Metallic solid projectile, tool arrangement and method for producing metallic solid projectiles

The invention relates to a metallic solid projectile for practice cartridges, in particular for use on police firing ranges. The invention also concerns a tool arrangement for the production of metallic solid projectiles for training cartridges. The invention also includes a method for producing metallic solid projectiles for practice cartridges. For use on police shooting ranges, projectiles for training cartridges must meet the requirements of the "Technical Directive (TR) Cartridge 9 mm x 19, Reduced Pollutant" (in particular: as of September 2009), with the proviso that for training cartridges some of the requirements of the aforementioned technical directive for training cartridges, inter alia with regard to the end-ballistic effect, need not be met.

A standard solid projectile for practice cartridges is known from EP 2 498 045 A1. The conventional solid projectile consists of a curved ogive at the front and a cylindrical area adjacent to it. In the area of the curved ogive, the known solid projectile is equipped with an ogival wall which circumferentially bounds an ogival cavity and is formed on the inside with predetermined breaking points in the form of notches and edges. These predetermined breaking points serve as predetermined zones for initiating or promoting material failure. They facilitate the folding of the projectile solid material with the formation of cracks in the outer skin of the ogive when the projectile strikes a target at the front. When the projectile hits its target according to EP 2 498 045 A1, it should deform ("mushroom up"). When the projectile is deformed, its kinetic energy is converted into deformation energy. The conversion of kinetic energy into deformation energy should take place as quickly as possible in practice cartridge projectiles in order to prevent the projectile from remaining with a sufficient amount of kinetic energy to penetrate in particular protective vests, for example police protective vests. In the case of the well-known solid projectile for practice cartridges, it has been found to be disadvantageous that the crack effect of the predetermined breaking points can cause the projectile to splinter on impact with the target or a hard surface, such as the wall of a shooting range. The splintering of a practice projectile can result in dangerous cross impact splinters for practicing shooters.

Embodiments of the invention seek to provide a metallic solid projectile for practice cartridges, which may overcome the disadvantages of the state of the art, in particular in compliance with

the "Technical Guideline (TR) Cartridge 9 mm x 19, reduced pollutant", and in which the splintering of the solid projectile on impact with a hard surface may be avoided.

An aspect of the present disclosure provides a metallic solid projectile for practice cartridges, in particular for use on preferably police shooting ranges, wherein the solid projectile comprises an ogival portion at the front side and a cylinder portion for holding the solid projectile in a cartridge case and defines a projectile length in the axial direction, wherein the ogival portion comprises an ogival wall and a rotationally symmetrical ogival cavity circumferentially bounded by the ogival wall, characterized in that a fully cylindrical stem portion of the solid projectile extends in the axial direction over less than 45% of the projectile length.

Another aspect of the present disclosure provides a tool arrangement for producing metallic solid projectiles for practice cartridges, preferably with a rotationally symmetrical ogival cavity, comprising a preform press having a hollow cylindrical projectile blank receptacle which is bounded in the axial direction by a bottom side, a preform punch, having a preform section which tapers in the axial direction relative to a front surface, preferably at least in sections conically, in particular in the form of a truncated cone, and in particular rotationally symmetrical, the preform portion being movable relative to the bottom side for forming a projectile blank to a preform end position in which the preform punch, the bottom side and the projectile blank receptacle define a preform cavity for the projectile blank, characterized in that in the preform end position, an axial distance between the bottom side and the front surface is less than 45% of a maximum height of the cavity in the axial direction.

Another aspect of the present disclosure provides a method for producing metallic solid projectiles for practice cartridges, preferably with a rotationally symmetrical ogive cavity, in which a metal blank formed in particular from cut-to-length metal wire is provided, preferably with a cylindrical outer surface, characterized in that, in a preforming step, the metal blank is formed into a projectile blank with a sleeve-shaped portion which, at the end of the preforming step, extends over more than half of the greatest axial blank height, in particular the sleeve-shaped portion being formed with a preferably continuously tapering inner contour.

