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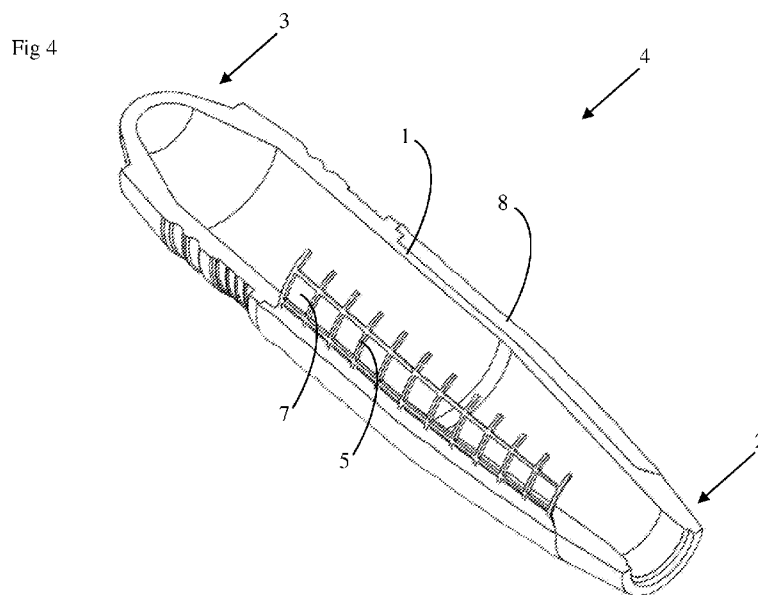
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(57) Abstract: A procedure for producing a warhead (4) with controlled fragmentation comprising the step that an inner shell (1) is manufactured and filled with an explosive substance. The procedure further comprises the steps of providing a net (5) around the outer surface of the inner shell (1) as well as depositing a material (8) on and around the net (5). A warhead is produced by the procedure and comprises an inner shell (1). A material (8) applied to the warhead (4) comprises weak points for guided fragmentation of the deposited material (8) upon detonation of the warhead (4).



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WARHEAD AND METHOD OF PRODUCING SAME

TECHNICAL AREA:

5 The present invention concerns a procedure for producing a warhead with controlled fragmentation, whereby the procedure comprises the step that an inner shell is manufactured and filled with an explosive substance.

10 The invention also concerns a warhead produced by the procedure and comprising an inner shell.

OLDER TECHNOLOGY

15 Provision of preformed projectiles in warheads has been known for a long time. The effect is that with detonation the effectiveness as regards hard and soft targets varies depending on the spread upon detonation of projectiles with a preset size and mass. It is also possible to affect the direction in which the preformed projectiles will be spread.

20 Another way known to a person skilled in the art to produce projectiles with a predetermined size and mass is to effect controlled fragmentation of the warhead. In essence this means that weaknesses are provided in the warhead, for example by milling tracks in its material, so that at detonation the warhead divides according to these weaknesses rather than randomly.

25 It is also possible to combine the provision of preformed projectiles with controlled fragmentation in one and the same warhead.

30 A rubber fixture is often used during part of the manufacturing process to position preformed projectiles. Manufacture of the rubber fixture is in itself quite expensive and labor intensive. In a corresponding way, it is often difficult and work-intensive to produce guided fragmentation by milling tracks in the material of the warhead.

THE PROBLEM

It is desirable to produce a simpler, faster, and more cost-effective method to manufacture a warhead with preformed projectiles and controlled fragmentation.

5 SOLUTION TO THE PROBLEM

The objective of the invention is achieved when the procedure based on the invention is characterized in that it includes the following steps: a net is provided around the outer surface of the inner shell and a material is deposited on and around the net.

10

The objective regarding the warhead is reached if it is characterized by a material deposited on the warhead comprising weak spots for guided fragmentation of the deposited material upon detonation of the warhead.

15 Further advantages are achieved if the invention also is given one or more of the characteristics in the dependent patent claims.

