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Metallic Practice Cartridge Bullet

The invention relates to a metallic practice cartridge bullet, in particular for use on preferably police shooting ranges. Furthermore, the present invention relates to a method and tool for producing metallic practice cartridge bullets, in particular for use on preferably police shooting ranges.

For use on police shooting ranges, bullets for practice cartridges must comply with various requirements, for example in accordance with the "Technical Guideline (TR) Cartridge 9 mm x 19, pollutant reduced" (in particular: as of September 2009) or other, in particular country-specific, ballistic requirements, with the proviso that for practice cartridges some of the requirements placed on cartridges for use in the aforementioned technical guideline need not be met, inter alia with regard to the end ballistic effect.

A generic practice cartridge bullet is known from EP 2 498 045 A1. The generic bullet consists of a face side, arc-shaped ogive and a cylindrical area adjoining it. In the region of the arcuate ogive, the known bullet is equipped with an ogive wall which delimits an ogive cavity circumferentially and is formed on the inner side with predetermined breaking points in the form of notches and edges. These predetermined breaking points serve as predetermined zones for leading into or promoting material failure. They facilitate folding of the bullet solid material to form cracks in the outer skin of the ogive when the bullet impacts a target on the face side. When the bullet impacts its target according to EP 2 498 045 A1, it is said to deform ("fold in") in a mushroom shape. As the bullet deforms, its kinetic energy is converted into deformation energy. The conversion of kinetic energy into deformation energy is intended to occur as quickly as possible in practice cartridge bullets to prevent the bullet from retaining a sufficient amount of kinetic energy to penetrate in particular protective vests, such as police body

armor. With the known practice cartridge bullet, it has been found to be disadvantageous that the cracking effect of the predetermined breaking points can lead to the bullet splintering upon impact with the target or a hard surface, such as the wall of a shooting ranges. Splintering of a practice bullet can result in dangerous ricochet splinters for practicing shooters.

Furthermore, a metallic practice cartridge bullet for use on police shooting ranges is known from the applicant's international publication WO 2018024754 A1, which compresses significantly in the axial direction on impact with a bulletproof vest, for example of protection class I. The bullet has proven itself in principle and is very popular. The bullet has basically proven itself and is very popular. However, it has become apparent that it is desirable to improve or simplify its manufacture without impairing its precision/target ballistics. The inventors of the present invention have found that during the forming manufacture of the bullet of WO 2018024754 A1, a relatively high amount of forming and deforming work is performed in the ogive region, leading to material hardening in the ogive region. However, these material hardenings can lead to the practice cartridge bullets penetrating protective vests.

It is an object of the present invention to overcome the disadvantages of the prior art, in particular to improve metallic practice cartridge bullets in such a way that they can be produced more cost-effectively and/or with less effort and/or that penetration of protective vests, for example of protection class I, is more reliably avoided.

This object is solved by the features of the independent claims.

According to this, a metallic practice cartridge bullet is provided in particular for use on, in particular police, shooting ranges. Bullets according to the invention can also be referred to as solid bullets, since they are formed in one piece, in particular from a homogeneous material. The solid bullet is provided in particular for practice cartridges for use in handguns, i.e. revolvers, machine guns and/or pistols. A metallic practice cartridge bullet may also be provided for practice cartridges for rifles. Preferably, the bullet is provided for practice cartridges up to a caliber of 20 mm, in particular up to a caliber of 12 mm. Cartridges are comprised in a usual manner of a bullet, a cartridge case, propellant powder and a primer. The bullet is the object fired from the gun. With a cartridge caliber of 9 mm x 19 (Luger or Para caliber), the weight of a bullet can be

between 3g and 20g, in particular between 5g and 15g, preferably between 5,5g and 9g, particularly preferably between 6,0g and 6,3g, for example 6,1g, for which use the penetration of a protective vest is to be excluded. Due to their weight and shape, the bullets of authority-standard 9 mm Luger caliber cartridges achieve muzzle velocities of 340 m/sec. or more. The material of the bullet is preferably lead-free and/or lead alloy-free. Caliber is generally referred to as a measure of the outer diameter of projectiles or bullets and the inside diameter of a firearm barrel. For example, bullets according to the invention are also used for ammunition with a caliber of less than 9 mm, less than 7 mm or at most 5.6 mm. In contrast to full metal jacket bullets, which are generally comprised of a bullet jacket made of a deformable material, such as tombac, and a bullet core arranged therein, usually pressed, which is produced separately from the bullet jacket, bullets do not have a separate jacket. In particular, the bullet is made in one piece.

The bullet may have a, in particular an ogive-shaped, bullet nose with a central cavity, and a bullet tail. The bullet tail can be made substantially of solid material and/or be fully cylindrical at least sectionally. The maximum outer diameter defining the caliber of the bullet may be present in the region of the bullet tail. When in the present description reference is made to nose, front, nose-side or front-side, or tail, tail-side or rear-side, this is to be understood with reference to a longitudinal axis of the bullet pointing in the direction of bullet flight. The bullet tail can, for example, have the guiding band, which is, in particular at least sectionally, cylindrical, for guiding the deformation bullet in the firearm barrel. The guide band may, for example, be configured to engage a land-and-groove profile of the firearm barrel, which serves in particular to impart a twist to the deformation bullet as it slides along within the firearm barrel in order to stabilize the bullet trajectory. The bullet nose can have a nose wall delimiting the cavity, which has an ogive-shaped contour on its outer side at least sectionally.

A phase section may be arranged at the tail-side end of the bullet tail to facilitate insertion of the hollow point bullet into a neck of a cartridge case and/or to form a particularly aerodynamic tail end (commonly referred to as a "boat-tail").

The bullet nose, particularly the ogive section thereof, may have an ogive wall and a rotationally symmetric ogive cavity circumferentially delimited by the ogive wall. The ogive cavity allows the bullet to undergo deformation in the form of compression upon impact with a target or other resistance. Upon compression of the bullet according to the invention, its kinetic energy is rapidly converted into deformation energy. When the bullet is compressed, the tip of the bullet deforms preferably relative to the, in particular cylindrical, tail section, substantially only in the axial direction. In particular, upon perpendicular impact of the bullet against a flat resistor, there is preferably no deformation of the bullet tip in the radial direction across the diameter of the undeformed cylindrical section. The ogive cavity is preferably empty, i.e., filled only with ambient air. An inner contour encompassing the ogive cavity, which is defined by the ogive wall, is preferably formed without steps and/or interruptions in the circumferential direction and/or has exclusively rounded edges. An ogive outer surface defined by the ogive wall is preferably formed without steps in the circumferential direction and/or has a constant wall thickness circumferentially, in particular fully circumferentially.

According to an aspect of the invention, the bullet is made of iron, in particular soft iron. By means of the bullet according to the invention, an environmentally compatible bullet is created which exhibits improved ballistics. Furthermore, iron is inexpensive and is characterized by good formability, which simplifies the production of bullets. It has been found that the iron bullets of the invention are particularly well suited for production by solid forming, in particular by cold forming, such as deep drawing or extrusion, as an alternative to machining. Iron also has the advantage that it can be after-treated, in particular thermally after-treated, such as soft annealed, better than the bullet materials used to date.

According to an exemplary embodiment, the bullet is made of steel. The carbon content can be more than 0,05%. It has been found that increasing the carbon content increases the hardness and tensile strength of the bullet, which has a beneficial effect on bullet ballistics. Furthermore, the carbon content according to the invention has been found to have a corrosion-protective effect on the bullet. Furthermore, the increased carbon content also helps to delimit diffusion between the firearm barrel and the bullet when the latter is terminated by means of a firearm. For example, the carbon content may be

in the range from 0,06% to 1,14%, particularly in the range from 0,08% to 0,12%. Such carbon ranges have been found to be particularly advantageous in terms of ballistics. In particular, it has been found that if the carbon content is too high, the brittleness of the bullet body is increased too much, which has a detrimental effect on the manufacture and formability of the bullet.

