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(54) Title: METHOD FOR FASTENING INCREMENT CHARGES TO MORTAR SHELL, SHELL AND INCREMENT CHARGE

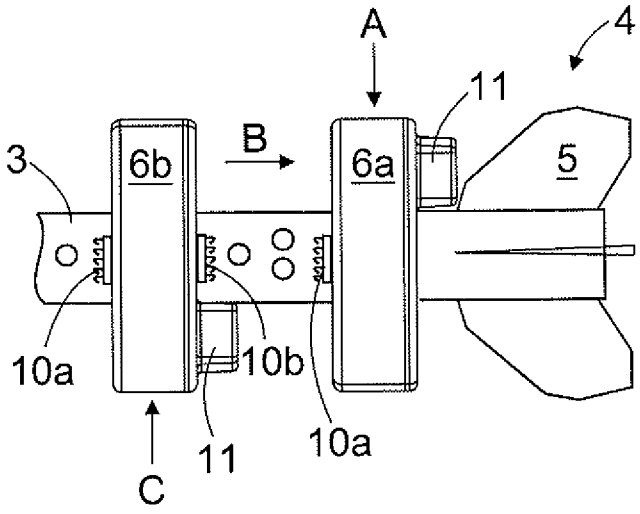


FIG. 4

(57) Abstract: The invention relates to a method of fastening increment charges to a mortar shell, a mortar shell, and an increment charge system. A fin-stabilized mortar shell (1) comprises a shell part (2) and a tail shaft (3) on the extension thereof, the tail shaft comprising guide fins (5). The tail shaft is provided with an increment charge system (12) comprising several increment charges (6) arranged around the tail shaft and fastened to the tail shaft in a form-locking manner. In order to ensure the fastening, the increment charge system utilizes a Velcro tape fastening (13).

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METHOD FOR FASTENING INCREMENT CHARGES TO MORTAR SHELL, SHELL AND INCREMENT CHARGE

BACKGROUND OF THE INVENTION

[0001] The invention relates to a method of fastening increment charges to a tail shaft of a fin-stabilized mortar shell. The invention further relates to a fin-stabilized mortar shell equipped with increment charges, and further to an increment charge.

[0002] The fields of the invention are defined in closer detail in the preambles of the independent claims.

[0003] A fin-stabilized mortar shell is provided with a shell part which contains the actual explosive charge and on the extension of which in a rear part of the shell typically a tail shaft is provided which includes a tail comprising several guide fins. Inside the tail shaft, a basic charge is provided which ignites upon launch and provides the shell with its departure speed and trajectory. The trajectory of the shell may be controlled by placing a desired number of increment charges around the tail shaft, which, upon launch, ignite and burn in the shaft of the mortar and provide the shell with an additional propulsive thrust. The basic charge and the increment charges thus together form a propelling charge of the shell. The trajectory of the shell may be controlled not only by influencing the number of increment charges but also e.g. by selecting increment charges with different burning properties.

[0004] Typically, increment charges are substantially shaped like a horseshoe. An increment charge is dimensioned such that it fits in a shaft of a mortar. For the same reason, the increment charge is substantially circular in its external form. A central section of the increment charges is provided with a central space which may receive a tail shaft. Such an increment charge further includes an installation opening which extends from an outer edge of the increment charge to the central space and through which the increment charge may be pushed in a transverse direction into place so that the tail shaft settles in the central space. The width of the installation opening is dimensioned to be slightly smaller than the diameter of the tail shaft in order to ensure that the increment charge stays around the tail shaft. It has been noticed, however, that increment charges do not always stay in place around the tail shaft but they may fall off when the shells are being handled. This, of course, presents a serious safety risk.

BRIEF DESCRIPTION OF THE INVENTION

[0005] An object of the invention is to provide a novel and improved method and arrangement for fastening increment charges to a mortar shell.

[0006] A method according to the invention is characterized by ensuring the fastening of the increment charges by a Velcro tape fastening.

[0007] A shell according to the invention is characterized in that the fastening of the increment charges is ensured by a Velcro tape fastening.

[0008] An increment charge according to the invention is characterized in that the increment charge comprises at least one Velcro tape component.

[0009] An idea of the invention is that the fastening of the increment charges arranged around the tail shaft of the shell is ensured by means of a Velcro tape.