OVERVIEW OF THE DRAWINGS

20 The invention will now be described with reference to the attached drawings. These show:

Fig 1 a perspective view of the inner shell of a warhead according to the invention;

25

Fig 2 a perspective view of the inner shell according to Fig 1, provided with a surrounding net;

30

Fig 3 a perspective view of a warhead with an outer layer of a deposited material;

Fig 4 a partially cut view of a warhead according to Fig 3;

- Fig 5 a view corresponding to the one in Fig 2 of a second embodiment of the invention;
- Fig 6 a cut view of a section of the second embodiment of the warhead;
- 5 Fig 7 a perspective view of a partially assembled warhead according to the third embodiment of the invention; and
- Fig 8 a view corresponding to the one in Fig 2 of a third embodiment of the invention.
- 10

PREFERRED EMBODIMENT

Fig 1a shows an inner shell of a warhead according to the invention; The inner shell
15 1 is hollow in order to enable provision of an explosive substance there. The inner shell 1 is also designed for receiving a nose part and a rear part at its front 2 respectively rear 3 end. The nose part and rear part can be given a number of embodiments depending on the desired characteristics of the warhead, but since they do not have to do with the present invention, they are not shown on the drawing
20 figures. Part 6 in the middle is somewhat recessed in the embodiment shown, i.e. it has a somewhat smaller radius than the front 2 and rear 3 ends.

The inner shell 1 is preferably manufactured of some material judged by experts to be suitable for the purpose, most often a metallic material. A number of examples of
25 materials are already known in the area. The present invention does not comprise manufacturing the material itself or the manufacturing method for inner shell 1. The invention functions independently of the choice of material and the manufacturing method of the inner shell.

30 A step in manufacturing a warhead 4 according to the invention is shown in Fig 2; A net 5 is provided around inner shell 1, preferably so that it encloses inner shell 1 in the circumferential direction. Net 5 extends along part of the inner shell 1 in the axial direction, but in the preferred embodiment the front end 2 and the back end 3 are left

free for attachment to the nose resp. back parts. In the preferred embodiment net 5 is thus provided around recessed part 6.

5 In the embodiment shown, net 5 has square meshes 7, the size and form of which vary somewhat in the axial direction of the warhead in order to attach to the form of inner shell 1 with a radius that varies somewhat in the axial direction. The form of mesh 7 is variable within wide limits as is its size.

10 The manufactured material of net 5 is in many cases a metal that is selected so that it has characteristics that function together with a material applied to net 5. it will be described in further detail below. Some typical characteristics to consider with the choice of the material in net 5 are its melting point, its friability after heat treatment, and its ability to form alloys with other materials, especially material added later.

15 In certain embodiments net 5 has a retentive function for preformed projectiles provided inside the net. The size and form of the projectiles are variable. Some examples will be described below. Net 5 is designed so that it functions for intended retention of the projectiles, whereby the form and size of mesh 7 stops the projectiles from passing through them.

20 Fig 3 shows warhead 4 after a further manufacturing step. Laid-on material 8 has been applied on top of net 5 shown in Fig 2. The method of application varies, but a preferred embodiment is some form of additive manufacturing method. The material is applicable in powder form or in the form of threads and is melted in connection
25 with the application so that it is immediately fixed at the intended place on warhead 4.

The choice between powder and thread in additive manufacture depends on, among other things, the geometric dimensions and the adhesiveness that is required of the
30 finished product. Powder is often preferred with tight manufacturing tolerances, i.e. when the material that is added must reach spaces with small dimensions. Material in thread form is, however, generally more cost effective and is often viewed to be adequate for the relevant dimensions and requirements for strength. Material in thread form also has the manufacturing advantage that the amount of material which

is unintentionally emitted to the environment is minimal, i.e. in principle, the process does not raise dust at all.

The high temperatures necessary for smelting the applied material 8 also means that
5 the material in the underlying net 5 is affected. With a suitable choice of material,
both of the material in net 5 as in the applied material 8, the material in net 5 melts,
becomes brittle, or forms an alloy with the added material 8. An alternative is that net
5 and the added material 8 do not affect each other's physical properties more than
that the layer of added material 8 becomes thinner on top of the material added to net
10 5. In all of these cases, the added material and the temperature when adding the
material are chosen so that the result is that the added material 8 and the net 5 form a
unit together that includes weak spots where net 5 was originally placed.

The weak spots in the unit that is formed by the added material 8 and the net 5 will
15 function to control fragmentation at the detonation of warhead 4. The part of the
added material 8 which is arrayed in the mesh 7 of net 5 will thus form projectiles.
This aspect of the preferred embodiment will be considered in the choice of added
material 8 so that the projectiles formed have a suitable mass, and in the choice of the
size and form of the mesh, so that the projectiles formed have a suitable size and
20 form.

Some examples of material that can be chosen for the added material are aluminum,
steel of various qualities, including stainless steel, and titanium, etc.

