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PROJECTILE HAVING A PYROTECHNIC CHARGE

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Description

[0001] The invention relates to a pyrotechnic active charge or active substance in a projectile, in particular in the medium caliber range, as described, 5 for example, in DE3240310 A.

[0002] Known types of ammunition often no longer have a penetrating effect against modern armor systems. Moreover, newer types of ammunition, such as the PELE[®] ammunition, are intended to achieve a large splinter effect after penetrating the target object. 10

[0003] EP 1 316 774 B1, EP 1 000 311 B1 describe the so-called PELE effect which is applied in so-called PELE-T or PELE-T pen projectiles. Furthermore, HE ammunition is known which achieves splinter acceleration via 15 detonative reaction of secondary explosives.

[0004] The lateral acceleration produced by the PELE effect is essentially determined by the target speed. The higher the firing distance, the weaker the effect. As a result, the cone of splinters becomes smaller. In practice, this 20 constitutes weakened effectiveness of the projectile in the target.

[0005] The splinter acceleration when using HE (high-explosive) projectiles or ammunition, such as explosive shells, is known to be very good. However, explosives are used which increase the safety risk of such a projectile 25 throughout its life cycle. In addition, separate detonator components are needed.

[0006] Multi-purpose (MP) ammunition exhibits the same problem as the HE ammunition, even if no classical detonation chains are employed here. However, the problem of undefined states arises, such as duds or reactions in the 30 weapon in the event of feed problems.

[0007] Both HE and MP projectiles generally contain secondary explosives initiated by a pyrotechnic composition (MP) or a separate detonator (HE).

5 **[0008]** EP 0 531 697 B1 discloses a multi-purpose projectile which has a casing, a penetrator and at least one incendiary charge. Therein, the incendiary charge is pressed in across its entire cross-section.

[0009] DE 10 2005 039 901 B4 discloses a projectile with an external and/or
10 central penetrator. The external penetrator as well as the central penetrator may be formed by sub-projectiles. While this type of projectile is practical, also here, the effectiveness or the performance in the target is dependent on the impact velocity.

15 **[0010]** In this respect, the object of the invention is to present a projectile which overcomes the aforementioned disadvantages.

[0011] The object is achieved by the features of independent claims 1 and
20 12. Advantageous embodiments are contained in the dependent claims.

[0012] The invention is based on the idea of presenting a projectile which,
without requiring explosives and detonators, achieves a significant increase
in the lateral splinter effect compared to a PELE projectile. The aim is to
combine a pyrotechnic active charge in combination with the proven PELE
25 effect in a medium-caliber projectile in particular.

[0013] Explosive-free projectiles are known from DE 10 2012 023 700 A1
and DE 10 2013 002 119 A1. The explosion-free projectile according to
DE 10 2012 023 700 A1 releases a fuel or a fuel mixture as a flammable air-
30 fuel mixture upon disintegration in the target. This mixture is spontaneously
reacted by at least one explosive-free, spark-producing detonation mechanism
triggered upon impact disintegration. These explosive-free projectiles
serve to create an optical and thermal target signature.

[0014] In the implementation of this idea, a non-detonable pyrotechnic composition is incorporated as an active substance. A metal powder/oxidizing agent is preferably provided as the pyrotechnic composition. Upon impact in the target, the shock wave acts to form splinters and simultaneously initiates the active substance, so that the expanding gases of the pyrotechnics additionally accelerate the casing splinters of the projectile body surrounding them laterally and independently of the firing distance and hence of the impact velocity. This utilizes the redox reaction in which a sudden exothermic redox reaction occurs as a result of the chemical reaction of the pyrotechnic composition, in which gas is released, expands extensively due to temperature and thus effects the explosive force.

[0015] A certain secondary blast effect can be achieved by using the redox system or redox systems. The pyrotechnic active substance may also produce a flash and bang effect at the target or improve perception acoustically. Apart from marking the point of impact, the enemy may be held down in this manner.

