



(43) International Publication Date
4 September 2014 (04.09.2014)

- (51) **International Patent Classification:**
F24B 3/00 (2006.01) *F41C 27/00* (2006.01)
B23D 15/14 (2006.01)
- (21) **International Application Number:**
PCT/GB2013/053361
- (22) **International Filing Date:**
19 December 2013 (19.12.2013)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**
1303519.1 27 February 2013 (27.02.2013) GB
1316808.3 22 September 2013 (22.09.2013) GB
- (71) **Applicant:** ALFORD RESEARCH LIMITED [GB/GB];
Unit 18, Glenmore Business Park, Vincients Road, Bump-
ers Farm Industrial Estate, Chippenham, Wiltshire SN14
6BB (GB).
- (72) **Inventors:** ALFORD, Roland; Bardley Mill House, Yarn-
brook, Wiltshire BA14 6AB (GB). OWEN, Christopher;
53 High Street, Malmesbury, Wiltshire SN16 9AG (GB).
- (74) **Agents:** BRYERS LLP et al.; 7 Gay Street, Bath, Bath
and North, East Somerset BA1 2PH (GB).

(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, 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, KN, KP, KR,
KZ, LA, LC, LK, LR, LS, LT, 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, 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:** A WIRE CUTTING DEVICE

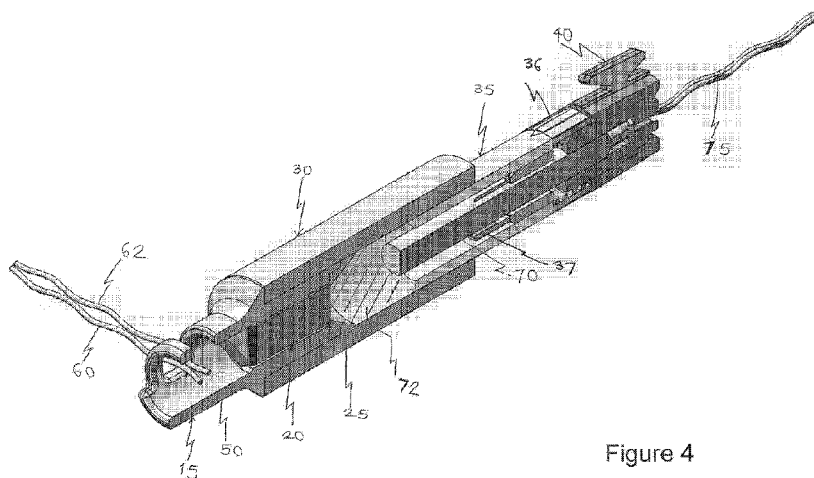


Figure 4

(57) **Abstract:** A user-fillable, high explosive-driven wire cutting device for explosive ordnance disposal comprising: a cutting member (20); a wire holder (50) for receiving one or more wires (60,62); and a housing (30,35) for receiving high explosive (72). In use a high explosive detonation is used to propel the cutting member towards the wire holder so as to cut through the wires.

A WIRE CUTTING DEVICE

The present invention relates generally to a wire cutter and particularly to a wire cutting device suitable for use in explosive ordnance disposal.

5

There are a variety of considerations when deciding how best to cut wires associated with explosive ordnance such as improvised explosive devices. The most important is the safety of the operator and, for this reason, remote operability is a significant benefit. In addition, portability of any such device and any associated equipment required for its use is an important consideration, particularly for use in the field.

10

According to an aspect of the present invention there is provided a user-fillable, high explosive-driven wire cutting device for explosive ordnance disposal, the device comprising: a cutting member; a wire holder for receiving one or more wires; and a housing for receiving high explosive; whereby in use a high explosive detonation is used to propel the cutting member towards the wire holder so as to cut through the wire/s.

15

According to a further aspect of the present invention, there is provided a disposable wire cutting device for explosive ordnance disposal, the device comprising: a propellable cutting member; and a wire holder for receiving one or more wires; the cutting member being propellable towards the wire holder so as to cut the wire/s.

20

According to a further aspect there is provided a remote wire cutting device for explosive ordnance disposal, the device comprising: a propellable, piston like cutting member; and a barrel; the assembly being propellable through the barrel to cut one or more wires.

25

According to a further aspect of the present invention, there is provided an explosive wire cutting device for explosive ordnance disposal, the device comprising: a cutting member; a wire holder

for receiving one or more wires; a barrel; and means for causing detonation to propel the cutting member along the barrel towards the wire holder so as to cut through the wire/s.

According to a further aspect of the present invention, there is provided a remote wire cutting device for explosive ordnance disposal, the device comprising: a moveable cutting member; a wire holder for receiving one or more wires; and a barrel through which the cutting member can be moved so as to cut the wire/s.

Aspects and embodiments of the present invention therefore provide a wire cutting device in which a moveable cutting member is used to cut through one or more wires. If used as a remotely operated device, this can have significant safety benefits.

In some aspects and embodiments the present invention relates generally to the use of a high explosive or propellant to accelerate a piston with a blade down a barrel to cut one or more wires.

The device may be adapted for use with a high explosive (i.e. a material which detonates and explodes faster than the speed of sound). By using a high explosive which generates pressure very quickly this may allow the use of a housing which is not strong or rigid (for example in some embodiments a cardboard tube may be used).

In some aspects and embodiments the device may be user-fillable i.e. the device does not need to be pre-loaded with propellant.

In some embodiments the device may be configured so that it can be armed contemporaneously with the requirement for use i.e. filled with high explosive at the point of use. Similarly the device may be configured so that a detonator only needs to be added at the point of use.

By allowing the device to be finally assembled at the time of use this simplifies transport and storage because the basic, "unarmed" components can be shipped through normal channels.

Furthermore, in some embodiments the device may be configured so that it can work with standard high explosive and/or detonators i.e. equipment which is commonly available and is not specific to the device.

- 5 The cutting member may comprise one or more blades and may also comprise a blade holder. For example, a blade assembly comprising a holder and a metal blade may be used.

The or each blade may be generally laminar. For example, the blade may be, or may be similar to, a safety knife blade.

10

The device may further comprise an anvil against which the cutting member is propelled. In some embodiments, an anvil is used; however, in other embodiments, no anvil is present and a cutting member may project partially or completely out of the device following cutting; in other words the cutting member does not require a surface against which to press the wires to cut them. The

- 15 energy of the cutting member is sufficient to cut directly through unsupported wires.

In some embodiments the cutting member continues moving past the cut ends of the wires. This action can be used to separate cut wires to reduce any risk of shorting.

- 20 The barrel and wire holder (where present) may be formed integrally with one another. For example, the barrel and wire holder may be formed as a one-piece moulding.

The wire holder may comprise a channel in which one or more wires can be received. For example, one or more wires may be receivable generally perpendicularly to the direction of travel

- 25 of the cutting member.

The wire holder may comprise means for holding the wire/s captive during cutting. For example, the holder may comprise projections or other structures which prevent the wire/s from falling out of the device after it has been set up and ready for a cutting procedure. The wire/s may, for

example, be partly or completely threaded into a channel, for example, needing to pass over or around a projection which then prevents accidental removal of the wire/s.

