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(54) **SOFT STEEL PROJECTILE**

GESCHOSSAUSWEICHSTAHL

PROJECTILE EN ACIER DOUX

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Description

[0001] This invention relates to a bullet or a projectile for firearms, preferably riflebores, and more specifically to a projectile made of steel, the employment of steel for producing such a projectile and a method for producing said projectile.

[0002] The predominant material used in rifle bore bullets is lead (Pb), most frequently surrounded by a jacket made from copper-zink alloy or from plated steel. On one hand, the jacket functions as a protection for the soft lead core against external deformation, and on the other hand to allow firing at the high muzzle velocities connected with modern firearms. At these velocities, a non-jacketed bullet would deposit lead in the barrel bore due to friction heat. Furthermore, in game hunting, the jacket increases the bullets effect upon impact in that it preserves the form of the lead core as the bullet penetrates the game and thereby permits a desired, deep penetration. This later aspect, of course, is of little importance in the field of practise- and contest shooting.

[0003] The jacketed lead bullet is manufactured through several steps. Jacket blanks are punched from a jacket plate and formed to a sleeve through two or more form pressing operations. The lead core, possibly with antimony added to increase the hardness, is draw formed through tapered bores to have the accurate gauge, and cold formed to fit the jacket. In a joining operation the lead core is fitted within the jacket, whereupon a close fit between core and jacket is of utmost importance, since the occurance of airpockets would cause unbalance with the bullet, resulting in a poor score. In the joining operation, multiple tools are employed, generally up to six tools, between which the bullets and jackets are moved under the operation, and finally the completed bullets are controlled with respect to e.g. gauge and weight.

[0004] The jacketed lead bullet is available in multiple embodiments, among which the common feature is, that the varied shapings particularly in the sense of jacket construction, are contemplated to increase the effect and penetration ability of the bullet upon game hunting. However, the major part of firearms ammunition is used for practice- and contest shooting, wherein such properties as a fast kill are of no importance. Naturally, for the purpose of sight adjustment and range finding of hunting rifles, some target shooting will take place with the ammunition that later is used for the game hunting, but this particular gallery shooting constitutes merely a minor part of the total amount of rifle ammunition fired in practice- and contest shooting. Considering that one manufacturer of small arms ammunition alone on the swedish market distributes in the range of 5 million cartridges for target shooting, and knowing that as much as 90-95 % of the bullet weight is lead, one readily realizes that considerable amounts of this toxic metal is spread annually in the environment, and that any measures directed to limiting and reducing this deposition of lead, naturally, is of utmost importance.

[0005] Bullets made of steel are known per se, see e.g. DE Al 3 104 234 and US A 2 303 449. A problem with firing a steel bullet through the steel barrel of a rifle is the friction wear caused by the bullet when discharged through the barrel bore. To overcome this problem, known steel or iron bullets are often provided with an external layer of softer metal, preferably copper or compositions including copper, which is applied to an amount that substantially prevents contact between the hard bullet core and the barrel. The layer also serves as an anticorrosive means for protecting the steel or iron core from humidity. In this way, previous steel bullets may be considered to be jacketed bullets.

[0006] The present invention finds a solution to the friction wear problem of previous steel or iron core bullets by providing a solid projectile body of a steel alloy having improved machineability, thereby deforming to the lands of the barrel bore and reducing the friction wear upon discharge therethrough.

[0007] It is therefore an object of the present invention to provide a small arms projectile with a minimum of lead content, which, through a simplified manufacturing process will have a low selling price and with preserved target shooting performance.

[0008] This object is achieved by a small arms projectile comprising the features stated in the appended claims.

[0009] The invention is hereinafter described more in detail, with reference made to the appended drawings, of which:

Fig 1 shows a partially sectioned elevational view of a projectile according to the invention,

Fig 2 shows a target penetrated by a conventional jacketed lead bullet,

Fig 3 shows a target penetrated by a projectile according to the invention, and

Fig 4 shows a second embodiment of the inventive projectile.

