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The technical scope of the present invention is that of practice munitions and projectiles and in particular those of projectiles which disintegrate upon exiting from the barrel of a weapon.

Among practice munitions a distinction is generally made between those which are designed to reproduce the actual ballistics of a live projectile, but over a short distance, and those which are designed only to reproduce the environment specific to firing (noise, recoil, smoke, etc.).

The first type of practice munitions may be illustrated by patent FR-A-2 509 457, and patent DE-A-734 429, which both disclose a projectile comprising a body formed by assembling several segments. This projectile is designed to reproduce the actual ballistics of a live projectile over a certain distance. It thus has means which hold the different segments together over part of the trajectory. This requires the installation of a firing safety zone and may only be used to reproduce the firing environment.

With regard to those munitions designed to reproduce the firing environment, so-called "blank" munitions are known which do not comprise a projectile. The disadvantage of these munitions is that they require the addition of auxiliary devices to the weapon to enable rearming in particular.

Munitions called "break up munitions" are also known, which fire a projectile comprising a steel or tungsten powder charge placed inside a brittle envelope. This projectile explodes upon exiting the barrel under the influence of the centrifugal inertial forces. Patents US-A-3 338 167 and CH-A-445 341 disclose such munitions, which have the advantage of being able to be fired without modification of the weapon.

However, a "break up" munition has certain disadvantages. The first of which is its cost, since it requires a metallic powder charge having specific mechanical properties to be produced.

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This charge must in particular be sufficiently dense and compact to ensure the mechanical strength of the projectile, but it must nevertheless disperse easily upon exiting from the barrel of the weapon.

The storage stability of such a charge is somewhat aleatory and therefore the metallic powders sometimes oxidize, thereby prejudicing the behaviour of the projectile in the barrel and upon exit from the latter.

Moreover, these projectiles are frequently found to explode within the barrel of the weapon, thus causing the barrel to deteriorate quickly.

Lastly, the dense powder, which is dispersed in the vicinity of the muzzle of the weapon, is likely to damage the sights, or even injure the crew.

The aim of the invention is to propose a practice projectile which disintegrates upon exiting the barrel of the weapon but which does not have the disadvantages of the "break up" projectiles according to the state of the technique.

The projectile according to the invention is thus inexpensive and does not deteriorate the barrel of the weapon. It also has excellent storage stability even in the harshest weather conditions.

A further aim of the invention is to propose a particularly advantageous production process for such a practice projectile.

The subject of the invention is thus a practice projectile which is charaterised in that it comprises a body formed by assembling several segments, and a base having a housing designed to accommodate these segments, said segments being made of a material of the plastic type, and means to hold the segments together during the handling phases, means designed so as to free the segments upon exit from the barrel of a weapon when a projectile is fired.

The segments are preferably made of a material of thermo-plastic type.

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According to various embodiments, the holding means may comprise a nose cap which fits around the front part of the projectile.

The nose cap may carry a flange which penetrates in a ring-shaped groove arranged on the segments, thereby fastening the nose cap to the segments.

According to various embodiments, the holding means may comprise :

- a sleeve which fits around a front part of the projectile, a sleeve made of a heat-shrinkable material,
- at least one spot weld between two contiguous segments,
- at least one protrusion, integral with one segment and working in conjunction with a groove arranged on a contiguous segment to the former, a groove having a shape which matches the protrusion,
- a central section formed of a single piece with at least two segments evenly distributed at an angle and forming a first group of segments.

In this last case, the first group of segments demarcates housings in which the other segments are placed, and the latter, which form a second group of segments, are made integral with the former by a nose cap.

The second group of segments may be formed of a single piece with the nose cap.

According to one particular embodiment, the segments are welded, two by two, along their outer contact edges.

A further subject of the invention is a production process for a projectile, a process which comprises the following steps :

- grouping the segments so as to form the body of the projectile,
- positioning at least one front section of the projectile body is a tool designed to heat its outer surface to a temperature which is high enough to locally melt the constituent material of the segments in order to weld them together along their outer contact edges,
- cooling the projectile body,

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- assembling the projectile body and base.

According to an advantageous embodiment, the different segments are made in one casting operation, all being connected to make a star shape by their tips.

