

DESCRIPTION

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Sabot with bionic structures

10 The invention is concerned with the production of a
sabot of a sub-caliber kinetic-energy projectile in the
small-caliber, medium-caliber and large caliber ranges.
The invention considers ideas about obtaining a bionic
sabot of reduced weight by for example providing
15 globular cavities in the sabot.

To achieve high penetrating powers, so-called KE
(kinetic-energy) munitions are used. The munitions
generally consist of a metallic penetrator (kinetic-
20 energy projectile), preferably of heavy metal of a high
strength and toughness. The penetrators are of a form
similar to a nail or arrow. They are smaller in caliber
(sub- caliber) than the barrel of the weapon from which
they are fired. To be able to be fired from the barrel
25 of a weapon, a sabot is required, enclosing the
penetrator and maintaining the caliber with respect to
the barrel. The sabot assumes the task of sealing the
barrel of the weapon from powder gases during firing.
By means of the gas pressure that is created by the
30 burning off of the powder, a force is applied over
projected surface areas of the sabot, with the joint
effect of accelerating the sabot.

The task of the sabot is to carry the penetrator along
35 as it passes through the barrel, to apply the
acceleration, to provide a seal with respect to the
barrel of the weapon, to guide the penetrator and to

release the penetrator without any disturbance after it leaves the muzzle of the barrel.

Depending on the caliber, the sabots are produced from plastic, metals or a combination of the two. The heavier the sabot is, the lower the acceleration, and consequently the lower the achievable muzzle velocity. Therefore, the lighter the sabot, the higher the muzzle velocity becomes, and the higher the achievable range of engagement. With the same range of engagement, a higher depth of penetration/penetrating power of the penetrator can be achieved.

In practice, for battle tank ammunition, high-strength aluminum or packed plastic is used as the material for the sabots. Further weight savings are made by introducing bores, slits, etc.

DE 196 25 273 A1 discloses a sub-caliber kinetic-energy projectile, the sabot of which consists of a fiber-reinforced material. The bottom of the sabot is provided with openings. The fiber-reinforced material is a carbon-fiber-reinforced plastic or a carbon-fiber-reinforced carbon. Other reinforcing fibers for plastics may be aramid fibers or polyethylene fibers. Reinforcing fibers for metals, such as aluminum, magnesium or titanium, include Al_2O_3 fibers or SiC fibers.

A sabot for a sub-caliber sabot projectile is disclosed by DE 29 24 041 C2. The material of the sabot is a ceramic or glass, with a prestress. Prestressed glass or other ceramic materials with corresponding behavior have a very high mechanical strength. The disintegration of the sabot is initiated by a mass, which is propelled against the inner wall of the sabot. The mass itself is held in a cavity.

A sub-caliber kinetic energy projectile with a projectile guide that can be broken up is described by DE 30 34 471 A1. To achieve a low dead weight while retaining the compressive and tensile strength, the projectile guide is produced as a pressed part from hollow glass beads with polymer binding material or glass binding material. Alternatively, foam glass or syntactic foams are mentioned.

A sabot according to DE 10 2009 049 440 A1 is distinguished by being completely or at least partially made up of a material foam. The material foam may be a metal foam such as aluminum foam, zinc foam, Foaminal, etc., wherein the material foam can be used as a sandwich component having layers of the same or a different material, a reinforced fiber material and/or a core of a different material.

In the case of plastics/fiber composites, aging, chemical compatibility with the powders, susceptibility to UV radiation, etc. combined with high costs of production may be mentioned as disadvantages. The required insensitivity during handling of the munition (dropping, vibration while being transported in the ammunition containers) is problematic.

The object of the invention is that the obtainment of parts of a sabot of reduced weight with respect to systems introduced and of sufficient environmental resistance that can be produced at low cost, while retaining a maximum muzzle velocity, can be ensured.

The object is achieved by the features of patent claim 1.

The invention is based on the idea of producing the sabot or the parts of the sabot with reduced weight by means of bionic structures, the structures ensuring

sufficient stability, etc. of the sabot or the parts of the sabot. In this case, these structures are only created during the production process. In other words, the bionic structures (for example honeycombs, struts, voids, spherical cavities and combinations thereof) are created by the production process in that they are left out during production.

Such processes may be for example the 3D printing process, for example from plastics, or laser sintering processes. By means of plastic laser sintering, the sabot or the sabot parts or segments are produced with bionic structures of plastic. Metal laser sintering makes it possible to produce the sabot or sabot parts or segments with the bionic structures from a metal, such as for example aluminum. The range here is from lightweight metal through to superalloys. Likewise not excluded from these considerations is production by means of 3D cocooners, even though this process appears to be more elaborate. It involves creating the bionic structures from a handling spinneret. At present, for this, glass fibers are adhesively bonded and simultaneously laminated with UV-curing resin to form complex structures.