[0010] Fig 1 shows a projectile or a bullet according to the invention, generally indicated by the reference numeral 1. The bullet 1 comprises a torpedo section 2 and a guide section 3. In its periphery, the guide section 3 includes circumferentially applied grooves and protruding lands 4, acting to provide a tight seal between bullet and rifle bore and thus preventing the powder combustion gases to pass the bullet. The grooves are provided to allow the material

of the lands (4) to "escape" when being compressed by the lands of the rifle bore. In the embodiment of fig. 1, the transition section, between the torpedo section 2 and guide section 3, comprises a shoulder with a slanting front face 5, having an angle a to the vertical axis 1 within a range of 25-35°, preferably 30°. The guide section 3 further comprises a chamfered rear edge 6. In the embodiment of fig 1, the torpedo section 2 is pointed, but the bullet can alternatively be formed with hollow or ogive points or with a flat or a round nose.

[0011] Naturally, the projectile of the invention is not limited to the design shown in fig 1, but can be given any desired shape to meet the specific requirements of penetration ability or stopping effect.

[0012] The bullet 1 is solid and manufactured from steel of a low carbon (C) content (up to an amount of 0.40 %) and preferably including lead (Pb), which adds to the steel an enhanced cutting capacity (related cutting capacity) rising from the standard machine-steel cutting capacity index 100 (DIN 9SMn23 or SS 1912) to an index 150 for the lead-bearing alloy steel (DIN 9SMnPb28 or BX 1914). In the present invention, the high machineability of the lead-bearing alloy steel is utilized for producing, preferably by turning in a lathe, a small arms bullet which has a competitive selling price.

[0013] Tellurium (Te) is added to the steel. Tellurium-bearing free-cutting steel has a limited industrial appliance but is used e.g. in tyre studs and is sold by Boxholm, Sweden, under the product symbol 1914-04+Te, and can be obtained with a tellurium additive of 0.02-0.04 %. This steel alloy comprises lead to an amount of 0.15-0.35 %.

[0014] Thus, through the addition of lead and tellurium, the machinability of the alloy steel is increased, and in the present invention the lubricant effect of the tellurium acting in conjunction with the included lead, is utilized for the production of a bullet with a minimum of lead content, which bullet will not damage the rifle bore upon passage therethrough.

[0015] In manufacturing, the bullet 1 is advantageously machined in a lathe and cut off from a bar, which can be of a somewhat smaller diameter than the rifle gauge to permit a coating with an antioxidant compound, such as copper, zinc, nickel or a composition including one or more of these metals. The coating is advantageously applied electrochemically, but can also be achieved through a common jacket blank. The bullet can be completed within three or four steps in an automatic lathe, provided with a bar magazine feed and a tool adapter for several cutters. After machining (and/or after coating) the bullet is gauged, polished by tumbling in fluid, eventually with an addition of abrasive and detergent, whereupon the coating is applied. An alternative coating is the application of a layer of polytetrafluoroethylene (PTFE), which will further decrease the friction wear during the passage of the bullet through the bore.

[0016] Alternatively, the steel is subjected to normalization to decrease its hardness, e.g. in the case where the bullet is manufactured from cold drawn material.

[0017] The soft steel projectile or bullet of the invention has been subjected to several shooting tests for determination of its performance under various conditions.

[0018] In a first series of shooting tests, the bullet was machined from steel including a 0.25 percentage of Pb and a 0.04 percentage of Te. The bullet was coated with a surrounding Cu-layer of appr. 10 micron. In this embodiment the bullet 1 holds a weight of 62 grains (4 g) in caliber 6.5 mm, whereas a jacketed lead bullet of corresponding caliber generally holds a weight of 80 to 160 grains (5 to 10 g), depending on the design and purpose of the bullet.

[0019] The test shooting verifies that the inventive bullet of comparatively less (weight) weight gains a comparatively high muzzle velocity. The test record also shows that the bullet 1 at this muzzle velocity obtains good firing groups.

[0020] The test shooting was performed outdoors at noon and with a humidity of 40 %. Weather conditions showed a slight cloudiness, light winds to cross wind gusts of 2-8 m/s. The shooting range was 100 m and the muzzle velocities were measured with a chronograph. The test results were compared to a simultaneously performed laboratory test.

