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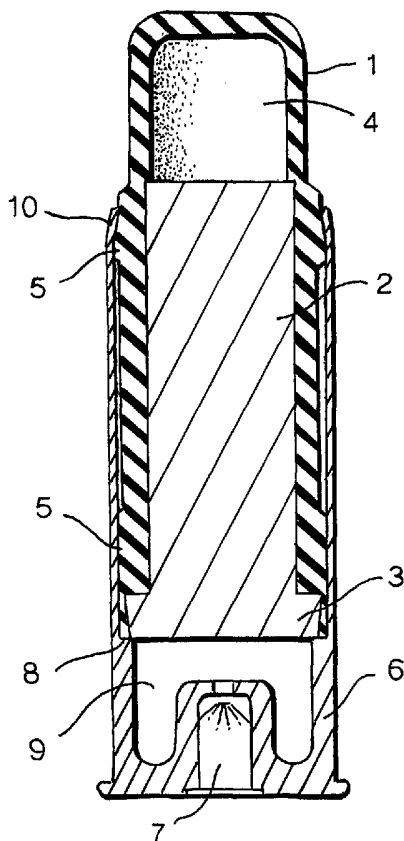
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(54) Title: NON LETHAL PROJECTILE



(57) Abstract: A less lethal projectile formed of resilient material, for use as a deterrent or in situations where behaviour modification of an individual or individuals is necessary. The projectile incorporates a crushable zone in its nose portion, advantageously comprising a hollow chamber (4), which deforms on impact with a hard surface such as the skull but which does not deform when striking an area of soft tissue such as the abdomen. This provides that the projectile will cause sufficient pain in a target to act as a deterrent, whilst carrying a much lower risk of causing severe or permanent injury when compared with solid projectiles.



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Non Lethal Projectile

The present invention relates to a non-lethal projectile the design of which produces energy attenuating properties that reduce the force imparted to the target on impact.

The invention is of particular relevance to the work of the police and security services, where there is often a need to control social disturbances. The Authorities dealing with these events require a method of stopping dangerous individuals and deterring them from committing violent acts, without causing serious or permanent injury.

The teachings of the prior art provide a number of possible methods of achieving this objective, in particular they disclose the use of non-lethal projectiles that are fired at the agitators or perpetrators in order to incapacitate them and dissuade them from further offences. The requirements for projectiles of this type are that they must provide a real and effective deterrent, that they must be capable of being delivered with a high degree of accuracy and they must not cause serious or permanent injury to the target. All of the projectiles disclosed by the prior art fail to adequately meet at least one of these requirements.

Chief among these non-lethal projectile technologies are plastic bullets, or baton rounds, which are fired from guns or other launching devices at insurgents in order to incapacitate them and prevent unlawful behaviour. These baton rounds consist of solid polymer or rubber projectiles, and may be fired from conventional firearms whilst providing reduced impact force and target penetration in comparison with conventional metal rounds. These existing rounds provide an effective deterrent, since they cause a significant amount of pain in the target and they can also be fired with a high degree of accuracy thereby avoiding accidental contact with innocent bystanders. However there is a significant drawback to the prior art in that the baton rounds can still cause serious injury and can be fatal, particularly if the shot is off target and strikes a protagonist in the head.

Another solution offered by the prior art is a frangible projectile, which absorbs some of the kinetic energy of the projectile by spreading out or breaking into fragments on impact. However this system also presents problems in that it introduces fragments which may in themselves cause an increased risk of injury to the target. It is not possible to control the motion of these fragments therefore there is a risk of causing unintended injury to persons nearby. Frangible rounds are also less durable than the baton rounds.

