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(54) **5.56MM SMALL ARMS AMMUNITION**

5,56-MM-HANDFEUERWAFFENMUNITION

MUNITION POUR ARME PORTATIVE 5,56 MM

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Description

[0001] This invention relates to a combination of a gun having a rifled barrel and a round of ammunition to be fired from said gun, and to a projectile for use in the combination, as described in FR 2540239 A, which gives a basis to independent claim 1. The invention is especially, but not exclusively related to an improved form of projectile for small arms ammunition.

[0002] When a projectile is fired from a rifled barrel, the projectile must deform as it travels along the barrel so that material forming part of the projectile is forced into the spaces between the lands forming the rifling. This process is called engraving, and causes a spin to be imparted to the projectile by virtue of the longitudinal twist of the rifling.

[0003] The deformation of the projectile, its travel along the barrel effectively as a force fit to the rifling, the high linear acceleration imparted by the gun propellant on firing, and the consequent high rate of angular acceleration and associated force acting between rifling and projectile all contribute to substantial wear on the barrel.

[0004] If this wear rate can be reduced, substantial benefits follow, including increased barrel life, higher muzzle velocity and hence increased accuracy and lethality.

[0005] For this reason, low friction, readily deformable materials are normally selected for small arms bullets, for example lead. In order to increase the overall density of the bullet, it has also been proposed to use steel. However, steel is not readily deformable, and causes unacceptable barrel wear. On the other hand, hardness is a very desirable characteristic for the bullet material, in order to minimise nose tip ablation during penetration of hardened targets such as, for example, titanium/kevlar body armour. For these purposes, a Vickers Hardness of at least 550 (using a 10kg load) is the minimum desirable.

[0006] In seeking to overcome these problems, it has been common practice to make a small arms bullet from a steel core enclosed in a lead sheath which in turn is enclosed in a gilding metal jacket.

[0007] This latter solution is practical, but results in a bullet having a relatively expensive construction. This is a very significant disadvantage since small arms ammunition is consumed in large quantities, and the market for such ammunition is highly competitive.

[0008] In US Patent No 5686693 there is disclosed a 7.62mm bullet formed from a steel alloy, having a forward body portion whose diameter corresponds to the diameter of the barrel defined by the rifling lands of an associated gun, and a rearward body portion having a greater diameter, and provided with annular grooves. The body is provided with a coating which can be of copper. In use, the copper coating acts as a lubricant, and is less thick than the depth of the rifling. When fired from the rifled barrel, the rifling therefore cuts through the copper coating so that the steel body of the bullet is engraved by the

rifling. In the disclosure it is stressed that the steel of the body must be soft, so as to permit this engraving to occur without undue barrel wear. The maximum value for the hardness of the steel body mentioned in the disclosure is 210 Brinell, which equates to a Vickers Hardness of 213, i.e. very much less than the desirable minimum value of 550 Vickers Hardness. As a result, the bullet disclosed in US Patent No 5686693 will lack the desirable target penetration capability.

[0009] It would therefore be a considerable advantage if a way could be found to utilise steel or other metal having a Vickers Hardness equal to at least 550 (using a 10kg load) as the principal component of a small arms projectile, while enabling the projectile to be engraved by the rifling and not introducing unacceptable friction or wear, and avoiding the expensive construction of applying a jacket to the projectile.

[0010] According to the present invention there is provided a combination of a gun having a rifled barrel and a round of ammunition to be fired from said gun; the rifling of the barrel comprising rifling grooves which are separated by lands extending helically along a length of the barrel; the round of ammunition comprising a projectile; the projectile comprising: a body comprising a substantially cylindrical body portion comprising a plurality of splines or knurl lines producing a corresponding plurality of grooves which extend lengthwise along a section of the substantially cylindrical body portion; and a deformable jacket substantially surrounding the section of the substantially cylindrical body portion; wherein the body of the projectile is formed from a metal having a Vickers Hardness of not less than 550 HV, an outer diameter of said substantially cylindrical body portion is substantially equal to an internal diameter of the barrel defined by the land, an outer diameter of the deformable jacket is substantially equal to an internal diameter of the barrel defined by the rifling grooves, and wherein during firing of the projectile the deformable jacket is deformed by the lands of the barrel into the grooves formed between the splines or knurl lines of the projectile body.