[0010] An advantage of the invention is that the Velcro tape prevents the increment charges from becoming unintentionally detached from the tail shaft. This enables dangerous situations due to the increment charges being detached to be avoided. Thus, the Velcro tape improves the safety of shell handling e.g. when shells are transferred from a shell storage to a charging device or when the shells are being handled otherwise. The Velcro tape is simple, inexpensive and reliable, and its use requires no substantial changes to the shell, increment charges or mortar. Further, the Velcro tape fastening is easy and quick to carry out even under demanding conditions. Still further, it is easy to remove one or more increment charge from the increment charge system.

[0011] An idea of an embodiment is that successive increment charges are fastened to one another by a Velcro tape fastening. Side surfaces of the successive increment charges facing one another are equipped with Velcro tape components that may be pressed against one another, in which case the successive increment charges become fastened to one another.

[0012] An idea of an embodiment is that the increment charges are fastened to the tail shaft by a Velcro tape fastening. In a surface to be arranged against the tail shaft, the increment charges comprise a first Velcro tape component. In addition, the tail shaft is equipped with a second Velcro tape component. When the increment charge is arranged in its place in the tail shaft, the Velcro tape components become fastened to one another. The first Velcro tape component of the increment charges may comprise several hooks

or corresponding grip projections. The tail shaft may be provided with a gauze-like fabric attached thereto to which the hooks of the first Velcro tape component may become fastened.

[0013] An idea of an embodiment is that the outer edge of the increment charges is provided with a Velcro tape fastening. The outer edge of each increment charge may be equipped with one or more first Velcro tape components. The first Velcro tape components provided in the outer edges of the increment charges are placed in a line, after which an elongated second Velcro tape component is pressed against several aligned first Velcro tape components, whereby the increment charges become fastened to one another by means of the second Velcro tape component.

[0014] An idea of an embodiment is that the outer edge of each increment charge is equipped with one or more Velcro tape components provided with hooks or corresponding grip projections. Subsequently, a fabric is arranged around the increment charge system, the yarns or fibres of the fabric becoming fastened to the Velcro tape components provided in the outer edges of the increment charges and forming a Velcro tape fastening.

[0015] An idea of an embodiment is that a flexible mantle or collar has been rolled around the increment charge system to surround all the increment charges. The mantle is closed into a loop by means of one or more Velcro tape components. A connecting edge of the mantle may be provided with components comprising hooks, which may become fastened to the yarns or fibres of the mantle made from a fabric material.

[0016] An idea of an embodiment is that the material of the Velcro tape components has been selected such that they burn off substantially completely in the shaft of the mortar when a shell is launched. Such a burnable material may be e.g. nitrocellulose. Also many plastic materials burn off well during the launch of a shell.

BRIEF DESCRIPTION OF THE FIGURES

[0017] Some embodiments of the invention are described in closer detail in the accompanying drawings, in which

Figure 1 is a schematic side view showing a fin-stabilized mortar shell,

Figures 2a to 2c are schematic views showing an increment charge whose sides are equippped with Velcro tape components, as seen from different directions,

Figure 3 is a schematic perspective view showing a mortar shell equipped with an increment charge system,

Figure 4 is a schematic side view showing installation of the increment charges shown in Figures 2a to 2c in place,

Figure 5a schematically shows an increment charge whose central opening is equipped with a Velcro tape component,

Figure 5b schematically shows a tail shaft equipped with a Velcro tape component,

Figure 5c is a schematic view showing a configuration in which the increment charge according to Figure 5a has been installed around the tail shaft according to Figure 5b, as seen in a longitudinal direction of the shell,

Figure 6 schematically shows a principle of another increment charge, and

Figure 7 is a schematic and perspective view showing a mortar shell, wherein an outer surface of an increment charge system of the shell is provided with a Velcro tape.

[0018] For the sake of clarity, the figures show some embodiments of the invention in a simplified manner. In the figures, like reference numerals identify like elements.

DETAILED DESCRIPTION OF THE INVENTION

[0019] A mortar shell 1 shown in Figure 1 comprises a shell part 2, a tail shaft 3 on the extension thereof, and further a tail 4 located in a rear part of the shell 1. The tail 4 typically comprises several guide fins 5. The actual explosive of the shell 1 is positioned in the shell part 2. The inside of the tail shaft 3, in turn, is provided with a basic charge which, upon launch, provides the shell 1 with its departure speed.