The problem to be solved by the invention is therefore to provide a projectile that delivers enough force to provide an effective deterrent, and that can be fired accurately and consistently over the required range, but which does not cause serious injury or death. The present invention achieves this by providing a compressible "crush zone" at the nose of the projectile, which deforms and deflects on striking the target, this distortion absorbs a significant amount of the kinetic energy possessed by the projectile and/or delays the release of said kinetic energy, thus reducing the force transmitted to the target. The projectile does not rupture therefore its performance is more predictable. The invention is a further improvement on the prior art in that all of the energy attenuating deformation in the preferred embodiment is elastic. The elastic nature of the collision ensures that the projectile will not be damaged and it will regain its original shape after rebounding from the target. Since the projectile remains in one piece throughout its use there is no danger of fragments breaking off and introducing additional risks of injury in the target individual or others nearby.

The invention consists of a projectile that advantageously may be shaped substantially like a bullet and which is formed from a resilient material. Preferably said resilient material will be a polymer or a rubber. The properties of this material must be carefully selected in order to obtain optimum performance from the projectile. The most critical of these material properties are hardness and resilience. For the present invention the most effective results are obtained when the hardness of the projectile lies in the range 85 IRHD to 100 IRHD (International Rubber Hardness Degrees), preferably in the range of from 92 to 95 IRHD and the resilience of the material lies in the range 35% to 70%, preferably in the range of from 48% to 60 %. A suitable

material may be further defined as having a specific gravity of $1 - 2\text{g/cm}^3$. In the most preferred embodiment of the invention the resilient material selected shall be a polymer such as a polyurethane. A suitable polyurethane is advantageously produced from toluene diisocyanate polyester or polyether prepolymer cured with methylene bis ortho chloroaniline (MOCA) for a suitable curing time and at a suitable curing temperature, which results in a polyurethane of hardness and resilience in the ranges mentioned above. Such curing times and temperatures can be routinely determined by those skilled in the art.

The crushable zone at the nose of the projectile may consist of easily deformable material or may advantageously be created by producing a void adjacent to its leading edge. Thus when the projectile strikes a target the nose area is crushed, absorbing kinetic energy by distorting the resilient material and producing heat. This crushable zone also increases the time period over which the energy of the projectile is delivered, by providing what is effectively a cushioned rather than a rigid impact. Due to extension of this time period the delivery of energy remains more constant, therefore the peak forces upon impact are reduced in comparison with standard plastic baton rounds. Since it is these peak forces that are most likely to cause a serious injury in the target individual, such as serious head or thoracic injury, the invention provides a significant improvement over the prior art systems in terms of injury prevention. The rate of onset of the forces is also reduced by the extended impact, which further lowers the risk of producing shock injuries in the target.

Where the crushable zone at the nose of the projectile is provided by a void, it is possible to control the force required to distort the nose by precisely controlling the wall thickness surrounding the hollow area. The material, the wall thickness and the size of the void can therefore be tuned to adjust the apparent stiffness of the projectile so that it performs differently depending on the resilience of the target or part of the body it strikes. For example, if the projectile strikes a very hard, rigid part of the body, such as the skull, the nose of the projectile will distort, providing significant energy attenuation and thus reducing the force of the impact. However, should the projectile strike soft tissue, such as the abdomen, which is the preferred target, the

projectile will remain rigid and the body will distort around it thus absorbing the kinetic energy of the round.

It will be appreciated that the thickness of the nose wall is critical for this application. If the wall is too thick the nose will not be deflected enough to produce sufficient energy attenuation, however if the wall is too thin then the nose will be squashed during firing from the gun barrel, adversely effecting performance. In order to achieve the desired effects, it is preferable that the wall thickness is between 2% and 15% of the overall diameter of the nose section or between 1mm and 5mm for a 37mm calibre projectile. Advantageously the wall thickness is between 4% and 8% of the overall diameter of the nose section.

As indicated above the second critical element of the design of the invention is the size of the crushable void in the nose. The volume enclosed by this void is critical to both the energy attenuating performance of the projectile, and its aerodynamic/ballistic performance. The greater the size of this volume the more energy attenuation is possible, however as the nose of the projectile is hollow the centre of gravity is moved towards the rear of the projectile which causes stability problems if the void is too large. It is therefore necessary to strictly control the volume in order to produce the correct balance. In the preferred embodiment the void is controlled to extend between 10% and 30% of the length of the projectile or approximately 10mm to 30mm for a 37mm calibre round of 104mm length. Advantageously the void will extend for approximately 20% of the projectile length.