Accordingly, a metallic solid projectile is provided for practice cartridges, in particular for use on preferably police shooting ranges, wherein the solid projectile comprises a front-side ogival portion and a cylinder portion for holding the solid projectile in a cartridge case and defines a projectile length in the axial direction. Solid projectiles differ from partial jacket projectiles and solid jacket projectiles in that a solid projectile is formed in one piece, in particular from a homogeneous material. The solid projectile is intended in particular for practice cartridges for use in handguns, i.e. revolvers, submachine guns and/or pistols. A metallic solid projectile may also be provided for training cartridges for rifles. Preferably the solid projectile is intended for practice cartridges up to a caliber of 20 mm, in particular up to a caliber of 12 mm. Cartridges usually consist of a projectile, a cartridge case, propellant powder and a primer. The projectile is the object fired from the weapon. The weight of a projectile can be between 3g and 20g, in particular between 5g and 15g, preferably between 5.5g and 9g, in particular preferably between 6.0g and 6.3g, for example 6.1g, for a cartridge caliber of 9 mm x 19 (Luger caliber or Para caliber), when using which the penetration of a protective vest is to be ruled out. Due to their weight and shape, the projectiles of standard Luger caliber cartridges reach muzzle velocities of 340 mm/sec. or more at 9 mm. The material of the solid projectile is preferably lead-free and/or lead alloy-free. The metal of the solid projectile is preferably copper. In particular, at least 95%, at least 99% or at least 99.9% of the metal of the solid projectile consists of copper. The particularly uncoated projectile consists particularly preferably of pure copper (Cu-ETP), preferably with a specific weight of 8.93 g/cm^3, in particular of CU-ETP1 according to DIN EN1977 with at least 99.9% copper content and less than 100 ppm oxygen. According to less preferred configurations, the metal material of the solid projectile may be brass (i.e. a mixture of copper and zinc such as tombac). The specific weight of copper is 8.9g/ccm. The specific weight of zinc is 7.2 g/ccm. The specific weight of brass is at least 8.3 g/ccm, while the specific weight of tombak is about 8.6 g/ccm.

Preferably the cylinder section of the solid projectile is directly adjacent to the ogival section, in particular the arcuate ogival section. The ogival section arranged at the front in the flight direction of the solid projectile can be described as the front side. The rear cylinder section of the solid projectile in the flight direction of the projectile can be designated as the foot side or the rear side. The ogival section is arranged axially in front of the cylinder section of the solid projectile. The cylinder section preferably has a circular outer contour in cross-section. The shape of the cylinder section preferably corresponds to a vertical or straight circular cylinder.

Claims:

1. Metallic solid projectile for practice cartridges, in particular for use on preferably police shooting ranges, wherein the solid projectile comprises an ogival portion at the front side and a cylinder portion for holding the solid projectile in a cartridge case and defines a projectile length in the axial direction,
   wherein the ogival portion comprises an ogival wall and a rotationally symmetrical ogival cavity circumferentially bounded by the ogival wall, characterized in that
   a fully cylindrical stem portion of the solid projectile extends in the axial direction over less than 45% of the projectile length.

2. Metallic solid projectile, in particular according to claim 1, for practice cartridges, in particular for use on preferably police shooting ranges, wherein the solid projectile comprises a ogival portion at the front side and a cylinder portion for holding the solid projectile in a cartridge case,
   the ogival portion having an ogival wall and a rotationally symmetrical ogival cavity circumferentially bounded by the ogival wall,
   characterized in that
   starting from a bottom of the ogival cavity, a shaft extends into the cylinder portion, which shaft forms a microchannel and/or a deformation cavity, wherein the deformation cavity is shaped at least in sections to be cylindrical and/or at least in sections to be conical with a taper at the front side.

3. Solid projectile according to claim 1 or 2, characterized in that the ogival wall has an ogival wall thickness and the solid projectile forms an annular deformation sleeve wall in the cylinder portion in the axial direction at least in sections, which has a deformation sleeve wall thickness which is greater than the ogival wall thickness, preferably the ogival wall thickness being less than half the radius of the solid projectile and/or preferably the deformation sleeve wall thickness being less than or equal to the radius of the solid projectile.

4. Solid projectile according to one of the claims 1 to 3, characterized in that the solid projectile is blunt at the front side and/or has an opening at the front side which opens into the ogive cavity and has an inner opening diameter which

is greater than 0.5 mm, in particular greater than 1.0 mm, and/or is smaller than 3 mm, in particular smaller than 1.5 mm.

5. Solid projectile according to one of the preceding claims, characterized in that the fully cylindrical stem portion extends in the axial direction over less than 3 mm, less than 2 mm or less than 1 mm and/or that a calotte is recessed at the rear end of the solid projectile.

6. Solid projectile according to one of the preceding claims, characterized in that an inner contour surrounding the ogival cavity is completely rounded in the axial direction, preferably formed step-free and/or has exclusively rounded edges.

7. Tool arrangement for producing metallic solid projectiles for practice cartridges, preferably with a rotationally symmetrical ogival cavity, comprising a preform press having
a hollow cylindrical projectile blank receptacle which is bounded in the axial direction by a bottom side,
a preform punch, having a preform section which tapers in the axial direction relative to a front surface, preferably at least in sections conically, in particular in the form of a truncated cone, and in particular rotationally symmetrical, the preform portion being movable relative to the bottom side for forming a projectile blank to a preform end position in which the preform punch, the bottom side and the projectile blank receptacle define a preform cavity for the projectile blank,
characterized in that
in the preform end position, an axial distance between the bottom side and the front surface is less than 45% of a maximum height of the cavity in the axial direction.