[0011] The present invention also provides a projectile for use in the combination as claimed in claim 1; the projectile comprising: a body comprising a substantially cylindrical body portion comprising a plurality of longitudinally extending knurl lines or splines producing a corresponding plurality of grooves which extend lengthwise along a section of the substantially cylindrical body portion; and a deformable jacket substantially surrounding the section of the substantially cylindrical body portion;

[0012] Normally, the projectile will also have an ogival nose portion of the body forward of said substantially cylindrical body portion, although other forms are possible.

[0013] The body of the projectile (i.e. excluding the deformable jacket) should have a diameter which is not greater than that defined by the rifling lands. The deformable jacket of the projectile has an outer diameter which is designed so that upon firing of the projectile the rifling

lands engage the deformable jacket which is designed to deform into the groove air gaps between said splines or knurl lines. The engagement of the deformable jacket with the rifling lands induces spin in the projectile due to the twist of the rifling. This deformation gives the projectile an interference fit with the rifling so as also to provide effective obturation by restricting or preventing the escape of propellant gases past the projectile via the rifling grooves. The length and precise diameter of the projectile should be designed with these factors in mind.

[0014] Regard must also be taken to ensure that the force required to effect the deformation of the jacket material and to propel the projectile along the barrel is not excessive, and this is the reason why the diameter of the body should not be greater than that of the rifling lands. This force is substantially reduced by the presence of the air gaps between the knurl lines or splines allowing the deformable jacket to deform into said groove air gaps during the passage of the body along the barrel.

[0015] The depth of said grooves in the projectile or knurl lines should preferably be between about 1% and 10% of the nominal calibre of the projectile, and an optimum design may be between 2% and 6%.

[0016] The material selected for the projectile body will depend partly upon the function which the projectile is to perform, but in the case of High Performance Ammunition should not be below a Vickers Hardness of 550 HV.

[0017] For a warshot ammunition nature to be used in combat conditions, steel is a suitable material, as it is inexpensive and can be readily formed into the desired shape, eg. by a cold-forming process. Tungsten is another possible material because hardness is an important characteristic for target defeat, as are alloys of tungsten, and tungsten carbide.

[0018] The invention is particularly but not exclusively applicable to small arms weapons systems, having a nominal calibre of 20mm or less, especially 9mm or less, such as 5.56mm.

[0019] The invention will now be described by way of example only with reference to the accompanying drawings, of which:-

Figure 1 shows a diagrammatic representation of a round of small arms ammunition comprising a projectile comprising a body incorporating grooves or knurl lines in combination with a gun having a rifled barrel, in accordance with an embodiment of the invention; and

Figures 2A and 2B each shows a cross sectional elevation A-A through the projectile shown in Figure 1, additionally depicting the envelope of said projectile.

[0020] As shown in Figure 1, a small arms ammunition projectile 1 comprises a body comprising a cylindrical body portion 2, a tip portion 3 and along the substantially cylindrical body portion a plurality of grooves or knurl lines

4 extending lengthwise along a section of the substantially cylindrical body producing a corresponding plurality of splines 5 and air gaps, or grooves, 6.

[0021] The projectile body is of elongate form and is cold formed from steel having a Vickers Hardness of at least 550. It can subsequently be given a heat treatment to provide the desired hardness or other physical properties.

[0022] Because of the substantial hardness of the projectile body material, the projectile is highly effective at penetration of targets such as titanium/kevlar body armour. Moreover, the hardness also serves to minimise ablation of the projectile tip profile, thus further contributing to its effectiveness in target penetration.

[0023] Figures 2A and 2B show representative cross sections A-A on Figure 1. In Figure 2A, the detail of the knurl lines 9 and associated 'groove' air gaps 6 of the projectile body 7 is shown when the projectile body 7 is located within a surrounding deformable jacket 11. Similarly, in Figure 2B, the splines 5 and associated 'groove' air gaps 8 of the projectile body 7 is shown when the projectile body 7 is located within a surrounding deformable jacket 11.

[0024] When the body 7 and deformable jacket 11 passes from the gun chamber into the rifled part of the barrel, by virtue of its diameter, the jacket material 11 is deformed by the lands of a rifled barrel into the corresponding groove air gaps 6, 8 corresponding to the splines 5 or knurl lines 9. The outer diameter 10 of the jacket material 11 should be substantially equal to the diameter of any rifling grooves (not shown).

[0025] The presence of the grooves 6, 8 facilitates the necessary deformation of the jacket 11, thus enabling the rifle engraving to take place with a substantially reduced axial force. The fact that the jacket material 11 can deform into the grooves 6, 8 contributes considerably to a dramatic reduction in the axial force required for engraving to occur.