[0016] The multi-purpose projectile thus created achieves the object of armor penetration performance, i.e., the projectile can penetrate an armor, form splinters and also form pyrotechnic effects, such as fire, blast, flash and/or bang effects, in the target.

[0017] The advantage of this solution is that both secondary explosives and a detonator or detonator chains can be omitted. Since the pyrotechnic active substance is initiated even at low impact velocities, the problem of duds is small. Instead, classic duds will not occur in any case due to the use of a pyrotechnic active substance.

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[0018] In a first embodiment, the pyrotechnic active substance is introduced into a projectile body of the projectile. It may be fixed in position by a disk, an

epoxy resin or the like. Alternatively, the pyrotechnic active substance may be introduced into a projectile tip of the projectile.

5 **[0019]** A second embodiment arises when a core is introduced into the projectile. The latter can then fix the pyrotechnic active substance in position. The material of the core may have a lower density than the projectile body, which is not a condition, however. Preferably, a metal or plastic material can be used.

10 **[0020]** In a third, preferred embodiment, the pyrotechnic active substance can be located between a projectile body and a penetrator. The active substance may be enclosed and sealed by a core, which preferably also consists of a metal or a plastic material.

15 **[0021]** In a further development of this idea, the pyrotechnic active substance is fitted annularly around the penetrator. The projectile body enveloping the pyrotechnic active substance forms the desired splinters after initiation of the active substance.

20 **[0022]** Thus, a projectile with a new active substance or active charge in a projectile body, preferably in the medium caliber range, is proposed. Upon impact of the projectile, a shock wave is produced which leads to the formation of splinters or fragments of at least the projectile body. At the same time, the pyrotechnic active substance is initiated by the introduced shock
25 wave, so that the pyrotechnic active substance is reacted and the expanding gases of the pyrotechnic active substance additionally accelerate the casing fragments of the projectile body surrounding them. As such, the active substance is reacted non-detonatively, so that it belongs to a different class of substances than conventional explosives. Therefore, disposal of the ammunition
30 tion is less expensive. In addition, the handling safety of such ammunition is increased. The lateral effect is increased compared to pure PELE projectiles. Moreover, a secondary composition is omitted. The lateral effect of the PELE

ammunition is increased and leads to a less pronounced drop with long firing distances.

[0023] The invention will be explained in more detail with reference to an exemplary embodiment accompanied by drawings. In the drawings:

Fig. 1 shows a version of a projectile which is not part of the invention.

Fig. 2 shows a version of the projectile according to the invention.

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Fig. 3 shows a further version of the projectile.

[0024] In one embodiment shown in Fig. 1, a projectile 1 comprises a projectile body 2 which has a projectile tip 3, also referred to as an ogive or cap, on the front side and a projectile tail 4 on the rear side. A pyrotechnic active substance 5 is introduced into projectile body 2. The former may be fixed in position by a disk, an epoxy resin 16 or the like. Alternatively, pyrotechnic active substance 5 may be incorporated up into the projectile tip 3.

[0025] A projectile according to the invention is shown in Fig. 2. Pyrotechnic active substance 5 is incorporated between a core 6 and a projectile body 7 of a projectile 8. Core 6 preferably consists of a metal or a plastic material.

[0026] Fig. 3 shows a projectile 9 according to the invention having a projectile body 10 and a penetrator 11. Here, too, projectile body 10 has a projectile tip 3 on the front side and a projectile tail 4 on the rear side. Penetrator 11 itself may be breakable. Pyrotechnic active substance 5 is incorporated between projectile body 10 and penetrator 11. In the preferred embodiment, pyrotechnic active substance 5 is preferably fitted annularly around penetrator 11. As such, active substance 5 may completely, or at least partially, cover penetrator 11. Active substance 5 is enclosed by a core 14 and sealed thereby. As such, core 14 is mounted at least partially on penetrator 11. Preferably, core 14 has a bore 15 into which penetrator 11 may project. This

bore 15 is preferably matched to the outer geometry of penetrator 11. Preferably, core 14 itself consists of a metal or a plastic material. By means of core 14, penetrator 11 can be fixed in position in the projectile 9 or in the projectile body 10. Alternatives to the mounting for fixing penetrator 11 are also possible.