[0021] The soft steel bullet was loaded with a powder charge of 30 grains (appr. 1.95 g) and achieved with this charge an average muzzle velocity of 952.4 m/s in a test series of 10 rounds. The factory-loaded jacketed lead bullet used as comparison object had a weight of appr. 93 grains (6 g) and achieved an average muzzle velocity of 926.3 m/s with a charge of 32 grains (appr. 2.1 g), likewise in a test series of 10 rounds.

[0022]

MUZZLE VELOCITY M/S			
Soft steel bullet, charged manually		Jacketed lead bullet, factory-charged	
1.	953	1.	932
2.	945	2.	955
3.	951	3.	911
4.	954	4.	922

(continued)

MUZZLE VELOCITY M/S			
Soft steel bullet, charged manually		Jacketed lead bullet, factory-charged	
5.	953	5.	923
6.	959	6.	930
7.	960	7.	925
8.	942	8.	933
9.	955	9.	912
10.	952	10.	920

[0023] For comparison of firing groups the resp. type of bullet was fired in five series of three rounds each. The firing groups of the steel bullet then ranged from 17 to 22 mm, and the groups of the jacketed lead bullet ranged from 17 to 25 mm.

[0024]

FIRING GROUPS			
Soft steel bullet		Jacketed lead bullet	
1.	22 mm	1.	25 mm
2.	17 mm	2.	20 mm
3.	20 mm	3.	22 mm
4.	21 mm	4.	17 mm
5.	21 mm	5.	18 mm

[0025] The spread is partly explained by the irregular crosswinds appearing on the test shooting occasion but the accuracy results from the comparison test still verifies the competitive target shooting performance of the inventive bullet.

[0026] Through the slanted shoulder 5 in the transitionary section between the torpedo section 2 and guide section 3 the effect of the bullet,upon penetrating the target, punching a cylindrical through hole with clean cut edges will be achieved, see fig. 3. As comparison, a target being shot through using conventional, jacketed lead bullets is shown (fig. 2). In the embodiment, used in the precision test referred to above, the shoulder of the bullet 1 is given a slanting angle a to the vertical axis of 30°, which, in respect of the air resistance and the punching efficiency, is considered to be an advantageous chamfer.

[0027] The chamfered rear edge 6 of the guide section 3, which preferably is rounded or has an angle of chamfer of 45°, is considered to have an advantageous influence on the flight of the bullet by promoting an even bypass of combustion gases when the bullet exits the bore at the rifle muzzle.

[0028] In a second series of shooting tests, a soft steel bullet of the abovesaid tellurium bearing steel alloy and of the embodiment shown in fig. 4 was used in the .308 W gauge. In this embodiment, the bullet 1' comprises lands 4' with rounded off edges and an extended, conical guide section 3' with a rounded rear edge 6'. This second test was accomplished to determine the bullets performance in conjunction with automatic rifles and machine guns, and the test was performed under varying temperature conditions ranging from -54 to + 52 degrees C. The test shows that the inventive bullet, with respect to automatic fire functions, is not inferior to a reference bullet of conventional type. No deposit material was observed in the barrel bores after shooting.

AUTO FIRE FUNCTION TEST	
Ammunition components	
Cartridge:	Ordinary 7.62 cartridge with primer
Powder:	NC 1055 p 86030
Charge:	45 grains (appr. 2.92 g). Pressure appr. 340 MPa

(continued)

AUTO FIRE FUNCTION TEST		
Ammunition components		
Projectile:	According to the embodiment of fig. 4, giving an overall cartridge length of 70.7 mm. Weight = 124 grains (8.05 g)	
Automatic carbine AK4		
Rounds	Temp	Firing rate, rounds/min
20	+21	730 (Reference ammunition)
2x20	+21	731 (Inventive bullet)
20	-54	704 -"-
20	+52	731 -"-
Machine gun ksp 58		
20	+21	670 (Reference ammunition)
2x20	+21	671 (Inventive bullet)
20	-54	690 -"-
20	+52	649 -"-

[0029] Being produced from a steel alloy including tellurium in accordance with the abovesaid, the inventive bullet will achieve enhanced characteristics during the discharge process. At the firing moment, a rifle bullet is not only exposed to high temperature, but also to a gas pressure as high as 3.000 kp/cm^2 or more, which might cause deformation in a conventional lead bullet. With a bullet according to the invention, this drawback, as well as the drawback of slippage within the rifle bore, will be cleared away.