[0026] Therefore, despite the hardness of the material forming the main part of the projectile body, barrel wear from this factor is minimised.

[0027] It will be evident to the skilled addressee that all of these factors reducing the engraving force will also result in reduced barrel wear, higher muzzle velocity, and hence increased lethality and accuracy.

[0028] The projectile which forms part of the combination of gun and ammunition according to the invention is also considerably less expensive to manufacture than a corresponding conventional projectile in, for example, a gilding metal jacket.

[0029] The optimum design parameters for the projectile according to the invention can be determined by those skilled in the art, based on the teaching contained herein.

[0030] The invention is particularly but not exclusively applicable to small arms ammunition. In one particular example, the invention has been successfully applied to 5.56mm gun and ammunition.

Claims

1. A combination of a gun having a rifled barrel and a round of ammunition; the rifling of the barrel comprising rifling grooves which are separated by lands extending helically along a length of the barrel; the round of ammunition comprising a projectile (1); the projectile comprising: a body comprising a substantially cylindrical body portion (2) comprising a plurality of splines (5) or knurl lines (4,9) producing a corresponding plurality of grooves (6;8) which extend lengthwise along a section of the substantially cylindrical body portion (2); and a deformable jacket (11) substantially surrounding the section of the substantially cylindrical body portion (2); wherein the body of the projectile is formed from a metal having a Vickers Hardness of not less than 550 HV, an outer diameter of said substantially cylindrical body portion (2) is substantially equal to an internal diameter of the barrel defined by the lands, an outer diameter of the deformable jacket (11) is substantially equal to an internal diameter of the barrel defined by the rifling grooves, and wherein during firing of the projectile the deformable jacket (11) is deformed by the lands of the barrel into the grooves (6; 8) formed between the splines (5) or knurl lines (4; 9) of the projectile body.
2. A combination according to claim 1 wherein the projectile (1) has an ogival nose portion (3) of the body forward of said substantially cylindrical body portion (2).
3. A combination according to claim 1 or claim 2 wherein said grooves (6;8) of the projectile have a depth between about 1% and 10% of a nominal calibre of the projectile (1).
4. A combination according to claim 3 wherein the depth of said grooves (6;8) in the projectile is between about 2% and 6% of a nominal calibre of the projectile (1).
5. A combination according to any one preceding claim wherein the projectile body is made from one of steel, tungsten, alloys of tungsten, or tungsten carbide.
6. A combination according to any one preceding claim, wherein upon firing deformation of the jacket (11) provides the projectile (1) with an interference fit with the rifling lands rifling so as to provide effective obturation by restricting or preventing the escape of propellant gases past the projectile via the rifling grooves.
7. A projectile (1) for use in the combination as claimed in any one preceding claim; the projectile comprising: a body comprising a substantially cylindrical body portion (2) comprising a plurality of longitudinally extending knurl lines (4,9) or splines (5) producing a corresponding plurality of grooves (6;8) which extend lengthwise along a section of the substantially cylindrical body portion (2); and a deformable jacket (11) substantially surrounding the section of the substantially cylindrical body portion (2); wherein the body of the projectile is formed from a metal having a Vickers Hardness of not less than 550, and an outer diameter of said substantially cylindrical body portion (2) is adapted to be substantially equal to an internal diameter of the barrel defined by the lands, an outer diameter of the deformable jacket (11) is adapted to be substantially equal to an internal diameter of the barrel defined by the rifle grooves, and wherein during firing of the projectile the deformable jacket (11) is adapted to be deformed by the lands of the barrel into the grooves (6;8) formed between the splines (5) or knurl lines (4,9) of the projectile body.
8. A projectile (1) according to claim 7 wherein said grooves (6;8) in the projectile have a depth between about 1% and 10% of a nominal calibre of the projectile (1).
9. A projectile (1) according to claims 7 or 8 wherein the projectile body is made from one of steel, tungsten, alloys of tungsten, or tungsten carbide.
10. A projectile (1) according to any one of claims 7 to 9 having a nominal calibre of 9mm or less.
11. A projectile (1) according to claim 10 wherein said nominal calibre is 5.56mm.
12. A projectile (1) as claimed in any one of claims 7 to 11, wherein upon firing deformation of the jacket (11) is designed to provide the projectile (1) with an interference fit with the rifling lands rifling so as to provide effective obturation by restricting or preventing the escape of propellant gases past the projectile via the rifling grooves.

