



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
18.01.2012 Bulletin 2012/03

(51) Int Cl.:
F42B 12/04 (2006.01)

(21) Application number: **11172327.6**

(22) Date of filing: **01.07.2011**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

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(30) Priority: **12.07.2010 CZ 20100542**

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(54) **Projectile with tubular penetrator**

(57) The invention relates to the projectile with tubular penetrator, which comprises a ballistic cap (1) mounted on the front opened section of the tube casing (2), which is filled with filler material, while the tube casing (2) is made of material with expressively higher density than the density of filler material (5). The tube casing (2)

from its front to its rear end features in a stepwise manner decreasing outer diameter and on its rear end it is closed with a bottom (20) and provided with a thread (21), on which the rear part (4) of projectile is screwed-on, which in direction towards the front end of the graduated tube casing (2) covers a section of length of the graduated tube casing (2).

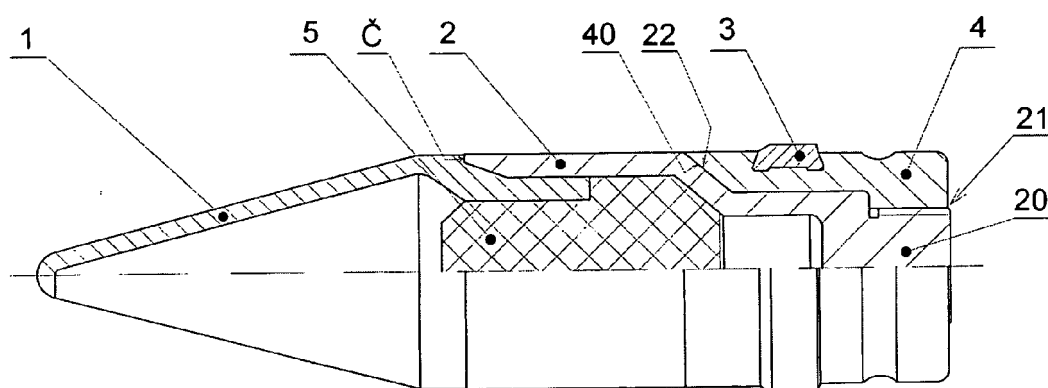


Fig. 1

Description

Technical field

[0001] The invention relates to the projectile with tubular penetrator, which comprises a ballistic cap mounted on the front opened section of the tube casing, which is filled with filler material, while the tube casing is made of material with expressively higher density than the density of filler material.

Background art

[0002] The concept of projectiles with penetrators in literature usually designated with abbreviation PELE (Penetrator with Enhanced Lateral Efficiency) represents a sort of projectiles which, though do not comprise an explosive, after impact to a target exercise a fragment effect accompanied with piercing effect.

[0003] This type of penetrators is generally known for example from DE patent No. 197 00 349 (analogy - US 6 659 013), which discloses a projectile comprising a tube casing of material with high density (e.g. of wolfram alloy, depleted uranium, high-strength steel, etc.), while in cavity of the tube casing a filler material of low density is positioned (e.g. plastic, aluminium or its alloy, etc.). Principle of the desired effect of the projectile is a sufficient difference of material density of cylindrical body and the filler material. Once such projectile hits the target, e.g. surface of a machine like automobile, armoured car, aircraft, wall (even a concrete one), etc., the tube casing penetrates with its face side into the target, e.g. into the armour and it cuts out from it approximately a circle segment of a lower thickness, than the thickness of the affected wall of the target was before impact of the projectile. The segment being cut-out from a wall of the target during this process is supported by an impact compressed filler material, through which a radial pressure having magnitude of giga-bars in order is created in the filler material. This pressure acts upon the tube casing in radial direction and opens it. After passing the wall of the target, e.g. the armour, the tube casing being opened gradually splits into splinters and upon assistance of fragments of armour, a fragment cluster widening progressively in conical manner is created.

[0004] Known are practically utilised projectiles that make use of this effect, namely the military ammunition from calibre of 20 mm to calibre of 125 mm. The disadvantage of to date known practical realisations of Penetrators with Enhanced Lateral Efficiency is, that with decreasing calibre of the projectile the fragment effect of the projectile decreases, or development of fragments decreases, which is remarkable especially at projectiles with calibre of 20 mm.