The bionic structures give the sabot or the sabot segments the necessary strength and stiffness for passing through the barrel along with a maximum weight reduction.

The advantage of such processes lies in the definable configurations of the cavities, etc. The size and shape (volume) of the cavities can be influenced directly (programming in 3D). A direct influence is also possible on the number or amount and distribution within the sabot or the sabot segments (sabot parts).

Proposed is a sabot in which bionic structures are provided, generated or created by a 3D production process in a defined manner in terms of size, shape and/or volume and in a specifically directed manner within the sabot during the production of the sabot. Specifically directed in this case are the local embedding within the sabot and the number of bionic structures, i.e. the local and quantitative embedding within the sabot.

The invention is to be explained in more detail with the drawing on the basis of an exemplary embodiment. The single figure diagrammatically shows a munition 1 with a sabot 2 and a penetrator 3. The sabot 2 encloses the penetrator 2 and can be connected to the penetrator 2 at least in the form-fitting region 4. The form-fitting region 4 may comprise a thread (not represented any more specifically). The sabot 2 may consist of a number of segments 2.1, 2.2, which are held together by way of a sealing and/or guiding band (not represented any more specifically).

To reduce weight, the segmented sabots 2.1, 2.2 have bionic structures 5. Shapes such as honeycombs, struts, voids, cavities and combinations thereof are defined as bionic structures 5. The cavities 6 may in this case be spherical, angular, etc.

The sabot 2 or the sabot segments 2.1, 2.2 may be produced by 3D printing or the SLS process (laser sintering). The geometrical data of the sabot segments 2.1, 2.2 are in a three-dimensional form for this and are stored as layer data.

In the case of metal laser sintering, furthermore, a casting pattern (not represented any more specifically) is produced from the geometrical molds. Then the available CAD data of the sabot segments 2.1, 2.2 (for

example STL format) are used to build up the sabot segments 2.1, 2.2 layer by layer in a layered buildup. Regions are left out in the layers, so that the bionic structures 5, for example globular cavities 6, can be introduced/integrated into the sabot segments 2.1, 2.2 in a defined manner in terms of shape, size and volume.

In the case of 3D printing, a layered buildup of the sabot segments 2.1, 2.2 takes place in layers without a casting mold. For this purpose, the sabot segments 2.1, 2.2 with their bionic structures 5, 6 are available in three-dimensional data and are built up layer by layer.

Patent claims

1. A process of manufacturing a sabot (2) for a sub-caliber projectile (3), wherein bionic structures (5, 6) are provided in the sabot (2) defined by a 3D manufacturing process and purposefully are created in the manufacturing of the sabot (2), such that the bionic structures are left out in the production.
2. The manufacturing process according to claim 1, **characterized in that** the size, shape and/or volume of the bionic structures (5, 6) are predeterminable.
3. The manufacturing process according to claim 1 or 2, **characterized in that** the number of bionic structures (5, 6) is predeterminable.
4. The manufacturing process according to one of claims 1 to 3, **characterized in that** the 3D manufacturing process is a 3D printing process.
5. The manufacturing process according to one of claims 1 to 3, **characterized in that** the 3D manufacturing process is an SLS.
6. The manufacturing process according to one of claims 1 to 3, **characterized in that** the production takes place by means of 3D cocooner, wherein the bionic structures are created from a handling spinneret.
7. The manufacturing process according to one of claims 1 to 6, **characterized in that** geometric data of the sabot (2) and the sabot segments (2.1, 2.2) are in a three dimensional-form for this and are stored in as layer data.

8. The manufacturing process according to one of claims 1 to 7, **characterized in that** the bionical structures (5, 6) are honeycombs, struts, voids, spherical cavities and combinations thereof.
9. The sabot (2), manufactured according to one of claims 1 to 7.
10. The sabot (2) according to claim 9, **characterized in that** the material of the sabot (2) is a lightweight metal, a metal and/or plastic.
11. The sabot (2) according to one of claims 9 or 10, **characterized in that** the sabot (2) consists of a plurality of segments (2.1, 2.2).
12. The sabot (2) according to claim 11, **characterized in that** the sabot (2) consists of at least two sabot segments (2.1, 2.2).
13. Ammunition (1) with a sabot (2) according to any one of claims 9 to 12 and a sub-caliber projectile (3).