[0027] Projectile body 2, 7, 10 and projectile tip 4 may be connected to one another via a screw connection. Alternative connections, such as a snap connection, are also possible.

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[0028] The operating principle is as follows: The known PELE effect is triggered by the impact of projectile 1, 8, 9 in the target, e.g., a metal plate. At the same time, a shock wave is introduced into projectile body 2, 7, 10 and, if present, also into core 6 (Fig. 2) or into core 14 and penetrator 14 (Fig. 3).

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[0029] On the one hand, the shock wave acts on the casing of projectile body 2, 7, 10 to form splinters (not shown in detail). Furthermore, this shock wave simultaneously initiates pyrotechnic composition 5 or pyrotechnic active substance 5 through adiabatic compression. As a result, the reaction temperature or reaction threshold of the redox system, i.e., of active substance 5 (pyrotechnics), is exceeded. Active substance 5 reacts immediately. The gases of pyrotechnic active substance 5, which are now expanding, themselves additionally laterally accelerate the casing fragments of projectile body 2, 7, 10 which surround active substance 5 and are formed by the shock wave upon impact.

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[0030] Active substance 5 may also be multiple pyrotechnic compositions which produce a fire effect, a flash and/or a bang effect at the target.

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[0031] It is advantageous that the splitter cone (opening angle of the cone) of the casing fragments of projectile body 2, 7, 10 forming is constant since it is independent of firing distance (the impact velocity).

[0032] Projectile body 2, 7, 10 can additionally be provided with predetermined breaking points (not shown in detail) on its circumference. These can then support the splinter formation of projectile 1, 8, 9. The size of the casing fragments of projectile body 2, 7, 10 can also be better defined by the predetermined breaking points.

Patenttivaatimukset

1. Ammus (8, 9), jossa on vähintään yksi ammuksen runko (7, 10), jossa on ammuksen kärki (3) ja ammuksen perä (4), ja aktiivimassa (5), jolloin aktiivimassa (5) on vähintään yksi ei-räjähtävä pyrotekninen yhdiste ja ammus (8, 9) on konfiguroitu siten, että siinä ei ole räjähdettä ja sytytintä, joka on **tunnettu** ammuksen rungossa olevasta ytimestä (6, 14), joka sulkee sisäänsä ja tiivistää ei-räjähtävän pyrotekninen aktiivimassan (5).
- 10 2. Patenttivaatimuksen 1 mukainen ammus (8, 9), **tunnettu** siitä, että ydin (6, 14) on materiaalia, jonka tiheys on pienempi kuin ammuksen rungon (7, 10).
- 15 3. Patenttivaatimuksen 1 tai 2 mukainen ammus (8, 9), **tunnettu** siitä, että ytimen (6, 14) materiaali on metalli- tai muovimateriaalia.
4. Jonkin patenttivaatimuksen 1–3 mukainen ammus (9), **tunnettu** siitä, että ydin (14) on asennettu ainakin osittain läpäisijään (11).
- 20 5. Patenttivaatimuksen 4 mukainen ammus (9), **tunnettu** siitä, että ytimestä (14) on reikä (15), johon läpäisijä (11) työntyy.
- 25 6. Patenttivaatimuksen 5 mukainen ammus (9), **tunnettu** siitä, että reikä (15) on sovitettu läpäisijän (11) ulkogeometriaan.
7. Jonkin patenttivaatimuksen 4–6 mukainen ammus (9), **tunnettu** siitä, että ei-räjähtävä pyrotekninen aktiivimassa (5) on viety ammuksen rungon (10) ja läpäisijän (11) väliin.

