

5 Small-calibre deformation projectile and method for the manufacture thereof

 The present invention relates to small-calibre ammunition in accordance with the preamble to the claim.

10 It is generally well-known that the high penetration capacity of the ammunition used in instances of police action often leads to shots passing cleanly right through, so that the person hit is not effectively prevented from resistance and/or is able to flee. Ricochets lead to disintegration of the ammunition as well, and frequently endanger persons not involved. In addition, commonly used projectiles have a lead core, which has an unacceptable and
15 adverse long-term effect on the person hit and on the environment.

 A projectile, especially for hand guns, is therefore known (EP-B1-0 636 853), which comprises a cylindrical base member of metal, the leading end of which is in the form of an ogive or truncated cone, a ballistic additional member in the form of a ball of impact-resistant plastics material being inserted in this base member. This projectile is particularly intended
20 not to form secondary projectiles.

 Such a ball provided for small-calibre ammunition that becomes detached from the base member in the target is difficult to detect in a wounded person, since even when metals are added to the plastics material, there is only a very small effective cross-section for X-rays. Such a ball that has become detached from the base member can therefore remain
25 undetected, especially in the vicinity of bone, even when using high-resolution X-ray apparatus, and can lead to lasting, permanent disorders in the human body.

 The two-part construction of the projectile using different materials is also a disadvantage, giving rise on the one hand to manufacturing problems and on the other hand, on account of the limited ballistic final energy, failing to provide the energy deposition
30 stipulated in police circles of almost 60 J/cm in the case of 9 mm ammunition, at a target distance of 5 m, measured in so-called ballistic soap.

Furthermore, US-A-4,136,616 discloses projectiles in accordance with the preamble to claim 1. In a projectile a so-called ballistic cap encloses a cavity, which carries a thorn-like spike on its base. On impact on the target, in one variant of the projectile the cap is deformed and pierced; it unrolls peripherally around the spike so that the resulting hollow
5 cylinder of the base member opened at the front is able to mushroom and deliver its kinetic energy to the target over a correspondingly enlarged area. In another variant, the cavity is filled with gunpowder and ignites, or explosively severs the ballistic cap before the target is reached. Further embodiments are designed for hunting and recreational shooting and in some cases have complicated turned parts which are pressed by the target into more or less
10 conically shaped bores or straight slots and allow the base body to expand. Individual constructions can even be mechanically adjusted prior to shooting in respect of their later penetration behaviour. The feature common to all the variants is that the inner displaceable core, that is, the ballistic cap, either runs onto a spike or is in the form of a solid body and/or a conical annular region is provided to ensure mushrooming.

15 The drawback to all of these solutions is that they have relatively complicated component parts, which are manufactured at least partly on metal-cutting tools. Material deformation in the target is dependent on many parameters, so that consistent dispersion patterns or defined energy depositions cannot be expected.

It is therefore the object of the present invention to eliminate the disadvantages
20 mentioned and to produce a small-calibre projectile that causes high energy deposition with a direct hit, that is, puts the person hit out of action, without causing lasting injury as a consequence of dispersed pieces of projectile and/or highly toxic heavy metals. The projectile shall furthermore be capable of being adapted to the conditions for a police action and have great reliability and precision. In addition, it shall be possible to manufacture the
25 projectile economically and in particular without any complicated turned parts being required.

That object is achieved by the features of claim 1.

The interference fit mentioned in the claim is selected here so that the inner
cylindrical part is firmly held over its full length by a non-positive fit and in a front position in
the base member throughout the entire ballistic trajectory, or so that it is already displaced
30 into a rear position by the firing acceleration and here comes into contact with the base body with its rear face.

The over-dimension of the fit necessary for this is advantageously effected on the hole-basis system of fits.

The subject matter of the invention poses minimum threat to the environment despite high penetration capacity against hard targets. The projectile deformation, that is, the
5 mushrooming, is effected in a specific manner and is predictable in its effect; the energy release in biological material is controlled. The appearance of the projectile is that of a full jacketed projectile, and has the advantages thereof, that is, no moisture is able to penetrate into the propelling charge.

The projectile does not disintegrate in a target; the projectile found in a target in all
10 cases had 100% of its original weight. The air space present between the base member and the inserted sleeve core acts like a dynamic spring on impact on a soft target (ballistic soap); deformation is effected only in the frontal region of the base member, the sleeve core displaced rearwardly into the annular space at the rear side itself absorbs virtually no deformation energy.

15 Deformation is initiated by the above-mentioned translatory movement, so that the resulting projecting front region of the base member is relatively easily deformable and mushrooms on impact on hard targets in the manner of a flanging on both sides, that is, it spreads. On softer targets, there is bulging accompanied by a frontal cross-sectional enlargement. This type of compaction of the two parts prevents dissociation even in very
20 hard targets.

It has unexpectedly been found that, as tests have shown, materials such as clothing etc. in front of the target do not adversely affect deformation of the projectile.