25 A partial cut through warhead 4 is shown in Fig 4, where both the net 5 and the
added material 8 are visible.

Fig 5 shows a second embodiment of the invention. In this embodiment net 5 has
considerably smaller mesh 7 than that shown in Fig 2 and Fig 4. A conceivable
30 method of production of the net in Fig 5 is that holes of the desired size are made in
sheet metal, for example by die cutting, etching, laser cutting, or with some other
method of production that persons skilled in the art view as suitable. The net shown
is especially suitable for retention of preformed projectiles with a cross section that is
somewhat larger than the size of mesh 7. A cut view of inner shell 1, net 5, added

material 8, and a large number of preformed projectiles 9 of warhead 4 is shown in Fig 6.

Arrangement of a number of preformed projectiles 9 in the warhead is accomplished
5 with the help of a net 5 that is either a standard product or which can be
manufactured in a relatively simple and cost-effect manufacturing process. Net 5
does not need to be removed but remains an integrated part of warhead 4, which
considerably simplifies the manufacturing process. Net 5 also contributes to
10 controlled fragmentation of warhead 4 in a way that provides cost-effective
production of warhead 4.

ALTERNATIVE EMBODIMENTS

An additional embodiment of a warhead 4 according to the invention is shown in Fig
15 7. The difference in relation to the embodiment that is shown in Fig 6 is that the
preformed projectiles 9 that are arrayed outside inner shell 1 are in part larger and in
part essentially square. Depending on the desired characteristics at detonation of
warhead 4, this embodiment is interesting in certain applications, but it can naturally
be varied further by a person skilled in the art.

20 Figure 8 shows warhead 4 according to Fig 7 with a net 5 provided on the outside of
the preformed projectiles 9. It is clear that the mesh 7 of net 5 is smaller than the
preformed projectiles 9 and will retain them before an external material 8 is laid on
it.

25 The invention is thus variable in the framework of the attached patent claims. It can
in particular be maintained that the invention comprises embodiments both with and
without preformed projectiles 9. Net 5 constitutes controlled fragmentation such that
it in many cases can be considered sufficient to constitute the desired effect of
30 warhead 4. Embodiments with a combination of preformed projectiles 9 and
controlled fragmentation are preferred in other cases.

PATENT CLAIMS

1. A procedure for producing a warhead (4) with controlled fragmentation, whereby the procedure comprises the step that an inner shell (1) is
5 manufactured and filled with an explosive substance **characterized in that** the procedure further comprises the steps:
- a net (5) provided around the outer surface of the inner shell (1);
 - a material (8) applied in powder form or in thread form with an additive method of manufacture on and around the net (5);
- 10
2. A procedure according to claim 1, with steps **characterized in that**
- a number of preformed projectiles (9) are manufactured;
 - the preformed projectiles (9) are arrayed along the outer surface of the
15 inner shell (1), inside the net (5), so that the preformed projectiles (9) are retained in their respective positions;
 - the material (8) is applied in powder form or in thread form with an additive method of manufacture on and around the preformed projectiles (9) at the same time as it is affixed on and around the net
20 (5);
3. A procedure according to claim 1 or claim 2, with steps **characterized in that**
- the material (8) which is applied in powder form or in thread form
25 with an additive method of manufacture is applied with varying speed, so that weak points are produced in the material (8).
4. A procedure according to claims 1-3, with steps **characterized in that**
- the material (8) which is applied in powder form or in thread form
30 with an additive method of manufacture is applied with varying temperature, so that weak points are produced in the material (8).
5. A warhead produced by a procedure according to any one of claims 1-4 and including an inner shell (1), **characterized in that** a material (8)

applied to the warhead (4) comprises weak points for a guided fragmentation of the applied material (8) with detonation of the warhead (4).

- 5 6. A warhead (4) according to claim 5, **characterized in that** weak points in the applied material (8) are arranged in positions corresponding to the position of a net (5) that is provided outside the inner shell (1).
- 10 7. A warhead (4) according to claim 5 or claim 6, **characterized in that** weak points in the applied material (8) are arranged in other positions that are selected by deposition of the material.
- 15 8. A warhead according to any one of claims 5-7, **characterized in that** a number of preformed fragments (9) are provided inside the applied material (8).