In some embodiments, at least part of the device may be formed from a plastics material, such as an injection moulded material. Components of the device may be selected to produce a lightweight, disposable device to make transporting, deployment and use as easy as possible.

The wire/s may be free-floating in the device or, if necessary/preferable, means for gripping or otherwise firmly holding one or more wires (separately or together) may be provided.

10

The cutting member may be propelled / urged to move by any convenient means, including the use of an explosion, some other form of propellant (e.g. a compressed gas), or a mechanical actuator.

15 The “driver” or means for urging the cutting member towards the wire/s may comprise a detonator or an EOD sound unit/maroon (banger) which is a high energy propellant and may enable the cutting of much thicker wires.

The device may be pre-fitted or retrofitted with a driver. The driver may therefore form part of the device or be separate from and associatable with the device.

20

The device may be a high energy device.

In some embodiments the velocity of the cutting member may be in the range 100 to 1000 m/s; for example 200 to 500 m/s. In some embodiments the cutting time (the time taken for the wire/s to be cut) may be in the range 5 to 50 microseconds; for example 10 to 25 microseconds. Variations in velocity and/or cutting time may, for example, be at least partly due to the driver (the “propellant”, such as a detonator or sound unit) and barrel type.

25

According to a further aspect there is provided a device as described herein in combination with a driver. Means for remotely activating the driver to cause cutting of the wire/s may further be provided.

5 Different aspects of the invention may be used separately or together.

Further particular and preferred aspects of the present invention are set out in the accompanying independent and dependent claims. Features of the dependent claims may be combined with the features of the independent claims as appropriate, and in combination other than those explicitly
10 set out in the claims.

The present invention will now be more particularly described, by way of example, with reference to the accompanying drawings, in which:-

15 Figure 1 is a perspective view of a wire cutting device formed according to the present invention;

Figure 2 is a perspective exploded view of the device of Figure 1;

20 Figure 3 is a section of the device of Figure 1;

Figure 4 is a section of the device in use;

Figure 5 is a magnified view of the cutting assembly and wire holder of the device of
25 Figure 4; prior to activation;

Figure 6 is a magnified view of the region of Figure 5 shown following detonation showing the blade assembly travelling towards the wire holder;

Figures 7 and 8 show the device at a point during cutting;

Figure 9 is a magnified view showing the cutting operation; and

5 Figure 10 is a magnified view of the cutting region after the cutting operation and as the blade assembly begins to leave the remainder of the device.

Referring first to Figures 1 to 3, there is shown a wire cutting device generally indicated, 10.

10 The device comprises: A barrel and wire holder, 15; a blade assembly, 20; a retaining ring, 25; a tubular housing body, 30; a detonator housing tube, 35; and a split screw detonator holder, 40.

The barrel and holder component, 15, is generally tubular and comprises a hollow cylindrical barrel, 45, which merges into a wire holder, 50. A generally frusto-conical flange, 55, extends
15 radially outwardly from the exterior of the component, 15.

The barrel has, at its end, opposite the holder, 50, a recess, 46, defined by a step, 47. In the region of the flange, 55, the barrel, 45, widens slightly at a further step, 48.

20 The holder, 50, is a generally tubular continuation of the barrel, 45, except that it is generally open, including an arcuate base, 51, and a hoop, 52, which effectively forms a short cylinder co-actual with the barrel. The hoop, 52 comprises a rearwardly projecting lug, 53, which extends partly across the open channel, 54, formed between the hoop, 52, and the barrel, 45.

25 The blade assembly comprises a generally cylindrical holder, 21, having a slot, 22, at one end into which a blade, 23, can be pushed. At the other end of the holder, 22, is a pair of thin tabs, 24 (best shown in Figures 2 and 5). The holder, 22, is dimensioned to fit within the barrel, 45 and is generally cylindrical but has a flat surface 19 to orientate it within the barrel. The tabs, 24, allow

the holder to be pushed into the barrel, 45, only as far as shown in Figure 3, in which the tabs, 24, abuts the recess step, 47.

5 The retaining ring, 25, is generally annular and comprises a step, 26, defining an upper, 27 and lower, 28, annulus. The retaining ring, 25, can be assembled into the barrel, 45, so that the upper annulus, 27, abuts against the recess step, 47 and the ring step, 26, abuts against the free end of the holder, 15; this retains the blade assembly in the barrel.

10 The body, 30, comprises, in this embodiment, a cardboard tube into which the barrel and holder component, 15, is pushed until the flange, 55, abuts against the end of the body, 30, as shown in Figures 1 and 3. At the other end of the body, 30, the detonator housing tube, 35, is pushed partially in. At the end of the detonator housing tube opposite the body, 30, a screw threaded fitment, 36, permits attachment of the split screw detonator holder, 40. The fitment 36 includes a plurality of splines 37 which grip the detonator (see Figure 4).

15

Referring now to Figures 4 and 5, a driver, in this embodiment a detonator, 70, is positioned in the housing tube, 35, and is held by the detonator holder, 40 in the form of a split screw, with a detonating chord, 75, extending away from the holder, 40.

20 Propellant, in this embodiment high explosive 72, is user-filled into the housing 30 behind the ring 25 prior to fitting the detonator 35. The detonator housing, carrying the detonator 70, is then fitted into the housing 30 so that the detonator 70 embeds in the high explosive 72.

25 The device, 10, is now ready for firing. It will be noted that the use of a split screw holder and the resilient splines 37 in the fitment mean that detonators with different widths can easily be accommodated i.e. a specific detonator is not required.

In use wires, 60, 62 are placed into the recess, 54, passing over the lug, 53. The lug, 53, prevents the wire, 60, 62, from falling out of the recess, 54.

Upon detonation, the blast in the housing 30 resulting from detonation of the high explosive 72 causes the assembly, 20, to be propelled rapidly down the barrel, 45, as shown in Figure 6. The tabs, 23, are sheared off as the holder, 22, moves away from the retaining ring, 25. The housing
5 is destroyed by the detonation. Because a high explosive is used there is no requirement to counter reactive forces, so a lighter, less rigid housing such as a cardboard tube can be used.

The assembly, 20, accelerates through the barrel, 45, to cause the blade, 23, to cut through the wires, 60, 62 as shown progressively in Figures 6 to 9. In other embodiments (not shown)
10 multiple blades may be used to provide multiple cuts in wire/s. It has been shown by the inventors that the considerable speed with which the blade is propelled means that the duration of the “short” in wires as they cut is extremely short, so much so that the blade does not need to be non-conducting in order to avoid generating a current in the wires.

15 Following cutting, the blade assembly, 20, continues to move through the device and will eventually exit through the hoop, 52 or may remain on the wire holder 15, having remotely cut through the wires, 60, 62.

Although illustrative embodiments of the invention have been disclosed in detail herein, with
20 reference to the accompanying drawings, it is understood that the invention is not limited to the precise embodiments shown and that various changes and modifications can be effected therein by one skilled in the art without departing from the scope of the invention as defined by the appended claims and their equivalents.

