



(12) **DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION**

(13) **A1**

(86) Date de dépôt PCT/PCT Filing Date: 2017/09/14
(87) Date publication PCT/PCT Publication Date: 2018/03/22
(85) Entrée phase nationale/National Entry: 2019/02/08
(86) N° demande PCT/PCT Application No.: SE 2017/050901
(87) N° publication PCT/PCT Publication No.: 2018/052365
(30) Priorité/Priority: 2016/09/15 (SE1630224-2)

(51) Cl.Int./Int.Cl. *F42B 12/62* (2006.01),
F42B 30/00 (2006.01)
(71) Demandeur/Applicant:
BAE SYSTEMS BOFORS AB, SE
(72) Inventeur/Inventor:
HEICHE, ULF, SE...
(74) Agent: FETHERSTONHAUGH & CO.

(54) Titre : PROCEDE ET AGENCEMENT POUR MODIFIER UN PROJECTILE SEPARABLE
(54) Title: METHOD AND ARRANGEMENT FOR MODIFYING A SEPARABLE PROJECTILE

Fig. 1

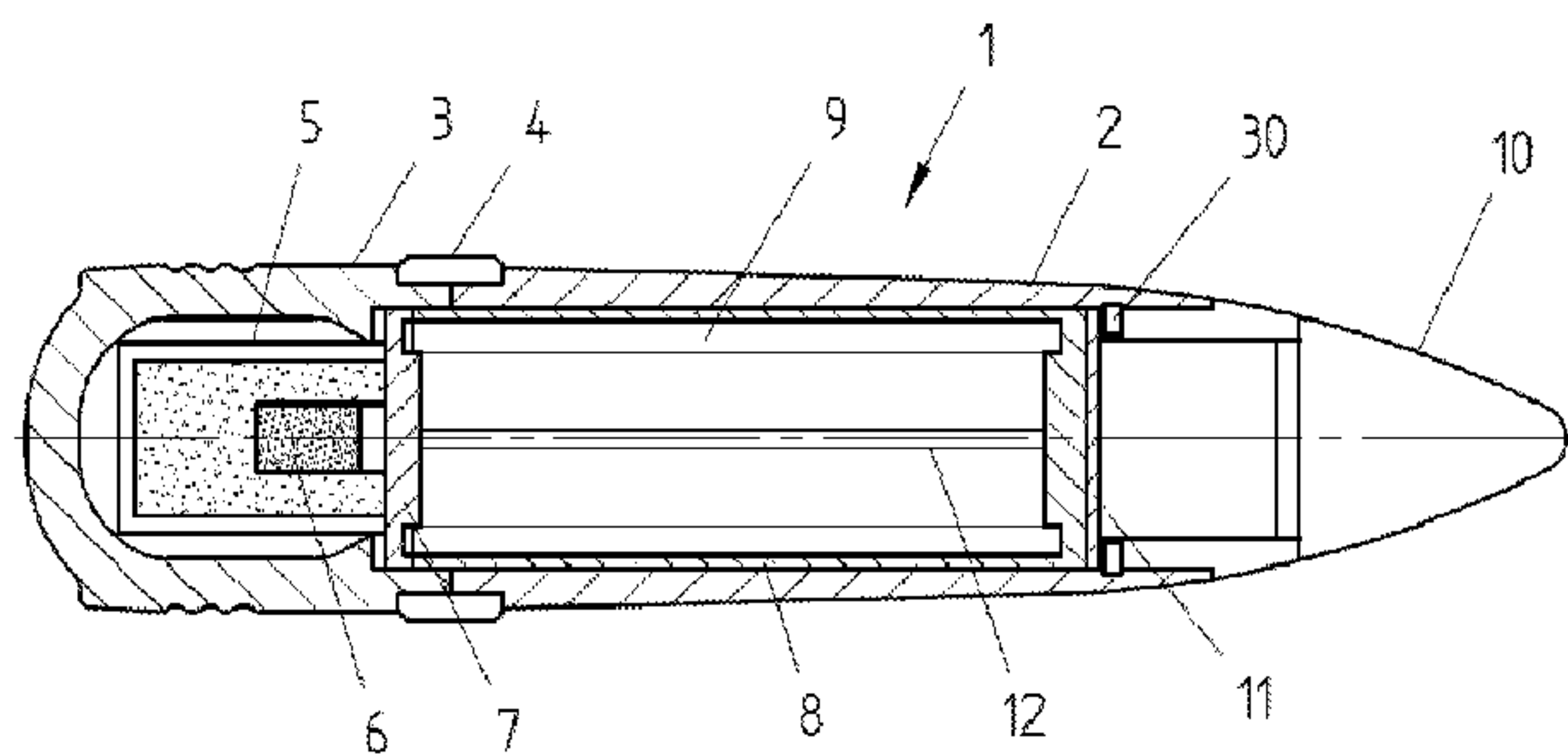
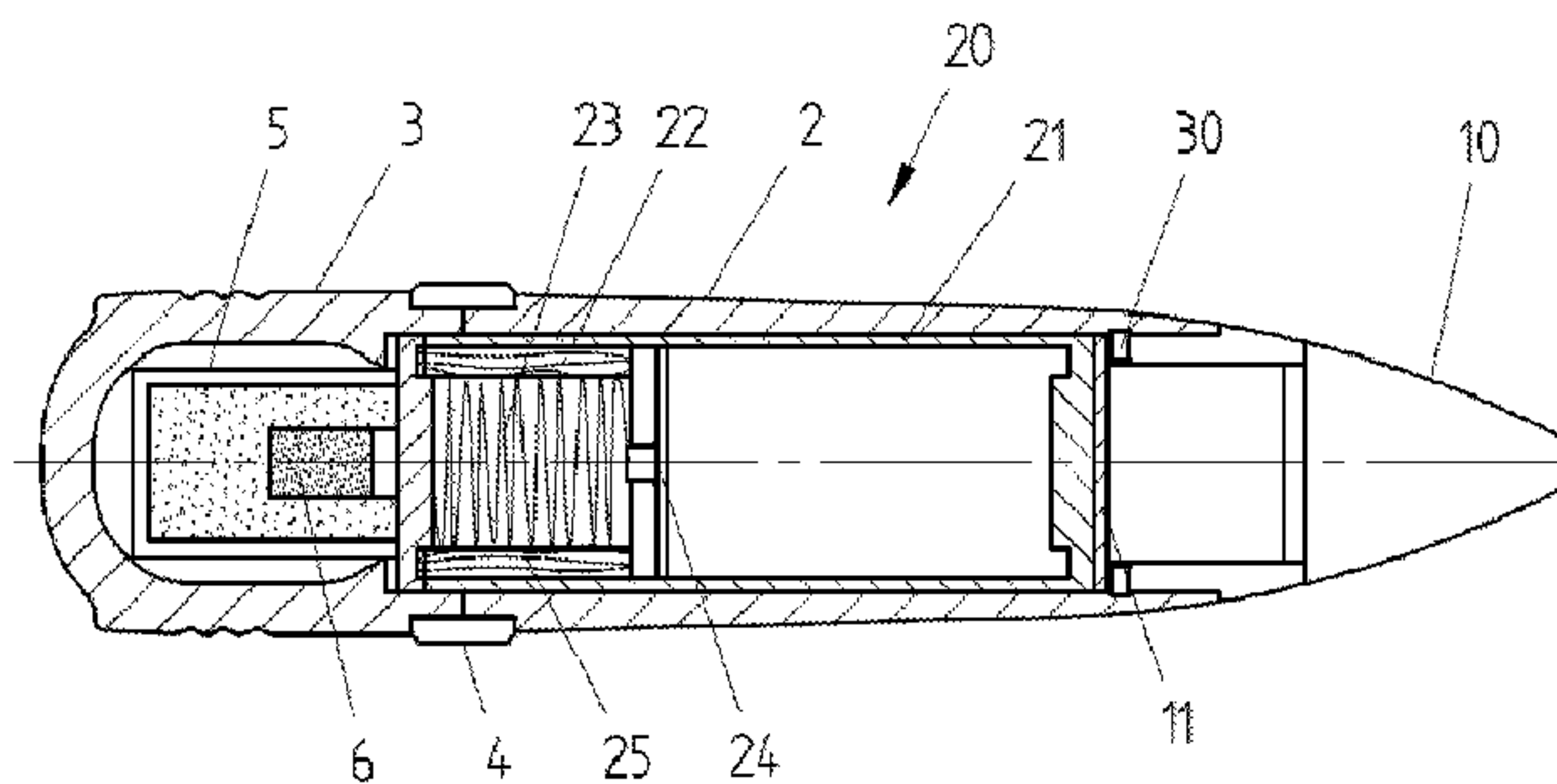