When the round strikes the abdomen area of the body, which is the intended target area, the objective is to cause severe, internal, visceral pain by stimulating visceral receptors in the subject disabling them temporarily. In order to produce this visceral pain deflection or intrusion of the body wall of the subject is required and this is dependent on the momentum of the projectile. The momentum of the projectile proposed by the current invention has been shown in tests to be substantially the same as that of a conventional solid rubber baton round of equivalent calibre; therefore significant body wall deflection can be achieved. In this way the invention ensures that the projectile delivers enough pain to provide an effective deterrent to the targeted

individual, whilst effectively reducing the risk of serious injury or death arising from a wayward shot striking the head or face.

The distortion of the nose of the projectile also allows the invention to reduce the risk of the projectile penetrating the body of the target. In a preferred embodiment, the risk of penetration is further reduced by making the diameter of the projectile relatively large, preferably greater than 35mm. Additionally, this embodiment is likely to significantly reduce the risk of damage to the target's eyes. However, it will be recognised that the invention is not dependent on size and is suitable for use over a large range of projectile sizes.

A further advantage of the present invention is the preferred use of a resilient material with elastic performance. The prior art discloses the use of either frangible or plastic materials to provide energy attenuation, however this is disadvantageous in terms of accuracy and stability. Materials that deform plastically or shatter on impact are unpredictable by nature and introduce fragments and uneven surfaces, which can provide additional, unwanted injury mechanisms both for the targeted individual and any other person nearby. Since in the preferred embodiment the present invention uses fully elastic deformation it behaves in a much more consistent way and does not produce any fragments, thus reducing the risks to bystanders. Whilst the prior art projectiles may only be used once, there is no physical reason why the invented projectile may not be reused by loading the fired projectiles into new cartridges.

In a preferred embodiment the invention comprises two major parts. The exterior portion of the projectile body is formed of a hollow tube made of resilient material, having one open end and one closed end which is formed into an ogival shape and forms the leading edge of the projectile. Into this projectile body is inserted a cylindrical plug. This plug is shorter than the projectile body and incorporates a retaining flange that connects with the diameter of the trailing edge of the projectile body and prevents the plug from extending to the end of the body, thus producing a void that creates the crushable zone in the projectile nose. This flange has the added

function of preventing the plug from moving forwards within the tube to fill the crushable zone when the projectile strikes a target.

In an alternative preferred embodiment, the exterior portion of the projectile is formed of a hollow tube made of a resilient material, said hollow tube having one open end and one closed end which is formed into an ogival shape, such that the closed end forms the leading edge of the projectile. A plug may be inserted through the open end of the tube to separate a region at the closed end of the projectile from the main body of the hollow chamber creating a void at the nose. The remaining cylindrical volume is then filled with a resilient material to form a continuous body of the projectile.

It is preferable that an adhesive is also used between the plug and the tube to ensure that there is no relative movement between them. Suitable adhesives include any commercially available adhesives for bonding the type of polymer used to manufacture the round. For example, epoxy resins may be suitable for bonding polyurethanes. In a preferred option, the commercially available adhesive, ARALDITE (Registered Trade Mark) may be used. Typically, any adhesive which provides a bond strength that is greater than 500N (as measured using conventional destructive bond strength test apparatus) would be suitable. Assembly of the plug into the projectile body may be aided by including flutes in the surface of the plug in order to contain the adhesive. The plug can then be rotated as it is inserted in order to spread the adhesive around the diameter of the plug to provide an effective seal.

In either of the preferred embodiments described above, it is preferred that the rear of the plug is tapered towards its rear edge in order to provide greater aerodynamic stability and reduce the friction with the cartridge casing and the gun barrel.