8. Jonkin patenttivaatimuksen 4–7 mukainen ammus (9), **tunnettu** siitä, että ei-räjähävä pyrotekninen aktiivimassa (5) on sovitettu osittain tai kokonaan läpäisijän (11) ympärille.
- 5 9. Jonkin patenttivaatimuksen 4–8 mukainen ammus (9), **tunnettu** siitä, että ei-räjähävä pyrotekninen aktiivimassa (5) on järjestetty renkaan muotoisesti läpäisijän (11) ympärille.
- 10 10. Jonkin patenttivaatimuksen 1–9 mukainen ammus (8, 9), **tunnettu** siitä, että ei-räjähävä pyrotekninen aktiivimassa (5) on tulen, sumun, välähdyksen ja/tai räjähdysten aikaansaava aine.
- 15 11. Jonkin patenttivaatimuksen 1–10 mukainen ammus (8, 9), **tunnettu** siitä, että ammuksen rungossa (7, 10) on kehällä ennalta määritellyt murtumiskohdat.
12. Menetelmä kohteen saavuttamiseksi käyttämällä jonkin patenttivaatimuksen 1–11 mukaista ammusta (8, 9), jossa ammuksen rungossa (7, 10) on kotelo, **tunnettu** seuraavista vaiheista, joissa:
- 20 • tuotetaan iskuaalto ammuksen (8, 9) törmätessä kohteeseen, jolloin
- iskuaalto, joka vaikuttaa ammuksen rungon (7, 10) koteloon, muodostaa siihen sirpaleita ja fragmentteja,
- ei-räjähävä aktiivimassa (5) on samanaikaisesti adiabaattisen puristuksen aiheuttaman iskuaallon initioima, ja
- 25 • laajenevat kaasut lisäksi kiihdyttävät ammuksen rungon (7, 10) vaippafragmentteja, jotka ympäröivät pyroteknistä aktiivimassa (5) ja jotka muodostuvat iskuaallon vaikutuksesta törmäyksen aikana.