The invention will be better understood after reading the following description of different embodiments, a description made with reference to the appended drawings wherein :

- figures 1a and 1b show a projectile according to a first embodiment of the invention, figure 1a being an axial longitudinal section and figure 1b a cross section along plane AA in figure 1a,
- figures 2a and 2b show a projectile according to a second embodiment of the invention, figure 2b being a cross section along plane BB in figure 2a,
- figures 3a and 3b show a projectile according to a third embodiment of the invention, figure 3b being a cross section along plane CC in figure 3a,
- figures 4a and 4b show a projectile according to a fourth embodiment of the invention, figure 4b being a cross section along plane DD in figure 4a and figure 4a being a section along plane EE in figure 4b,
- figures 5a and 5b show a projectile according to a fifth embodiment of the invention, figure 5b being a cross section along plane FF in figure 5a and figure 5a being a section along plane GG in figure 5b,
- figures 6a and 6b show a projectile according to a sixth embodiment of the invention, figure 6b being a cross section along plane HH in figure 6a and figure 6a being a section along plane II in figure 6b,
- figures 7a and 7b show a projectile according to a seventh embodiment of the invention, figure 7b being a cross section along plane JJ in figure 7a and figure 7a being a section along plane KK in figure 7b,
- figure 8 illustrates the various steps in the production process of the projectile according to figures 7a and 7b.

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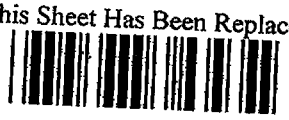

With reference to figures 1a and 1b, a practice projectile 1 according to a first embodiment of the invention comprises a body 2 formed by assembling six identical segments 3a, 3b, 3c, 3d, 3e and 3f.

Each segment is marked out by two intersecting planes 4a, 4b which make a 60° angle. Thus, after assembly, each segment is in contact with two adjacent segments at its intersecting planes. The absence of empty space between the segments ensures excellent rigidity of the projectile.

The projectile also comprises a base 5 having a housing 6 designed to accommodate the segments 3. The base 5 has a ring-shaped swelling 7 which forms a belt designed to provide a seal to the propellant gases inside the barrel of the weapon. The base also has a ring-shaped groove 8 designed to allow the projectile to be made integral with a propellant charge case (not shown).

The base 5 has an inner rim 9 which penetrates in a groove 10 arranged on the body 2. This rim makes the base integral with the body.

The main function of the base is to provide a seal to the propellant gases in the barrel of the weapon, this on the one hand by means of the belt 7, and on the other by means of the bottom wall 11 of the base which prevents the gases from penetrating between the various segments.

The segments and the base are made of a plastic material of the thermo-plastic type. These components are produced, for example, by injection. This material gives the projectile good resistance to the different temperature and humidity stresses encountered during storage.

Different thermo-plastic materials may be considered. One of the following materials may, for example, be selected : polyethylene, polyamide, polypropylene, polystyrene, polycarbonate, polyphenylene oxide, or acrylonitrile butadiene styrene.

The projectile comprises means to hold the segments together during the transport and handling phases.

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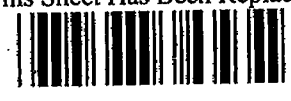

These means guarantee the mechanical resistance of the projectile to vibrations and other mechanical stresses encountered during the transportation or loading of the weapon.

According to the first embodiment described herein, these means comprises a spot weld 12 which joins the various segments together at the front part 13 of the projectile.

This weld may be made by locally heating the front part 13 of the projectile.

The holding means are designed so as to free the segments upon exit from the barrel of a weapon during the firing of a projectile. The mechanical strength of the weld is not enough to withstand the strains developed during firing.

After the weld has broken the segments can separate, they remain held together, however, by the barrel of the weapon, but they separate upon exiting the latter under the influence of the aerodynamic forces exerted on the projectile (forces to which may be added centrifugal force in the event of firing from a weapon having a rifled barrel).

It can thus be seen that by the appropriate sizing of the holding means, it is possible to design a practice projectile designed to be fired from a smooth barrel. Known projectiles of the "break up" type, mentioned in the foreword, on the contrary will only break up if fired from a rifled barrel.

Because of the lightness of the plastic material, the segments are quickly braked after their separation upon exit from the barrel. They are therefore dispersed at a short distance from the weapon (around 50m for a 20 mm calibre).

The advantages afforded by the invention in comparison with known "break up" type munitions may thus be noted : behaviour in the barrel is excellent since the segments form a rigid projectile body, their separation upon exiting the barrel is guarantied as the holding means are

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sized to this end. The barrel of the weapon is not adversely affected by the segments and the energy of the latter after dispersal is not enough to damage the sights or injure the gun crew.

The projectile is assembled in the following manner :

- the segments are assembled so as to form the body 2, which is then placed in a tool of a matching shape,
- the base is set in place of the rear part of the body by elastic deformation,
- the projectile is removed from the tool and the weld 12 is made by heating the front part 13.

Such a projectile is inexpensive to make.

As an alternative, the holding means may be formed of the base alone which, in this event, will be long enough to hold the segments together.

In the other embodiments which will now be described with reference to figure 2 to 6, certain components of the projectile will bear the same numbers as those attributed with reference to figures 1a and 1b.

These components will not be described in greater detail when they are structurally identical to those described hereabove.