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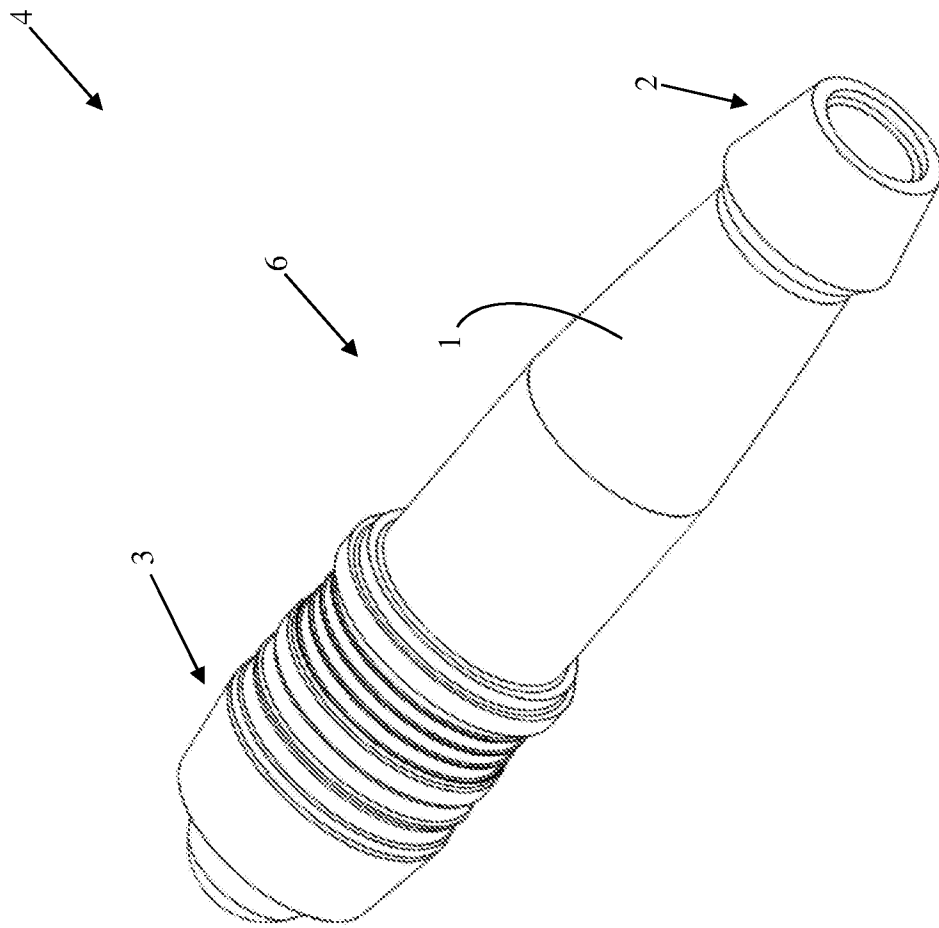


Fig 1

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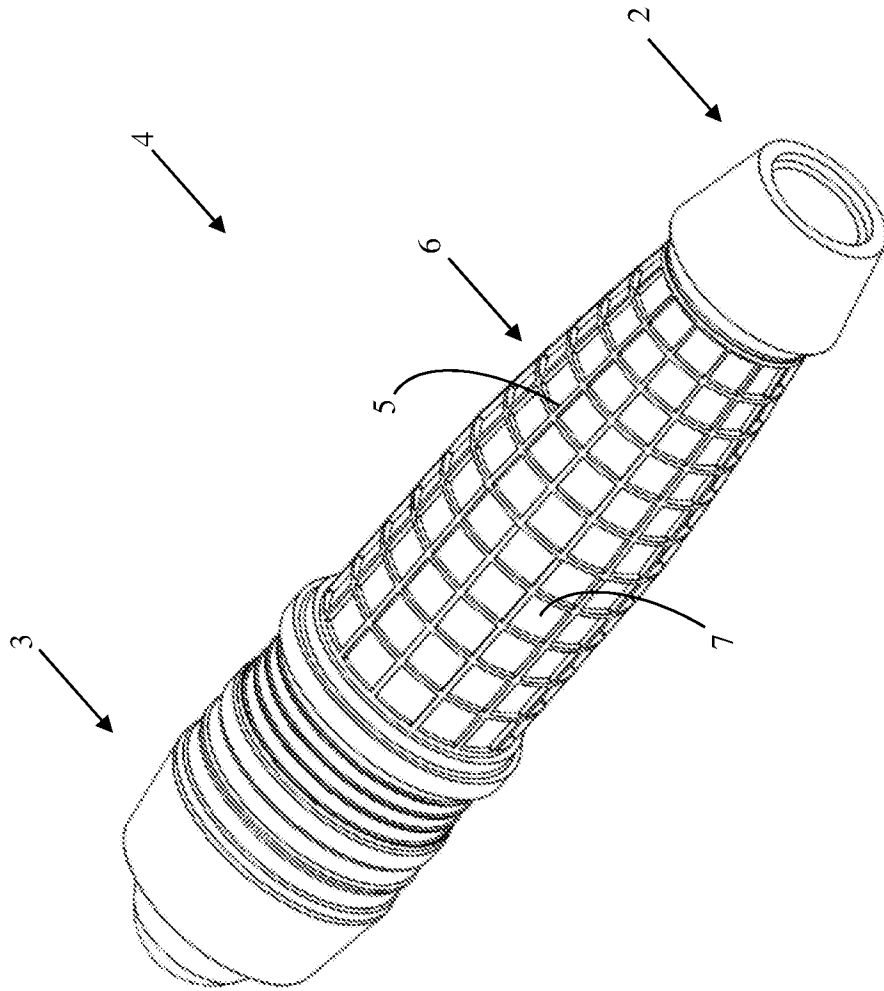