A further advantage consists in the minimal resulting mechanical stress on the weapon; the compressibility, especially of the rear part of the projectile, reduces wear in the
25 barrel, so that projectiles according to the invention are also particularly suitable for practice ammunition. In that connection, it is also beneficial that the entire projectile body consists of a single, easily recycled material and can be cleared from target areas so that the environment is not harmed.

The manufacturing process according to claim 6 is especially efficient and allows an
30 economical large-scale series fabrication.

Advantageous developments of the invention are described in dependent claims.

The choice of an identical material for the base member and the sleeve core not only has benefits for manufacture; the materials also have an identical thermal expansion, so that parts, once joined together, have the same stress.

5 An external annular groove at the front end also produces in the base member a space for partially receiving the sleeve core that has become compressed on entering the target.

Analogously, an additional deformation zone can be produced in the sleeve core, in that an external annular groove is provided there.

10 Apart from the customary fits for an interference fit, for example, H7/n6, when the sleeve core is not intended to be displaced until the projectile is in the target, and a holding fit, when the sleeve core is intended to be displaced at even low firing accelerations, the sleeve core can be of conical construction compared with the bore in order to achieve an interference fit with matching effect. The reverse option is likewise possible, that is, the bore can be conical compared with the sleeve core.

15 Manufacture of the two parts base member and sleeve core is especially economical through the use of deep drawing processes known *per se*.

A further increase in efficiency in manufacture is possible by the use of flat strip stock, which is fed via a roller to the relevant stamping press.

20 Precise joining of the two parts is effected by means of a shaping die, which presses the sleeve core at its end face with a positive fit into the base member.

Exemplary embodiments of the invention are explained below with reference to the drawings, in which:

25 Fig. 1 shows, in sectional view, a projectile according to the invention for pistol ammunition;

Fig. 2 shows a first variant of the projectile, having an effect analogous to that of Fig. 1;

30 Fig. 3a and Fig. 3b

show the two component parts of the projectile shown in Fig. 1, prior to

assembly;

Fig. 4 shows a third variant of a projectile with reduced ricochet behaviour;

5 Fig. 5 shows a further variant of a projectile, with increased penetration capacity;

Fig. 6 shows a cup produced by deep drawing, as a preliminary stage for forming a base member, and

10 Fig. 7 shows a further cup, as a preliminary stage for forming a sleeve core.

In Figure 1, a cylindrical base member is denoted by the numeral 1. This base member is pressed in known manner into the casing 10 of a cartridge for pistol ammunition.

In the sleeve member 1 there is an additional member in the form of a sleeve core 2, which together with the sleeve member forms, with no transitions, the projectile tip. In the lower region of this projectile there is a circular disc-shaped annular space 3a, which, together with the blind bore 3b above it in the sleeve core 2, forms an enclosed air space.

A circular symbol, denoted by the letter S, the centre of gravity of the projectile, is also marked in Fig. 1.

20 The end face 2' of the sleeve core 2 spaced from the bottom 4 of the base member is displaced in a translatory movement when the projectile hits a target and strikes against the bottom 4. It is therefore possible to deform the projectile tip in a specific manner; it mushrooms and at the same time surrounds the tip of the sleeve core 2 at the edge with a flange.

25 Even if the translatory displacement should be effected only to a slight extent on account of the selected mass ratios between base member and sleeve core, the base member and the sleeve core are wedged together, so that the entire mass of the discharged projectile is preserved intact in the target, as demonstrated by practical tests with weight measurements.

30 On the one hand, this produces an energy conversion, and on the other hand the front end outer diameter of the projectile enlarges, so that the delivery of energy to the target

is intensified – on the basis of the larger surface area.

The positive engagement of the two parts, which is effected in the manner of riveting, imparts high mechanical strength to the projectile; in the case of a hard target it behaves like a solid body projectile, without having the disadvantages thereof.

5 The deformation of the projectile can be predetermined in wide limits by means and features known *per se*; in particular, these include the hardness and ductility of the materials and the corresponding dimensioning of the projectile parts.

In subsequent Figures, parts of identical function have been given the same reference numerals.

10 The variant shown in Fig. 2 has a larger mass compared with the construction shown in Fig. 1, the deformation in the target causes only mushrooming, which is facilitated by the peripheral annular space 3c. The hollow space 3a has approximately the same volume as it does in Fig. 1, but has a smaller diameter, so that the axial displacement path for the sleeve core 2 is longer.

15 The constituent parts of the two-part projectile are illustrated in Figs 3a and 3b, prior to assembly.

From Fig. 3a in conjunction with Fig. 3b, it is apparent that the radius R_1 of the ogive is the same in the transition region of the sleeve core 2 and the base member.

In addition, the length L of the cylindrical part of the sleeve core 2 is marked, which is
20 always shorter than the corresponding recess in the base member 1.

The diameters of the parts of the base member 1 and the sleeve core 2 to be slid together are matched to one another in the manner of a so-called press fit (force fit), a conicity of 0.06 mm facilitating assembly at room temperature yet ensuring that the parts hold together over the entire ballistic trajectory and in the target even in the case of any
25 temperature gradient between the parts.