In an exemplary embodiment, the bullet according to the invention is made of a material which, in addition to iron, has at least one further transition metal, for example selected from the group comprising manganese and copper, in particular at a mass fraction from 0,01% to 1,2% or from 0,3% to 1%.

In another exemplary embodiment of the present invention, the material of the bullet may include at least one other additive selected from the carbon group, the nitrogen group, and/or the oxygen group. By way of example, the at least one additive may be a semimetal. By way of example, the at least one additive may have a weight percentage of at least 0,01% to at most 0,48%.

In another exemplary embodiment, the iron of the bullet has a manganese content from 0,01% to 0,8%, in particular from 0,3% to 0,6%.

According to an exemplary further development, the iron has a silicon content of less than 3,5%, in particular less than 0,4% or less than 0,3%.

In another exemplary embodiment, the iron has a phosphorus content in the range from 0,01% to 0,04%, particularly in the range from 0,02% to 0,03%.

Furthermore, it may be provided that the iron has a sulfur content in the range from 0,01% to 0,04%, in particular in the range from 0,02% to 0,03%.

In another exemplary embodiment, the iron has a copper content of less than 0,4%, particularly less than 0,3% or less than 0,25%.

For example, the bullet may be made of a Saar steel C10C.

In an exemplary further development of the bullet according to the invention, the bullet does not contain lead.

According to another aspect of the present invention, which may be combined with the foregoing aspects and exemplary embodiments, a metallic practice cartridge bullet is provided in particular for use on, in particular police, shooting ranges. The bullet may be formed according to any of the previously described aspects or exemplary embodiments. Bullets according to the invention may also be referred to as solid bullets, since they are formed in one piece, in particular from a homogeneous material. The solid bullet is provided in particular for practice cartridges for use in handguns, i.e. revolvers, machine guns and/or pistols. A metallic practice cartridge bullet may also be provided for practice cartridges for rifles. Preferably, the bullet is provided for practice cartridges up to a caliber of 20 mm, in particular up to a caliber of 13 mm. Cartridges are comprised in a usual manner of a bullet, a cartridge case, propellant powder and a primer. The bullet is the object fired from the gun. With a cartridge caliber of 9 mm x 19 (Luger or Para caliber), the weight of a bullet can be between 3g and 20g, in particular between 5g and 15g, preferably between 5.5g and 9g, particularly preferably between 6.0g and 6.3g, for example 6.1g, for which use the penetration of a protective vest is to be excluded. Due to their weight and shape, the bullets of authority-standard 9 mm Luger caliber cartridges achieve muzzle velocities of 340 m/sec. or more. The material of the bullet is preferably lead-free and/or lead alloy-free. Caliber is generally referred to as a measure of the outside diameter of projectiles or bullets and the inside diameter of a firearm barrel. For example, bullets according to the invention are also used for ammunition with a caliber of less than 9 mm, less than 7 mm or at most 5,6 mm. In contrast to full metal jacket bullets, which are generally comprised of a bullet jacket made of a deformable material, such as tombac, and a bullet core arranged therein, usually pressed, which is produced separately from the bullet jacket, bullets do not have a separate jacket. In particular, the bullet is made in one piece.

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bullet in the firearm barrel. The guide band may, for example, be configured to engage a land-and-groove profile of the firearm barrel, which serves in particular to impart a twist to the bullet as it slides along within the firearm barrel in order to stabilize the bullet trajectory. The bullet nose can have a nose wall delimiting the cavity, which has an ogive-shaped contour on its outer side at least sectionally.

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The bullet nose, particularly the ogive section thereof, may have an ogive wall and a rotationally symmetric ogive cavity circumferentially delimited by the ogive wall. The ogive cavity allows the bullet to undergo deformation in the form of compression upon impact with a target or other resistance. Upon compression of the bullet according to the invention, its kinetic energy is rapidly converted into deformation energy. When the bullet is compressed, the tip of the bullet deforms preferably relative to the, in particular cylindrical, tail section, substantially only in the axial direction. In particular, upon perpendicular impact of the bullet against a flat resistor, there is preferably no deformation of the bullet tip in the radial direction across the diameter of the undeformed cylindrical section. The ogive cavity is preferably empty, i.e., filled only with ambient air. An inner contour encompassing the ogive cavity, which is defined by the ogive wall, is preferably formed without steps and/or interruptions in the circumferential direction and/or has exclusively rounded edges. An ogive outer surface defined by the ogive wall is preferably formed without steps in the circumferential direction and/or has a constant wall thickness circumferentially, in particular fully circumferentially.

For example, the bullet may be produced without machining. The bullet may further have an intermediate state of production, in which the bullet is present as an intermediate, in which the jacket wall forming the bullet nose on the finished bullet has a substantially constant rectilinear extension, in particular a constant inner and/or outer diameter.

According to a further aspect of the present invention, a nose wall delimiting the cavity circumferentially is provided on its inner and/or outer side with at least one

circumferential predetermined buckling point at which the wall thickness of the nose wall decreases abruptly. The predetermined buckling point results in a predefined deformation in the target ballistics, namely buckling of the nose wall at the predetermined buckling point. The goal of increasing the diameter as much and as fast as possible ("flattening") can be achieved. The deformation behavior can be deliberately adjusted via the position of the predetermined buckling point in relation to the longitudinal direction of the bullet and via the extent, in particular its radial and/or axial dimension, of the predetermined buckling point. In accordance with the invention, it was found that the effect of a predetermined buckling point arranged on the outside is improved if the predetermined buckling point is positioned as far forward in the ogive region as possible, in particular as close as possible to the bullet tip. A torque can then be created which positively influences the flattening. For example, the deformation can be such that, although the diameter of the deforming bullet does not increase more rapidly, the deformation energy is minimized so that, on impact with a target, the desired rapid flattening of the bullet and hence increase in diameter occurs. The sudden reduction in wall thickness also ensures that the predetermined buckling point is as reactive as possible, i.e. it is "activated" quickly, so that when the bullet strikes a target, axial compression occurs as quickly as possible as a result of buckling of the nose wall at the predetermined buckling point. If the predetermined buckling point is located on the outside of the nose wall, it has also proved advantageous that the predetermined buckling point on the outside represents a safety-relevant haptic recognition feature for users.

In an exemplary embodiment of the bullet, the nose wall is provided with at least two or three predetermined buckling points arranged at a distance from one another in the longitudinal direction of the bullet. For example, the at least two or at least three predetermined buckling points are arranged at a constant distance from the tail-side cavity base to the tip of the bullet. The plurality of predetermined buckling points makes it possible to achieve a stepwise buckling behavior of the bullet in that, when the bullet strikes a target, the predetermined buckling points are activated one after the other, starting from the bullet tip, i.e. the nose wall buckles sectionally or stepwise successively at the predetermined buckling points adjoining in the longitudinal direction of the bullet. In this way, particularly effective axial compression of the bullet can be achieved. In other words, the deformation results in successive failure of the

outer shape of the bullet nose, wherein it is ensured in particular that no disintegration occurs.

In another exemplary embodiment of a bullet, the change in wall thickness is in the range from 1% to 5%, in particular in the range from 2,5% to 3,5%, of the caliber diameter. Alternatively or additionally, the change in wall thickness is in the range from 15% to 25%, in particular about 20%, of the wall thickness of the nose wall at the axial height of the predetermined buckling point. The above-mentioned preferred dimensions for the change in wall thickness have proved to be optimum with regard to the deformation behavior, in particular the axial compression of the bullet on impact with a target, without the stability of the bullet being adversely affected by excessive losses.

The nominal thickness can, for example, be realized as a groove, notch or edge and/or be produced by cold forming or, alternatively, by a metal-cutting production process.