[0030] The bullet 1 according to the invention is not to be considered as being limited to the embodiments, shown in figs. 1 and 4. For the man, skilled in the art, it is readily apparent that modifications of the shape of the bullet, such as an extended guide section or torpedo section to increase the weight of the bullet or to manipulate the center of gravity, can be accomplished to impart other ballistic properties to the bullet. Furthermore, in game hunting, the torpedo section can be modified to slow the bullet down upon impact within living targets, e.g. by shaping the bullet with a hollow or ogive point or a flat nose. The coating, in the disclosed embodiments made of copper, could also, as mentioned above, be composed of zink, nickel, a compound containing e.g. lead and one or more of these metals and/or polytetrafluoroethylene (PTFE). In this respect, the polytetrafluoroethylene coating can be applied in the form of a fully surrounding protective layer or in the form of peripheral rings around the guide section 3, closely fitting within the rifle bore.

[0031] The initially stated purpose is well accomplished by a bullet according to the invention: to provide a bullet, primarely for practice and contest shooting, which significantly reduces the deposition of lead in the environment. The addition of lead of the bullet 1 amounts to only somewhat more than 1/400 in comparison with a corresponding conventional bullet. By producing the bullet, making use of tellurium-bearing alloy steel, a lubricant effect that will spare the rifle bore is achieved.

[0032] In the disclosure, the bullet of the invention has been presented as a projectile primarily intended for rifle bores. However, this will not exclude the utilization of the tellurium bearing alloy steel for a projectile intended for smooth barrel guns and for producing round shots.

Claims

1. Small arms projectile with a solid body of alloy steel and an anticorrosive coating, characterized in that the alloy steel comprising the addition of tellurium (Te).

2. Projectile according to claim 1, characterized in that tellurium (Te) is included to an amount of 0.02-0.04%.

3. Projectile according to claim 1, characterized in that lead (Pb) is included to an amount of 0.15-0.35%.

4. Projectile according to claim 1, characterized in that the anticorrosive coating includes at least one from the group of metals consisting of copper (Cu), zink (Zn) and nickel (Ni).

5. Projectile according to claim 1, characterized in that the anticorrosive coating at least partially incorporates polytetrafluoroethylene (PTFE).

6. Projectile according to claim 1, characterized in that the solid body is spherical.

7. Projectile according to claim 1, characterized by a torpedo section (2,2') and a guide section (3,3'), the guide section having circumferentially applied grooves and lands (4,4') and a chamfered (6) rear edge.

8. Projectile according to claims 1 and 7, characterized in that the torpedo section (2,2') is shaped with a pointed, or a hollow pointed, or an ogival, or a flat, or a rounded nose.

9. The application of alloy steel including tellurium (Te) for designing a small arms projectile.

10. The application of alloy steel according to claim 9, wherein tellurium (Te) is included to an amount of 0.02-0.04%.

11. The application of alloy steel according to claim 9, wherein lead (Pb) is included to an amount of 0.15-0.35%.

12. Method for producing a small arms projectile with a solid body of alloy steel including tellurium (Te) and having an anticorrosive coating according to claim 1, characterized by the following steps:

- forming a projectile body from a bar section,
- gauging the body,
- polishing the body by tumbling in fluid,
- coating the body by applying a layer including at least one from the group of metals consisting of copper (Cu), zink (Zn) and nickel (Ni).

13. Method according to claim 12, characterized in that the step of coating the body includes applying, at least partially, a layer of polytetrafluoroethylene (PTFE).

14. Method according to claim 12, characterized by the step of heating the projectile body to normalization temperature before coating.

Patentansprüche

1. Schusswaffengeschoss mit einem festen Körper aus Stahllegierung und einer rosthindernden Beschichtung, dadurch gekennzeichnet, dass die Stahllegierung Tellur (Te) umfasst.