8. Tool arrangement according to claim 7 further comprising an inner contour forming press having
a hollow cylindrical projectile blank receptacle which is bounded in the axial direction by a bottom side, and
an inner contour forming punch comprising an inner contour forming portion extending axially to a front surface, said inner contour forming portion being movable relative to the bottom side for forming the projectile blank to an inner contour forming end position, wherein said inner contour forming punch, said bottom side and said projectile blank receptacle define an inner contour forming cavity for said projectile blank,

wherein, in particular in the inner contour form end position, an axial distance between the bottom side and the front surface is greater than the axial distance between the bottom side of the preform press and the front surface of the preform punch in the preform end position.

9. Tool arrangement according to claim 8, characterized in that the front surface of the inner contour forming punch is formed as a blunt cone tip, in particular with a rounded front edge tip, and/or the inner contour forming portion is formed in sections in the axial direction as a sleeve forming section with an essentially cylindrical outer contour, in particular the inner contour forming portion having adjacent to a guide portion of the inner contour forming punch a frustoconical transition portion extending radially from the inner contour forming portion to the guide portion.

10. Tool arrangement according to claim 8 or 9, characterized in that the taper of the preform portion of the preform punch is sharper than the preferably tapered outer contour of the inner contour portion, in particular the sleeve portion, of the inner contour punch.

11. Tool arrangement according to one of the claims 7 to 10, characterized in that the tool arrangement further comprises a setting press having a hollow cylindrical metal blank receptacle bounded in axial direction by a bottom side and having a setting punch, which is movable relative to the bottom side for forming the metal blank up to a setting end position, in which the setting punch and the projectile blank receptacle form a setting cavity with a predetermined clear width for defining a constant outer diameter, in particular the caliber diameter, of the metal blank.

12. Tool arrangement according to one of claims 7 to 11, characterized in that the tool arrangement further comprises an ogival forming press which has a hollow cylindrical projectile receptacle which is bounded in the axial direction by a concave, ogival-shaped bottom side and which has a projectile rear punch for holding and/or centering the rear end of the, in particular, internally contour-shaped projectile blank, which is movable relative to the bottom side for forming the solid projectile to an ogival shape end position, in which the projectile rear punch, the projectile receptacle and the bottom side define a cavity defining a projectile negative with an ogival portion and a cylinder portion adjacent thereto.

13. Method for producing metallic solid projectiles for practice cartridges, preferably with a rotationally symmetrical ogive cavity, in which
a metal blank formed in particular from cut-to-length metal wire is provided, preferably with a cylindrical outer surface,
characterized in that, in a preforming step, the metal blank is formed into a projectile blank with a sleeve-shaped portion which, at the end of the preforming step, extends over more than half of the greatest axial blank height, in particular the sleeve-shaped portion being formed with a preferably continuously tapering inner contour.

14. Method according to claim 13, characterized in that the metal blank is formed in the preforming step while maintaining a remaining fully-cylindrical stem portion of a projectile blank extending in the axial direction over less than 45% of the greatest axial blank height, or in that the metal blank is completely penetrated in the axial direction in the preforming step for forming the projectile blank.

15. Method according to claim 13 or 14, characterized in that the projectile blank is deformed after the preforming step in an inner contour forming step in such a manner,
that a front-side sleeve portion of the projectile blank is formed with a radially outer sleeve wall of substantially constant wall thickness and/or cylindrical inner contour,
that a rear-side sleeve portion of the projectile blank is formed with a shoulder projecting radially inwards from the sleeve wall, and
that a shaft starting from the shoulder is formed which extends into the rear-side sleeve portion of the projectile blank, which shaft in particular forms a microchannel and/or a deformation cavity, wherein the deformation cavity is formed at least sectionally cylindrically and/or at least sectionally conically with taper at the end.

16. Method according to claim 15, characterized in that in the inner contour forming step the projectile blank is being formed in such a way,
that the deformation cavity forms a waist-shaped constriction at the front side, wherein a microchannel is formed in particular between the deformation cavity and the shoulder, in which microchannel the inner wall surface of the sleeve section is brought together flat in particular in contact, and/or

that a distance in the axial direction between the shoulder and a rear becomes greater than the axial height of the fully cylindrical stem portion of the projectile blank which may be present at the end of the preforming step.

17. Method according to one of the claims 13 to 16, characterized in that the projectile blank, in particular after the inner contour forming step, is formed in an ogival forming step in such a way that the front side sleeve wall forms an ogival outer surface in sections, in particular an opening being maintained at the front side which preferably opens into an ogival cavity defined circumferentially by the sleeve wall.

18. Method according to one of the claims 13 to 17, characterized in that the preforming step, the inner contour forming step and/or the ogival forming step are carried out without cutting, in particular by cold forming, preferably by pressing.