In a further exemplary embodiment, the predetermined buckling point has a sharp-edged base receding radially inwards, provided that the predetermined buckling point is arranged on the outer side of the nose wall. In the event that the predetermined buckling point is arranged on the inner side of the nose wall, the predetermined buckling point may have a base projecting radially outwards. The base delimiting the predetermined buckling point at the tail-side may be arranged transversely with respect to the longitudinal direction of the bullet, in particular at an obtuse angle thereto. For example, the angle of the predetermined buckling point base in relation to the longitudinal axis of the bullet is in the range from 50° to 90° , in particular in the range from 60° to 85° or in the range from 70° to 85° . Alternatively or additionally, the predetermined buckling point may have a flank oriented at an acute angle with respect to the longitudinal direction of the bullet. For example, the angle may be in the range from 0° to 40° , in particular in the range from 5° to 35° or at about 30° . It should be understood that the closer the predetermined buckling points are positioned to the bullet tip and/or are arranged on a nose wall section which is increasingly tapered in the direction of the bullet tip, in particular is ogive-like shaped, instead of the longitudinal axis of the bullet as a reference line, for example, the inner side or outer side of the nose wall can be used as a reference line, depending on whether it is an

inner side or outer side predetermined buckling point. In other words, the predetermined buckling point can be shaped in such a way that, irrespective of its positioning in relation to the longitudinal direction/-axis of the bullet, the tail-side predetermined buckling point base has a significantly lower ratio of axial longitudinal extension to radial dimension compared to the front side predetermined buckling point flank.

According to a further aspect of the present invention, which can be combined with the preceding aspects and exemplary embodiments, there is provided a metallic practice cartridge bullet, in particular according to one of the preceding claims, in particular for use on, in particular police, shooting ranges, for example with a caliber of less than 20 mm, in particular of less than 13 mm or of at most 9 mm. The bullet may be formed according to any of the previously described aspects or exemplary embodiments, respectively. In this respect, the previously described features are independently applicable to the independent aspect of the present invention described below.

The bullet comprises an in particular ogive-shaped bullet nose with a central cavity and a bullet tail. With regard to preferred embodiments of the bullet nose, the cavity and the bullet tail, reference can be made to the preceding descriptions.

In accordance with a further aspect of the invention, a nose wall delimiting the cavity circumferentially tapers continuously from a tail-side cavity towards a bullet tip and/or is formed in a step-like manner. By the tapering wall thickness of the nose wall and/or its step-like design, material hardening, which is undesirable in particular because of its increased penetration performance, in the bullet nose region, in particular in the ogive region, which occurs during the production of the bullet, in particular by cold forming, can be compensated. By the material thickness tapering or the step-like design of the bullet nose weakening's on the front side can be introduced so that, for example, it can be reliably ensured that the bullet cannot penetrate a protective vest. For example, the measures according to the invention make it unnecessary to use thermal post-treatment steps such as soft annealing. By the targeted insertion in the form of the step-like formation of the bullet nose and/or weakening of the bullet nose by reducing the wall thickness in the direction of the bullet tip, a deformation of the bullet can be achieved such that a reduced cross-sectional load is produced as reliably and/or

reactively as possible as a result of the impact of the bullet on a target, so that the penetration performance of the bullet is reduced.

In an exemplary embodiment of the bullet, the cavity extends from a forward opening toward a tail-side cavity base. In this case, the wall thickness of the nose wall at the axial height of the front opening can be in the range from 10% to 50% of the wall thickness of the nose wall at the axial height of the cavity base. The reference wall thickness of the cavity base can, for example, be the wall thickness at the transition from the concave shaped cavity base into the adjoining nose side wall, which extends in particular in the longitudinal direction of the bullet.

Due to the tapering wall thickness in the direction of the bullet tip, the nose wall is deliberately increasingly weakened in the region where the bullet is increasingly material-hardened by increased deforming.

In an exemplary further development, each step is formed by a change in wall thickness in the range from 1% to 5%, in particular in the range from 2.5% to 3.5%, of the caliber diameter and/or in the range from 15% to 25%, in particular about 20%, of the wall thickness of the nose wall at the axial height of the step. The dimensioning of the change in wall thickness affects the degree of deformation and responsiveness to the impact energy of the bullet.

According to another aspect of the present invention, combinable with the preceding aspects and exemplary embodiments, there is provided a metallic practice cartridge bullet, in particular for use on, in particular police, shooting ranges, in particular having a caliber of less than 20 mm, less than 13 mm or less than 9 mm. The bullet may be formed according to any of the previously described aspects or exemplary embodiments, respectively. In this respect, the previously described features are independently applicable to the independent aspect of the present invention described below.

The bullet comprises a, in particular an ogive-shaped bullet nose, with a central cavity. The bullet nose and cavity can be formed according to one of the aspects described above or exemplary embodiments.

According to the further aspect of the invention, the wall thickness of a nose wall delimiting the cavity at the bullet tip is in the range from 0,1 mm to 2 mm, in particular in the range from 0,2 mm to 1,5 mm. For example, it may be provided that the wall thickness at the bullet tip must not be less than 0,05 mm. It has been recognized in the present case that the wall thickness at the bullet tip should be as thin as possible but as thick as necessary. The stressed areas represent the optimum in terms of manufacturability, target ballistics (deformation behavior) and stability of the bullet. The smaller the front-side wall thickness, especially at the bullet tip, of the nose wall, the less deformation energy is required to achieve fast, in particular fast-reacting, and/or reliable axial compression of the bullet. For example, 0,5 mm, in particular 0,2 mm, can be taken as the upper limit for the wall thickness.

In an exemplary embodiment, the bullet tip is formed by a circumferential, in particular planar, ring, in particular with a planar ring surface, the wall thickness or radial dimension of which is less than 2 mm, in particular less than 1,5 mm, in particular less than 1 mm, less than 0,5 mm or even less than 0,2 mm. Furthermore, it is possible that the wall thickness is smaller than 0,8 mm and/or greater than 0,5 mm.

According to a further aspect of the present invention, which can be combined with the preceding aspects and exemplary embodiments, there is provided a metallic practice cartridge bullet, in particular according to one of the preceding claims, in particular for use on, in particular police, shooting ranges, for example with a caliber of less than 20 mm, in particular of less than 13 mm or of at most 9 mm. The bullet may be formed according to any of the previously described aspects or exemplary embodiments, respectively. In this respect, the previously described features are independently applicable to the independent aspect of the present invention described below.

The bullet comprises a, in particular ogive-shaped, bullet nose with a central cavity and a bullet tail. With regard to preferred embodiments of the bullet nose, the cavity and the bullet tail, reference can be made to the preceding descriptions.

According to another aspect of the present invention, the cross-section of the cavity is point-symmetric and deviates from a circular shape. In other words, a nose wall

circumferentially delimiting the cavity has a point-symmetric inner cross-section that deviates from a circular shape. It has been found that the deformation behavior of the bullets can be adjusted or determined via the cavity inner geometry. For example, the cavity may have a polygonal, torx-like, or otherwise point-symmetric shape. For example, the cavity is solidly formed using a punch, in particular a press plunger, whose outer geometry determines the inner geometry of the cavity. In other words, the inner cross-section of the cavity is pressed into the bullet, in particular produced without machining production steps.

According to a further aspect of the present invention, which can be combined with the preceding aspects and exemplary embodiments, there is provided a metallic practice cartridge bullet, in particular according to one of the preceding claims, in particular for use on, in particular police, shooting ranges, for example with a caliber of less than 20 mm, in particular of less than 13 mm or of at most 9 mm. The bullet may be formed according to any of the previously described aspects or exemplary embodiments, respectively. In this respect, the previously described features are independently applicable to the independent aspect of the present invention described below.

The bullet comprises a, in particular ogive-shaped, bullet nose with a central cavity and a bullet tail. With regard to preferred embodiments of the bullet nose, the cavity and the bullet tail, reference can be made to the preceding descriptions.

According to another aspect of the present invention, a nose wall delimiting the cavity has on its inner and/or outer side at least one edge oriented in the longitudinal direction of the bullet. The edge may be triangular in cross-section, U-shaped, and/or rounded. The inventors of the present invention have found that, in simplified terms, axial edges can also be used to advantageously influence the deformation behavior of the bullets, in particular to improve the desired compression to reduce the cross-sectional load. Axial edges also cause reductions in wall thickness in the nose wall, which leads to local weakening so that when the bullet impacts a target, the nose wall is reliably deformed.