Patentansprüche

1. Eine Kombination aus einer Schusswaffe mit einem gezogenen Lauf und einer Ladung Munition; wobei der Drall des Laufs Drallzüge beinhaltet, die durch Felder, welche sich spiralförmig entlang einer Länge des Laufs erstrecken, getrennt sind; wobei die Ladung Munition ein Geschoss (1) beinhaltet; wobei das Geschoss Folgendes beinhaltet: einen Körper, der einen im Wesentlichen zylindrischen Körperabschnitt (2) beinhaltet, welcher eine Vielzahl von Rippen (5) oder Rändellinien (4, 9) beinhaltet, die eine entsprechende Vielzahl von Rillen (6; 8), welche sich entlang einer Sektion des im Wesentlichen zy-

- lindrischen Körperabschnitts (2) längs erstrecken, produzieren; und einen verformbaren Mantel (11), der die Sektion des im Wesentlichen zylindrischen Körperabschnitts (2) im Wesentlichen umgibt; wobei der Körper des Geschosses aus einem Metall mit einer Vickershärte von nicht weniger als 550 HV gebildet ist, ein äußerer Durchmesser des im Wesentlichen zylindrischen Körperabschnitts (2) im Wesentlichen gleich einem durch die Felder definierten **Innendurchmesser des Laufs ist, ein äußerer Durchmesser des** verformbaren Mantels (11) im Wesentlichen gleich einem durch die Drallzüge definierten Innendurchmesser des Laufs ist, und wobei der verformbare Mantel (11) während des Feuerns des Geschosses von den Feldern des Laufs in die zwischen den Rippen (5) oder Rändellungslinien (4; 9) des Geschosskörpers gebildeten Rillen (6; 8) verformt wird.
2. Kombination gemäß Anspruch 1, wobei das Geschoss (1) vor dem im Wesentlichen zylindrischen Körperabschnitt (2) einen ogivalen Spitzenabschnitt (3) des Körpers aufweist.
 3. Kombination gemäß Anspruch 1 oder Anspruch 2, wobei die Rillen (6; 8) des Geschosses eine Tiefe von zwischen etwa 1 % und 10 % eines nominalen Kalibers des Geschosses (1) aufweisen.
 4. Kombination gemäß Anspruch 3, wobei die Tiefe der Rillen (6; 8) in dem Geschoss zwischen etwa 2 % und 6 % eines nominalen Kalibers des Geschosses (1) beträgt.
 5. Kombination gemäß einem der vorhergehenden Ansprüche, wobei der Geschosskörper aus einem von Stahl, Wolfram, Legierungen von Wolfram oder Wolframkarbid gefertigt ist.
 6. Kombination gemäß einem der vorhergehenden Ansprüche, wobei die Verformung des Mantels (11) beim Feuern das Geschoss (1) mit einer Presspassung mit dem Drall der Drallfelder versieht, um eine effektive Liderung bereitzustellen, indem das Entweichen von Treibladungsgasen über die Drallzüge an dem Geschoss vorbei eingeschränkt oder verhindert wird.
 7. Ein Geschoss (1) zur Verwendung in der Kombination gemäß einem der vorhergehenden Ansprüche, wobei das Geschoss Folgendes beinhaltet: einen Körper, der einen im Wesentlichen zylindrischen Körperabschnitt (2) beinhaltet, welcher eine Vielzahl von sich longitudinal erstreckenden Rändellungslinien (4, 9) oder Rippen (5) beinhaltet, die eine entsprechende Vielzahl von Rillen (6; 8), welche sich entlang einer Sektion des im Wesentlichen zylindrischen Körperabschnitts (2) längs erstrecken, produzieren; und einen verformbaren Mantel (11), der die Sektion des im Wesentlichen zylindrischen Körperabschnitts (2) im Wesentlichen umgibt; wobei der Körper des Geschosses aus einem Metall mit einer Vickershärte von nicht weniger als 550 gebildet ist und ein äußerer Durchmesser des im Wesentlichen zylindrischen Körperabschnitts (2) angepasst ist, um im Wesentlichen gleich einem durch die Felder definierten Innendurchmesser des Laufs zu sein, wobei ein äußerer Durchmesser des verformbaren Mantels (11) angepasst ist, um im Wesentlichen gleich einem durch die Drallzüge definierten Innendurchmesser des Laufs zu sein, und wobei der verformbare Mantel (11) angepasst ist, um während des Feuerns des Geschosses von den Feldern des Laufs in die zwischen den Rippen (5) oder Rändellungslinien (4, 9) des Geschosskörpers gebildeten Rillen (6; 8) verformt zu werden.
 8. Geschoss (1) gemäß Anspruch 7, wobei die Rillen (6; 8) in dem Geschoss eine Tiefe von zwischen etwa 1 % und 10 % eines nominalen Kalibers des Geschosses (1) aufweisen.
 9. Geschoss (1) gemäß Anspruch 7 oder 8, wobei der Geschosskörper aus einem von Stahl, Wolfram, Legierungen von Wolfram oder Wolframkarbid gefertigt ist.
 10. Geschoss (1) gemäß einem der Ansprüche 7 bis 9, das ein nominales Kaliber von 9 mm oder weniger aufweist.
 11. Geschoss (1) gemäß Anspruch 10, wobei das nominale Kaliber 5,56 mm beträgt.
 12. Geschoss (1) gemäß einem der Ansprüche 7 bis 11, wobei die Verformung des Mantels (11) beim Feuern entworfen ist, um das Geschoss (1) mit einer Presspassung mit dem Drall der Drallfelder zu versehen, um eine effektive Liderung bereitzustellen, indem das Entweichen von Treibladungsgasen über die Drallzüge an dem Geschoss vorbei eingeschränkt oder verhindert wird.

