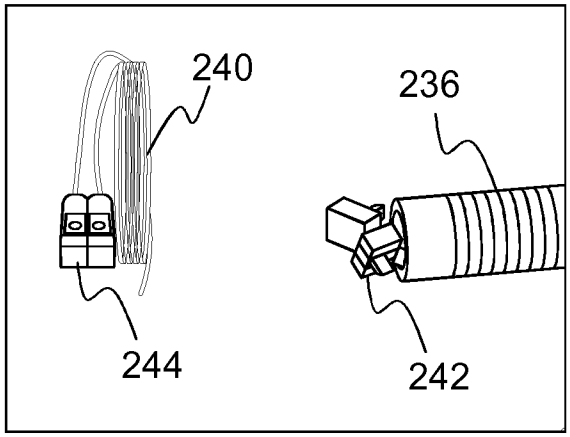

FIG. 15

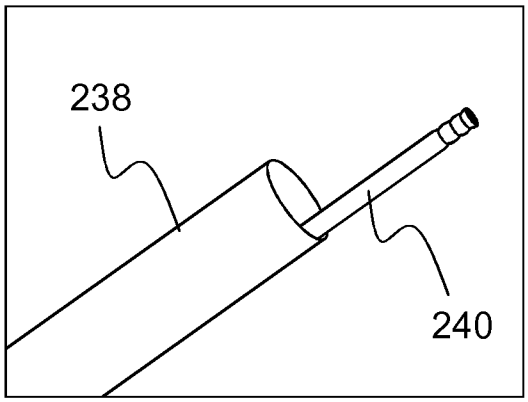

FIG. 16

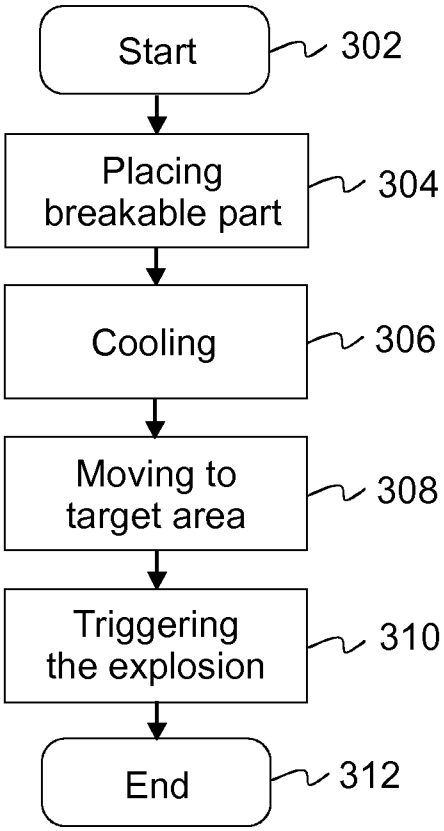
Start
302
Placing breakable part
304
Cooling
306
Moving to target area
308
Triggering the explosion
310
End
312

FIG. 17

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI2020/050415

A. **CLASSIFICATION OF SUBJECT MATTER**

See extra sheet

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)

IPC: B08B

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

FI, SE, NO, DK

Electronic data base consulted during the international search (name of data base, and, where practicable, search terms used)

EPODOC, WPIAP, NPL & EPO-Internal full-text databases

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	DE 102016202421 A1 (STEINBERG BERTHOLD [DE]) 06 July 2017 (06.07.2017) paragraphs [0007], [0013], [0014], [0019]–[0021] and [0032]–[0037]; figures 1a–3b	1, 2, 3, 5–14
Y	US 2001007247 A1 (ZILKA FRANCIS [US] et al.) 12 July 2001 (12.07.2001) paragraphs [0035]–[0039], [0049]–[0050] and [0052]–[0055]; figures 1, 2 and 3	1, 2, 3, 5–14
Y	WO 2013032323 A1 (BWADVISE [NL]) 07 March 2013 (07.03.2013) page 6 line 5 – page 7 line 31; figures 1, 2 and 3	1–6, 8–14
Y	WO 2018215582 A1 (BANG & CLEAN GMBH [CH]) 29 November 2018 (29.11.2018) page 53 line 14 – page 54 line 22; figure 13	1–14

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

*	Special categories of cited documents:	"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
"A"	document defining the general state of the art which is not considered to be of particular relevance	"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
"D"	document cited by the applicant in the international application	"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
"E"	earlier application or patent but published on or after the international filing date	"&"	document member of the same patent family
"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		

Date of the actual completion of the international search	Date of mailing of the international search report
20 August 2020 (20.08.2020)	10 September 2020 (10.09.2020)

Name and mailing address of the ISA/FI
Finnish Patent and Registration Office
FI-00091 PRH, FINLAND
Facsimile No. +358 29 509 5328

Authorized officer
Petri Ojamies
Telephone No. +358 29 509 5000

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI2020/050415

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2015375274 A1 (FLURY RAINER [CH] et al.) 31 December 2015 (31.12.2015) paragraphs [0208], [0222]–[0224] and [0243]–[0246]; figures 1 and 2	1–14