According to an exemplary further development, the edge is formed as a notch, in particular produced by machining production steps, and/or the nose wall has a

plurality of edges arranged at a, in particular uniform, distance from one another in the circumferential direction. For example, the edges are arranged point-symmetrically to one another. This makes it possible to achieve particularly uniform, symmetrical compression of the bullet.

According to a further exemplary embodiment, the nose wall has, on its inner or outer side or both on the inner and outer sides, at least one circumferentially oriented, in particular completely, circumferential, notch. For example, at least two or at least three notches arranged at a, in particular uniform, distance from one another are provided. The notches can, for example, act as predetermined breaking points and be introduced into the wall by machining. For example, the notches may already have been introduced during the production of a preliminary or intermediate product, in particular intermediate, for the production of the final bullet. The notches can be introduced and/or arranged in such a way that the deformation behavior of the bullet can be adjusted.

In an exemplary further development, the notch depth is at most 60% of the wall thickness of the nose wall. The wall thickness at the axial height of the respective notch can be used as a reference. For example, the notch depth can be at least 10% or at least 15% or at least 20% of the wall thickness of the nose wall at the axial height of the corresponding notch. The cross-section of the notch can in principle be of any shape. However, the inventors of the present invention have also found that the cross-section of the notch can be used to further adjust, in particular fine-tune, the deformation behavior. For example, the notch has a front-side, elongated flank which merges into a short, sharp notch base at, in particular, an acute angle. The notch base may have a larger radial- as well as axial dimension. The flank has a larger axial- than radial dimension.

In another exemplary embodiment of the present invention, the metal- or iron bullet body is subjected to a heat treatment process, in particular an annealing step. For example, the temperature may be in excess of 600°C, in particular 650°C. Further, the heat treatment process may be undertaken for a period of time of several hours approximately 4,5 hours. Through the heat treatment process, in particular heat post-treatment step, the deformation behavior of the bullet can be changed or adjusted. By

means of the heat treatment, it is possible, for example, to compensate for, in particular to neutralize, the material hardening that occurs during the, in particular cold forming, production of the bullet nose, in particular during ogive forming. For example, by means of the parameter's temperature and duration, the heat treatment process can influence the adjustment of the deformation behavior.

According to an alternative embodiment, the bullet is produced without a heat treatment process. In particular, the bullet, in particular the bullet nose, is not annealed, especially not soft-annealed.

In another exemplary embodiment, the bullet is made of iron, in particular soft iron, for example steel. A carbon content may be, for example, more than 0,05% and/or at most 1,14% or 0,12%.

In another exemplary embodiment, the central cavity of the bullet is produced by solid forming, in particular by cold forming, such as deep drawing or extrusion. For example, the entire bullet is produced by means of solid forming, in particular by cold forming, such as deep drawing or extrusion. The production of the bullet makes it possible, based on a metal wire or metal blank, to produce a bullet in a manufacturingly simple manner. Waste can be avoided.

In another aspect of the present invention, which is combinable with the foregoing aspects of the exemplary embodiments, there is provided a metallic intermediate for the production of a practice cartridge bullet, in particular for use on, in particular police, shooting ranges, in particular according to any of the foregoing aspects or exemplary embodiments, comprising a ductile base body or blank, for example of iron. In this respect, the previously described features are independently applicable to the independent aspect of the present invention described below. The base body may be made of a homogeneous metal material such as copper, copper alloy, brass, preferably iron, such as steel. Preferably, the base body is made of a lead-free material. The base body may be made from a cut blank, which may in particular be formed from a cut ductile metal material.

According to the invention, the base body is cold-massively deformed into the intermediate by means of pressing, in particular by means of deep-drawing or

extrusion, for example using a punch-die arrangement. The base body or blank to be deformed into the intermediate forms a cylindrical, solid base end section and an adjoining press end section with a central press recess introduced by pressing, which can form the front-side bullet cavity present on the final bullet. The base end section may include a substantially planar front surface to be facing the bullet case. The press end section, which is diametrically opposite the base end section in the axial direction of the bullet, has a wall delimiting the press recess for forming a, in particular an ogive-shaped, bullet nose.

According to the further aspect of the invention, the wall of the press end section has a stair contour on the inside and/or outside. For example, the stair contour is produced by cold forming, in particular by means of the punch-die arrangement. The stair contour can, for example, be formed by a, in particular uniform, sequence of steps, in particular in the longitudinal direction of the bullet. For example, the wall tapers progressively toward the open press section end, which is diametrically opposite the planar base surface of the solid base end section. By providing the stair contour, it is possible on the one hand to achieve in a technically simple manner that the wall thickness of the wall increasingly tapers towards the bullet nose, so that the material hardening which increases towards the bullet nose and which occurs during the production, in particular cold-forming production, of the bullet nose is compensated or neutralized. Furthermore, the stair contour has the effect that predetermined buckling points or notches or indentations are provided in the bullet nose wall in the final bullet, at which the nose wall is further weakened, in particular to the effect that the impact of the bullet on a target is accompanied by buckling or folding, in particular axial compression, of the wall.

In an exemplary embodiment of the intermediate, the stair contour has at least two or at least three steps arranged in a, in particular constant, distance from one another in the longitudinal direction of the bullet. The steps can be realized in the same way in terms of their dimensions. This means that a radial shoulder of the steps may be equally dimensioned with respect to the wall thickness prevailing at the respective axial height. For example, a change in wall thickness is formed at each step, which is in the range from 1% to 5%, in particular in the range from 2,5% to 3,5%, of the caliber diameter of the spinal bullet and/or in the range from 15% to 25%, in particular at

about 20%, of the wall thickness of the nose wall at the axial height of the respective step. The intermediate may further be formed such that its maximum outer diameter, which is present, for example, in the region of the rear base end section, substantially corresponds to the final caliber diameter of the final bullet.

According to a further exemplary embodiment of the intermediate according to the invention, the stair contour has at least one step. The at least one step can have a step base receding radially inwardly or projecting radially outwardly and oriented substantially transversely to the longitudinal direction of the intermediate and/or a step flank, substantially perpendicularly adjoining it. The at least one step may be formed for forming the predetermined buckling point, notch or indentation in the final bullet. For example, a longitudinal extension of the step flank is greater than a radial extension of the step base. For example, the longitudinal extent of the step flank may be at least 50%, 75% or at least 100% greater than the radial extension of the step base.

According to a further exemplary further development, the press recess extends from a front opening, which is in particular diametrically opposite the planar end face of the base end section, without forming an undercut in the direction of a tail-side, in particular planar press recess base. For example, the press recess has a constant cylindrical cross-section. The cross-section may, for example, be rotationally symmetrical and deviate from a round shape, for example polygonal, torx-like, or otherwise shaped.

According to another exemplary embodiment, the intermediate has a substantially constant outer diameter. For example, the outer diameter is selected or produced so that it substantially corresponds to the caliber of the final bullet.

In another aspect of the present invention, which is combinable with the foregoing aspects of the exemplary embodiments, there is provided a metallic intermediate for producing a practice cartridge bullet, in particular for use on, in particular police, shooting ranges, in particular according to any of the foregoing aspects or exemplary embodiments, comprising a ductile base body or blank, for example of iron. In this respect, the previously described features are independently applicable to the independent aspect of the present invention described below. The base body may be made of a homogeneous metal material such as copper, copper alloy, brass, preferably

iron, such as steel. Preferably, the base body is made of a lead-free material. The base body may be made from a cut blank, which may in particular be formed from a cut ductile metal material.

According to the invention, the base body is cold-massively deformed into the intermediate by means of pressing, in particular by means of deep-drawing or extrusion, for example using a punch-die arrangement. The base body or blank to be deformed into the intermediate forms a cylindrical, solid base end section and an adjoining press end section with a central press recess introduced by pressing, which can form the front-side bullet cavity present on the final bullet. The base end section may include a substantially planar front surface to be facing the bullet case. The press end section, which is diametrically opposite the base end section in the axial direction of the bullet, has a wall delimiting the press recess for forming a, in particular ogive-shaped, bullet nose.