Fig. 2



(57) **Abrégé/Abstract:**

The invention relates to a method for modifying a separable projectile (1,20) between a test embodiment or an effect embodiment by: i. detaching the front projectile body from the rear projectile body (3), ii. arranging a payload container (8,21) in the front

(57) **Abrégé(suite)/Abstract(continued):**

projectile body where the payload container comprises measuring equipment or an effect part, and iii. fitting the front projectile body (2) to the rear projectile body (3) by way of a belt (4). The invention also relates to a separable projectile (1,20), which can be modified between a test embodiment and an effect embodiment.

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

(19) World Intellectual Property
Organization
International Bureau(43) International Publication Date
22 March 2018 (22.03.2018)(10) International Publication Number
WO 2018/052365 A1

(51) International Patent Classification:

F42B 12/62 (2006.01) *F42B 30/00* (2006.01)

(21) International Application Number:

PCT/SE2017/050901

(22) International Filing Date:

14 September 2017 (14.09.2017)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

1630224-2 15 September 2016 (15.09.2016) SE

(71) Applicant: **BAE SYSTEMS BOFORS AB** [SE/SE]; Industrivägen, SE-69180 Karlskoga (SE).(72) Inventor: **HEICHE, Ulf**; Skolgatan 31, SE-691 41 Karlskoga (SE).(74) Agent: **NOBELI BUSINESS SUPPORT AB**; Hyttåsvägen 10, SE-69180 Karlskoga (SE).(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, 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, 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: METHOD AND ARRANGEMENT FOR MODIFYING A SEPARABLE PROJECTILE