[0020] Figures 2a to 2c show an increment charge 6 as seen from different directions. Typically, an increment charge is substantially shaped like a horseshoe. Its outer edge 7 is substantially circular, so it fits in the shaft of the mortar. For the same reason, the outer dimension of the increment charge 6 is to be smaller than the largest diameter of the shell. A central part of the increment charge 6 is provided with a central space 8 which may receive the

tail shaft 3. The increment charge 6 is further provided with an installation opening 9 which extends from the outer edge 7 of the increment charge to the central space 8. In such a case, the increment charge 6 may be pushed in a transverse direction of the shell 1 into its place around the tail shaft 3. The width of the installation opening 9 is dimensioned to be slightly smaller than the diameter of the tail shaft 3, whereby a form-locking is provided between the increment charge 6 and the tail shaft 3. One side or both sides 10a and 10b of the increment charge 6 may be equipped with projections 11a and 11b which are dimensioned such that they fit in the installation opening 9 of an adjacent increment charge when increment charges 6 have been arranged successively around the tail shaft 3. The adjacent increment charges 6 are naturally arranged contrariwise with respect to one another, i.e. the installation openings of the adjacent increment charges point in opposite directions, as can be seen below in Figure 3. Such an increment charge has been described e.g. in US 2005/075 933 A1. The increment charge 6 may be a casing inside which gunpowder or another burning propellant suitable for the purpose is provided.

[0021] It may further be seen in Figures 2a to 2c that the sides 10a, 10b of the increment charge 6 may be provided with Velcro tape components 13a, 13b enabling adjacent increment charges 6 to be fastened to one another. A first Velcro tape component 13a may comprise a large number of small hooks while a second Velcro tape component 13b may comprise a large number of loops, hooks or corresponding members to which the hooks of the first Velcro tape component 13a may become fastened when the components are pressed against one another. The resulting connection may be undone without breaking any structures. The Velcro tape connection may thus be unfastened and fastened many times. Such a "hook and loop" type glue-free Velcro tape is marketed at least by the trademark Velcro®. The size of the Velcro tape components 13a, 13b may be dimensioned according to the necessary fastening force. On the side of one side surface 10, both branches of the increment charge 6 may be equipped with a Velcro tape component 13a, 13b. The number of Velcro tape components may, however, be dimensioned as necessary. If the increment charge 6 comprises no projections 11, it is possible to place the Velcro tape component in a section of the side surface 10 opposite to the installation opening 9. In some cases, the projections may comprise Velcro tape components. The Velcro tape components 13a, 13b may be fastened to the increment charge 6 e.g. with glue. The Velcro tape component

13a, 13b may also comprise a frame layer whose first surface is provided with hooks, loops, links, flock or other mechanical fastening members and whose second surface may be provided with sticker glue or the like.

[0022] The shell 1 shown in Figure 3 is equipped with an increment charge system 12 comprising several increment charges 6 arranged successively around the tail shaft 3. As can be seen in the figure, a Velcro tape fastening 13 is provided between adjacent increment charges to fasten the increment charges to one another. In such a case, an individual increment charge 6 cannot become detached from the increment charge system e.g. due to the influence of impacts or vibration. However, when desired, the Velcro tape fastening may be unfastened later so that one or more increment charges 6 may be removed from the increment charge system 12.

[0023] Figure 4 illustrates installation of the increment charges according to the previous Figures 2a to 2c. A first increment charge 6a has been pushed with the installation opening 9 first in transverse direction A around the tail shaft 3 and pushed in axial direction B against the tail 4. A projection 11 may project between the guide fins 5 and prevent the increment charge 6a from turning around the tail shaft 3. A second increment charge 6b is pushed in transverse direction C around the tail shaft 3, after which it is pushed in axial direction B against the first increment charge 6a. Then, the projection 11 provided in the side 10 of the second increment charge 6b is pushed into the installation opening 9 of the first increment charge 6a and, further, the Velcro tape components 10a, 10b provided in the side surfaces of the increment charges are pressed against one another, becoming fastened to one another. A desired number of increment charges may be fastened in a similar manner. The removal of increment charges from the increment charge system takes place in a reverse order.