Figures 2a and 2b show a second embodiment in which the holding means comprise a sleeve 14 made of a plastic material of the heat-shrinkable type. Such a material is known to the expert. It is thus possible to set in place a sleeve having a greater diametre than that of the body 2, then heat this sleeve in order to reduce its diametre such that it fits tightly around the body 2.

With this embodiment it is possible to precisely regulate the strength of the linking means by altering the length of the sleeve 14.

Figures 3a and 3b show a third embodiment in which the holding means comprise a nose cap 15 made of a plastic material (of the same type, for example, as that which makes up the body).

The nose cap 15 completely surrounds the front part of the projectile. On its rear part it has a flange 16 which

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penetrates into a ring-shaped groove 17 arranged on the segments 3. The flange fastens the nose cap 15 onto the segments which make up the projectile body. The nose cap is mounted by its elastic deformation.

The thickness of the cap will be decided according to the strength required for the linking means. It will be possible, in particular, to provide breaking points on the cap, for example, longitudinal thin areas evenly distributed at an angle.

The nose cap is a linking means which provides better mechanical resistance to environmental stresses than the spot weld described above.

The cap also has the added advantage of preventing moisture or dust from penetrating between the segments.

Figures 4a and 4b show a fourth embodiment in which the holding means comprise firstly a nose cap 15 made of a plastic material and secondly protrusions 18, integral with the different segments and working in conjunction with grooves 19 arranged on the segments. The grooves 19 are of a shape matching that of the protrusions 18.

The cap is identical to that described with reference to figures 3a and 3b and will therefore not be described here in greater detail.

`Each segment 3 carries a groove 19 on one of its intersecting planes 4a and a protrusion 18 on its other intersecting plane 4b.

Both grooves and protrusions extend roughly over the full length of each segment as may be seen in figure 4a.

The resistance of the linking means may be regulated by altering both the size of the protrusions 18 and the thickness of the cap 15.

Both grooves and protrusions also enable the mechanical resistance of the segment assembly to the environmental stresses to be increased.

As an alternative embodiment, it is possible not to provide a cap 15 and to hold the segments together using only the protrusions 18 and grooves 19.

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Figures 5a and 5b show a fifth embodiment in which the holding means comprise firstly a nose cap 15 (identical to that described with reference to figures 3a and 3b) and secondly a central section 20 formed in a single piece with the three segments 3a, 3c and 3e and which extends roughly over the full length of the latter.

These three segments are evenly distributed at an angle and they form what will hereafter be termed the first group of segments.

The first group of segments marks out housings 21 in which segments 3b, 3d and 3f (which make up what shall hereafter be termed the second group of segments).

The cap joins the first and second groups of segments together.

It is possible to alter the size of the central section 20, as well as the thickness of the cap, in order to regulate the resistance of the linking means.

Figures 6a and 6b show a sixth embodiment, analogous to the previous one but in which the second group of segments (made up of segments 3b, 3d and 3f) makes a single piece with the cap 15.

The first group of segments, made up of segments 3a, 3c and 3e connected by the central section 20, is thus housed inside the nose cap 15 which carries the second group of segments.

This particular embodiment makes assembly of the projectile particularly easy since only two operations are required :

- setting into place of the first group of segments inside the nose cap,
- fastening of the base.

The resistance of the linking means may be regulated by altering the size of the central section 20 and the thickness of the nose cap 15 opposite the first group of segments.

It will, in particular, be possible to provide longitudinal breaking points on the cap 15, which will be

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placed in the extension of the intersecting planes 4a and 4b of the second group segments.

Other alternatives are possible without departing from the scope of the invention. It is thus possible to combine two of the different holding means described above. For example :

- combine the spot weld 12 and the heat-shrinkable sleeve 14,

- combine the protrusion 18 and grooves 19 with the spot weld or a heat-shrinkable sleeve,

- replace, in the alternative embodiment shown in figures 5a and 5b, the nose cap by a weld or a heat-shrinkable sleeve.

Figures 7a and 7b show a seventh embodiment of a projectile according to the invention.

This embodiment is an alternative to the embodiment described with reference to figures 1a and 1b.

The body 2 of the projectile 1 is again formed by assembling six identical segments 3a, 3b, 3c, 3d, 3e and 3f.

The segments are all joined by their tips by means of a plastic link 22 obtained by casting with the segments.

The segments are also welded two by two along the outer contact edges 23 of their intersecting planes 4a, 4b.

These longitudinal welds 24 extend along the body 2 of the projectile from its front part 13 up to a ring-shaped swelling 7 of the base 5. They are produced by heating the body 2 along the outer contact edges 23 of its intersecting planes 4a, 4b.

The welds 24 also extend radially over a certain thickness towards the inside of the projectile.