Fig. 1

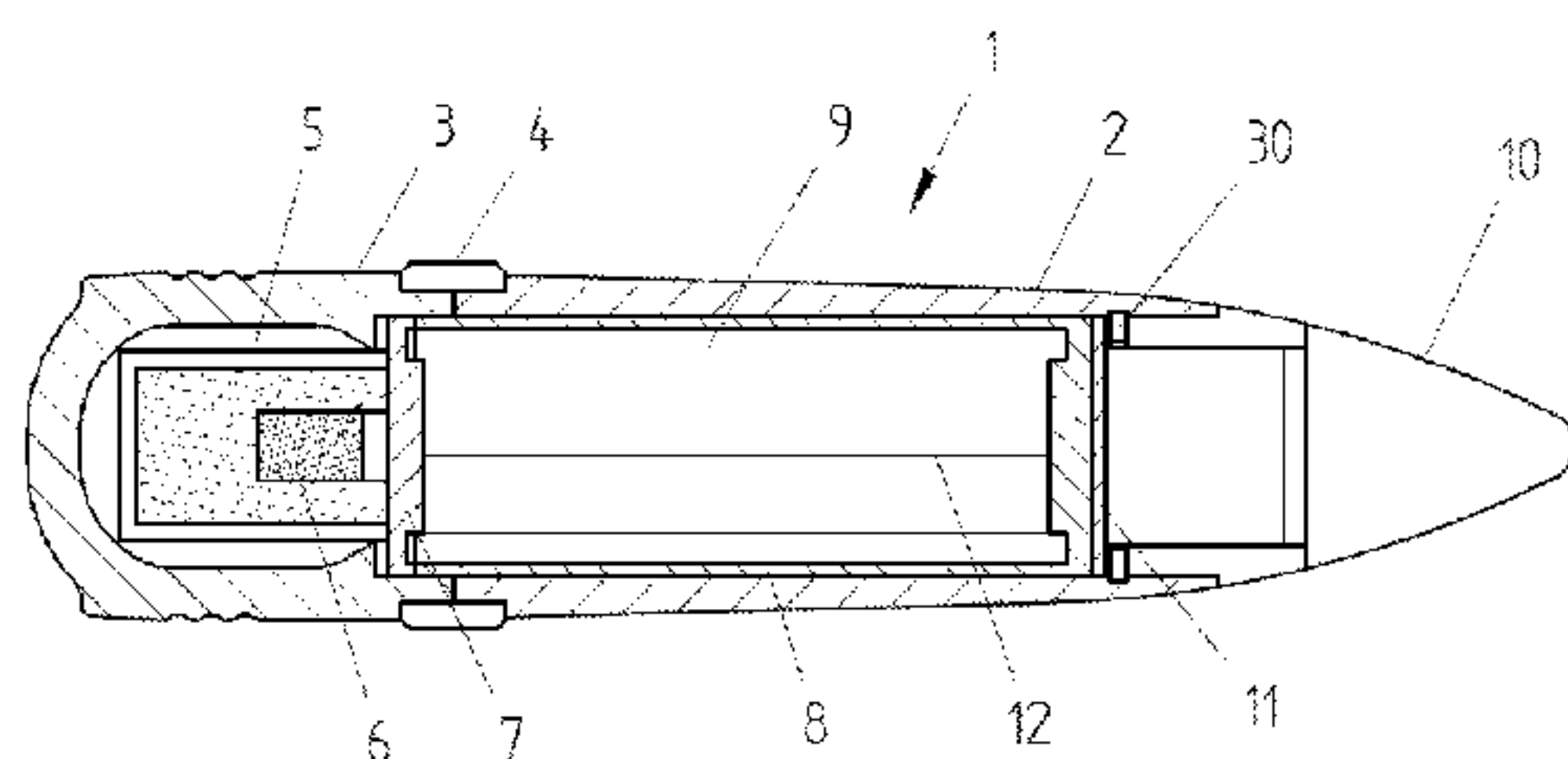
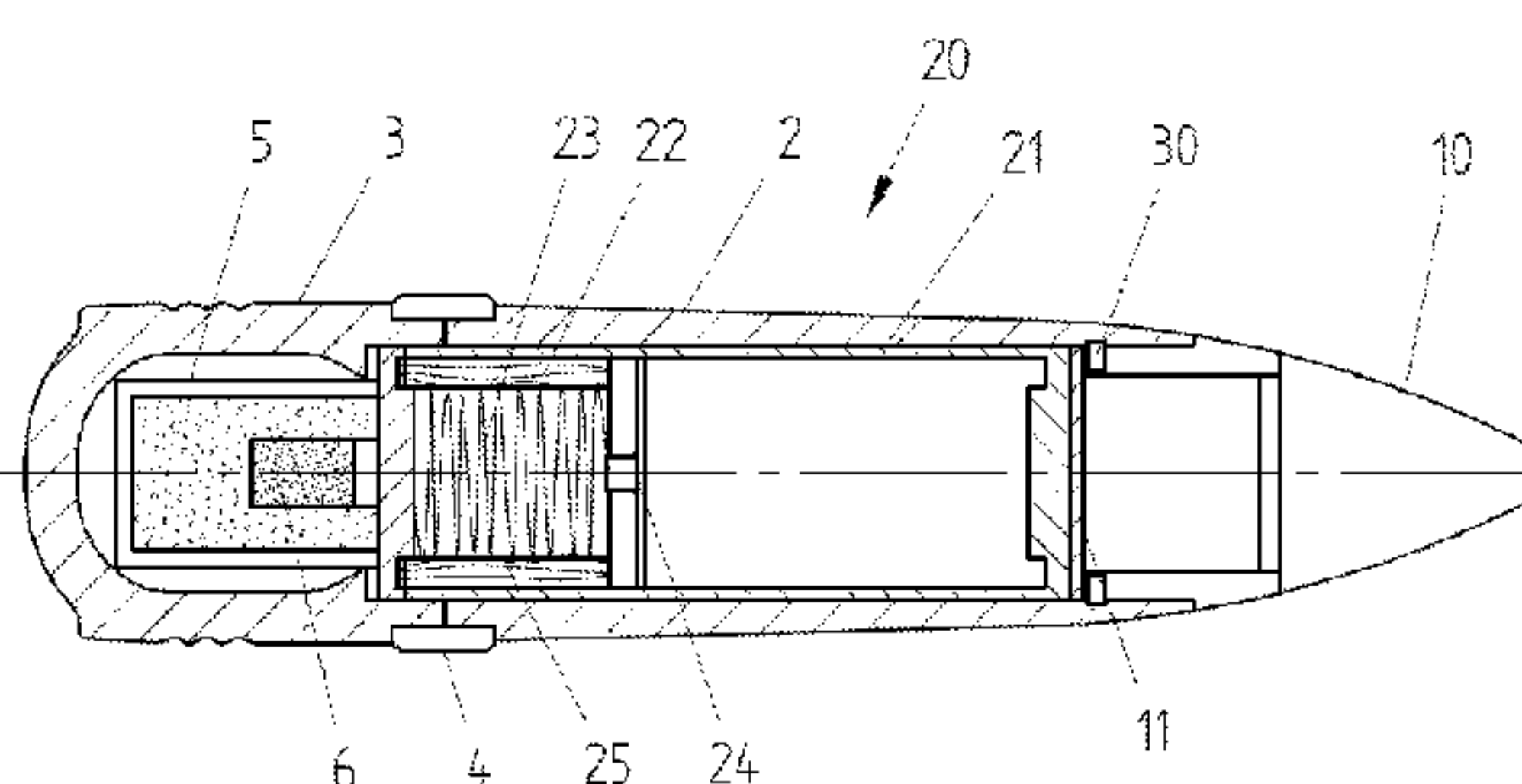