CLAIMS

1. A user-fillable, high explosive-driven wire cutting device for explosive ordnance disposal,
the device comprising: a cutting member; a wire holder for receiving one or more wires;
5 and a housing for receiving high explosive; whereby in use a high explosive detonation is
used to propel the cutting member towards the wire holder so as to cut through the
wire/s.
2. A device according to claim 1, the device further comprising a barrel through which the
10 cutting member can be moved so as to cut the wire/s.
3. A device according to claim 2, in which the barrel is, or forms part of, the housing.
4. A device according to any proceeding claim, in which the cutting member comprises one
15 or more blades.
5. A device according to any preceding claim, in which the cutting member comprises a
blade holder.
6. A device according to any preceding claim, further comprising an anvil against which the
20 cutting member is propelled to cut the wire/s.
7. A device according to any of claims 1 to 5, in which the cutting member cuts through the
wire/s in the absence of an anvil or the like.
25
8. A device according to any preceding claim, in which the cutting member projects at least
partly out of the device during or following cutting.

9. A device according to any preceding claim, in which the housing is formed integrally with the wire holder.
10. A device as claimed in any preceding claim, in which the wire holder comprises a channel
5 in which one or more wires can be received generally perpendicular to the direction of travel of the cutting member.
11. A device according to any preceding claim, in which the wire holder comprises means for holding the wire/s captive during cutting.
10
12. A device according to any preceding claim, in which the housing is a cardboard tube.
13. A device according to any preceding claim, further comprising a detonator housing.
14. A device substantially as herein before described with reference to, and as shown in, the
15 accompanying drawings.
15. A device as claimed in any preceding claim in combination with a driver.
16. A combination as claimed in claim 15, in which the driver comprises a detonator and a
20 high explosive propellant.