[0024] Figure 5a shows another increment charge 6 having a first Velcro tape component 13a fastened in connection with its central opening 8. The Velcro tape component 13a may be arranged to cover the edge of the central opening 8 substantially completely or only in part. The Velcro tape component 13a may comprise a large number of small hooks or corresponding grab projections. In a highly simplified manner, Figure 5b shows a tail shaft 3 equipped with a second Velcro tape component 13b. The Velcro tape component 13b may be made from a gauzelike or fringelike fabric or corresponding material to whose fibres or yarns the hooks of the first Velcro tape component

13a may become fastened. The fabric may surround the tail shaft 3 completely or only a part thereof. Of course, the second Velcro tape component 13b may also be different, e.g. an axially directed tape which has been fastened to the tail shaft by sticker glue and which comprises several loops. In Figure 5c, the increment charge 6 has been pushed in the transverse direction into its place, whereby the Velcro tape components 13a, 13b have stuck to one another.

[0025] Figure 6 shows still another embodiment wherein the outer edge 7 of the increment charge 6 is equipped with one or more first Velcro tape components 13a. Such increment charges 6 may be arranged around the tail shaft 3 in the manner shown in Figure 7 such that the first Velcro tape components 13a are placed in a line. Subsequently, a second Velcro tape component 13b may be arranged against the first Velcro tape components 13a, whereby a Velcro tape fastening is provided in the outer edge 7 of the increment charges 6 to connect the increment charges 6 included in the increment charge system 12 into one entity. However, in order to control the departure speed of the shell 1, it is possible to easily detach the second Velcro tape component 13b from a desired section and then push off one or more increment charges 6 in the transverse direction.

[0026] When necessary, one increment charge system 12 may comprise one or more above-disclosed Velcro tape fastenings 13.

[0027] It is to be noted that the Velcro tape fastening set forth in the present application may also be used in connection with increment charges of types of construction and fastening principle other than those disclosed in the present application. A Velcro tape is a simple fastening member for all kinds of increment charges being used in mortar shells. Velcro tape components contain relatively little material and, in addition, they may be made from a material which burns off well when the shell is launched. For instance, burn residues of a Velcro tape made from a plastic material are small.

[0028] In some cases, the features disclosed in the present application may be used as such, irrespective of other features. On the other hand, when necessary, the features set forth in the present application may be combined in order to provide different combinations.

[0029] The drawings and the related description are only intended to illustrate the idea of the invention. The details of the invention may vary within the scope of the claims.

CLAIMS

1. A method of fastening increment charges to a mortar shell (1) which comprises a shell part (2) and a tail shaft (3) on an extension of the shell part (2) and, further, several guide fins (5) in a section of an outer end of the tail shaft (3), and the method comprising:

installing a predetermined number of increment charges (6) around the tail shaft (3) of the shell (1); and

fastening the increment charges (6) to the tail shaft (3) by means of form-locking;

characterized by

ensuring the fastening of the increment charges (6) by a Velcro tape fastening (13).

2. A method as claimed in claim 1, characterized by

providing side surfaces (10a, 10b) of the increment charges (6) with Velcro tape components (13a, 13b);

arranging the increment charges (6) around the tail shaft (3); and

pushing the increment charges (6) in an axial direction against one another and pressing the Velcro tape components (13a, 13b) provided in the side surfaces (10a, 10b) of the increment charges (6) against one another, whereby the Velcro tape components (13a, 13b) stick to one another and connect successive increment charges (6) with one another.

3. A method as claimed in claim 1, characterized by

using increment charges (6) provided with a central space (8) and an installation opening (9) which extends from an outer edge (7) of the increment charge to the central space (8), whereby the increment charge (6) is pushable in a transverse direction of the shell (1) into its place so that the tail shaft (3) settles in the central space (8);

equipping the central spaces (8) of the increment charges with at least one first Velcro tape component (13a);

equipping the tail shaft (3) with at least one second Velcro tape component (13b); and

pushing the increment charges (6) in the transverse direction of the shell (1) into their place, whereby the Velcro tape components (13a, 13b) of the central space (8) and the tail shaft (3) become fastened to one another.

4. A method as claimed in any one of the preceding claims, c h a r a c t e r i z e d by

equipping the outer edge (7) of each increment charge (6) with at least one first Velcro tape component (13a);

arranging several increment charges (6) successively so that the at least one first Velcro tape component (13a) provided in their outer edges (7) are aligned; and

pressing at least one elongated second Velcro tape component (13b) against several aligned first Velcro tape components (13a), whereby a Velcro tape fastening (13) is provided between the increment charges (6).