According to a further aspect, the press end section has a wall of substantially constant wall thickness delimiting the press recess for forming a, in particular ogive-shaped, bullet nose. The constant wall thickness of the press recess wall has been found to be particularly advantageous with respect to low cost and ease of production of the final bullet. Furthermore, it has been found that the formation of a constant wall thickness and the associated avoidance of weakening's, tapering's, which could act as predetermined breaking points or the like in the final bullet, can prevent the bullet from disintegrating in the sense of a fragmentation bullet. In this respect, the press recess wall may have an annular cylindrical structure or a sleeve structure with constant inner and outer dimensions. Furthermore, the extension of the press recess wall may be parallel to the longitudinal axis of the intermediate, in particular concentric to its center axis.

According to a further aspect of the present invention, which is combinable with the preceding aspects and exemplary embodiments, there is provided a method as well as also a tool for producing a bullet formed according to one of the preceding claims, in particular by means of a metallic intermediate, in particular according to the invention, according to one of the previously described aspects or exemplary embodiments, in particular in a punch-die arrangement. In this respect, the previously described

features are independently applicable to the independent aspect of the present invention described below.

Preferred embodiments are given in the subclaims.

In the following, further properties, features and advantages of the invention will become clear by means of a description of preferred embodiments of the invention with reference to the accompanying exemplary drawings, in which show:

- | | |
|---------------|--|
| Figure 1 | a sectional view of an exemplary embodiment of an intermediate according to the invention for producing a practice cartridge bullet, in particular according to the invention; |
| Figure 2 | a sectional view of a practice cartridge bullet according to the invention made from the intermediate according to Figure 1; |
| Figure 3 | another exemplary embodiment of an intermediate according to the invention; |
| Figure 4 | a sectional view of a practice cartridge bullet according to the invention made from the intermediate of Figure 3; |
| Figure 5 | a schematic production step for producing a bullet according to the invention; |
| Figures 6-8 | schematic sectional views of Figure 5; |
| Figures 9-18 | perspective views of exemplary embodiments of intermediates for producing practice cartridge bullets; |
| Figures 19-23 | a schematic stage plan for producing an exemplary embodiment of a practice cartridge bullet according to the invention starting from a blank; |
| Figures 24-26 | another schematic stage plan for producing a further exemplary embodiment of a bullet according to the invention; and |
| Figures 27-32 | schematic side views of exemplary embodiments of practice cartridge bullets according to the invention. |

With reference to the following description of exemplary embodiments of the present invention with reference to the accompanying figures, the advantages according to the invention will become clear and further features of the present invention will become apparent. Bullets illustrated in the figures are practice cartridge bullets generally provided with the reference numeral 1, in particular for police shooting ranges, for example, with a caliber of less than 20 mm, in particular less than 13 mm or at most 9 mm. The bullets are made of metal, preferably iron. The same applies to the intermediate products and intermediates in the production sequence in the production of the bullets 1 according to the invention.

Figure 1 shows a schematic sectional view of an exemplary embodiment of an intermediate 10 according to the invention. The intermediate 10 generally represents a preliminary stage or intermediate product in the production of practice cartridge bullets 1 according to the invention from blanks, for example in the form of solid metallic bodies. The intermediate 10 basically comprises a ductile base body 47 or blank section, for example of iron, which is cold-massively deformed into the intermediate 10 by means of pressing. The intermediate 10 has a cylindrical base end section 49 and an adjoining press end section 51. The base end section 49 has a planar face side 53 that forms the bullet bottom 45 in the final bullet 1 (Figure 2). The press end section 51 comprises a central press recess in the form of a cavity 5 introduced by pressing and a jacket wall 25 delimiting the cavity 5, which is adapted to be deformed, in particular ogivoidally, to form the bullet nose 27 (Figure 2). The base end section 49 substantially forms the bullet tail 39 (Figure 2). The press end section 51 is formed open to one side of the intermediate, namely the opposite side with respect to the face side 53. In other words, the cavity 5 extends from a front opening 53 toward a rear-side cavity base 55.

According to an aspect in accordance with the invention, the intermediate 10 according to Figure 1 comprises a stair contour provided on the outer side of the jacket wall 25 in the region of the press end section 51, which is generally identified by the reference numeral 57. The stair contour comprises two steps 59, which are arranged at a distance from one another with respect to the longitudinal direction of the intermediate, or are arranged one behind the other. At each step 59, which has a step base 61 receding substantially radially inwardly and a step flank 63 oriented substantially in the longitudinal direction of the intermediate 10, there is a reduction in wall thickness of

the intermediate 10 in the region of the press end section 51. The change in wall thickness at each step at the axial height of the respective step is in the range from 15% to 25% of the wall thickness of the wall 25 at the axial height of the step. The intermediate 10 can be produced entirely by cold forming, in particular pressing, for example in a punch-die arrangement (not shown), in particular without machining production steps.

Referring to Figure 2, a schematic sectional view of a practice cartridge bullet according to the invention is shown, which is produced according to the intermediate 10 of Figure 1. The bullet tail 39, fabricated from the base end section 49, includes a centering recess 21 formed in the bullet bottom 45 that is substantially triangular in cross-section. A circumferential chamfer 43 may further be introduced in the region of the bullet bottom 45. In addition, the bullet tail 39 is made of solid material and has, at least sectionally, a guide band 89 (Figure 27; not shown in Figure 2) for engagement with the land-and-groove profile in the gun barrel.

In contrast to the bullet tail 39, the bullet nose 27 formed from the press end section 51 is hollow and includes a bullet cavity 31 and a nose wall 33 circumferentially delimiting the bullet cavity 31 and formed from the wall 25 of the intermediate 10.

The nose wall 33 is in particular ogivoidal in shape and leads into a bullet tip 35, which delimits the one front-side opening 63, which, however, may also be substantially, in particular completely, closed. The nose wall 33 may taper substantially continuously in the direction of the bullet tip 35. The cavity 31 may, for example, have a planar cavity base 65 as viewed at least in sections transversely to the longitudinal extension of the bullet 1, which may also be concave in shape. The concave or planar cavity base region 65 leads into an outer cavity base region 67 of greater curvature relative to the cavity base region 65. The concave curved outer cavity base section 67 merges at a transition 69 into a cavity sidewall 71, which is oriented substantially at or at an acute angle relative to the longitudinal direction of the bullet. For example, in the region of the front-side opening 35, the nose wall 33 may have a wall thickness in the range from 10% - 50% of the wall thickness in the nose wall 33 at the axial height of the cavity base 65 in the region of the transition 69 between the cavity and the side wall 71 and outer cavity base section 67. The wall thickness a in Figure 2 indicates the wall thickness in

the region of the front-side opening 35 and the reference sign b indicates the wall thickness in the region of the transition 69 of the nose wall 33.

Two predetermined buckling points or notches 73 are formed in the nose wall 33 at a distance from one another in the longitudinal direction of the bullet. The predetermined buckling points or notches 73 are results of the stair contour 57 of the intermediate 10. The forming of the intermediate 10 into the bullet 1, wherein the jacket wall 25 is increasingly bent radially inwards towards the bullet tip 35 for forming the bullet nose and in particular the nose wall 33, results in the predetermined buckling points or notches 73 shown schematically in Figure 2, which have an exemplary V-shaped or triangular cross section. At the predetermined buckling points 73, the wall thickness of the nose wall 33 decreases abruptly. The reduction in wall thickness is, for example, in the range from 1% to 5% of the caliber diameter and/or in the range from 15% to 20% of the wall thickness of the nose wall 33 at the axial height of the predetermined buckling points 73.