2. Geschoss nach Anspruch 1, dadurch gekennzeichnet, dass es Tellur (Te) in einer Menge von 0,02 bis 0,04 % enthält.

3. Geschoss nach Anspruch 1, dadurch gekennzeichnet, dass es Blei (Pb) in einer Menge von 0,15 bis 0,35 % enthält.

4. Geschoss nach Anspruch 1, dadurch gekennzeichnet, dass die rosthindernde Beschichtung mindestens ein Metall aus der Gruppe bestehend aus Kupfer (Cu), Zink (Zn) und Nickel (Ni), enthält.

5. Geschoss nach Anspruch 1, dadurch gekennzeichnet, dass der rosthindernden Beschichtung zumindest teilweise Polytetrafluorethylen (PTFE) einverleibt ist.

6. Geschoss nach Anspruch 1, dadurch gekennzeichnet, dass der feste Körper sphärisch ist.

7. Geschoss nach Anspruch 1, gekennzeichnet durch einen Torpedoabschnitt (2,2') und einen Führungsabschnitt (3,3'), wobei auf dem Umfang des Führungsabschnitts Nuten und hervorstehende Teile zwischen zwei Nuten (4,4') vorgesehen sind und eine rückwärtige Fläche (6) abgeschrägt ist.

8. Geschoss nach Anspruch 1 und 7, dadurch gekennzeichnet, dass der Torpedobereich (2,2') mit einer spitzen, einer hohlspitzigen, einer spitzbögigen oder einer flachen, bzw. einer abgerundeten Nase, ausgeformt ist.

9. Verwendung einer Stahllegierung, die Tellur (Te) enthält, zur Herstellung eines Schusswaffengeschosses.

10. Verwendung einer Stahllegierung nach Anspruch 9, die Tellur (Te) in einer Menge von 0,02 bis 0,04 % enthält.

11. Verwendung einer Stahllegierung nach Anspruch 9, die Blei (Pb) in einer Menge von 0,15 bis 0,35 % enthält.

12. Verfahren zur Herstellung eines Schusswaffengeschosses mit einem festen Körper aus Stahllegierung, die Tellur (Te) enthält, und die eine rosthindernde Beschichtung aufweist, nach Anspruch 1, dass gekennzeichnet ist durch die folgenden Stufen:

- Bildung eines Geschosskörpers aus einem Barrenbereich,
- Normierung des Körpers,
- Polieren des Körpers durch Taumeln in einem Fluid,
- Beschichtung des Körpers durch Anwendung einer Schicht, die mindestens ein Metall aus der Gruppe, bestehend aus Kupfer (Cu), Zink (Zn) und Nickel (Ni), enthält.

13. Verfahren nach Anspruch 12, dadurch gekennzeichnet, dass die Stufe einer Beschichtung des Körpers zumindest teilweise, eine Anwendung einer Schicht aus Polytetrafluorethylen (PTFE) beinhaltet.

14. Verfahren nach Anspruch 12, gekennzeichnet durch die Stufe eines Erwärmens des Geschosskörpers auf Normierungtemperatur vor einer Beschichtung.

Revendications

1. Projectile pour des armes de petite taille avec un corps plein en acier allié et un revêtement anticorrosion, caractérisé en ce que l'acier allié comprend l'ajout de tellure (Te).

2. Projectile selon la revendication 1, caractérisé en ce que le tellure (Te) est inclus à raison de 0,02 à 0,04 %.

3. Projectile selon la revendication 1, caractérisé en ce que du plomb (Pb) est inclus à raison de 0,15 à 0,35 %.

4. Projectile selon la revendication 1, caractérisé en ce que le revêtement anticorrosion inclut au moins un métal dans le groupe de métaux se composant du cuivre (Cu), du zinc (Zn) et du nickel (Ni).

5. Projectile selon la revendication 1, caractérisé en ce que le revêtement anticorrosion incorpore au moins partiellement du polytétrafluoréthylène (PTFE).

6. Projectile selon la revendication 1, caractérisé en ce que le corps plein est sphérique.

7. Projectile selon la revendication 1, caractérisé par une section de pénétration (2, 2') et une section de guidage (3, 3'), la section de guidage ayant des rainures appliquées circonférentiellement et des saillies (4, 4') ainsi qu'un bord arrière chanfreiné (6) .