The plug should be made of a resilient material, having similar properties to that used for the projectile body. It is desirable that the materials comprising the projectile body and plug have matching properties of thermal expansion and contraction to ensure consistent performance. This provides that when exposed to variations in temperature, the components behave in the same way, leading to a reduced risk of separation

caused by differential expansion and/or contraction. In order to achieve this synergy in the preferred embodiment of the invention the projectile body and the plug are made of the same material. This affords the possibility that the projectile body and plug may be formed in one piece. Nevertheless it will be recognised that any suitable material may be used for the components provided they have similar thermal properties. The use of a plug of different material composition to the projectile body would enable the forces transmitted by the projectile to be varied.

It is also advantageous for the thermal properties of the bonding adhesive to be matched with those of the projectile components to further reduce the risk of the plug and body separating and to optimise the energy attenuating performance of the projectile.

It is of further benefit that the exterior of the projectile body also incorporates one or more driving bands. These are raised bands or platforms that run radially around the diameter of the projectile perpendicular to the firing direction and provide a localised increase in the cross sectional area of the projectile. These bands provide a seal between the projectile and the cartridge wall so that the maximum amount of energy from the charge is contained to be utilised in driving the projectile forwards. The driving bands also engage any rifling in the barrel of the launching device to enable it to impart spin to the projectile. In the preferred embodiment the projectile has two driving bands, one substantially towards the front of the projectile and one substantially towards the rear of the projectile, adding greater stability to its flight. It is further preferred that the whole of the exterior of the projectile including the driving bands is comprised of the same homogenous material. These driving bands may advantageously also be coated in a lubricant of any known type to reduce heat build up and the wear on the inside of the gun barrel. In a preferred embodiment of the invention this lubricant shall be a dry film lubricant, for example a dry silicone film.

The projectile hereinbefore described may advantageously be fired from a conventional firearm, easing the transition from traditional baton rounds to energy attenuating rounds. The ammunition will then consist of a cartridge, size-matched to

the calibre of the projectile, for example 37mm calibre, in which the solid projectile is replaced by the energy-attenuating projectile described above.

In another aspect, this invention provides a modified cartridge case, which is suitable for holding any type of baton round but which is optimised for and provides further advantages when used with an attenuating energy projectile of the type described herein.

The cartridge case advantageously consists of a cylindrical metal envelope having one closed end containing the propellant assembly and one open end into which the projectile is substantially inserted. The projectile is not inserted into the cartridge completely, ensuring that a gap or chamber is maintained between the projectile and the propellant assembly. The purpose of the chamber is threefold, first it enables the desired pressure to build up within the cartridge casing during firing, prior to the separation of the casing and projectile, secondly the gap allows complete combustion of the propellant to occur, and thirdly, the gap prevents the projectile from being burnt or scorched following ignition of the propellant. In known cartridges this chamber is maintained by producing a crimp or indentation in the cartridge wall to hold the projectile and prevent over insertion. The disadvantage of this method is that when the cartridge heats up, expands and then contracts at lower temperatures the projectile can fall through the crimp to the propellant assembly beneath. This problem is particularly pronounced where, as in the current invention, the projectile is produced from a resilient material such as a polymer or elastomer because of the different expansion rates of the cartridge and projectile materials. The present invention solves this problem and prevents the projectile from being inserted to the very bottom of the casing by incorporating an increase in the wall thickness of the casing, such that its internal diameter is smaller than the rearward diameter of the projectile. The projectile then rests on this step in the inner wall of the cartridge effectively eliminating the problems of the prior art with regard to expansion.

The walls of the open end of the cartridge casing may also be crimped slightly inwards to form a seal with the projectile so that it may be handled as a single unit, and so that the gas pressure caused by firing is contained, such that it may be used

efficiently to propel the projectile forward. Advantageously this crimping of the open end against the projectile also provides a water-tight seal, which makes the rounds easier to store and handle in wet or humid environments.

By way of illustration only, a number of examples of the invention will now be described with reference to the following drawings.

Figure 1 shows the exterior of a hollow nose non-lethal projectile.