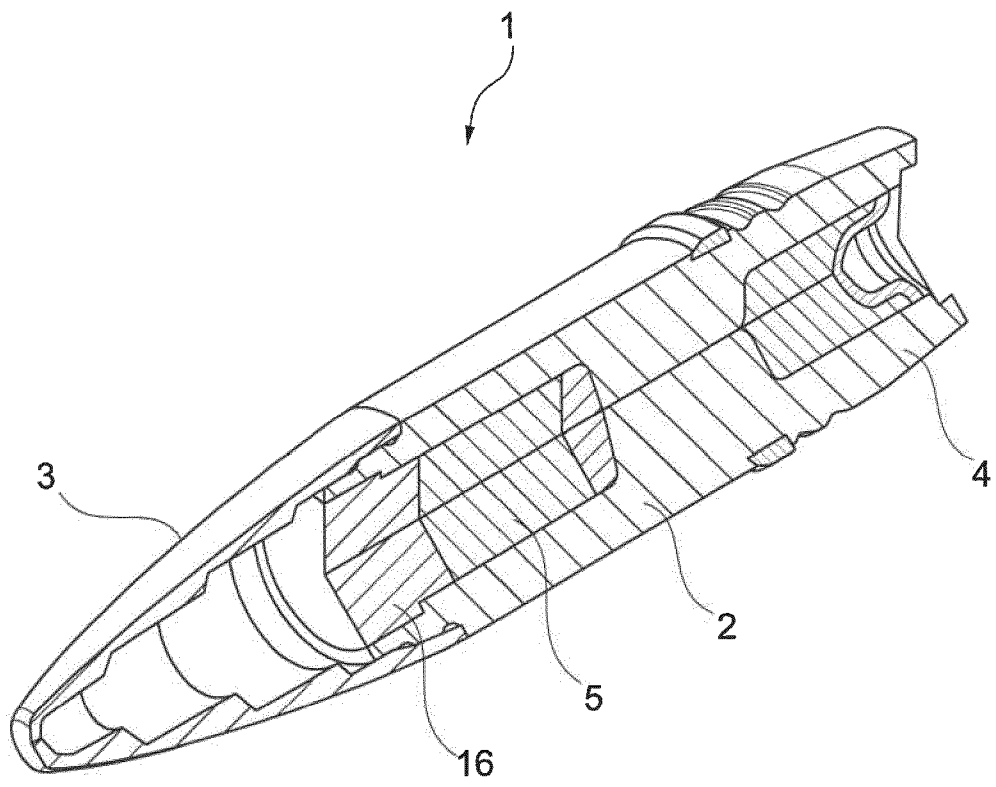


Fig. 1

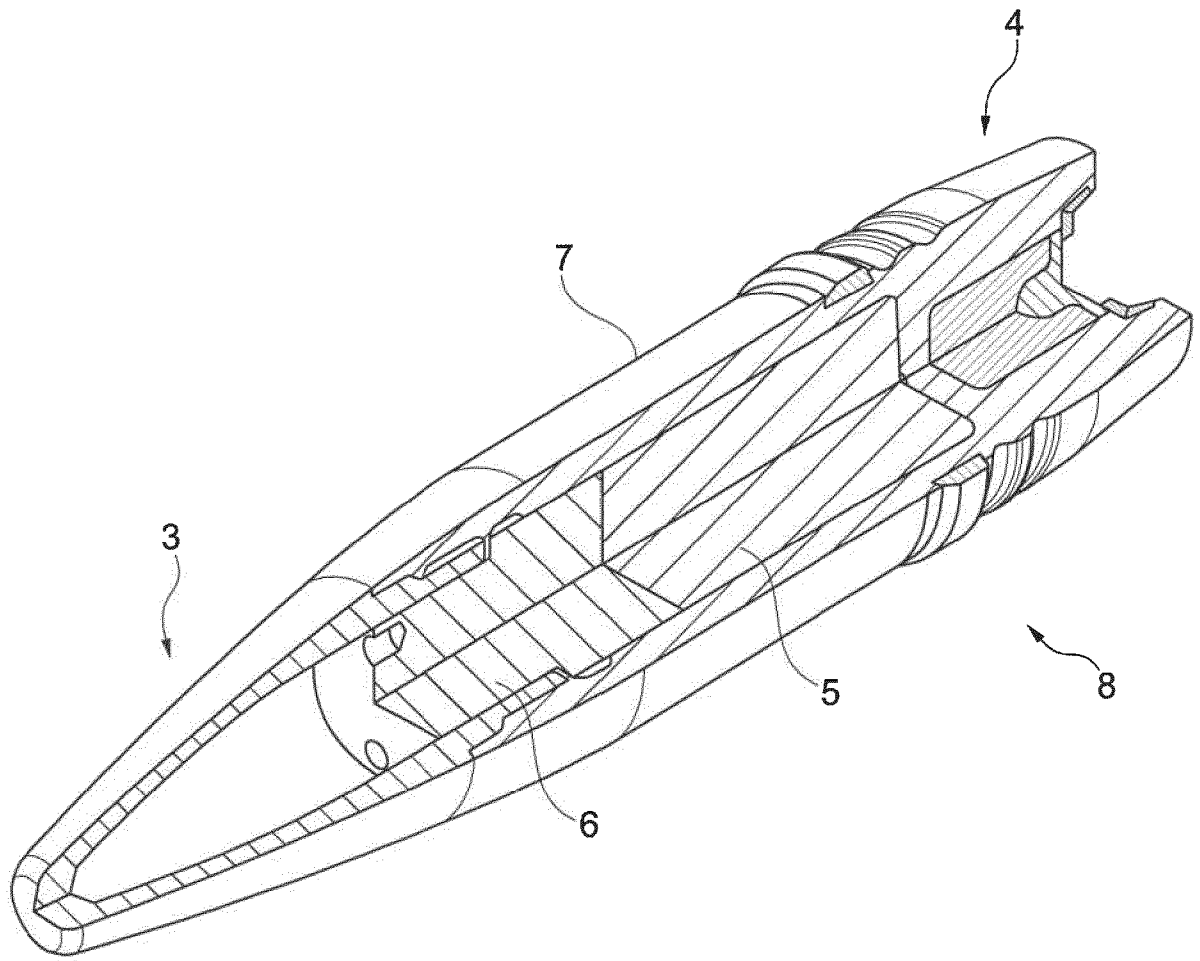