8. Projectile selon les revendications 1 et 7, caractérisé en ce que la section de pénétration (2, 2') est formée avec un bout pointu, un bout pointu creux, en forme d'ogive ou plat.

9. Utilisation d'acier allié comprenant du tellure (Te) pour concevoir un petit projectile pour des armes.

10. Utilisation d'acier allié selon la revendication 9, dans lequel le tellure (Te) est inclus à raison de 0,02 à 0,04 %.

11. Utilisation d'acier allié selon la revendication 9, dans laquelle du plomb (Pb) est inclus à raison de 0,15 à 0,35 %.

12. Procédé pour produire un projectile pour des armes de petite taille avec un corps plein en acier allié comprenant du tellure (Te) et ayant un revêtement anticorrosion selon la revendication 1, caractérisé par les étapes consistant à :

- former un corps de projectile à partir d'une section en forme de barre,

- calibrer le corps,
- polir le corps au tonneau dans un fluide,
- revêtir le corps en appliquant une couche comprenant au moins un métal dans le groupe de métaux se composant du cuivre (Cu), du zinc (Zn) et du nickel (Ni).

13. Procédé selon la revendication 12, caractérisé en ce que l'étape de revêtement du corps comprend l'application, au moins partielle, d'une couche de polytétrafluoréthylène (PTFE).

14. Procédé selon la revendication 12, caractérisé par l'étape consistant à chauffer le corps du projectile à une température de normalisation avant de le revêtir.