5. A mortar shell comprising:

a shell part (2) provided with an actual explosive of the shell (1);

a tail shaft (3) which is provided on an extension of the shell part (2) and inside which a basic charge of the shell (1) is provided;

a tail (4) which is located at an outer end of the tail shaft (3) and which comprises several guide fins (5); and

an increment charge system (12) comprising several increment charges (6) arranged around the tail shaft (3) successively and fastened to the tail shaft (3) in a form-locking manner;

c h a r a c t e r i z e d in that

the fastening of the increment charges (6) is ensured by a Velcro tape fastening (13).

6. A shell as claimed in claim 5, c h a r a c t e r i z e d in that

side surfaces (10a, 10b) of successive increment charges (6) facing one another are equipped with Velcro tape components (10a, 10b); and

the Velcro tape components (10a, 10b) provided in the side surfaces (10a, 10b) of the successive increment charges (6) are arranged against one another, whereby the successive increment charges (6) are fastened to one another by a Velcro tape fastening (13).

7. A shell as claimed in claim 5 or 6, c h a r a c t e r i z e d in that

the increment charges (6) comprise, on a surface to be arranged against the tail shaft (3), at least one first Velcro tape component (13a);

the tail shaft (3) is equipped with at least one second Velcro tape component (13b); and

the Velcro tape components (13a, 13b) of the increment charges (6) and the tail shaft (3) are arranged against one another, whereby the increment charges (6) are fastened to the tail shaft (3) by a Velcro tape fastening (13).

8. A shell as claimed in claim 7, characterized in that

the first Velcro tape component (13a) of the increment charges (6) comprises several hooks; and

to the tail shaft (3) a fabric is attached to which the hooks of the first Velcro tape component (13a) are fastened.

9. A shell as claimed in any one of the preceding claims 5 to 8, characterized in that

an outer edge (7) of each increment charge (6) is equipped with at least one first Velcro tape component (13a);

the first Velcro tape components (13a) provided in the outer edges (7) of the increment charges are aligned; and

at least one elongated second Velcro tape component (13b) is pressed against several aligned first Velcro tape components (13a), whereby the outer edge (7) of the increment charges (6) is provided with a Velcro tape fastening (13).

10. A mortar shell increment charge which is a discoidal object substantially shaped like a horseshoe and which comprises:

a curved outer edge (7);

side surfaces (10a, 10b);

a central space (8); and

an installation opening (9) which extends from the outer edge (7) of the increment charge (6) to the central space (8), whereby the increment charge (6) is pushable in a transverse direction of the shell (1) into its place so that the tail shaft (3) settles in the central space (8);

characterized in that

the increment charge (6) comprises at least one Velcro tape component (13a, 13b).

11. An increment charge as claimed in claim 10, characterized in that

at least one Velcro tape component (13a, 13b) is arranged in at least one side surface (10a, 10b).

12. An increment charge as claimed in claim 10 or 11, characterized in that

at least one Velcro tape component (13a, 13b) is arranged in an edge of the central space (8).

13. An increment charge as claimed in any one of the previous claims 10 to 12, c h a r a c t e r i z e d in that

at least one Velcro tape component (13a, 13b) is arranged in the outer edge (7).

14. An increment charge as claimed in any one of the previous claims 10 to 13, c h a r a c t e r i z e d in that

the increment charge (6) is a casing which comprises a cover structure made from a burnable material and a burning explosive therein.