DE 102016202421 A1	06/07/2017	DE 202016008755 U1	17/06/2019
		DE 202016008806 U1	31/10/2019
		DE 202016008807 U1	31/10/2019
US 2001007247 A1	12/07/2001	AT 213317 T	15/02/2002
		AT 258301 T	15/02/2004
		AT 262151 T	15/04/2004
		AU 6025398 A	07/08/1998
		AU 716358 B2	24/02/2000
		AU 6138299 A	17/04/2001
		AU 769275 B2	22/01/2004
		BR 9806915 A	18/04/2000
		CA 2284574 A1	23/07/1998
		CA 2284574 C	07/06/2005
		CA 2384334 A1	22/03/2001
		CA 2384334 C	07/02/2006
		CN 1243572 A	02/02/2000
		CN 1111271 C	11/06/2003
		DE 974035 T1	20/04/2000
		DE 10044991 A1	16/08/2001
		DE 29824579 U1	02/05/2002
		DE 69803840 D1	21/03/2002
		DE 69803840 T2	29/08/2002
		DE 69821263 D1	26/02/2004
		DE 69821263 T2	16/12/2004
		DE 69915710 D1	22/04/2004
		DE 69915710 T2	17/03/2005
		DK 0974035 T3	10/06/2002
		DK 1067349 T3	17/05/2004
		DK 1216391 T3	26/07/2004
		DK 200200062 U1	02/07/2002
		DK 200200062 U4	28/03/2003
		DK 200200413 U1	30/12/2002
		DK 200200413 U4	24/10/2003
		EP 0974035 A1	26/01/2000
		EP 0974035 B1	13/02/2002
		EP 1067349 A2	10/01/2001
		EP 1067349 B1	21/01/2004
		EP 1216391 A1	26/06/2002
		EP 1216391 B1	17/03/2004
		EP 1426719 A2	09/06/2004
		EP 1452813 A2	01/09/2004
		ES 2172873 T3	01/10/2002
		ES 2214220 T3	16/09/2004
		ES 2217813 T3	01/11/2004

		HK 1025146 A1	27/02/2004
		HU 0001662 A2	28/09/2000
		JP 2000510767 A	22/08/2000
		JP 3365512 B2	14/01/2003
		JP 2003510544 A	18/03/2003
		KR 20020032575 A	03/05/2002
		NL 02000011	28/10/2004
		NL 1016148 A1	13/03/2001
		NL 1016148 C2	23/04/2001
		NL 1016149 C1	19/10/2000
		NO 993503 D0	16/07/1999
		NO 993503 L	17/09/1999
		NO 319414 B1	08/08/2005
		NZ 336977 A	27/07/2001
		NZ 509787 A	31/01/2003
		NZ 517500 A	27/02/2004
		PL 352884 A1	22/09/2003
		PL 194016 B1	30/04/2007
		PT 974035 E	31/07/2002
		PT 1067349 E	30/06/2004
		PT 1216391 E	30/07/2004
		US 5769034 A	23/06/1998
		US 6321690 B1	27/11/2001
		US 6431073 B1	13/08/2002
		US 2002178957 A1	05/12/2002
		US 6604468 B2	12/08/2003
		US 2002112638 A1	22/08/2002
		US 6644201 B2	11/11/2003
		US 6755156 B1	29/06/2004
		US 2006027191 A1	09/02/2006
		US 7395760 B2	08/07/2008
		US 2004107858 A1	10/06/2004
		US 2004216698 A1	04/11/2004
		WO 0120239 A1	22/03/2001
		WO 9831975 A1	23/07/1998
		ZA 200202170 B	26/02/2003
WO 2013032323 A1	07/03/2013	NL 2007314 C2	04/03/2013
WO 2018215582 A1	29/11/2018	AR 111957 A1	04/09/2019
		AU 2018274168 A1	28/11/2019
		BR 112019023747 A2	26/05/2020
		CA 3061838 A1	29/10/2019
		CH 713804 A1	30/11/2018
		CN 110662611 A	07/01/2020

		EA 201992702 A1	18/03/2020
		EP 3630379 A1	08/04/2020
		IL 270737 D0	30/01/2020
		KR 20200010467 A	30/01/2020
		TW 201900292 A	01/01/2019
		US 2020094296 A1	26/03/2020
US 2015375274 A1	31/12/2015	US 10065220 B2	04/09/2018
		AU 2014214477 A1	03/09/2015
		AU 2014214477 B2	21/12/2017
		BR 112015019123 A2	18/07/2017
		CA 2900103 A1	14/08/2014
		CA 2900103 C	07/07/2020
		CN 105228761 A	06/01/2016
		CN 105228761 B	16/07/2019
		EA 201591493 A1	30/12/2015
		EA 031744 B1	28/02/2019
		EP 2953739 A1	16/12/2015
		GE P201706711 B	25/07/2017
		HK 1218528 A1	24/02/2017
		IL 240435 D0	24/09/2015
		JP 2016511688 A	21/04/2016
		JP 2019195808 A	14/11/2019
		KR 20160042806 A	20/04/2016
		KR 101981839 B1	23/05/2019
		NZ 710789 A	27/04/2018
		PH 12015501724 A1	09/11/2015
		PH 12015501724 B1	09/11/2015
		SG 10201706533Q A	28/09/2017
		SG 11201506181X A	29/09/2015
		WO 2014121409 A1	14/08/2014
		ZA 201506337 B	30/11/2016

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI2020/050415

CLASSIFICATION OF SUBJECT MATTER

IPC
B08B 7/00 (2006.01)
F42D 3/00 (2006.01)
F27D 25/00 (2010.01)
F28G 7/00 (2006.01)