1/10

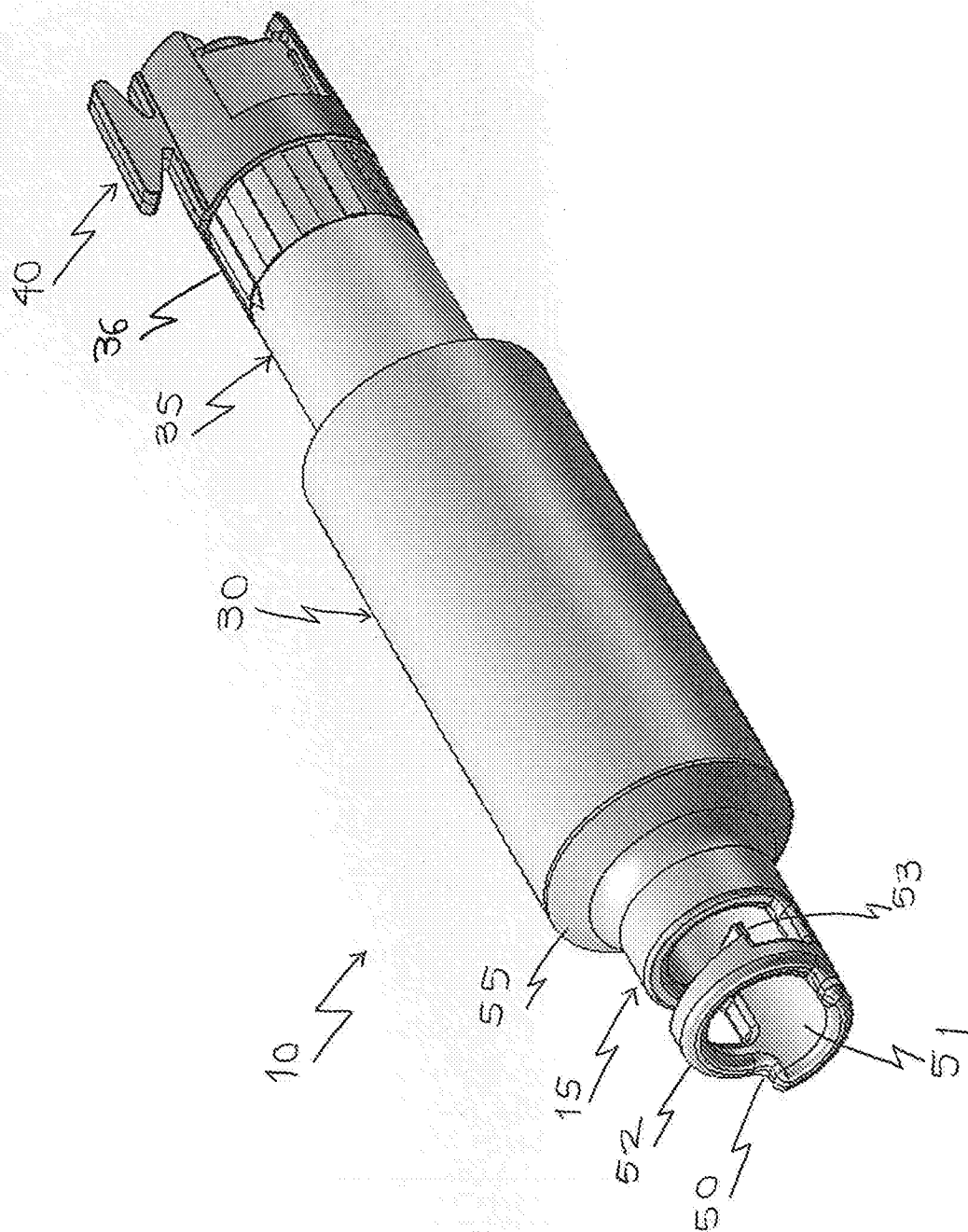


Figure 1

2/10

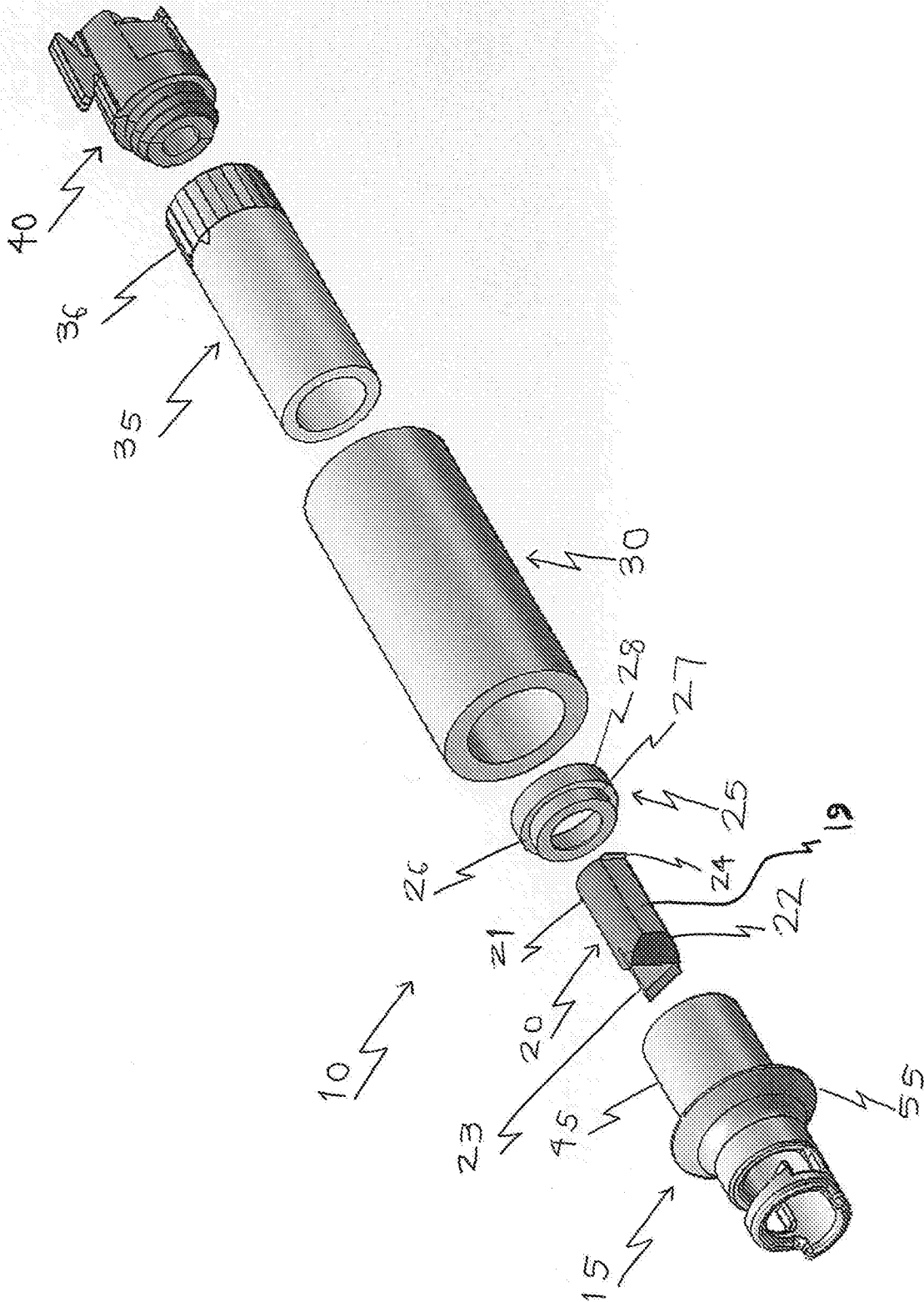


Figure 2

3/10