The exemplary embodiments shown Figs 4 and 5 are based on the same principle.

Compared with Fig. 1, the two projectiles have a centre of gravity S displaced towards the leading end and the rear end respectively. The projectile shown in Fig. 4 is constructed with thinner walls compared with Fig. 1 and is therefore more readily deformable;
30 it has a lower ricochet characteristic.

The construction shown in Fig. 5 has a larger mass and hence a higher penetration

capacity. The other advantages are maintained, so that a high energy deposition in the target is still effected; likewise, it does not disintegrate there. The length L remains stationary in the projectile itself throughout the entire ballistic trajectory of the projectile.

It is of special advantage, however, when the cylindrical sleeve core 2 shown in Fig. 1 – because of a correspondingly selected fit – is already displaced into the annular space 3a at discharge, so that the front portion of the base member 1 lies exposed and mushrooms very strongly because of the increased surface pressure.

In practice, it has been shown that the variant that becomes displaced at discharge has proved better, especially in police action, than the variant that is not displaced until it is in the target, because the more markedly mushroomed front portion delivers a large part of the kinetic energy to the surface (clothing, etc) and hence the penetration depth of the projectile is reduced and at the same time produces an intensified shock effect, resulting in less resistance. The wound ballistics are therefore further improved, without the projectile tip being able to cause injury before firing and/or the projectile tip being readily susceptible to mechanical damage.

Ductile tombac (commercially available brass alloy of the firm Trier Walzwerke GmbH, D-54296 Trier), especially in the form of strip stock, has proved successful for manufacturing the projectiles. As is customary in deep drawing processes, first of all circular discs (round blanks) were used to make a cup 100 of the kind shown in Fig. 6 for the base member 1, and a cup of the kind shown in Fig. 7, a cup 200, for the sleeve core.

The complete exclusion of turned parts and the use of conventional deep drawing and moulding processes made possible by the projectile form permits an economical manufacture, notwithstanding the improved end-ballistic properties of the projectiles.

The subject matter of the invention is intended for practical reasons for small-calibre projectiles (up to 0.5" diameter) and was designed for that purpose; however, it can be adapted in similar or analogous form also for larger projectiles.

Claims

1. Small calibre deformation projectile comprising a copper/zinc alloy, consisting of an outer hollow-cylindrical base member with a rear base and an ogive-shaped or conical front region and an at least partly cylindrical sleeve core inserted in and projecting beyond the base member, wherein the sleeve core closes off, with a non-positive fit in the base member, a hollow space and is fixedly held in a front position and wherein in the target the base member mushrooms, characterised in that the sleeve core (2) is slidably inserted with its cylindrical part in the base member (1) and in that, at least on impact of the projectile (1) on the target or in the target, the sleeve core (2) is displaced axially into the annular space (3a), into a rear position, and with its rear end face (2') comes into contact with the base member.
2. Small calibre deformation projectile according to claim 1, characterised in that the base member (1) and the sleeve core (2) consist of the identical copper/zinc alloy.
3. Small calibre deformation projectile according to claim 1 or 2, characterised in that an internal annular groove (3c) is provided towards the front in the base member (1).
4. Small calibre deformation projectile according to claim 1 or 2, characterised in that an external annular groove is provided in the sleeve core (2).
5. Small calibre deformation projectile according to claim 1 or 2, characterised in that the blind hole-like bore (3b) or the cylindrical part of the sleeve core (2) have a conicity.
6. A method for the manufacture of a small calibre deformation projectile from a copper/zinc alloy consisting of an outer hollow-cylindrical base member with a rear base and an ogive-shaped or conical front region and an at least partly cylindrical sleeve core inserted in and projecting beyond the base member, wherein the sleeve core closes off, with a non-positive fit in the base member, a hollow space and is fixedly held in a front position and

wherein in the target the base member mushrooms, characterised in that the base member and sleeve core are manufactured solely by deep drawing and moulding processes and in that the cylindrical sleeve core is pressed into the hollow cylinder of the base member with a force fit, such that at least between the base and the sleeve core a hollow space is formed, which space extends across the entire inner diameter of the base member.

7. A method for manufacture of a base member according to claim 6, characterised in that circular discs are punched from flat material, the circular discs being shaped in deep drawing processes to a hollow-cylindrical base member and after a subsequent calibration being squeezed to the predetermined length of the base member.

8. A method for manufacture of a sleeve core according to claim 6, characterised in that circular discs are punched from flat material, the circular discs being shaped in deep drawing processes to a hollow-cylindrical body and after a subsequent calibration being squeezed to the predetermined length of the sleeve core.

9. A method according to at least one of claims 7 and 8, characterised in that the flat material is strip stock and is fed from a roller to a stamping press or stamping and drawing press.

10. A method according to claim 6, characterised in that a sleeve core is inserted in a base member and in that both parts are pressed together by a shaping die at their end faces with a positive fit and with no transitions.