Figure 2 shows an exterior view of the projectile contained within a firing cartridge.

Figure 3 shows an axial cross section through the cartridge and projectile.

Figure 4 shows a graph of time versus acceleration illustrating the impact forces of both a conventional round and a round according to the invention, when impacting against a stiff surface. Trace A shows the performance of a solid baton round according to the prior art, and Trace B shows the performance of a round according to the invention.

Referring to figure 3: an energy-attenuating projectile comprises an external projectile body (1) that is substantially cylindrical, substantially hollow, and produced from a resilient material. This projectile body has one rounded closed end and one open end into which a plug (2) is inserted. Said plug is also produced of a resilient material having similar properties of thermal expansion and contraction to the projectile body (1). The plug (2) is of shorter length than the projectile body (1) and is shaped to closely fit its internal cavity. The plug (2) has a retaining flange (3) which makes contact with the rim of the open end of the projectile body (1), and prevents the plug (2) from reaching the top of the projectile body (1). This produces a void (4) in the nose of the projectile between the plug (2) and the front wall of the projectile body (1). An adhesive (not shown) is used to bond the plug (2) to the projectile body (1).

The projectile body (1) further incorporates two driving bands (5), being raised platforms running around the circumference of the body.

The projectile is housed in cartridge casing (6) having one closed end containing a propellant assembly (7) and one open end into which the projectile assembly described above is inserted. The projectile is prevented from being inserted to the bottom of the cartridge by a step (8) formed by an increase in the wall thickness of the cartridge. As the projectile may only be inserted as far as the step, a void is formed between the projectile and the propellant assembly (7). This void forms part of a chamber (9) that surrounds the propellant assembly. The walls of the casing are crimped at its open end (10) to contain the projectile.

When the ammunition above is fired from a conventional firearm, the firing pin strikes the propellant assembly (7) causing the propellant, which may be of any known type, to ignite, pressure then builds up in the chamber (9) forcing the projectile out of the cartridge. The void between the projectile and the propellant assembly allows complete combustion of the propellant, provides control over the peak pressure at which the projectile is ejected and prevents the projectile from being burnt or scorched. Once the projectile has left the cartridge the driving bands (5) engage the rifling in the gun barrel and spin is imparted to the projectile in order to stabilise the projectile in flight.

When the projectile strikes a hard, unyielding surface, such as a human head, the front of the projectile body (1) collapses to fill the void in the nose (4), the plug (2) then strikes the front wall of the projectile body (1), delivering the remainder of the kinetic energy to the target. The retaining flange (3) and the adhesive prevent the plug (2) from moving forward within the projectile body (1). The projectile then rebounds away from the target, remaining in one piece. Since the projectile is produced from a resilient material the deformation at the nose is elastic so the projectile returns to its original shape.

By way of further example and without limitation to the foregoing a specific embodiment of the invention will now be described.

The following description concerns a 37mm calibre embodiment of the invention for use with a conventional firearm of the type that is presently used to fire the solid baton rounds described by the prior art.

In this example the projectile is constructed as shown in figure 3. The projectile body (1) and plug (2) are both produced from the same composition of polyurethane so that they have matching thermal properties as explained above. The polyurethane used is produced from toluene diisocyanate polyester (or polyether prepolymer) cured with MOCA. The hardness of this material was found to lie between 92 and 95 degrees IRHD and its resilience between 48% and 60%. A reference value for the specific gravity of the polyurethane is 1.1g/cm^3 .

Although their material properties were the same the two components were produced in different colours by the addition of pigment.

In the present example the thickness used for the nose wall is approximately 2mm or approximately 6% of the overall diameter of the projectile, which was 34mm at the nose. The projectile incorporates two driving bands and the diameter of these is 37mm. The length of the projectile is 104mm and the length of the energy attenuating void at its nose is 21mm or approximately 20% of the overall projectile length. The overall weight of the projectile is approximately 100g.