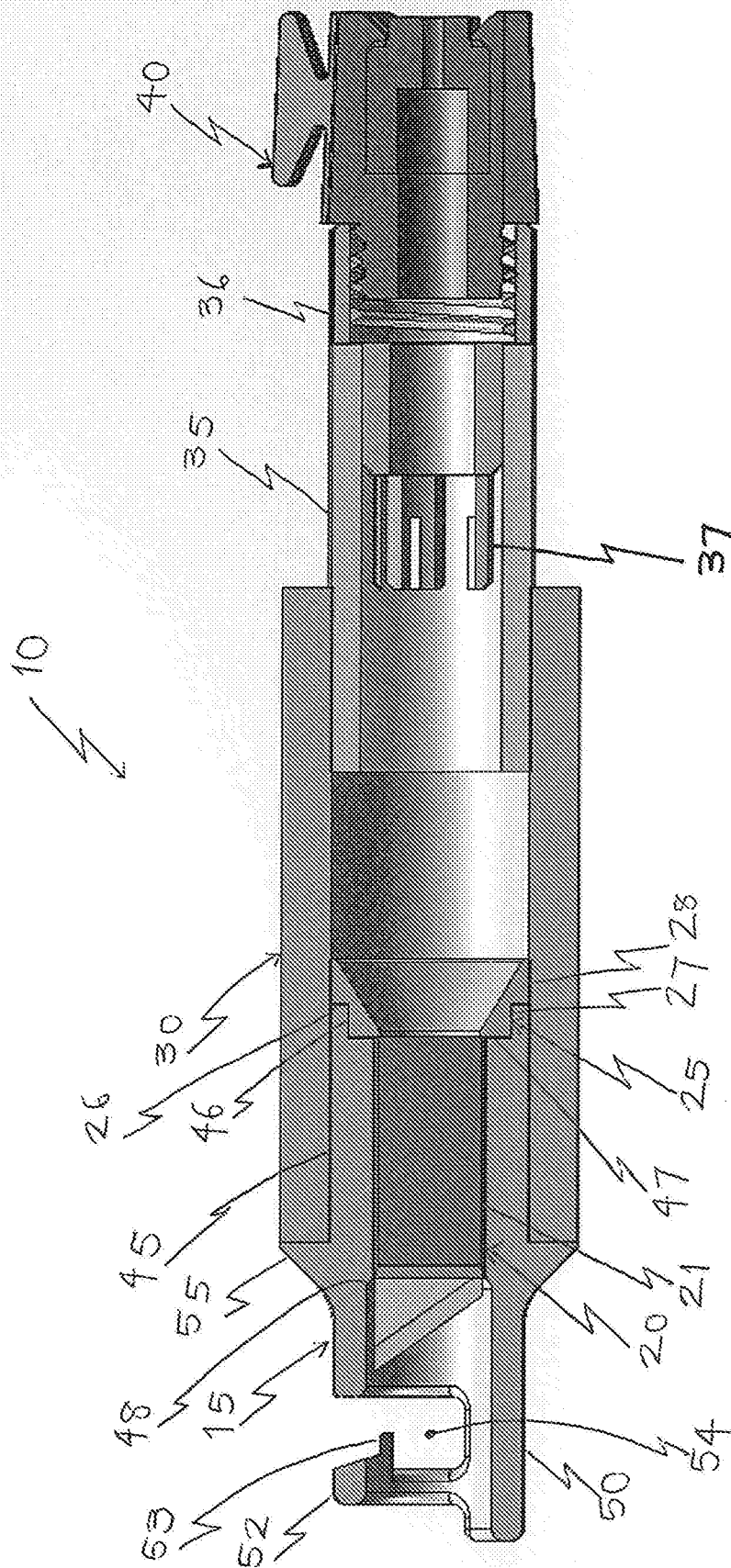


Figure 3

4/10

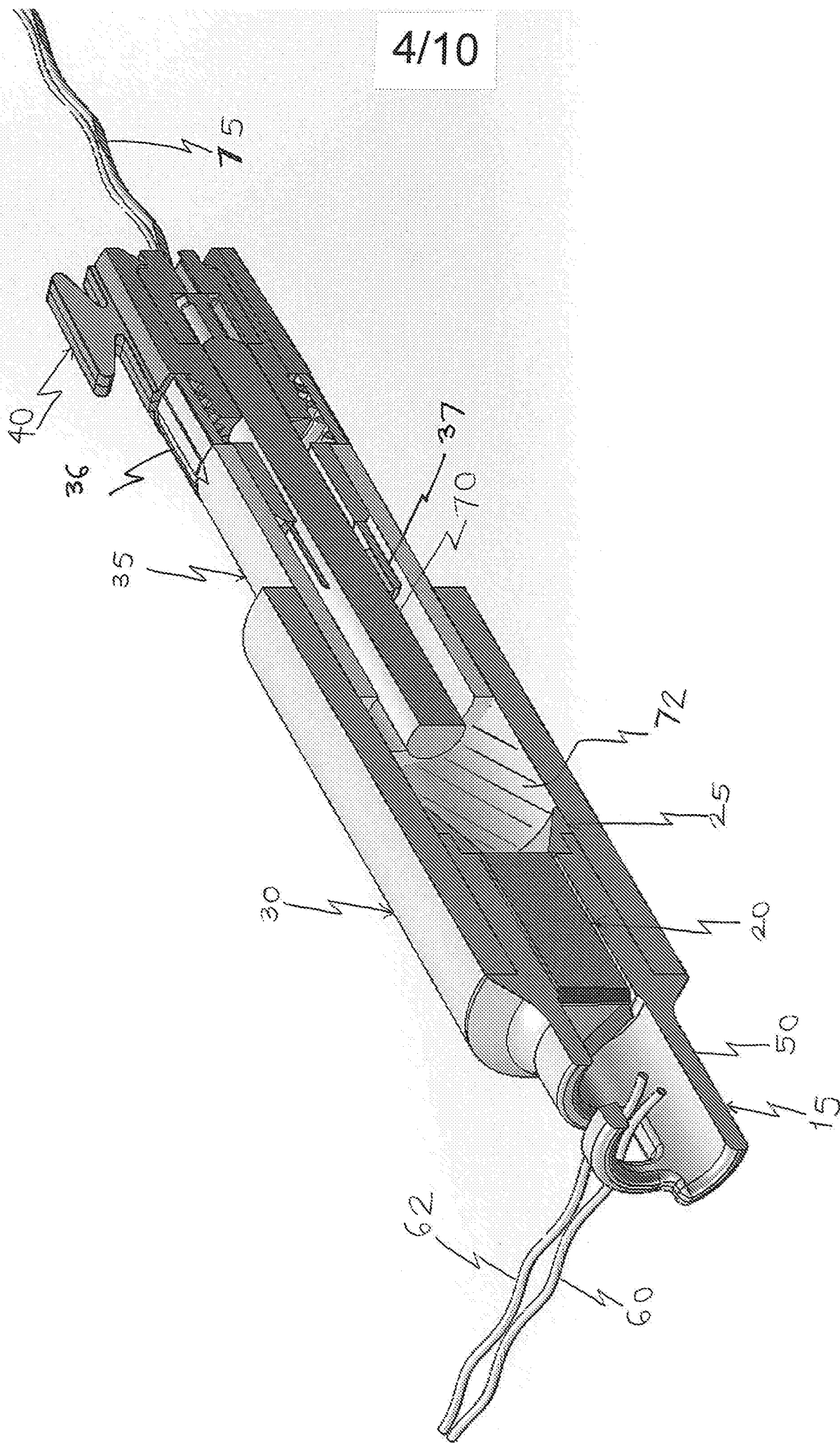


Figure 4