They form the means to hold the segment assembly together and their thickness is decided by the expert according to the mechanical resistance required for these holding means.

As in the previous alternative embodiments, a base 5 accommodates the segments 3 in a housing 6.

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This embodiment has the advantage of giving good mechanical resistance to the segments assembly during transportation or loading phases of the weapon.

Moreover, with a small number of parts and therefore a reduced production cost, this embodiment manages to prevent moisture or dust from penetrating between the segments. The longitudinal welds thus occupy the same function as the cap 15 described in the previous embodiments.

Figure 8 illustrates the different steps of a production process for a projectile according to this last embodiment.

First of all (step A) all the segments designed to form the projectile of the projectile are produced, and this in a single casting operation in a suitable mould, not shown.

The different segments 3a, 3b, 3c, 3d, 3e and 3f are thereafter joined in a star shape by the link 22 at their tips.

The segments are then grouped (step B) so as to form the body 2 of the projectile.

A front section 2a of the body 2 is placed inside a tool 26 designed to heat its outer surface (step C).

The tool 26 comprises to this end a housing of a shape matching that of the front section 2a of the projectile body, the heat is thus evenly spread over the whole of the outer surface of the front section 2a.

The tool 26 is designed so as to bring the front section 2a to a temperature which is high enough to locally melt the constitutive material of the segments, so that they can be welded along their outer contact edges 23.

Various technologies may be used for the heating tool 26. For example, an electric furnace connected to an energy supply 25.

A furnace in which a liquid coolant circulates may also be sued, or alternatively tooling sleeves 26 bearing

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the projectile body may be immersed in a thermostatic bath.

The expert will select the welding temperature and the length of time during which the projectile body will be kept at this temperature, according firstly to the properties of the thermo-plastic material used and secondly to the thickness required for the welds 24 (and thus according to the mechanical resistance of the linking means).

In fact it will be noted that for a given heating temperature, the thickness of the weld increases with the length of time during which the projectile body is kept at the temperature in question.

After being cooled, the body 2 is removed from the tooling 26 (step D1).

Sketch D1 no longer shows the separations between the segments on the projectile body, the welds 24 giving the front section 2a of the body a smooth surface.

A base 5 is made elsewhere by casting (step D2).

Lastly, the projectile body 2 and the base 5 are assembled (step E).

This production process is particularly economical and suitable for the large-scale production of projectiles according to the invention.

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CLAIMS

1. A practice projectile (1), characterised in that it comprises a body (2) formed by assembling several segments (3) and a base (5) having a housing (6) designed to accommodate these segments, said segments being made of a plastic type material, and means to hold the segment (3) assembly together during the handling phases, means designed so as to free the segments upon exiting from the barrel of a weapon during firing of the projectile.

2. A projectile according to Claim 1, characterised in that the segments are made of a thermo-plastic type material.

3. A projectile according to Claim 2, characterised in that said holding means comprise a nose cap (15) surrounding a front part of the projectile (1).

4. A projectile according to Claim 3, characterised in that the nose cap (15) has a flange (16) which penetrates into a ring-shaped groove (17) arranged on the segments (3) thereby fastening the nose cap to the latter.

5. A projectile according to Claim 2, characterised in that the holding means comprise a sleeve (14) surrounding a front part of the projectile (1), a sleeve made of a heat-shrinkable material.

6. A projectile according to one of Claims 1 to 5, characterised in that the holding means comprise at least one protrusion (18) integral with a segment and working in conjunction with a groove (19) arranged on a contiguous segments to the previous one, a groove of a matching shape to that of the protrusion.

7. A projectile according to one of Claims 1 to 6, characterised in that the holding means comprise a central section (20) formed in a single piece with at least two segments evenly distributed at an angle and forming a first group of segments.

8. A projectile according to Claim 7, characterised in that the first group of segments marks out housing (21) in which the other segments are placed, the latter, which

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form a second group of segments, being joined to the former by means of a nose cap (15).

9. A projectile according to Claim 8, characterised in that the second group of segments is formed in a single piece with the nose cap (15).

10. A projectile according to Claim 2, characterised in that the holding means comprise at least one spot weld (12) between two contiguous segments (3).

11. A projectile according to Claim 10, characterised in that the segments (3) are welded two by two along their outer contact edges (23).

12. A production process for a projectile according to Claim 11, characterised by the following steps :

- the segments (3) are grouped together so as to form the projectile body,
- at least a front section (2a) of the projectile body is placed in a tooling (26) designed to heat its outer surface to a high enough temperature to make the constitutive material of the segments (3) melt locally and weld them along their outer contact edges (23),
- the body (2) is cooled,
- the projectile body (2) and the base (5) are assembled.

13. A production process according to Claim 12, characterised in that the various segments (3) are made in a single operation by casting and are joined together in a star shape by their tips.

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