This embodiment of the invention has undergone strict testing to prove that it is effective in reducing the potential risk of injuries to targeted individuals.

To prove the effectiveness of the invention in reducing the injury potential of the projectile when it hits a hard target, a projectile according to this embodiment of the invention was fired from a conventional firearm at a rigid target and its deceleration on impact was measured. The data from these tests is plotted on a chart at figure 4, together with data from a traditional solid baton round for comparison. It will be seen that the very high peak force provided by the prior art system (A) has been replaced in the present invention by two substantially equal forces of a much lower magnitude which are delivered one after the other (B). These forces are produced when the

projectile nose hits the body and crumples and when the plug follows through to deliver the remaining kinetic energy respectively. It will also be seen that this more than doubles the duration of the impact reducing not only the peak force delivered but also the rate of onset of that force, thus greatly reducing the risk of causing serious injury.

These tests clearly show that the invented projectile carries a much lower risk of skull bone fracture when compared to a solid round.

The effectiveness of the invented projectile as a deterrent when striking soft tissue was then shown by firing the rounds at an abdominal simulant and measuring its displacement. This showed that the rounds according to the invention produced a similar amount of body wall displacement in the target to the prior art rounds, and as such would produce a comparable amount of pain. These test results were validated and confirmed by firing the test rounds against a body wall simulant.

It will be appreciated that the above is just an example of one specific embodiment of the invention and as such should not be taken as limiting the scope of the invention in any way.

Although of most use to police or security services in situations where behaviour modification of an individual or individuals is necessary, the invention may also find application in the control of wildlife or farm animals, or any other field in which a non-lethal deterrent or projectile is desirable. Therefore in the context of this specification the term individual should be interpreted as including animals and wildlife. The impact response of the projectile may be tuned in each case to suit the intended target.

Claims

1. A non-lethal projectile made of resilient material, wherein a substantial portion at the leading edge or nose of the projectile forms a crushable zone, such that the nose of the projectile deforms without rupturing on impact with a target attenuating the kinetic energy of the projectile and reducing the impact force on the target.
2. A non-lethal projectile as claimed in claim 1 wherein the crushable zone at the nose of the projectile behaves differently depending on the type of target struck, such that should the projectile hit a hard part of the body such as the head the crushable area deforms absorbing kinetic energy and reducing the impact force, however should the projectile hit an area of soft tissue such as the abdomen the projectile remains rigid delivering the maximum amount of kinetic energy to the target body.
3. A non-lethal projectile as claimed in either of claims 1 and 2, wherein the projectile deforms elastically and regains its original shape after impact so that it may be used again.
4. A non-lethal projectile as claimed in any of claims 1 to 3, wherein the crushable zone at the nose of the projectile consists of a hollow area.
5. A non-lethal projectile as claimed in any of claims 1 to 4 wherein the resilient material used is polyurethane.
6. A non-lethal projectile as claimed in claim 5 wherein the polyurethane is produced from a toluene diisocyanate polyester or polyether prepolymer.

7. A non-lethal projectile as claimed in claim 6 wherein the polyurethane is cured with MOCA.
8. A non-lethal projectile as claimed in any preceding claim in which the crushable zone at the nose of the projectile comprises a hollow area, wherein the projectile is constructed of two major parts, a first part forming the exterior of the projectile being a hollow tube of resilient material having one open end and one closed end which forms the nose of the projectile, and a second being a plug that is shaped to closely fit inside the of tube of the first part and being inserted therein such that a hollow space remains at the nose of the projectile.
9. A non-lethal projectile as claimed in claim 8 wherein the plug is made from a material having similar thermal properties to the material used for the external projectile body to avoid separation caused by differential thermal expansion.
10. A non-lethal projectile as claimed in claims 8 or 9 in wherein the plug is made from the same material as the external projectile body.
11. A non-lethal projectile as claimed in any of claims 8 to 10 wherein both the plug and the external projectile body are made from polyurethane.
12. A non-lethal projectile as claimed in any of claims 8 to 11 wherein the plug is retained within the exterior tube by means of an adhesive thus preventing the two components from separating.
13. A non-lethal projectile as claimed in claim 12 wherein the adhesive used has similar properties of thermal expansion and contraction to those of the materials comprising the plug and the external projectile body.
14. A non-lethal projectile as claimed in claims 12 or 13 wherein the adhesive used is an epoxy resin.