The predetermined buckling point 73 comprises a radially inwardly receding base 75, which is substantially responsible for the wall thickness reduction, and an elongated flank 77 oriented at an acute angle with respect to the longitudinal axis of the bullet. The flank 77 merges continuously with the outer contour of the nose wall 33. As can be seen in Figure 2, the flank 77 comprises a significantly greater extension in the longitudinal direction of the bullet 1 than transversely thereto in the radial direction. The base 55 is oriented substantially in the radial direction and thus has only a slight axial extension, if any, in the longitudinal direction of the bullet. However, if one considers the predetermined buckling point 73, which is located closer in the region of the bullet nose 35 and is thus provided at a position of the nose wall 33 which is more curved, it can be seen that it is quite possible for the base 75 also to have an axial component in its longitudinal extent, which results due to the radially inward bending of the nose wall 33.

Figures 3 and 4 show further exemplary embodiments of the present inventions, wherein Figure 3 shows an alternative embodiment of an intermediate 10 according to the invention and Figure 4 shows an alternative embodiment of a bullet 1 according to the invention, which is made from the intermediate 10 of Figure 3. The essential difference of the intermediate 10 of Figure 3 compared to the intermediate 10 of Figure

1 is that the stair contour 57 is provided on the inner side in the cavity 5. For example, the inner side stair contour 57 can be produced via a suitably shaped, stepped press plunger 3 (Figure 5), in particular using a punch-die arrangement (not shown). The individual steps 59 of the inner side stair contour 57 comprise a radially outwardly projecting or protruding step base 61 and an adjoining step flank 63, which in turn is oriented substantially in the longitudinal direction of the intermediate. The nose wall 25 is formed in a step-like manner analogous to the embodiment according to Figure 1 and tapers with respect to its wall thickness in the direction of the front-side opening 63 or the bullet tip 35.

Referring to Figure 4, it can be seen that inner side predetermined buckling points or notches 73 are produced from the inner side stair contour 57, which are again provided circumferentially and at which the wall thickness of the nose wall 33 decreases abruptly. It should be understood that a combination of outer- and inner-side stair contour 57 is equally possible at the intermediate in order to produce inner- and outer-side predetermined buckling points or notches 73 in the nose wall 33 at the finished bullet 1. In this way, the effect of axial compression of the bullet 1 on impact with a target can be further amplified, since the nose wall is weakened both on the inner side and on the outer side in such a way that predetermined buckling points are formed at which the nose wall specifically buckles and folds on impact with a target.

Figure 5 schematically shows a production step, namely a solid forming step, in the production of bullets according to the invention, which are generally identified by the reference numeral 1. A combination of Figures 6 to 8 and 5 shows a particularly simple way of producing internal geometries of bullets of any cross-sectional shape. This is achieved in that the final cavity geometry or its cross-section can be generated by means of a stamping tool 3 which is pressed axially into an intermediate or blank forming the bullet 1, for forming a central, front-side cavity 5.

Figures 6 to 8 show associated schematic cross-sectional views showing the outer shape of the press plunger 3 and the inner cross-sectional shape of the cavity 5. The press plunger 3 as well as the cavity are point-symmetrical in cross-section, wherein a circular cross-sectional shape results according to Figure 8, and polygonal cross-sectional shapes in Figures 6 and 7. Due to the axial press formation by means of the press plunger 3, the cavity cross section 5 is substantially constant when viewed in the

longitudinal direction of the bullet. Thus, the polygonal cavity inner geometry results in axial edges 7 formed along the complete longitudinal extension of the cavity 5 on an inner side of a nose wall 9 surrounding the cavity 5. A general advantage of the present invention is that the bullet geometry can be adapted very flexibly during solid forming. In particular, any internal geometry can be easily produced by simply adapting the outer shape or contour of the elongated substantially cylindrical.

Figures 9-18 illustrate further exemplary embodiments of possible interior bullet geometries on exemplary intermediates 10. For example, star-shaped internal geometries corresponding to Figures 9, 11, 14 and 16 are possible. The star geometries of Figures 14 and 16 differ from the star geometries of Figures 9 and 11 in particular in that, on the one hand, the star-shaped notches 6, the tip of each of which forms the axial edges 7, are distributed in the circumferential direction and are arranged at a distance from one another, so that two adjacent star-shaped notches 6 are separated from one another by an arcuate, in particular step-shaped free wall section 8. Figures 10 and 12 show polygonals in the geometries, wherein the inner geometries of Figures 13 and 15 are also basically polygonal in shape, but have concavely or convexly curved circumferential sections 10, each connecting two adjacent axial edges with each other. Figures 17 and 18 show two further internal geometries having a torx-like geometry, wherein according to Figure 17 a plurality of circumferentially distributed teeth 12 are provided having a frustoconical tapering section 14 and an adjoining substantially constant tooth section 16 having a substantially U-shaped cross-section. The internal geometry as shown in Figure 18 comprises a plurality of substantially U-shaped teeth substantially directly merging with each other, wherein a sharp-edged transition 16 connects two adjacent teeth 12 with each other.

With reference to Figures 19 to 23, which show a stage plan for the production of a bullet 1 according to the invention, the individual production steps become apparent. First, a blank 11 of metal, preferably iron, is provided (Figure 19), which is obtained from continuous raw material, such as a wire or tube, by cutting. The blank 11 is made of a particularly homogeneous material and is constructed in one piece, in particular from solid material.

In a first production step, the blank 11 is cold-formed into a set workpiece 13 by setting, for example by pressing (Figure 20a). As can be seen from a comparison of Figures 5

and 6, setting is accompanied by an expansion in length of the intermediate product, wherein the outer diameter remains substantially constant. The increase in length results from the central recess 15 introduced at an end face 17 of the set workpiece 13 during setting, which causes a displacement of material that is manifested in an expansion in length. Opposite the recess 15, that is, on the opposite face side 23, is a centering recess 21. Setting can be performed via a punch-die arrangement (not shown), wherein the punch outer geometry determines the recess inner geometry 15. A jacket wall 25 surrounding the recess 15 is further deformed in subsequent steps to form the subsequent bullet nose 27.

After setting, the set workpiece 13 is prepressed to form a preform 29 (Figure 20b). The set workpiece 13 is formed in the region of the jacket wall 25 for forming the preform 29, so that the final cavity geometry of the front cavity 31 of the bullet 1 is already obtained. The ring-cylindrical jacket wall 25 is deformed into a nose wall 33 which tapers at least sectionally in the shape of an ogive. As a result of the nose wall 33 tapering towards the bullet tip 35, i.e. decreasing in wall thickness, the longitudinal dimension of the bullet or the longitudinal dimension of the section forming the later bullet nose 27 is extended relative to the jacket wall 25.

The preform 29 is then further cold-formed for forming a cylindrical blank 37 shown in Figure 21, which for the most part already has the complete geometry of the final bullet 1. The cylindrical blank 37 is compressed in the axial direction starting from the preform 29, wherein the cavity interior geometry 31 is maintained. Due to the axial compression of the preform 29, the diameter at the cylindrical blank 37 increases. The cylindrical blank 37 has a fully cylindrical section 41 comprising substantially of solid material and arranged in the region of the later bullet tail 39, which is formed over a large part of the longitudinal extension of the cylindrical blank up to the ogive-like tapering of the nose jacket 33.

The bullet tail 39 can be further processed by cold forming steps. For example, a chamfer 43, which is circumferential, can be introduced at the tail-side (Figure 22).

The final bullet 1 (Figure 23) has a substantially planar bullet bottom 45 at the tail-side, in the center of which the centering recess 21 is located. Furthermore, it is possible that the bullet tail is for the most part no longer fully cylindrical, but deviates for the most

part from a cylindrical shape and is cylindrical only in regions, in particular in a region defining the guide band, which defines the caliber. In other respects, for example, the outer diameter of the bullet tail can be slightly reduced starting from the guide band in the direction of the bullet bottom 45.