[0005] The goal of this invention is to remedy or at least minimise the disadvantages of the background art.

Principle of the invention

[0006] The goal of the invention has been achieved through a projectile with tubular penetrator, whose principle consists in that, the tube casing from its front to its rear end features a decreasing outer diameter and on its rear end it is closed with a bottom and provided with a thread, on which the rear part of the projectile is screwed-on, which in direction towards the front end of the tube casing covers a section of length of the tube casing.

[0007] Projectile according to the invention shows utilisation of a whole cross-section for an optimum piercing effect and there are created tens of pieces of effective fragments in a progressively widening cone of fragment cluster. Another advantage of the solution according to the invention is that the fragment effect is achieved totally without usage of an explosive, only through optimising the shape and structural design of individual parts of the projectile. Another advantage is that this invention may be effectively used already from the calibre of 20 mm and it may be produced from available raw materials.

[0008] The preferred embodiments of the invention are the subject matter of patent claims.

Description of the drawing

[0009] The invention is schematically represented in the drawing in longitudinal section.

Examples of embodiment

[0010] The invention will be described on example of embodiment of projectile having the calibre of 20 mm with tubular penetrator.

[0011] The projectile comprises a ballistic cap 1, which is in a suitable manner positioned on the front opened end of the tubular penetrator, whose structural embodiment will be described in further text. The ballistic cap 1 is preferably a thin-walled one and it is on the front opened end of the tubular penetrator screwed-on or pressed in.

[0012] The tubular penetrator comprises the tube casing 2 with graduated outer diameter, while the tubular casing 2 has the largest diameter on its front end. Towards its rear end, where the tube casing is enclosed with the bottom 20, the diameter of the tube casing 2 decreases gradually, e.g. by a step-shaped and/or conical transition 22. The graduated tube casing 2 is made of material with a high density, e.g. of high-strength steel or of wolfram alloy (tungsten carbide) with strength limit R_m min. 1550 MPa and density cca 17700 kg.m⁻³, etc.

[0013] The cavity in the graduated tube casing 2 by its shape or profile in the front section in principle copies the outer shape or profile of the graduated tube casing 2 and it is nearly entirely filled with the filler material 5 of a low density when compared with density of material of the graduated tube casing 2. The filler material may overlap

the face C of the graduated tube casing 2, while the moment for beginning of opening the graduated tube casing 2 is set by the size of this overlap.

[0014] On outer circumference of the bottom 20 of graduated tube casing 2 the thread 21 is performed, e.g. thread with a small pitch M10 x 0,75, on which the rear part 4 of the projectile is screwed-on, which directs to the front end of the graduated tube casing 2, and which terminates in that area of the graduated tube casing 2, in which the largest outer diameter of the graduated tube casing 2 begins to decrease. At the same time the rear part 4 of projectile by its inner shape copies the outer shape of the graduated tube casing 2. The rear part 4 of projectile is made e.g. of duralumin of a high strength limit, that means of material with a sufficient mechanical properties and with a lower price than material of the graduated tube casing 2.

[0015] On outer circumference of the rear part 4 of projectile there is arranged at least one guiding rim 3 of a suitable material, e.g. metal (copper, copper alloy, etc.), or plastic (polyamide, etc.).

[0016] In the represented example of embodiment the rear part 4 of projectile on its front end is provided with a conical mating surface 40, by which it fits against the conical transition 22 on the graduated tube casing 2, through which a necessary alignment of penetrator is secured.

[0017] Assembly of the graduated tube casing 2 and of the rear part 4 of projectile features a total slenderness expressed as a ratio of length of this assembly to calibre of the projectile being equal or approximately equal to 2,0 - 2,5 and simultaneously the slenderness of the rear part 4 of the projectile expressed as a ratio of length of the rear part 4 of projectile to outer diameter of the rear part 4 of projectile is equal or approximately equal to 1,0 - 1,5, which corresponds to the prerequisite for usage of the entire cross-section of the projectile for optimum piercing effect and creating of several tens of pieces of active fragments in a fragment cluster. The bottom 20 of graduated tube casing 2 according to the invention considerably contributes to achieving a high piercing effect to the wall of a target, e.g. an armour and positively influences also creating of fragment cluster, while the rear part 4 of projectile participates in a sufficient number of active fragments as well as in formation of progressively widening cone of fragment cluster after the penetrator passes the wall of a target.