Fig 2

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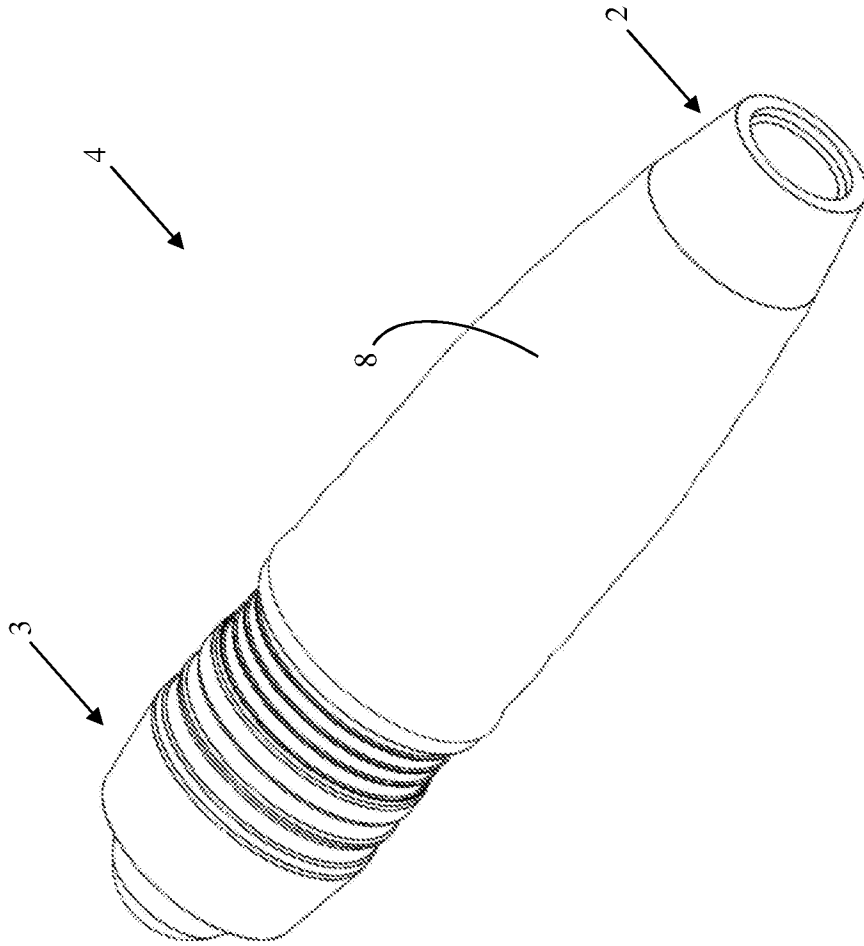