Revendications

1. Une combinaison d'un fusil présentant un canon rayé et des cartouches de munition ; les rayures du canon comprenant des sillons de rayures qui sont séparés par des filets s'étendant de façon hélicoïdale sur une longueur du canon ; les cartouches de munition comprenant un projectile (1) ; le projectile comprenant : un corps comprenant une portion de corps substantiellement cylindrique (2) comprenant une pluralité de cannelures (5) ou des lignes de moutage (4, 9) produisant une pluralité correspondante

- de sillons (6 ; 8) qui s'étendent dans le sens de la longueur le long d'une section de la portion de corps substantiellement cylindrique (2) ; et une enveloppe déformable (11) entourant substantiellement la section de la portion de corps substantiellement cylindrique (2) ; dans laquelle le corps du projectile est formé à partir d'un métal ayant une dureté Vickers qui n'est pas inférieure à 550 HV, un diamètre externe de ladite portion de corps substantiellement cylindrique (2) est substantiellement égal à un diamètre interne du canon défini par les filets, un diamètre externe de l'enveloppe déformable (11) est substantiellement égal à un diamètre interne du canon défini par les sillons de rayures, et dans laquelle au cours du tir du projectile, l'enveloppe déformable (11) est déformée par les filets du canon et entre dans les sillons (6 ; 8) formés entre les cannelures (5) ou les lignes de moletage (4 ; 9) du corps de projectile.
2. Une combinaison selon la revendication 1 dans laquelle le projectile (1) a une portion formant nez (3) ogivale du corps à l'avant de ladite portion de corps substantiellement cylindrique (2).
 3. Une combinaison selon la revendication 1 ou la revendication 2 dans laquelle lesdits sillons (6 ; 8) du projectile ont une profondeur comprise entre environ 1 % et 10 % d'un calibre nominal du projectile (1).
 4. Une combinaison selon la revendication 3 dans laquelle la profondeur desdits sillons (6 ; 8) dans le projectile est comprise entre environ 2 % et 6 % d'un calibre nominal du projectile (1).
 5. Une combinaison selon n'importe quelle revendication précédente dans laquelle le corps de projectile est réalisé à partir d'un matériau parmi l'acier, le tungstène, des alliages de tungstène, ou du carbure de tungstène.
 6. Une combinaison selon n'importe quelle revendication précédente, dans laquelle lors du tir, la déformation de l'enveloppe (11) confère au projectile (1) un ajustement serré avec les filets de rayures s'enrayant de façon à fournir une obturation efficace en limitant ou empêchant la fuite de gaz de propulsion au-delà du projectile par les sillons de rayures.
 7. Un projectile (1) destiné à être utilisé dans la combinaison telle que revendiquée dans n'importe quelle revendication précédente ; le projectile comprenant : un corps comprenant une portion de corps substantiellement cylindrique (2) comprenant une pluralité de lignes de moletage (4, 9) ou de cannelures (5) s'étendant longitudinalement produisant une pluralité correspondante de sillons (6 ; 8) qui s'étendent dans le sens de la longueur le long d'une section de la portion de corps substantiellement cylindrique (2) ; et une enveloppe déformable (11) entourant substantiellement la section de la portion de corps substantiellement cylindrique (2) ; dans lequel le corps du projectile est formé à partir d'un métal ayant une dureté Vickers qui n'est pas inférieure à 550, et un diamètre externe de ladite portion de corps substantiellement cylindrique (2) est adapté de façon à être substantiellement égal à un diamètre interne du canon défini par les filets, un diamètre externe de l'enveloppe déformable (11) est adapté de façon à être substantiellement égal à un diamètre interne du canon défini par les sillons de rayures, et dans lequel au cours du tir du projectile, l'enveloppe déformable (11) est adaptée de façon à être déformée par les filets du canon et entrer dans les sillons (6 ; 8) formés entre les cannelures (5) ou les lignes de moletage (4, 9) du corps de projectile.
 8. Un projectile (1) selon la revendication 7 dans lequel lesdits sillons (6 ; 8) dans le projectile ont une profondeur comprise entre environ 1 % et 10 % d'un calibre nominal du projectile (1).
 9. Un projectile (1) selon les revendications 7 ou 8 dans lequel le corps de projectile est réalisé à partir d'un matériau parmi l'acier, le tungstène, des alliages de tungstène, ou du carbure de tungstène.
 10. Un projectile (1) selon n'importe laquelle des revendications 7 à 9 présentant un calibre nominal de 9 mm ou en dessous.
 11. Un projectile (1) selon la revendication 10 dans lequel ledit calibre nominal est de 5,56 mm.
 12. Un projectile (1) tel que revendiqué dans n'importe laquelle des revendications 7 à 11, dans lequel lors du tir, la déformation de l'enveloppe (11) est conçue pour conférer au projectile (1) un ajustement serré avec les filets de rayures s'enrayant de façon à fournir une obturation efficace en limitant ou empêchant la fuite de gaz de propulsion au-delà du projectile par les sillons de rayures.