Fig. 2

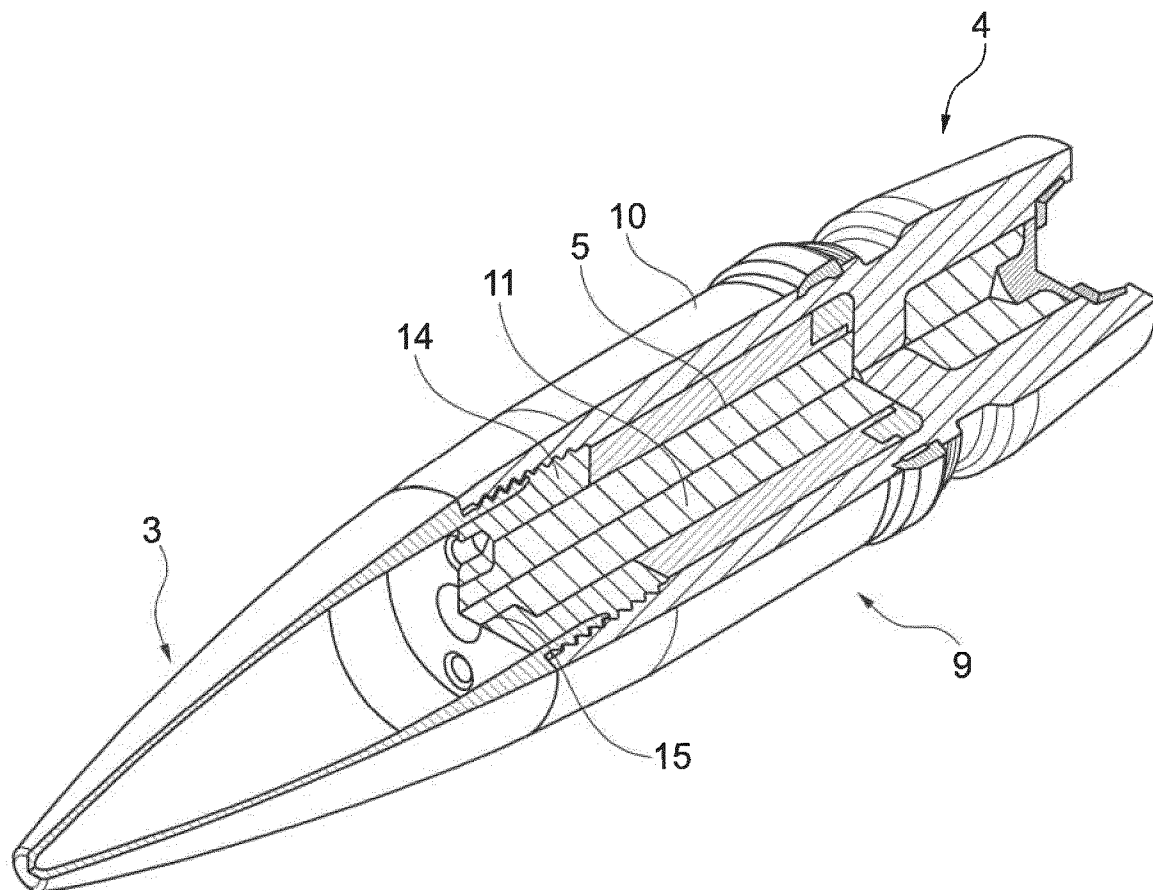


Fig. 3