Fig. 2



(57) Abstract: The invention relates to a method for modifying a separable projectile (1,20) between a test embodiment or an effect embodiment by: i. detaching the front projectile body from the rear projectile body (3), ii. arranging a payload container (8,21) in the front projectile body where the payload container comprises measuring equipment or an effect part, and iii. fitting the front projectile body (2) to the rear projectile body (3) by way of a belt (4). The invention also relates to a separable projectile (1,20), which can be modified between a test embodiment and an effect embodiment.

METHOD AND ARRANGEMENT FOR MODIFYING A SEPARABLE PROJECTILE

The present invention relates to a method and an arrangement for modifying a separable projectile.

BACKGROUND OF THE INVENTION

- 5 Separable projectile designs for the separation of one or more effect charges in the forward direction of the projectile are disclosed by the following patent documents: US4333400A US Navy 1980, US3839962 US Army 1973 and US3513777 US Army 1968, among others.
- 10 In the testing of a separable projectile as described above various types of measuring equipment are normally used in the projectile for registering parameters such as acceleration stresses, velocity, pressure etc., during the launch phase and trajectory phase of the projectile.
- 15 Recovery of the measuring equipment after testing for evaluation of the measurement data is done, for example, by slowing a projectile in compacted bales backed by a sand trap. The method has proved less suitable, however, for certain types of sensitive measuring equipment.
- 20 A need therefore exists for a separable projectile arranged in a test embodiment, comprising a recoverable measuring equipment for measuring characteristics of the projectile during the acceleration and trajectory phase without damaging the measuring equipment after testing.
- 25 It is also desirable that said separable projectile should be easy to modify from a test embodiment for testing out the projectile to an effect embodiment for terminal effect.

OBJECT AND CHARACTERISTICS OF THE INVENTION

A main object of the present invention has been to provide a separable projectile arranged in a test embodiment for measuring characteristics of the projectile during the acceleration and trajectory phase of the projectile without
5 ensuing damage to the measuring equipment.

A further object of the present invention has been to provide a method for modifying a separable projectile in that the projectile can easily be modified from a test embodiment to an effect embodiment; which means that the
10 projectile is produced in an unmodified state. The payload container, adapted for holding the measuring equipment or the effect charge, is produced and supplied separately. This affords flexibility in modifying said projectile to the desired form, that is to say the test embodiment or the
15 effect embodiment.

Said objects and other aims not enumerated here are satisfactorily achieved by the specifications of the present independent patent claims.

Embodiments of the invention are specified in the dependent
20 patent claims.

According to the present invention, a method has been provided for modifying a separable projectile from a test embodiment to an effect embodiment and vice versa, the projectile comprising a payload container and a separation
25 charge arranged behind the payload container for separating the payload container from the projectile in the forward direction of the projectile.

A characteristic feature of the method is that the projectile is modified from the test embodiment to the
30 effect embodiment in that the payload container is changed

from a payload container comprising measuring equipment to a payload container comprising an effect part by:

- i. detaching the front projectile body from the rear projectile body,
 - 5 ii. arranging a payload container in the front projectile body where the payload container comprises measuring equipment or at least one effect part, and
 - iii. fitting the front projectile body to the rear projectile body by way of a belt.
- 10 According to the present invention a separable projectile has also been provided, comprising a payload container and a separation charge arranged behind the payload container for separating the payload container from the projectile in the forward direction of the projectile, the projectile
- 15 being modifiable from a test embodiment to an effect embodiment by changing the payload container.

According to a second embodiment of the separable projectile the separation charge consists of a propellant charge comprising a smokeless nitrocellulose propellant.

- 20 According to a third embodiment of the separable projectile the projectile comprises a pyrotechnic primer charge for initiating the propellant charge.

- According to a fourth embodiment of the separable projectile the projectile comprises a fuse for initiating
- 25 the pyrotechnic primer charge.