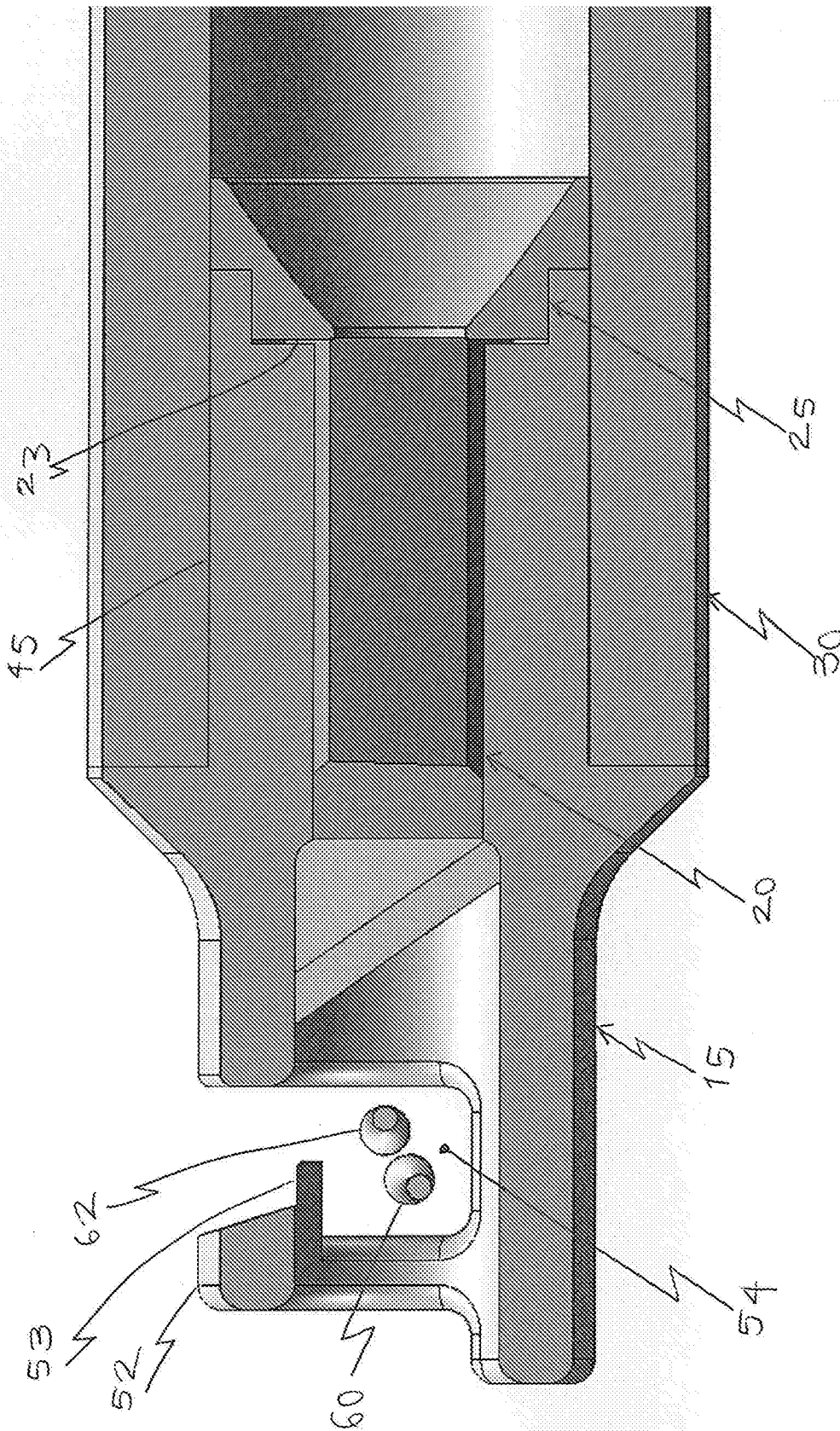


Figure 5

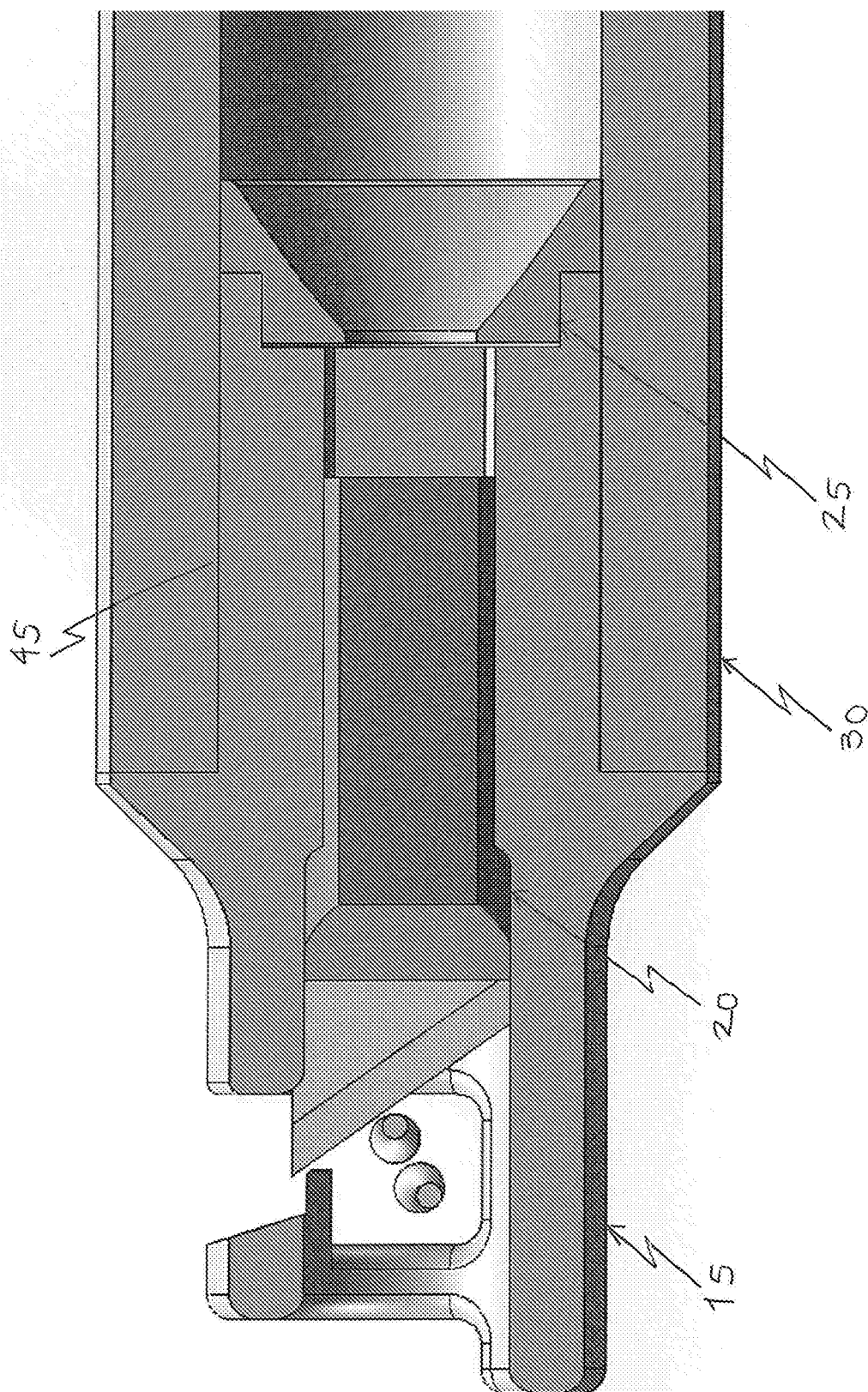
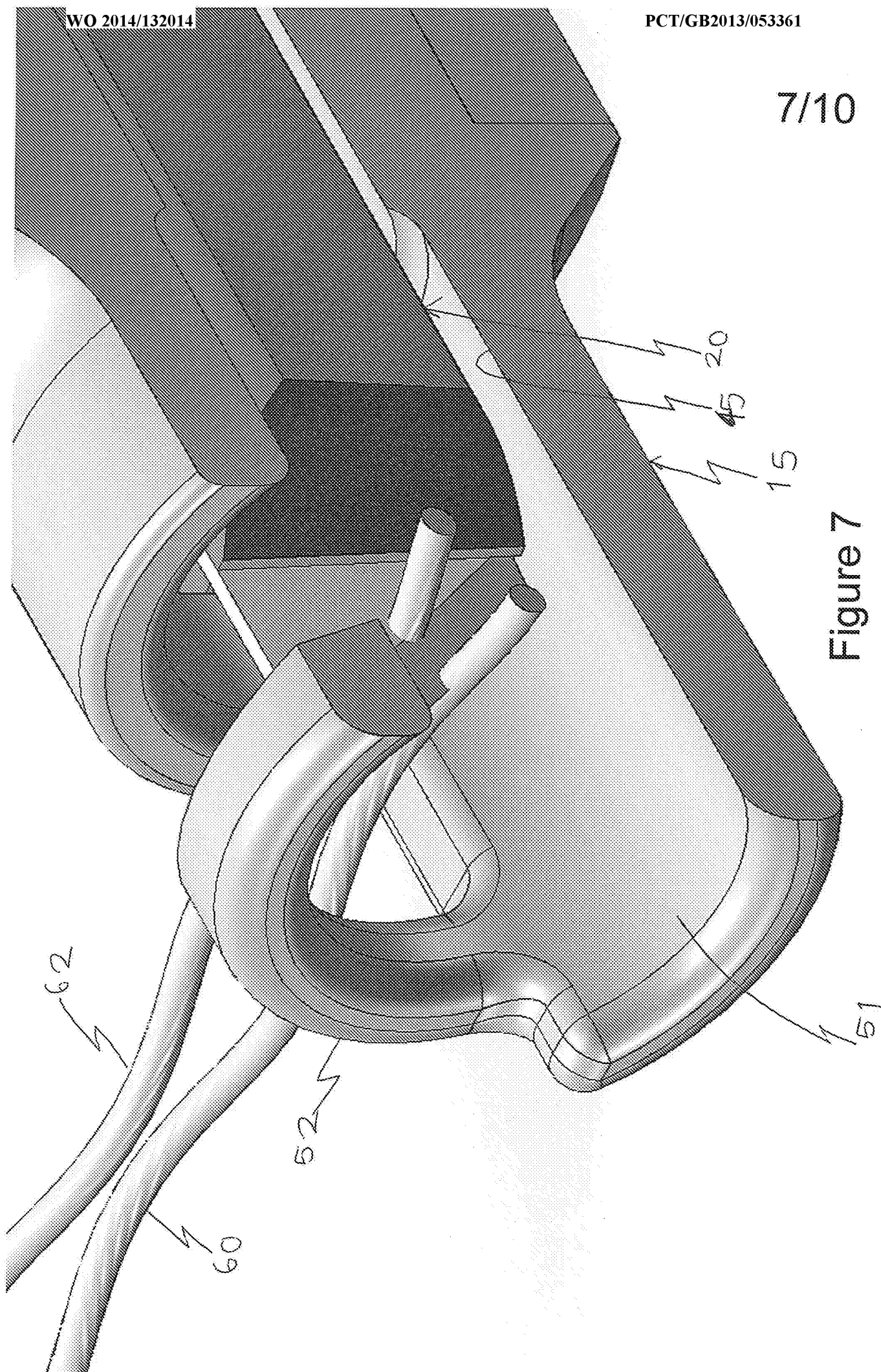