Fig 3

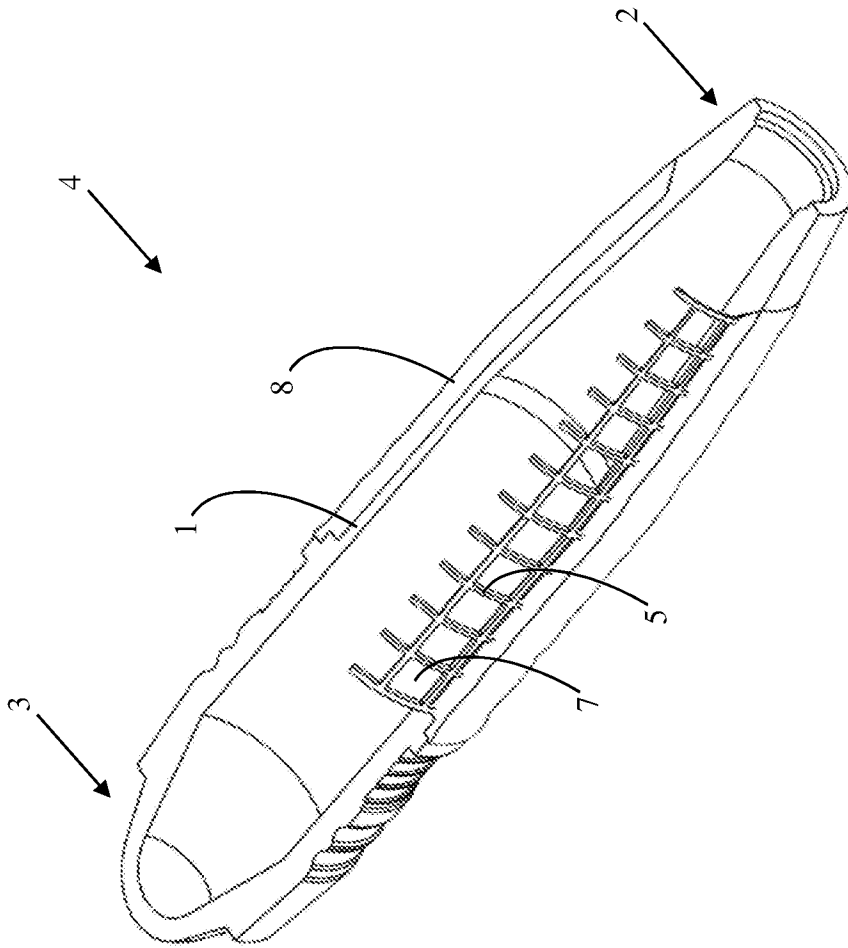


Fig 4

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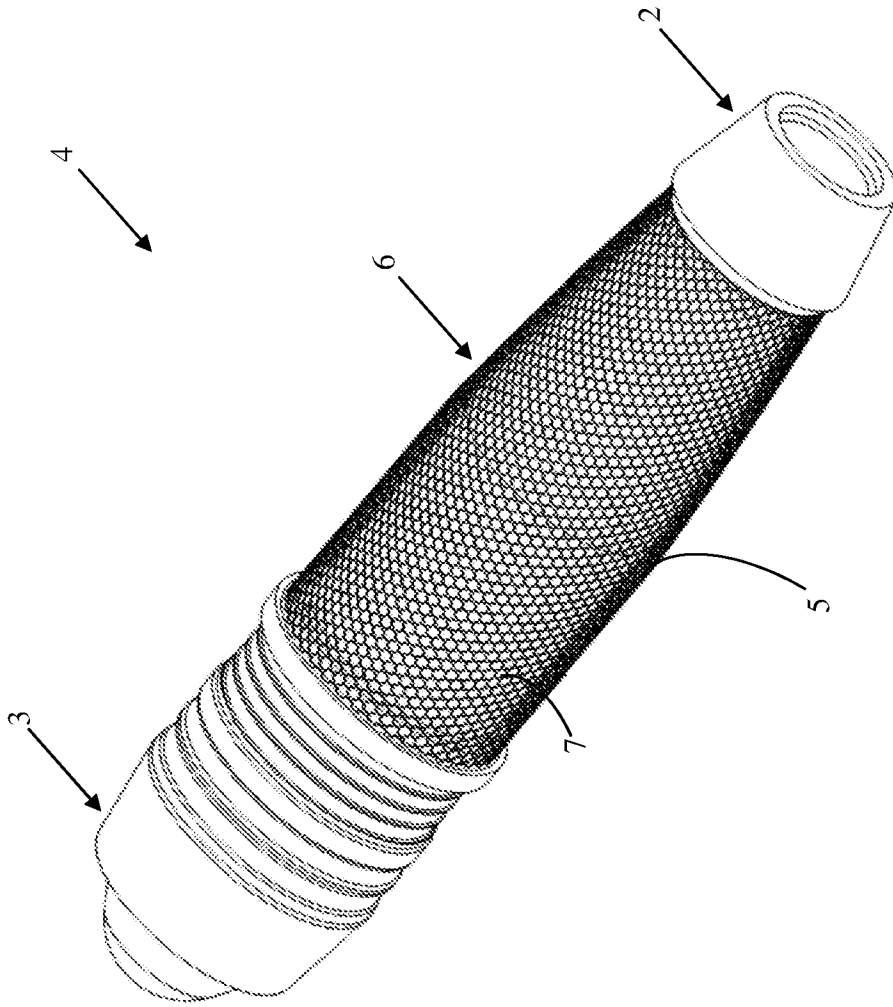
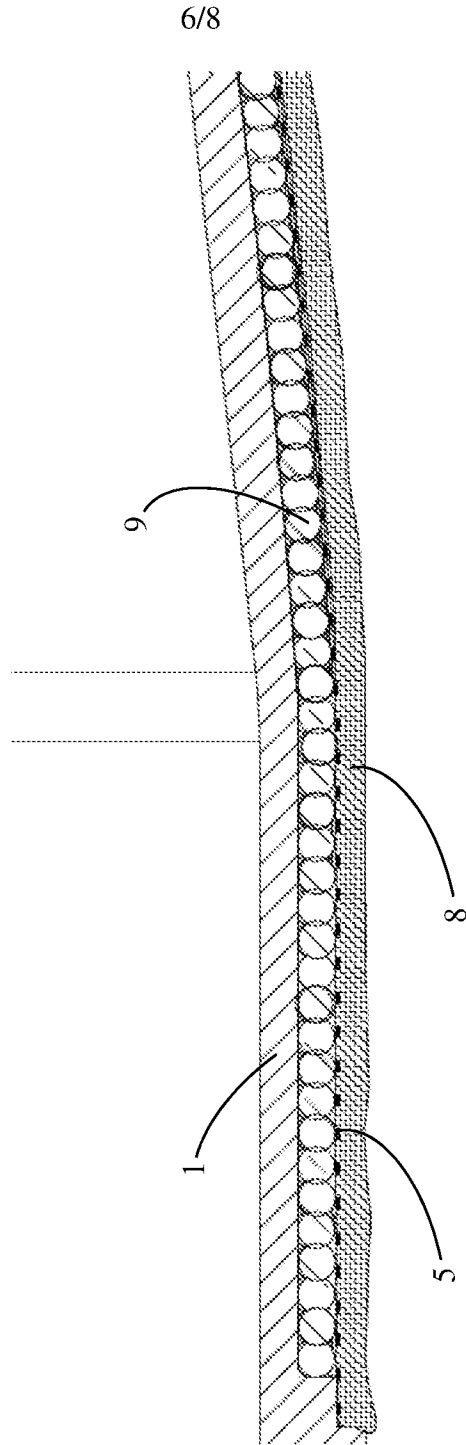