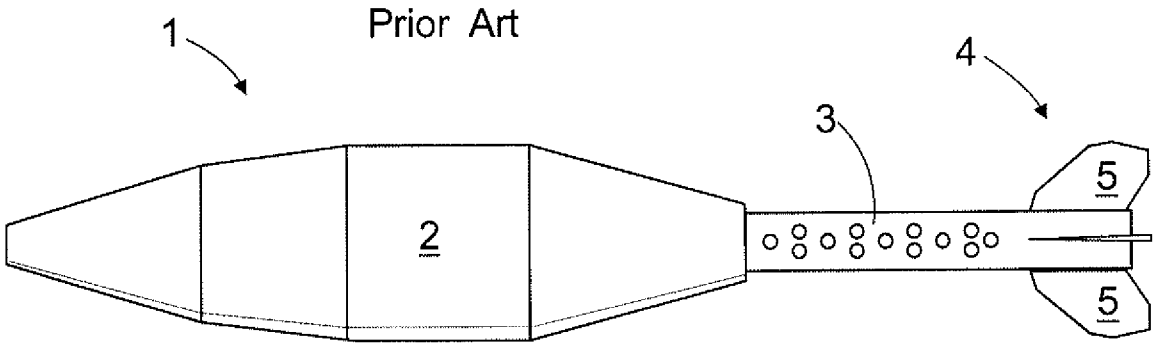


FIG. 1

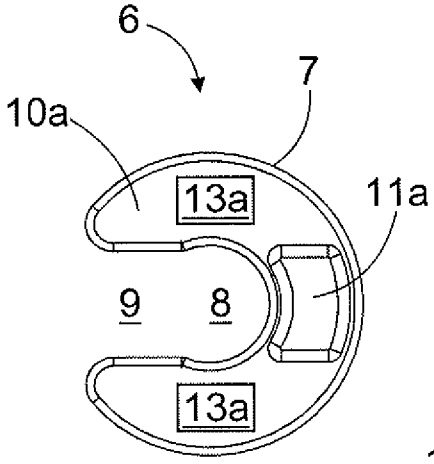


FIG. 2a

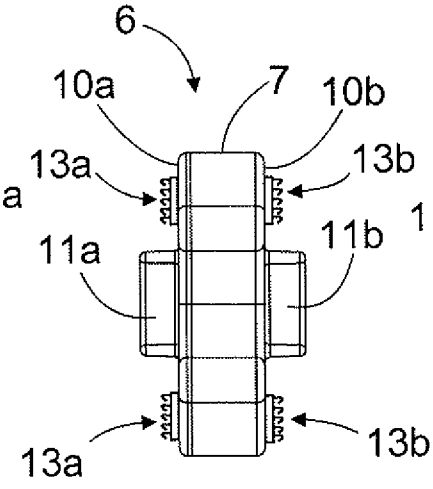


FIG. 2b

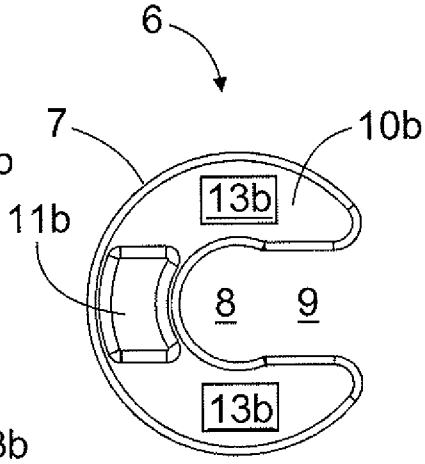


FIG. 2c

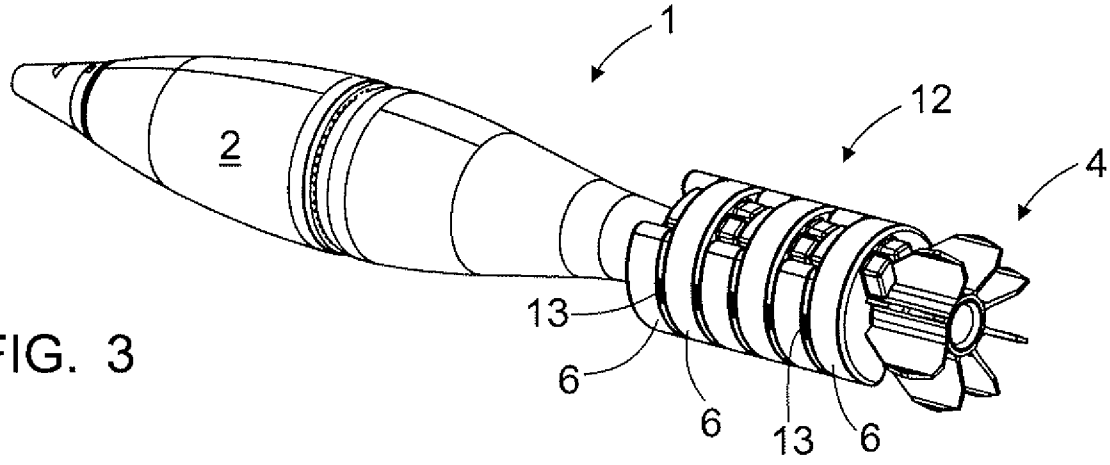


FIG. 3

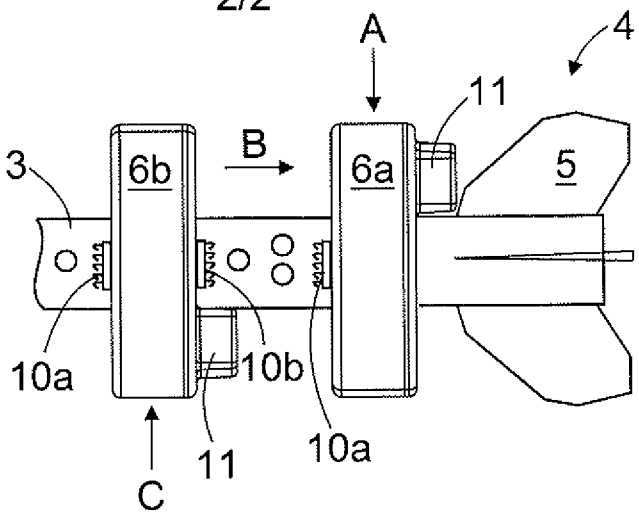


FIG. 4

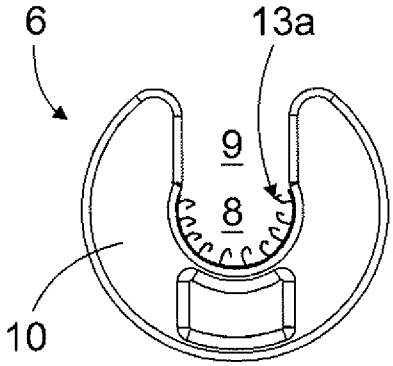


FIG. 5a

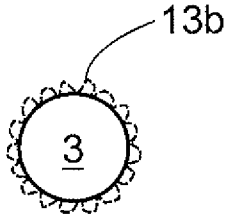


FIG. 5b

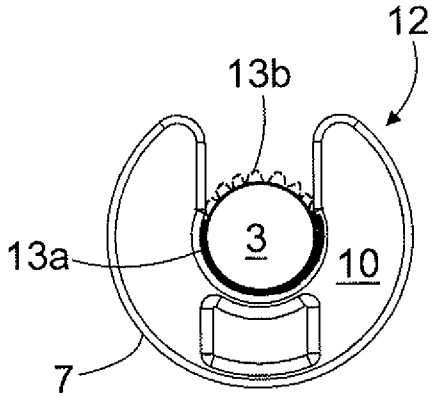


FIG. 5c

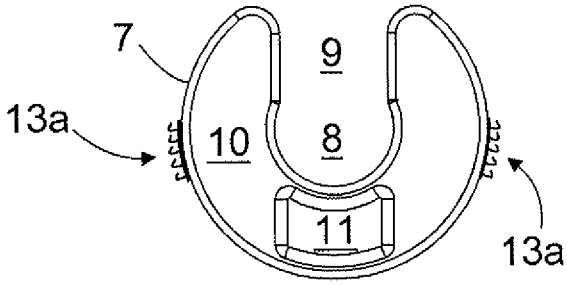


FIG. 6

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI2009/050052

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: F42B

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)

EPO-INTERNAL, WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	WO 2005075933 A1 (PATRIA WEAPON SYSTEMS OY) 18 August 2005 (18.08.2005)	
Y	chapters [0007]-[0009], Figures 1-4	1, 5, 10
Y	whole document	2-4, 6-9, 11-14
	US 5179250 A (CAMPOLI RALPH F) 12 January 1993 (12.01.1993)	
Y	column 1, lines 17-19, 53-68, column 2, lines 1-15, column 4, lines 37-43, Figure 1	1, 5, 10
Y	whole document	2-4, 6-9, 11-14
	US 5090323 A (KALLEVIG JOHN A et al.) 25 February 1992 (25.02.1992)	
Y	column 2, lines 15-25, Figures 2-3	1, 5, 10
Y	whole document	2-4, 6-9, 11-14

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

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Date of the actual completion of the international search	Date of mailing of the international search report
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Int.Cl.
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
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