According to a fifth embodiment of the projectile in a test embodiment the payload container comprises a measuring equipment for measuring the acceleration stresses, velocity, altitude, temperature etc. of the projectile

during the acceleration and trajectory phase of the projectile.

According to a sixth embodiment of the projectile in the test embodiment the payload container is connected to a
5 parachute for recovery of the payload container after separation from the projectile.

According to a seventh embodiment of the projectile in the effect embodiment the payload container consists of an integral unit, entirely or partially closed.

10 According to an eighth embodiment of the projectile in the test embodiment the parachute is arranged and packed in a separable parachute container on or in the rear part of the payload container.

According to a ninth embodiment of the projectile in the
15 effect embodiment the payload container comprises at least one effect part comprising at least one effect projectile and at least one explosive charge for aimed effect against a target.

According to a tenth embodiment of the projectile in an
20 effect embodiment the payload container comprises a delay charge for delayed initiation of said effect part.

According to an eleventh embodiment of the projectile in an effect embodiment the payload container is capable of separating into two or more parts after separation for
25 release of the effect part.

According to a twelfth embodiment of the projectile in an effect embodiment the projectile comprises a fuse for initiating the pyrotechnic primer charge and the pyrotechnic delay charge.

ADVANTAGES AND EFFECTS OF THE INVENTION

The invention affords a series of advantages and effects, the most important of which are:

- Modification of the separable projectile from a test
5 embodiment to an effect embodiment by changing the payload container affords a simplified and cost-effective method in which the projectile can be drawn directly from one and the same production line irrespective of the form of embodiment.
- 10 The separation of a payload container, comprising one or more effect charges, in the forward direction of the projectile prevents potentially disruptive action from the projectile body on the effect charge during the effect phase of the projectile.
- 15 The separation of a payload container, comprising a measuring equipment and a parachute, in the forward direction of the projectile allows recovery of the measuring equipment without damage occurring to the measuring equipment.
- 20 Further advantages and effects of the invention will emerge from a study and consideration of the following, detailed description of the invention, referring to the figures of the drawing 1, in which:
- Fig. 1 schematically shows a longitudinal section of a
25 separable projectile in an effect embodiment, comprising a payload container comprising an effect charge, and a separation charge for separating the container with a payload from the projectile.
- Fig. 2 schematically shows a longitudinal section of a
30 separable projectile in a test embodiment, comprising a

payload container comprising a measuring equipment, and a separation charge for separating the container with a payload from the projectile.

DETAILED DESCRIPTION OF EMBODIMENTS

- 5 The invention relates to a method for modifying a separable projectile from a test embodiment to an effect embodiment or vice versa.

The basic construction of the projectile is such that the projectile can easily be modified from the test embodiment
10 to the effect embodiment by changing the payload container. In a test embodiment the payload container is characterized in that that it comprises sensitive measuring equipment for measuring characteristics of the projectile during the launch and trajectory phase of the projectile. The payload
15 container is also connected to a parachute for recovery of the payload container after separation from the projectile. In the effect embodiment the payload container is characterized in that it comprises an effect part comprising one or more effect projectiles and effect
20 charges for effect against a target after separation of the payload container.

The content of the payload container differs, therefore, depending on the embodiment of the projectile. In order to fit the payload space of the projectile regardless of the
25 embodied form of the projectile, the payload containers are of similarly shaped design, preferably cylindrical, and of the same size.

The payload containers differ, however, with regard to their construction. In an effect embodiment the payload
30 container preferably comprises a longitudinally dividable cylinder, comprising two cylinder halves fixed to one

another so that the payload container, after separation from the projectile, divides into two halves for release of the effect part in the forward direction of the projectile. In a test embodiment the payload container consists of an
5 integral unit which does not divide after separation, entirely or partially closed, for safe preservation of the measuring equipment during the course of testing. In a special embodiment, not shown, the cylindrical payload container comprises a rear cylindrical cavity for the
10 connection of a parachute or a container holding a parachute.

In said test embodiment the payload container is connected to a parachute for recovery of the payload container after separation from the projectile.

15 The parachute, preferably packed in a separate, detachable parachute container, is arranged in or adjacent to the rear end of the payload container, preferably in the cylindrical cavity. The parachute container is preferably designed as a separable cylindrical module detachably fitted adjacent to
20 or in the rear cylindrical part of the payload container, for example by snap fasteners.

Fig. 1 shows the separable projectile 1 in an effect embodiment for effect in the forward direction of the projectile 1. The projectile 1 comprises a front projectile
25 body 2 and a rear projectile body 3 joined by a belt 4, the belt 4 joining the rear projectile body to the front projectile body by means of a threaded connection, shrink connection and/or press-fit connection, for example.

The rear projectile body 3 comprises a separation charge 5
30 and a pyrotechnic primer device 6 for initiating the separation charge 5. The primer device 6 is arranged in front of the separation charge 5 behind a drive plate 7

adjacent to the rear end of a payload container 8 and the front projectile body 2. The separation charge 5 preferably consists of a propellant charge of conventional type, for example a propellant charge comprising a smokeless
5 nitrocellulose propellant, or in an alternative embodiment a composite propellant.

The payload container 8 which is arranged in the front projectile body 2 and comprises at least one effect part 9 comprising one or more effect projectiles and effect
10 charges together with one or more delay charges, not shown, for delayed initiation of said minimum of one effect part 9. A proximity fuse, not shown, comprising an activation unit for activating the primer device 6, is arranged in the nose part 10 of the front projectile body 2, in front of
15 the payload container 8. The nose part 10 is fitted to the front projectile body 2 by a second drive plate 11 and by shear pins 30, which are designed to rupture under the effect of the pressure on the separation of the payload container 8 from the projectile 1. In an alternative
20 embodiment a continuous detonator wire 12, preferably a nonel, is arranged between the pyrotechnic primer device 6 and the second drive plate 11 for separating the nose part 10 from the projectile 1.