Fig.1.

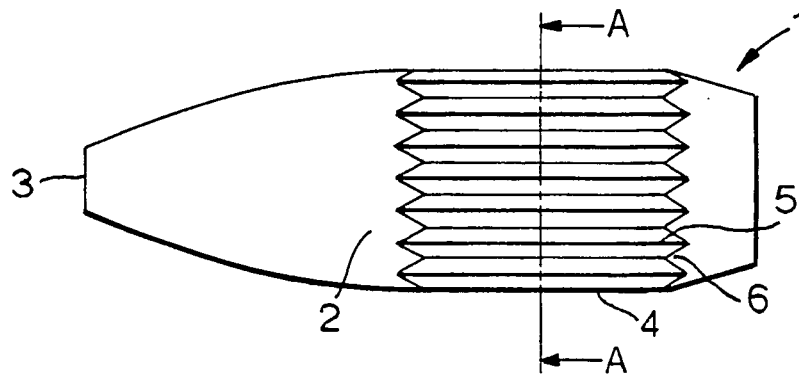


Fig.2A.

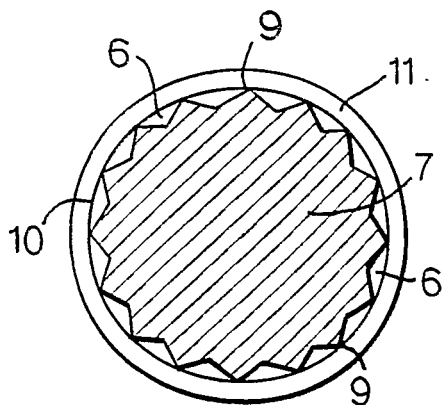
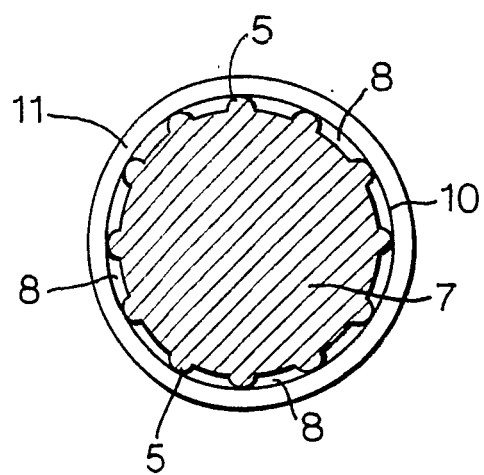


Fig.2B.



REFERENCES CITED IN THE DESCRIPTION

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