Industrial applicability

[0018] The invention may be utilised as a piercing projectile with combined piercing and enhanced fragment effect without presence of explosive, which may be produced of available raw materials.

List of referential markings

[0019]

- | | | |
|----|----|---|
| 5 | 1 | ballistic cap |
| | 2 | graduated tube casing |
| | 20 | bottom of graduated tube casing |
| 10 | 21 | thread |
| | 22 | conical transition of graduated tube casing |
| 15 | 3 | guiding rim |
| | 4 | rear part of projectile |
| | 40 | conical mating surface of rear part of projectile |
| 20 | 5 | filler material |
| | C | face edge of graduated tube casing |

Claims

- | | | |
|----|----|---|
| 25 | 1. | Projectile with tubular penetrator, which comprises a ballistic cap mounted on the front opened section of the tube casing, which is filled with filler material, while the tube casing is made of material with expressively higher density than the density of filler material, characterised in that , the tube casing (2) from its front to its rear end features in a stepwise manner decreasing outer diameter and on its rear end it is closed with a bottom (20) and provided with a thread (21), on which the rear part (4) of projectile is screwed-on, which in direction towards the front end of the graduated tube casing (2) covers a section of length of the graduated tube casing (2). |
| 30 | | |
| 35 | 2. | Projectile according to the claim 1, characterised in that , the assembly of the graduated tube casing (2) and of the rear part (4) of projectile features a total slenderness expressed as a ratio of length of this assembly to calibre of the projectile being equal or approximately equal to 2,0 - 2,5 and simultaneously the slenderness of the rear part (4) of the projectile expressed as a ratio of length of the rear part (4) of projectile to outer diameter of the rear part (4) of projectile is equal or approximately equal to 1,0 - 1,5. |
| 40 | | |
| 45 | | |
| 50 | 3. | Projectile according to the claim 1 or 2, characterised in that , the outer diameter of the graduated tube casing (2) in direction from the front end of the graduated tube casing (2) at first decreases by a conical transition (22), which fits against the conical |
| 55 | | |

mating surface (40) on the front end of the rear part (4) of projectile.

4. Projectile according to any of the claims 1 to 3, **characterised in that**, the rear part (4) of projectile on its outer circumference is provided with at least one guiding rim (3).

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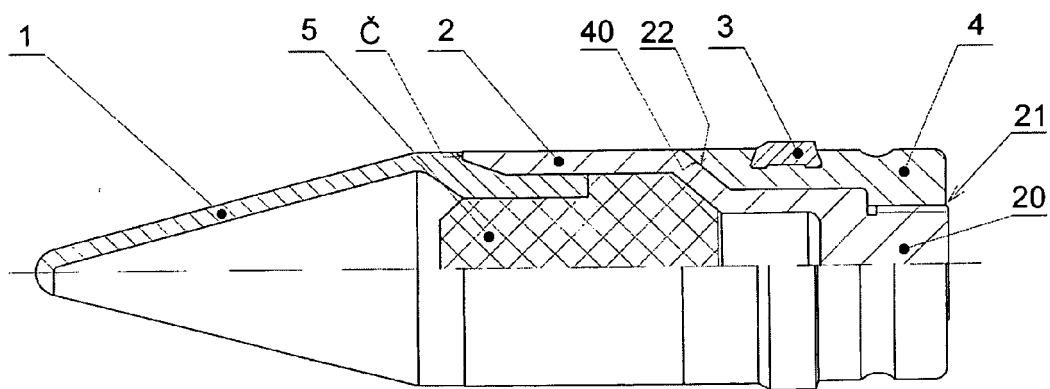


Fig. 1

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- DE 19700349 [0003]
- US 6659013 B [0003]