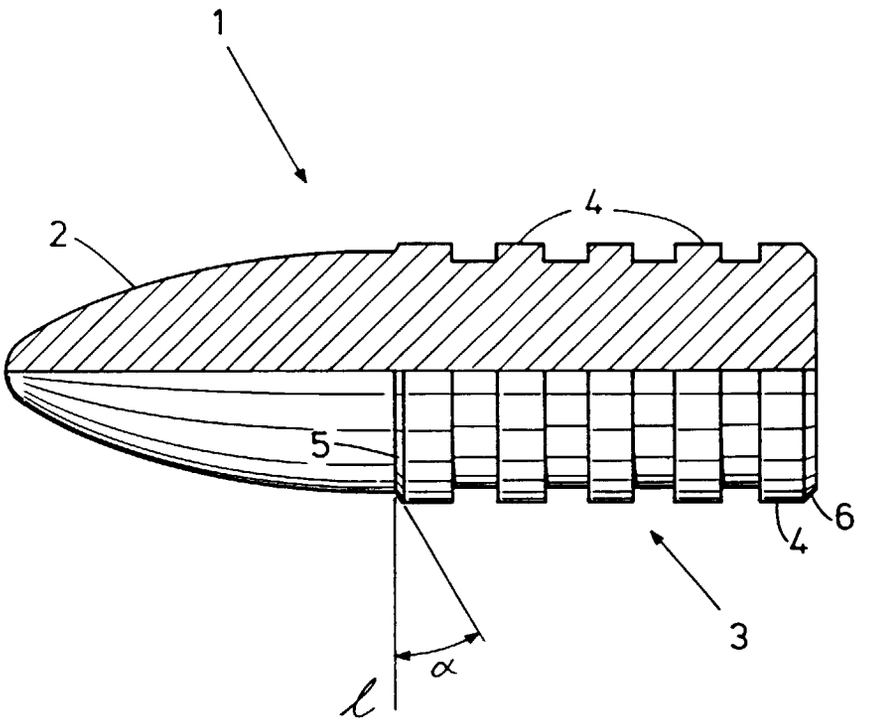

Fig. 1

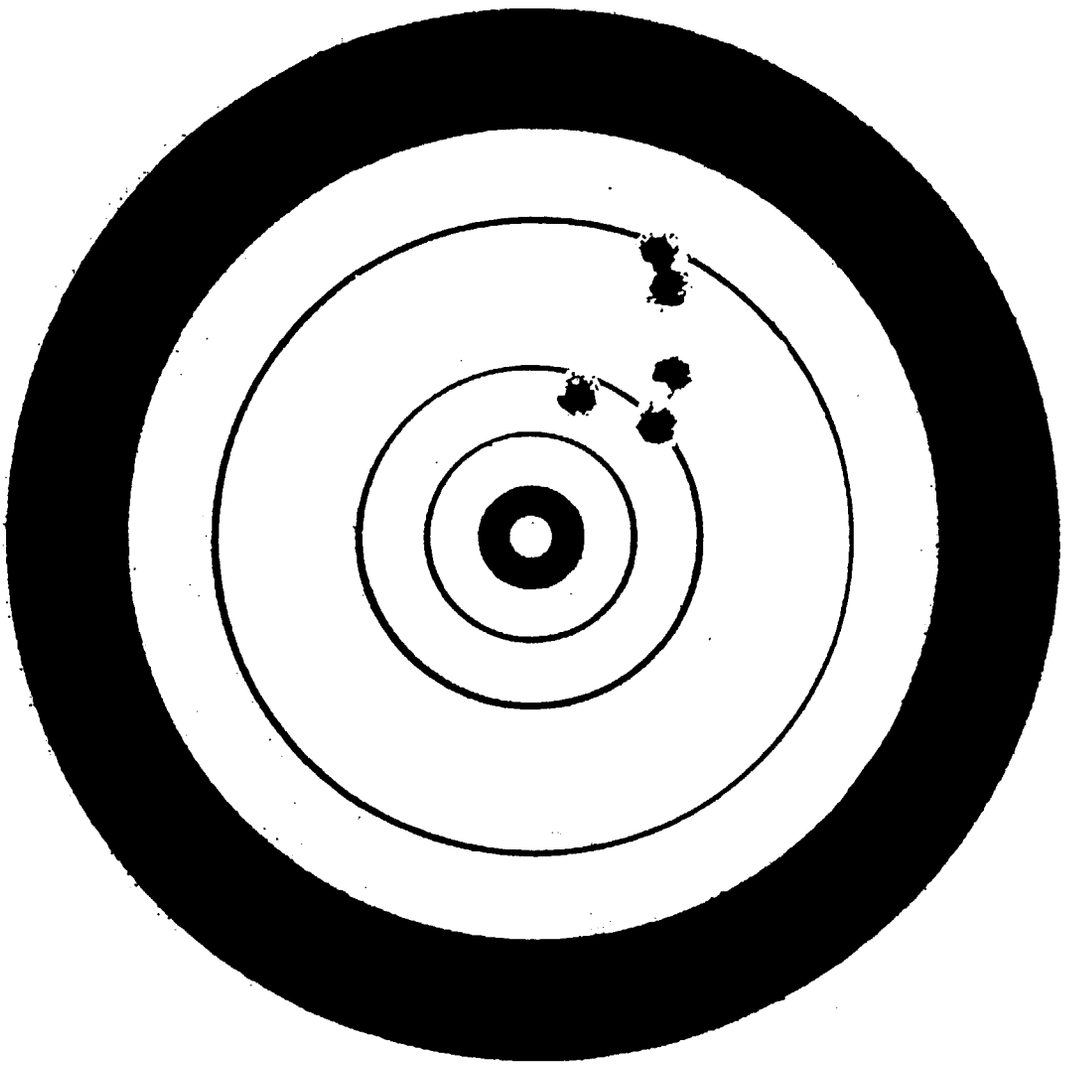

Fig. 2