In order to produce the final practice cartridge bullet, the preliminary stage shown in Figure 22 is subjected to a further forming step, in particular a cold forming step such as a pressing step, in the region of the bullet nose 27. The nose wall 33 is formed by bending the front-side wall 25 radially inwards so that the nose increasingly tapers towards the tip of the bullet. As exemplified in Figure 23, the bullet nose can also substantially close, which is achieved by contact of the annular bullet opening tip 35. It should be understood that the schematically illustrated staging plan is correspondingly applicable to fabrications of bullets 1 as illustrated in Figures 2 and 4, i.e., with stair contour 57 in the intermediate production step and nominal buckling points or notches 73 on the inside and/or outside of nose wall 33.

Figures 24 to 26 show a further schematic summarized staging plan showing the production of a further exemplary embodiment of a bullet 1 according to the invention (Figure 26) starting from an intermediate 10 (Figure 24), which is intermediately formed according to Figure 25 to form an interim intermediate 10'.

Like the intermediates 10 of Figures 1 and 3, the intermediate 10 of Figure 24 comprises a solid base end section 49 which is substantially fully cylindrical. In the longitudinal direction, this is immediately followed by the press end section 51, which is significantly more elongated than in Figures 1 and 3. Comparing the intermediate 10 of Figure 24 with the intermediate 10 of Figures 1 and 3, it is apparent that the intermediate 10 of Figure 24 comprises, instead of the stair contour 57, an inner side circumferential edge 79 at which the inner wall 81 of the jacket wall 25 changes from a substantially rectilinear extension oriented in the longitudinal direction of the intermediate to an acute angle with respect to the longitudinal direction of the intermediate. In this respect, the jacket wall 25 has a front-side annular cylindrical section 83 and an adjoining tail-side section 85 with frustoconical cross-section. In other words, the wall thickness of the jacket wall 25 increases continuously starting from the circumferential edge 79 in the rear-side direction to the cavity base 55.

In Figure 25, the intermediate 10 from Figure 24 is formed into an interim intermediate 10' as an intermediate stage to the finished bullet 1 according to Figure 26. Compared to the intermediate 10 of Figure 24, the interim intermediate 10' is compressed in the axial direction in such a way that, on the one hand, the jacket wall 25 is rounded on the outer side in the region of the opening 53 at the front-side, resulting in a rounded section 87, and, on the other hand, in such a way that the outer diameter of the intermediate 10', starting from the rear-side 54, is continuously reduced in the direction of the opening 53 at the front-side. The cavity interior geometry is formed substantially analogously to Figure 24. Starting from the interim intermediate 10' for producing the bullet 1 in Figure 26, the jacket wall 25 is bent radially inwards in analogy to the production step between Figure 22 and Figure 23, in order to form a, in particular ogive-shaped, bullet nose 33. In Figure 26, it can be seen that the cavity section at the tail-side, which is surrounded by a nose wall 33 of frustoconical cross-section, is substantially retained.

Figures 27 to 32 show schematic perspective views of final practice cartridge bullets 1. The bullet 1 of Figure 27 comprises the bullet tail 39, which has a guide band 89 adapted to engage the land-and-groove profile of a firearm barrel. The, in particular ogive-shaped, bullet nose 33 is arranged at the front-side of the practice band 39 and leads into a bullet front or tip 35, which can be closed or open. A bullet centerline M is shown by a dashed line. In Figure 27 it can be seen that the bullet 1 has no structural features according to the invention on its outside for influencing or desired adjustment of the deformation behavior, in particular the target ballistics. The cavity or internal geometry of the bullet, which is not shown, can be shaped as shown in Figure 4, for example.

The bullet nose 33 leads at the tail-side into the guide band 89, wherein an angular transition 91 can be provided between bullet nose 33 and guide band 89, at which the outer diameter of the bullet increases abruptly, wherein the guide band 89 generally defines or establishes the bullet caliber. In other words, the maximum outer diameter of the bullet 1 is present in the region of the guide band 89. At the tail-side of the guide band 89, a circumferential outer contour recess 93 is formed, at which the outer diameter of the bullet is continuously decreased and which is immediately followed by a substantially cylindrical section 95 of the bullet tail 39. Due to the radially outwardly projecting guide band 89, it is ensured that the bullet 1 engages the land profile of the

firearm barrel substantially exclusively with the guide band 89, which reduces the engagement and/or sliding contact between the bullet 1 and the firearm barrel. Thus, the penetration resistance of the bullet is reduced.

Referring to Figure 28, an exemplary embodiment of a practice cartridge bullet 1 according to the invention is illustrated, which differs from the embodiment according to Figure 27 in that it has external, circumferential predetermined buckling points or notches 73 in the bullet nose 33. For the rest, reference can be made to the preceding embodiments.

In the embodiment of the bullet according to Figure 29, it can be seen that axial edges can also be introduced in the bullet nose 33 in addition, or alternatively is also possible, to the outer side, circumferential predetermined buckling points or notches 73, wherein a distinction is to be made between outer side axial edges 97 and inner side axial edges 99 indicated by a broken line. The inner side axial edges 99 result, for example, from the polygonal intermediate interior geometry as indicated in Figures 6, 7 and 9 to 18, respectively.

The bullets 1 of Figures 30 to 32 each have two external, circumferential predetermined buckling points or notches 73 and differ from one another with regard to the axial position of the predetermined buckling points or notches 73 in relation to the longitudinal axis of the bullet. From experiments and simulations on the deformation of bullets 1 on impact with hard targets in particular, in which the axial compression distance was set as a function of the deformation energy, it was found that the effect of the outer side predetermined buckling points or notches 73 is amplified when the front predetermined buckling point or notch 73, which is located closer to the bullet tip, is increasingly positioned in the direction of the bullet tip. In particular, it was found that although the diameter of the deforming bullet 1 does not increase more rapidly, the deformation energy is minimized so that, as a consequence, the flattening of the bullet 1 occurs more rapidly in an advantageous manner.

The features disclosed in the foregoing description, figures, and claims may be significant, both individually and in any combination, for the realization of the invention in the various embodiments.

REFERENCE LIST

1	Bullet
3	Press plunger
5	Cavity
6	Star shaped notch
7	Axial edge
8	Circumferential section
9	Nose wall
10, 10'	Intermediate
11	Blank
12	Tooth
13	Set workpiece
14	Tapering section
15	Recess
16	Tooth section
17	Face side
18	Sharp-edged transition
21	Centering recess
23	Face side
25	Jacket wall
27	Bullet nose
29	Preform
31	Cavity
33	Nose wall
35	Bullet tip
37	Cylindrical blank
39	Bullet tail
41	Cylindrical section
43	Chamfer
45	Bullet bottom

47	Base body
49	Base end section
51	Press end section
53	Front-side opening
55	Cavity base
57	Stair contour
59	Step
61	Step base
63	Step flank
65	Bullet cavity base
67	Concave cavity base section
69	Transition
71	Cavity sidewall
73	Predetermined buckling point or notch
75	Base
77	Flank
79	Inner circumferential edge
81	Inner wall
83	Ring cylindrical wall section
85	Frustoconical wall section
87	Rounding section
89	Guide band
91	Transition
93	Outer contour recess
95	Cylindrical section
97	Outer side axial edge of bullet
99	Inner side axial edge of bullet
M	Center axis

CLAIMS

1. Metallic practice cartridge bullet (1), in particular for use on, in particular police, shooting ranges, comprising a, in particular ogive-shaped, bullet nose (27) with a central cavity and a bullet tail (39), wherein the bullet (1) is made of iron, in particular soft iron, with a carbon content of more than 0,05%.
- 5 2. Bullet (1) according to claim 1, wherein the carbon content is in the range from 0,06% to 1,14%, in particular in the range from 0,08% to 0,12%.
3. Bullet (1) according to claim 1 or 2, which is made of a material comprising, in addition to iron, at least one further transition metal, for example selected from the group comprising manganese and copper, in particular at a mass fraction
10 from 0,01% to 1,2% or from 0,3% to 1%.
4. Bullet (1) according to one of the preceding claims, wherein the iron of the bullet comprises at least one additive selected from the carbon group, the nitrogen group and/or the oxygen group, wherein in particular the at least one additive is a semimetal, in particular silicon, and/or has a weight percentage of
15 at least 0,01% to at most 0,48%.
5. Bullet (1) of any one of the preceding claims, wherein the iron has a manganese content from 0,01% to 0,8%, in particular from 0,03% to 0,6%.
6. Bullet (1) according to any one of the preceding claims, wherein the iron has a silicon content of less than 0,5%, in particular less than 0,4% or less than 0,3%.
- 20 7. Bullet (1) according to any one of the preceding claims, wherein the iron has a phosphorus content in the range from 0,01% to 0,04%, in particular in the range from 0,02% to 0,03%.
8. Bullet (1) according to any one of the preceding claims, wherein the iron has a sulfur content in the range from 0,01% to 0,04%, in particular in the range
25 from 0,02% to 0,03%.