Fig. 2 shows the separable projectile 20 in a test
25 embodiment for testing the projectile 20. In the test embodiment the payload container 21 comprises a measuring equipment for registering acceleration stresses on the payload container during the launch phase and the velocity, altitude and temperature during the trajectory phase. In
30 the test embodiment the projectile 20 differs in that it has no firing connection between the primer device 6 and the payload container 21, since there is no effect part 9 and no delay charges. Otherwise the projectile 20 in the

test embodiment is identical to the projectile 1 in the effect embodiment.

The payload container 21 in the test embodiment is designed as a strong, integral unit, entirely or partially closed,
5 intended to remain intact and not to disintegrate or break up after separation from the projectile. The payload container 21 with measuring equipment may also be connected/coupled to a parachute 22 by parachute lines 23 connected to the payload container 21 via a ball bearing-
10 guided pivot 24 on the rear end of the payload container 21. The parachute 22 is packed and arranged in a separable parachute container 25 of its own arranged behind or inside the payload container 21, preferably in a cylindrical space in the rear part of the payload container 21.

15 After separation of the payload container 21 and of the parachute container 25 from the projectile 20, the parachute container 25 is broken up into smaller parts at the same time that the parachute 22 is released and deploys, so that the payload container 21 with measuring
20 equipment slowly falls to the ground without the measuring equipment being damaged.

In an alternative embodiment, not shown, the effect part 9 of the projectile 1 in the effect embodiment of the projectile 1 is arranged in a payload container of the same
25 type as that used for the measuring equipment in the test embodiment of the projectile 20, that is to a payload container that does not break up after separation from the projectile and which comprises a separable parachute container 25 with parachute 22. The payload container
30 differs, however, in that its front end is open for releasing the effect part 9 when the payload container approaches a target.

The invention is not limited to the embodiments shown but may be modified in various ways without departing from the scope of the patent claims.

PATENT CLAIMS

1. Separable projectile (1,20) comprising a separation charge (5) arranged behind a payload container (8,21), wherein the payload container (8,21) may comprise
5 measuring equipment or an effect part (9).
2. Separable projectile (1,20) according to claim 1, wherein the separation charge (5) comprises a propellant charge comprising a smokeless nitrocellulose propellant.
3. Separable projectile (1,20) according to either
10 of claims 1 or 2, wherein the projectile (1,20) comprises a pyrotechnic primer charge (6) for initiating the separation charge (5).
4. Separable projectile (1,20) according to claim 3, wherein the projectile (1,20) comprises a proximity for
15 activating the pyrotechnic primer charge (6).
5. Separable projectile (1) according to one of claims 1-4, wherein the payload container (8), in the test embodiment, comprises measuring equipment for measuring the acceleration stresses, velocity, altitude, temperature etc.
20 of the projectile (1) during the acceleration and trajectory phase of the projectile (1).
6. Separable projectile (1) according to one of claims 1-5, wherein the payload container (8) consists of an integral unit, entirely or partially closed.
- 25 7. Separable projectile (1) according to one of claims 1-6, in a test embodiment, wherein the projectile (1) comprises a parachute (22) connected to the payload container (8) for recovery of the payload container (8) after separation from the projectile (1).

8. Separable projectile (1) according to claim 7, wherein the parachute (22) is arranged and packed in a separable parachute container (25) arranged in or adjacent to the rear part of the payload container (8).
- 5 9. Separable projectile (20) according to one of claims 1-4, wherein the payload container (21) in the effect embodiment is separable in two or more parts after separation from the projectile (20) for releasing an effect part (9).
- 10 10. Separable projectile (20) according to one of claims 1-4 or 9, wherein the payload container (21), in the effect embodiment, comprises an effect part (9) comprising at least one effect projectile and at least one explosive charge for aimed effect against a target in the forward
15 direction of the projectile (20).
11. Separable projectile (20) according to one of claims 1-4, 9 or 10, wherein the payload container (21) comprises a delay charge for delayed initiation of the effect part (9) of the payload container (21).
- 20 12. Method for modifying a separable projectile (1,20) according to one of claims 1-11 from a test embodiment to an effect embodiment by:
- i. detaching the front projectile body (2) from the rear projectile body (3),
- 25 ii. arranging a payload container (8,21) in the front projectile body (2) where the payload container (8,21) comprises measuring equipment or at least one effect part (9),
- iii. fitting the front projectile body (2) to the rear
30 projectile body (3) by way of a belt (4).