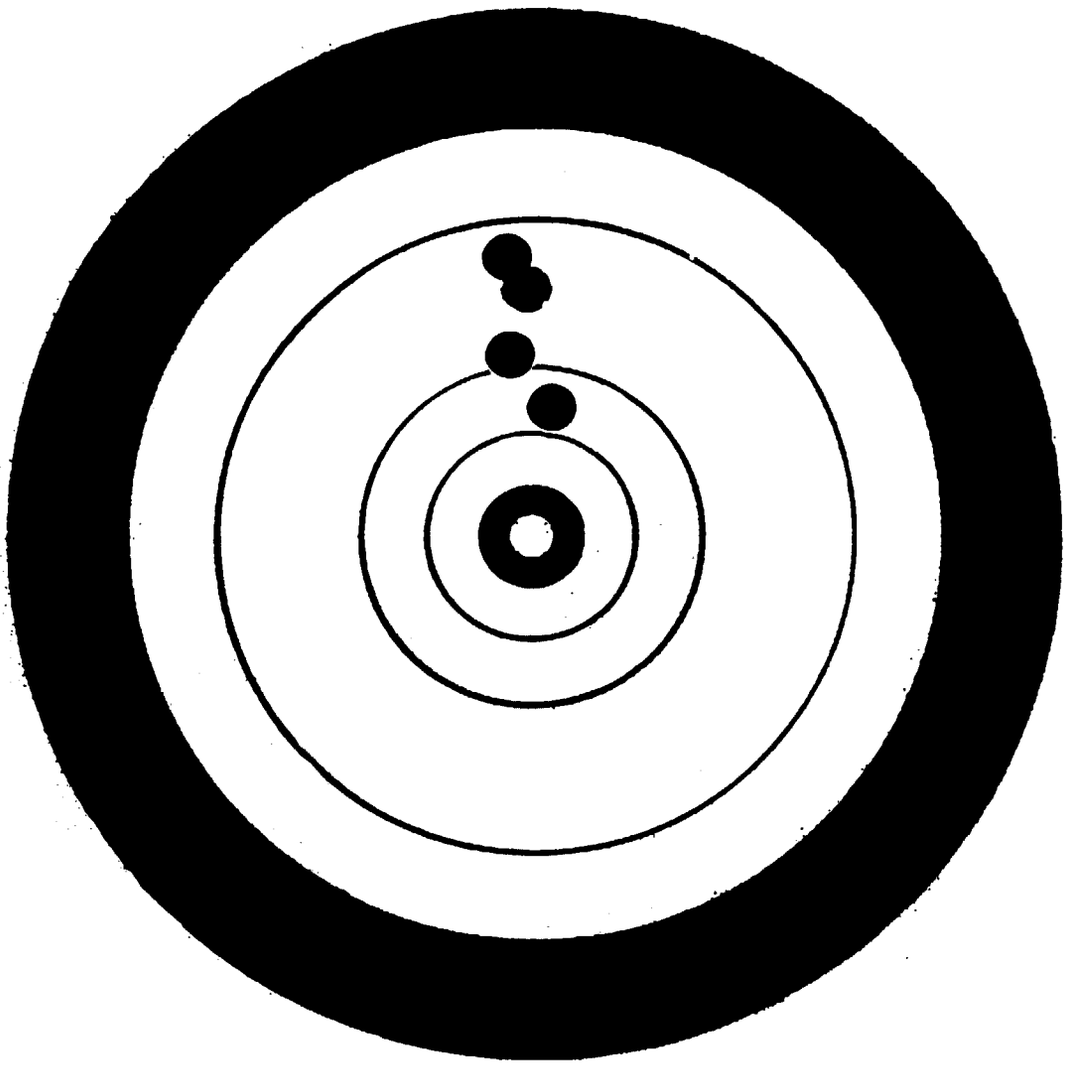

Fig. 3

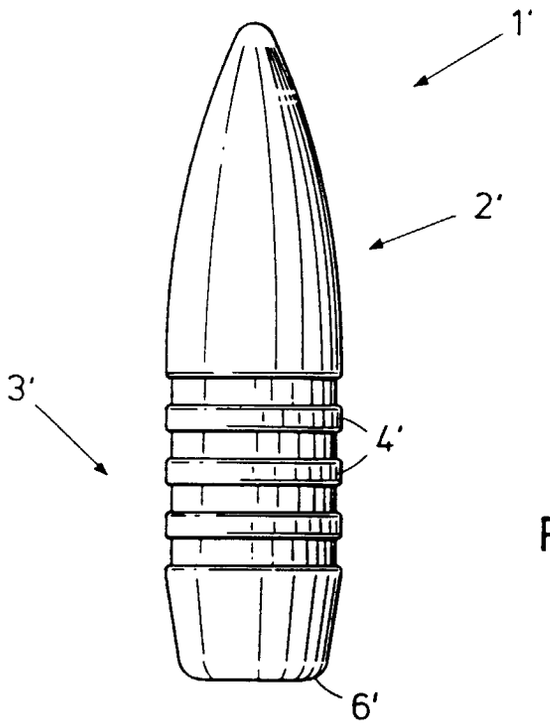

Fig. 4