Fig 5

Fig 6



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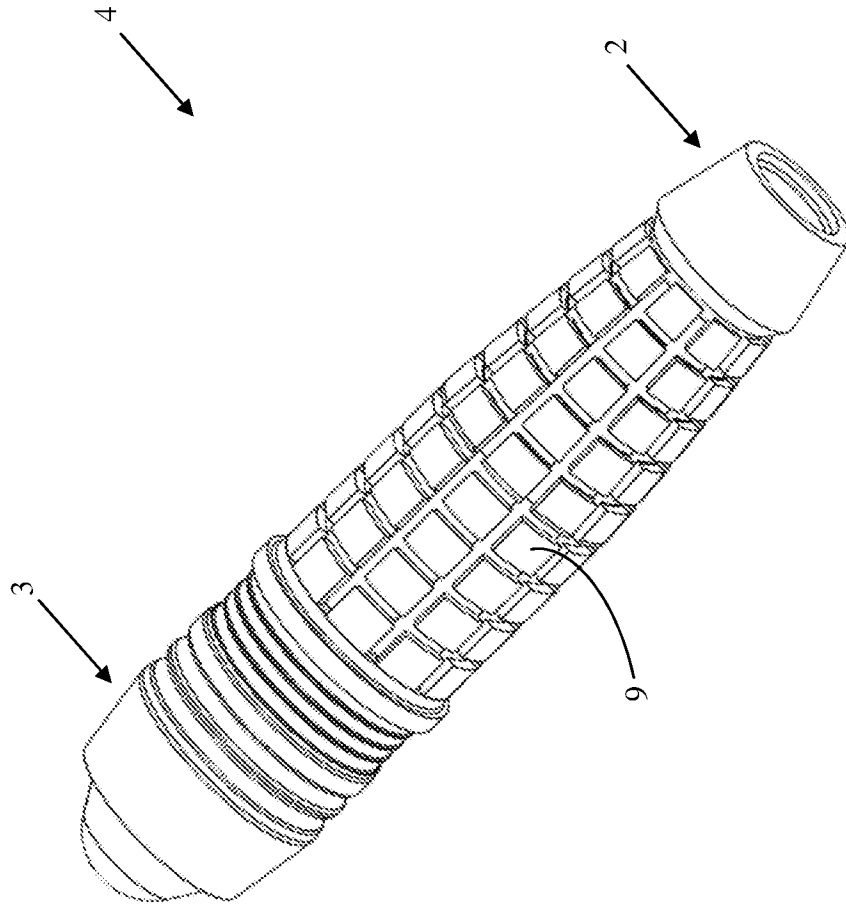