Fig. 1

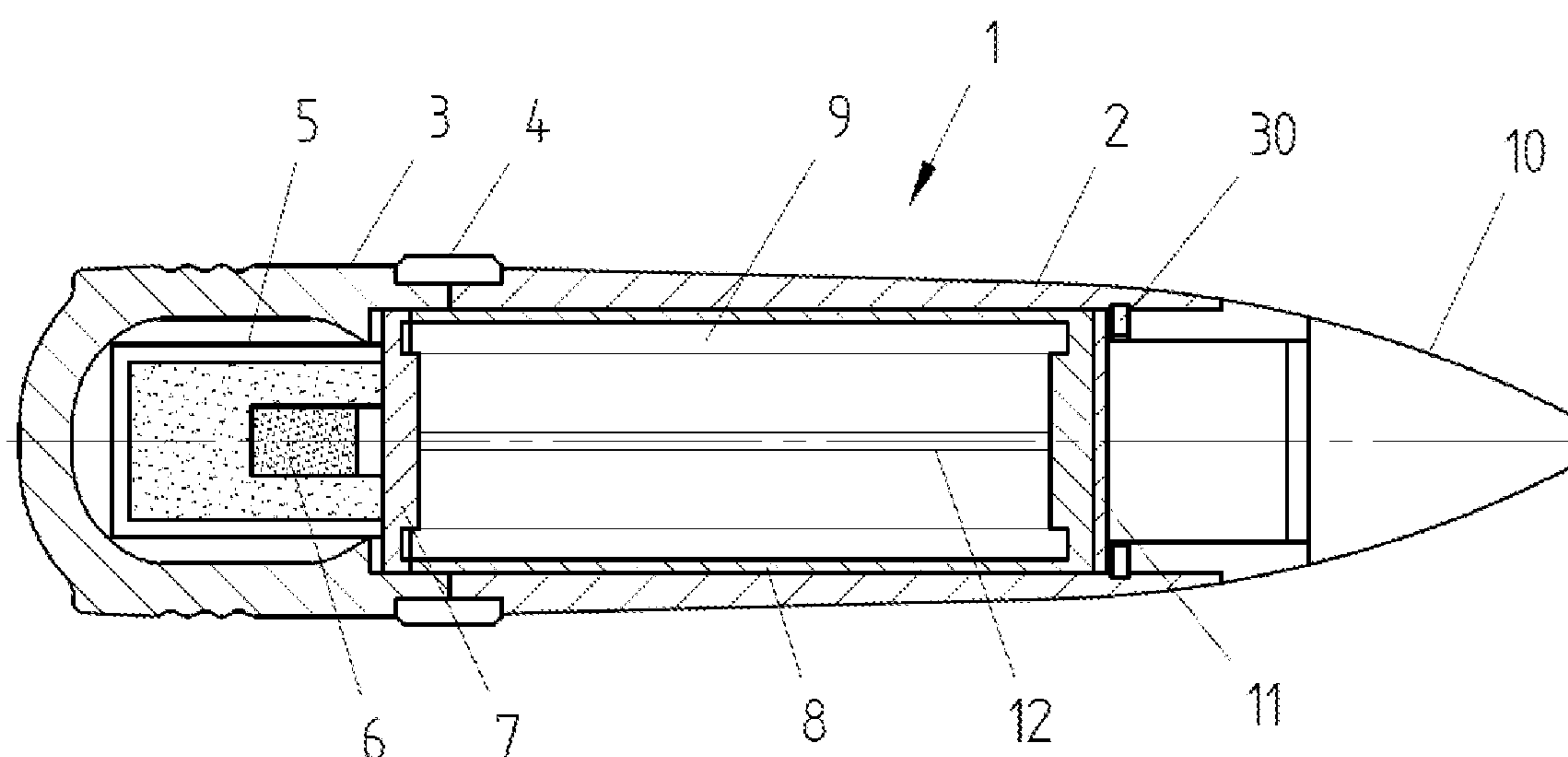


Fig. 2

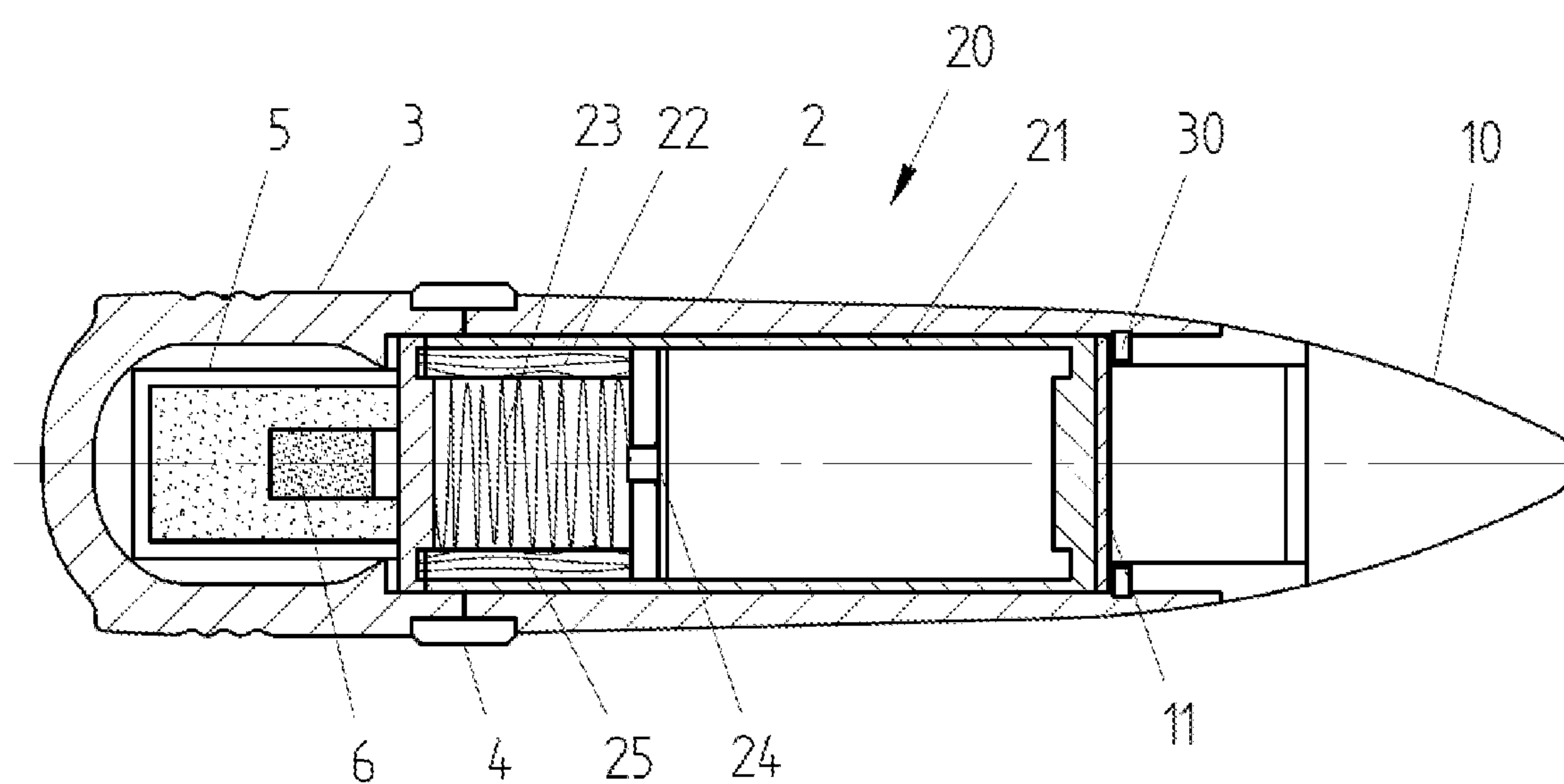