Figure 6



8/10

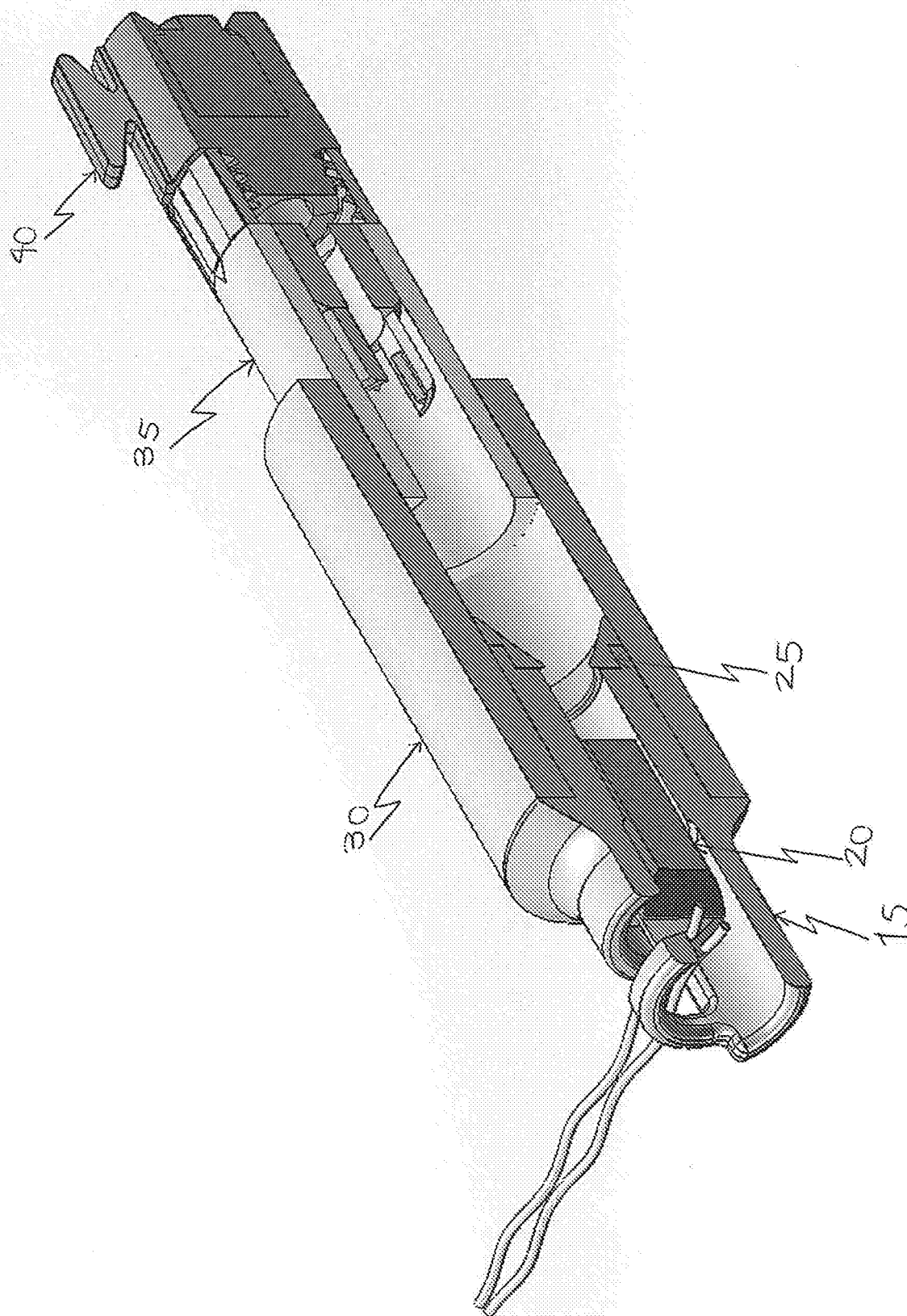


Figure 8

9/10

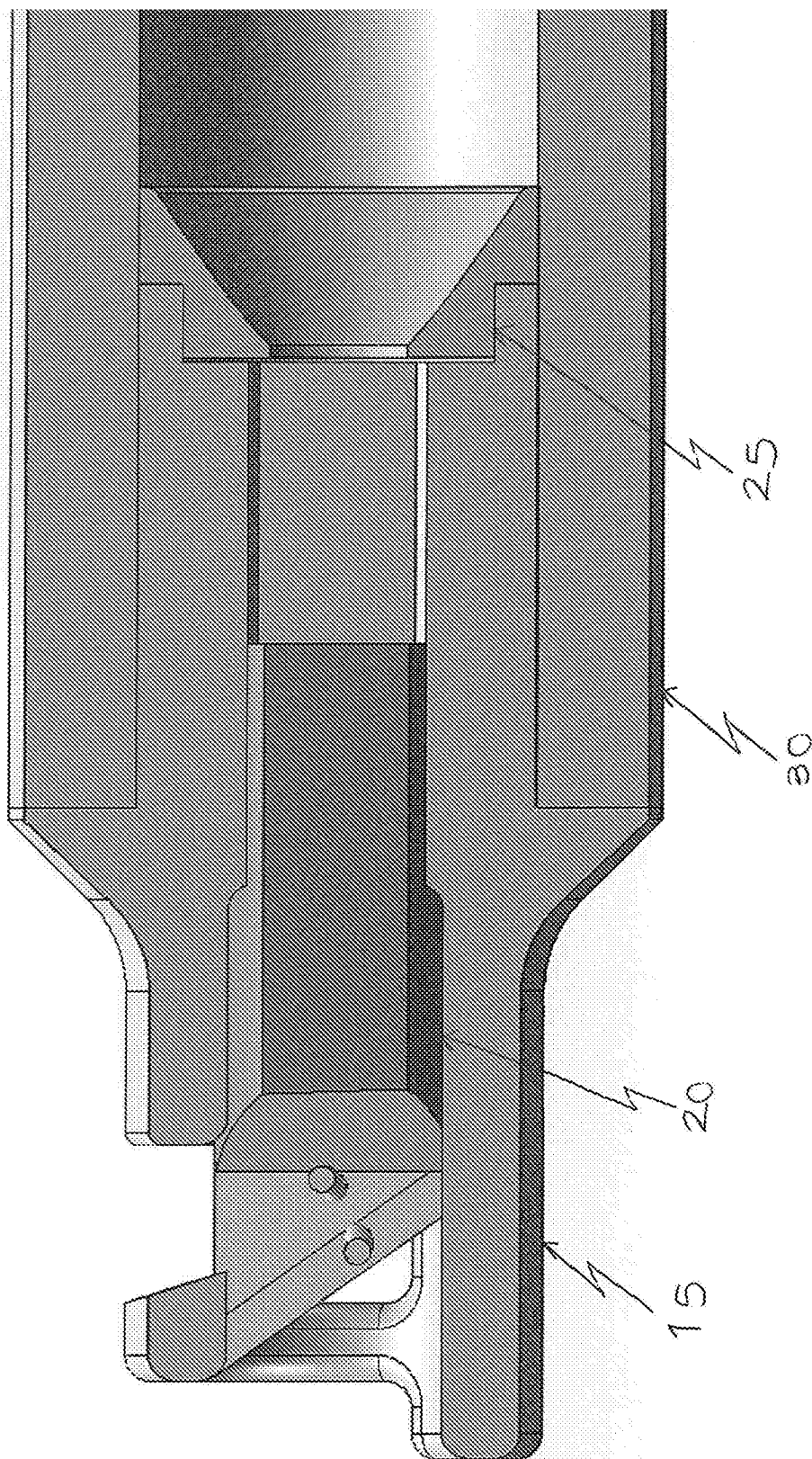
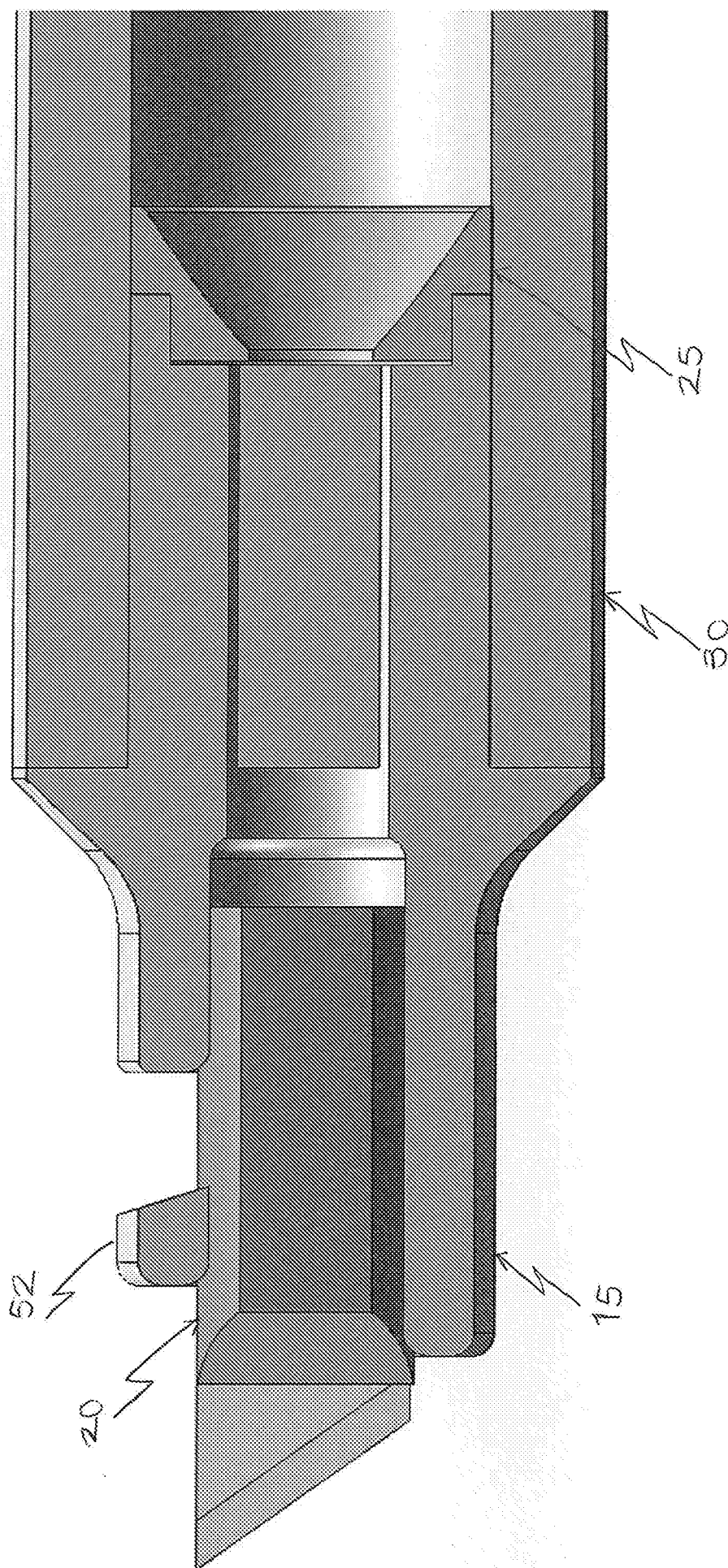


Figure 9



10/10

Figure 10

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2013/053361

A. CLASSIFICATION OF SUBJECT MATTER
INV. F42B3/00 B23D15/14 F41C27/20
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)
F42B B23D F41C

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, PAJ, 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 4 062 112 A (LAKE HILTON J) 13 December 1977 (1977-12-13) column 2, line 50 - column 4, line 60; figures 1-10 -----	1-4,7, 9-11, 13-16
X	CH 370 617 A (SIEBER KILIAN [CH]; BING ARTHUR [CH]) 15 July 1963 (1963-07-15) the whole document -----	1-5, 7-11, 13-16
X	US 3 353 267 A (ROBERT TEMPLE ET AL) 21 November 1967 (1967-11-21) page 1, line 43 - page 2, line 52; figures 1-4 ----- -/--	1-4,6, 9-11, 13-16



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

14 April 2014

Date of mailing of the international search report

24/04/2014

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Giesen, Maarten

INTERNATIONAL SEARCH REPORT

International application No

PCT/GB2013/053361

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 2 716 813 A (SMYRES LYNN E) 6 September 1955 (1955-09-06) the whole document -----	1-4,6, 10,11, 13-16
X	US 3 950 878 A (MUSGRAVE DANIEL D) 20 April 1976 (1976-04-20) -----	1-3,7,8, 10,11, 13-16
A	column 2, line 16 - page 3, line 5; figures 2,3 -----	9
X	US 3 991 649 A (PATRICHI MIHAI D) 16 November 1976 (1976-11-16) the whole document -----	1-4,7, 9-11, 13-16

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2013/053361

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 4062112	A	13-12-1977	NONE	
CH 370617	A	15-07-1963	NONE	
US 3353267	A	21-11-1967	NONE	
US 2716813	A	06-09-1955	NONE	
US 3950878	A	20-04-1976	NONE	
US 3991649	A	16-11-1976	NONE	