Fig 7

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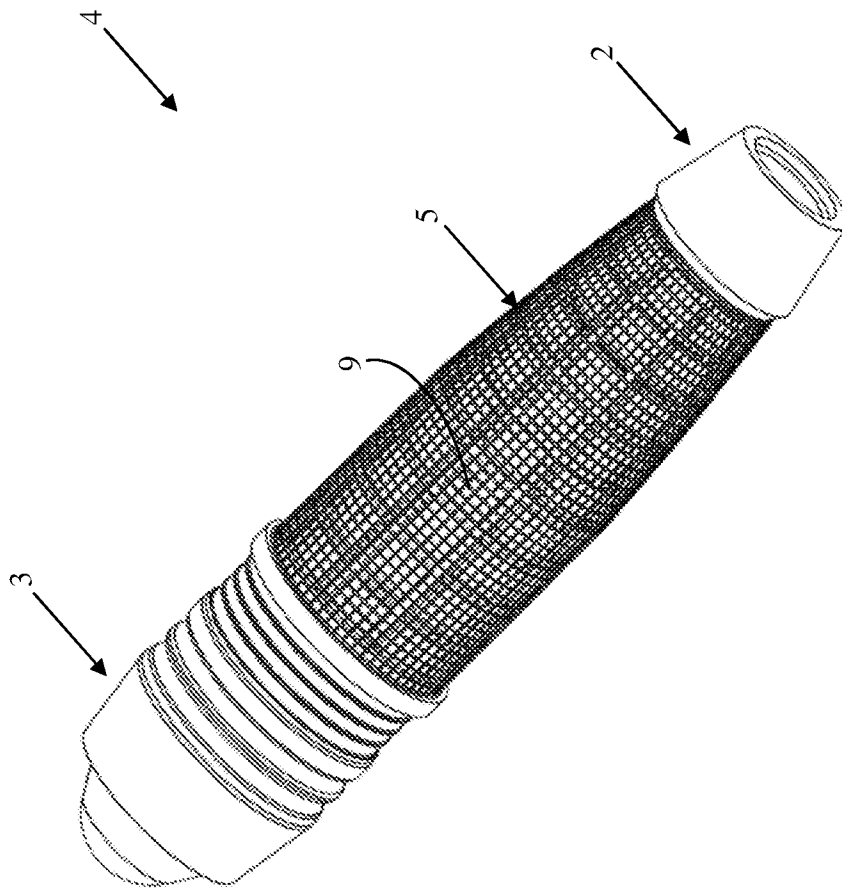


Fig 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2020/050256

A. CLASSIFICATION OF SUBJECT MATTER		
IPC: see extra sheet		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
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IPC: B33Y, F42B		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
SE, DK, FI, NO classes as above		
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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.
Y	US 20020014177 A1 (RENAUD-BEZOT JEAN-LUC ET AL), 7 February 2002 (2002-02-07); abstract; paragraphs [0026], [0032]-[0035], [0041]-[0042], [0051]-[0062]; all figures	1, 5-6
A	--	2-4, 7-8
Y	US 20170167833 A1 (JENNETT GASTON P ET AL), 15 June 2017 (2017-06-15); paragraphs [0002]-[0007], [0024]-[0030]	1, 5-6
A	--	2-4, 7-8
A	DE 2536308 A1 (DIEHL FA), 17 February 1977 (1977-02-17); page 4, line 8; page 5, line 19 - line 28; all figures	1-8
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<input checked="" type="checkbox"/>	Further documents are listed in the continuation of Box C.	<input checked="" type="checkbox"/> See patent family annex.
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INTERNATIONAL SEARCH REPORT

International application No.
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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A	US 4986188 A (DENIS JEAN-FRANCOIS ET AL), 22 January 1991 (1991-01-22); abstract; column 1, line 36 - line 54; column 2, line 13 - line 57; all figures --	1-8
A	DE 2923877 A1 (RHEINMETALL GMBH), 18 December 1980 (1980-12-18); page 7, line 19 - page 7, line 21 --	1-8
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INTERNATIONAL SEARCH REPORT

Information on patent family members

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