Fig. 1

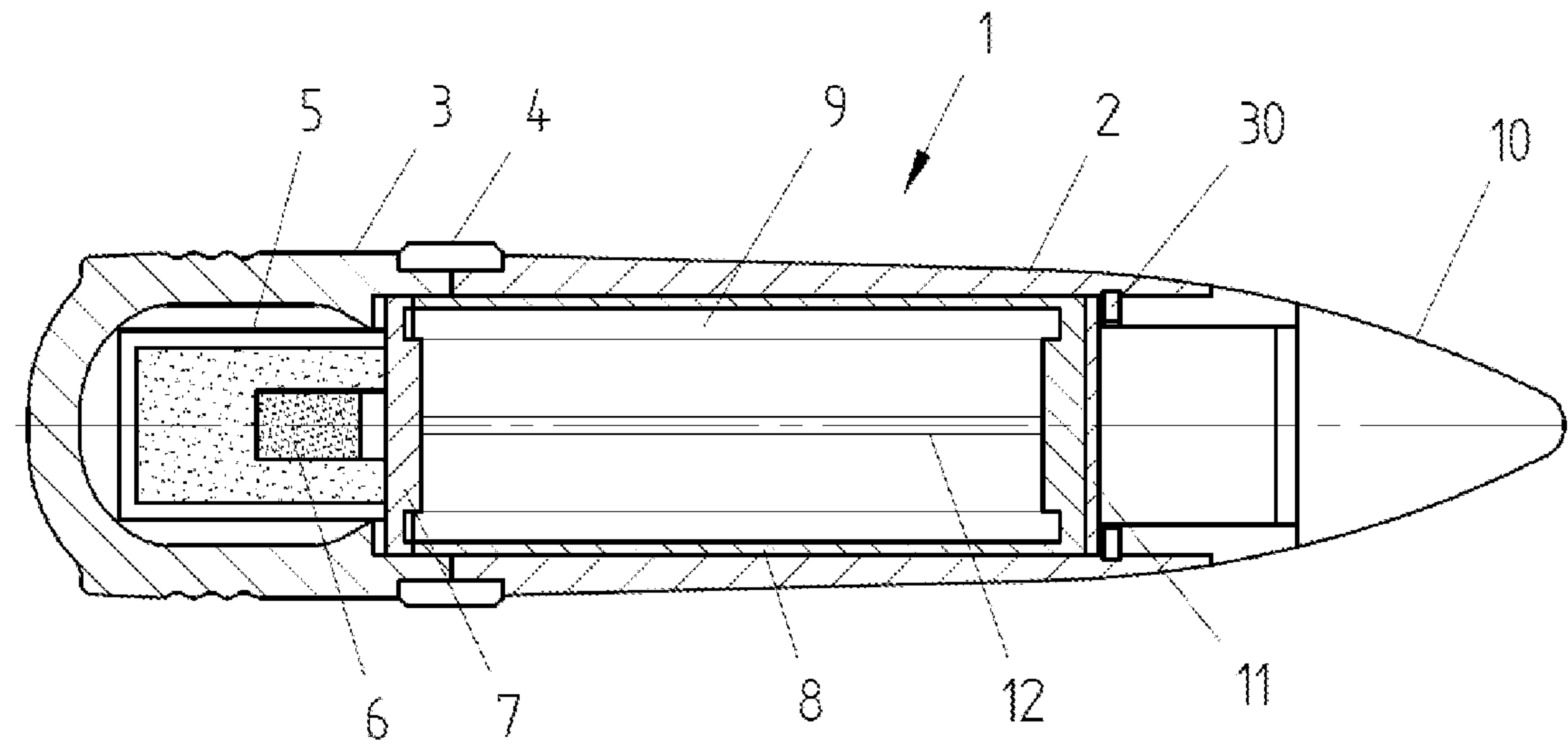


Fig. 2