9. Bullet (1) according to any one of the preceding claims, wherein the iron has a copper content of less than 0,4%, in particular less than 0,3% or less than 0,25%.
- 5 10. Metallic practice cartridge bullet (1), in particular according to one of the preceding claims, in particular for use on, in particular police, shooting ranges, comprising a, in particular ogive-shaped, bullet nose (27) with a central cavity and a bullet tail (39), wherein a nose wall (33) delimiting the cavity circumferentially is provided on its inner and/or outer side with at least one circumferential predetermined buckling point (73) at which the wall thickness
10 of the nose wall (33) decreases abruptly.
11. Bullet (1) according to claim 10, wherein the nose wall (33) is provided with at least two or three predetermined buckling points arranged at a distance from one another in the longitudinal direction of the bullet.
- 15 12. Bullet (1) according to claim 10 or 11, wherein the change in wall thickness is in the range from 1% to 5%, in particular in the range from 2,5% to 3,5%, of the caliber diameter and/or in the range from 15% to 25%, in particular about 20%, of the wall thickness of the nose wall (33) at the axial height of the predetermined buckling point (73).
- 20 13. Bullet (1) according to any one of claims 10 to 12, wherein the predetermined buckling point (73) has a sharp-edged base (75) receding radially inwards or projecting radially outwards and/or a flank (77) oriented at an acute angle with respect to the longitudinal direction of the bullet.
- 25 14. Metallic practice cartridge bullet (1), in particular according to one of the preceding claims, in particular for use on, in particular police, shooting ranges, comprising a, in particular ogive-shaped, bullet nose (27) with a central cavity and a bullet tail (39), wherein a nose wall (33) delimiting the cavity circumferentially tapers continuously from a tail-side cavity base towards a bullet tip (35) and/or is formed in a step-like manner.
- 30 15. Bullet (1) of claim 14, wherein the cavity extends from a front-side opening (53) toward a tail-side cavity base and the wall thickness of the nose wall (33) at the axial height of the front opening (53) is in the range from 10% to 50% of the wall thickness of the nose wall (33) at the axial height of the cavity base.

16. Bullet (1) according to claim 14 or 15, wherein each step (59) is formed by a change in wall thickness in the range from 1% to 5%, in particular in the range from 2,5% to 3,5%, of the caliber diameter and/or in the range from 15% to 25%, in particular of about 20%, of the wall thickness of the nose wall (33) at the axial height of the step (59).
17. Metallic practice cartridge bullet (1), in particular according to one of the preceding claims, in particular for use on, in particular police, shooting ranges, comprising a, in particular ogive-shaped, bullet nose (27) with a central cavity, wherein the wall thickness of a nose wall (33) delimiting the cavity at the bullet tip (35) is in the range from 0,1 mm to 2 mm, in particular in the range from 0,2 mm to 1,5 mm.
18. Bullet (1) according to one of the preceding claims, wherein the bullet tip (35) is formed by a circumferential, in particular planar, ring, the wall thickness of which is less than 1 mm or than 0,8 mm and/or greater than 0,5 mm.
19. Metallic practice cartridge bullet (1), in particular according to one of the preceding claims, in particular for use on, in particular police, shooting ranges, comprising a, in particular ogive-shaped, bullet nose (27) with a central cavity which is delimited at the tail-side by a cavity base, and a bullet tail (39), wherein the cross-section of the cavity base is point-symmetrical and deviates from a circular shape.
20. Metallic practice cartridge bullet (1), in particular according to one of the preceding claims, in particular for use on, in particular police, shooting ranges, comprising a, in particular ogive-shaped, bullet nose (27) with a central cavity which is delimited at the tail-side by a cavity base, and a bullet tail (39), wherein a nose wall (33) delimiting the cavity has on its inner and/or outer side at least one edge oriented in the longitudinal direction of the bullet.
21. Bullet (1) according to claim 20, wherein the edge is formed as a notch and/or wherein the nose wall (33) has a plurality of edges arranged at a, in particular uniform, distance from one another in the circumferential direction.
22. Bullet (1) according to one of the preceding claims, wherein the nose wall (33) has, on its inner or outer side, at least one circumferentially oriented, in

particular completely circumferential, notch, in particular at least two or at least three notches arranged at a distance from one another.

23. Bullet (1) of claim 22, wherein the notch has a notch depth of at most 60% of a wall thickness of the nose wall (33).
- 5 24. Bullet (1) according to one of the preceding claims, wherein the metal or iron bullet body is subjected to a heat treatment process, in particular annealing, for example at a temperature above 600 °C, in particular at 650 °C, and/or for a period of about 4,5 h.
25. Bullet (1) according to any of the preceding claims, which is produced without a
10 heat treatment process, in particular annealing.
26. Bullet (1) according to one of the preceding claims, the central cavity of which is produced by solid forming, in particular by cold forming, such as deep drawing or extrusion, wherein in particular the bullet (1) is produced by means of solid forming, in particular by cold forming, such as deep drawing or extrusion.
- 15 27. Metallic intermediate (10) for the production of a practice cartridge bullet, in particular according to one of the preceding claims, in particular for use on, in particular police, shooting ranges, comprising a ductile blank, for example of iron, which is cold-massively deformed into the intermediate (10) by means of pressing, a cylindrical solid base end section (49) and a press end section (51)
20 with a central press recess introduced by pressing and a wall delimiting the press recess for forming a, in particular ogive-shaped, bullet nose, the inside and/or outside of which has a stair contour (57).
28. Intermediate (10) according to claim 27, wherein the stair contour (57) has at least two or three steps (59) arranged at a distance from one another in the
25 longitudinal direction of the bullet, wherein in particular at each step (59) a change in wall thickness is formed which lies in the range from 1% to 5%, in particular in the range from 2,5% to 3,5%, of the outer diameter and/or in the range from 15% to 25%, in particular at about 20%, of the wall thickness of the wall at the axial height of the step (59).
- 30 29. Intermediate (10) according to claim 27 or 28, wherein the stair contour (57) comprises at least one step (59) and the at least one step (59) comprises a step

base (61) receding radially inwardly or projecting outwardly and oriented substantially transversely to the longitudinal direction of the intermediate and/or a step flank (63) oriented substantially in the longitudinal direction of the intermediate, in particular perpendicularly adjoining the step base (61).

- 5 30. Intermediate (10) according to any one of claims 27 to 29, wherein the press recess extends from a front opening (53) without forming an undercut in the direction of a tail-side, in particular planar, press recess base, wherein in particular the press recess has a constant cylindrical cross-section.
- 10 31. The intermediate (10) of any one of claims 27 to 30, having a substantially constant outer diameter.
- 15 32. Metallic intermediate (10), in particular according to any one of claims 27 to 31, for producing a practice cartridge bullet, in particular according to one of the preceding claims, in particular for use on, in particular police, shooting ranges, comprising a ductile blank, for example of iron, which is cold-massively deformed into the intermediate (10) by means of pressing, a cylindrical solid base end section (49) and a press end section (51) with a central press recess introduced by pressing and a wall of substantially constant wall thickness delimiting the press recess for forming a, in particular ogive-shaped, bullet nose.
- 20 33. Method of producing a bullet (1) formed according to any one of the preceding claims.
34. Tool for producing a bullet (1) formed according to any one of the preceding claims.