15. A non-lethal projectile as claimed in any of claims 8 to 14 wherein the plug is retained by means of a retaining flange at the rear end of the plug which abuts the rear diameter of the exterior tube preventing the plug from moving forward within the tube when the projectile makes contact with the target.
16. A non-lethal projectile as claimed in any of the preceding claims in which the projectile has a substantially cylindrical shape wherein the projectile incorporates one or more raised driving bands running radially around the cylinder perpendicular to the firing direction such that these driving bands can engage the rifling inside a gun barrel in order to impart spin to the projectile.
17. A non-lethal projectile as claimed in claim 16 wherein the driving band surfaces are covered in a lubricant, to reduce friction with the cartridge and gun barrel.
18. A non-lethal projectile as claimed in claim 17 wherein the lubricant used is a dry silicone film.
19. A non-lethal projectile according to any preceding claim wherein the diameter of the projectile is advantageously greater than 35mm in order to minimise the risk of body wall penetration.
20. A non-lethal projectile as claimed in claim 19 above wherein the diameter of the projectile is 37mm or 40mm.
21. A non-lethal projectile according to any preceding claim in which the crushable zone at the projectile nose comprises a hollow area wherein the wall thickness of the hollow nose portion lies in the range of 2% to 15% of the overall projectile diameter.

22. A non-lethal projectile according to claim 21 wherein the wall thickness of the hollow nose portion advantageously lies in the range 1mm to 5mm for a 37mm round.
23. A non-lethal projectile according to claim 21 or 22 wherein the wall thickness of the hollow nose portion is in the range of 4% to 8% of the overall projectile diameter.
24. A non-lethal projectile as claimed in any of the preceding claims wherein the hardness of the resilient material lies in the range 85 to 100 IRHD.
25. A non-lethal projectile as claimed in claim 24 wherein the hardness of the resilient material is in the range of from 92 to 95 IRHD.
26. A non-lethal projectile as claimed in any of the preceding claims wherein the resilience of the resilient material lies in the range 35 % to 70%.
27. A non-lethal projectile as claimed in claim 26 wherein the resilience of the resilient material is in the range of from 48 % to 60%.
28. A non-lethal projectile as claimed in any of the preceding claims wherein the specific gravity of the resilient material lies in the range $1 - 2\text{g/cm}^3$.
29. A non-lethal projectile according to any preceding claim in which the crushable zone at the projectile nose comprises a hollow area, wherein the hollow portion in the nose of the projectile extends for 10 – 30% of the overall projectile length in the firing direction.
30. A non-lethal projectile according to claim 29 wherein the length of the hollow portion in the projectile nose is approximately 20% of the overall length of the projectile in the direction of travel.

31. A non-lethal projectile as claimed in any of the preceding claims which is designed to be fired from a conventional firearm, wherein the projectile is incorporated into a firing cartridge comprising a cartridge body and a propellant assembly.
32. A non-lethal projectile cartridge wherein the projectile is separated from the propellant assembly by a void in order to prevent scorching.
33. A non-lethal projectile cartridge as claimed in claim 32 wherein the gap between the projectile and the propellant assembly is produced by incorporating a step in the internal wall of the cartridge upon which the projectile rests.
34. Use of a non-lethal projectile as claimed in any preceding claim wherein the projectile is fired accurately at targeted individuals in order to cause sufficient pain to incapacitate them and deter them from undesirable behaviour without causing serious injury or death.
35. A non-lethal projectile, substantially as described in the foregoing description with reference to the accompanying drawings.
36. A non-lethal projectile cartridge, substantially as described in the foregoing description with reference to the accompanying drawings.

Fig.1.

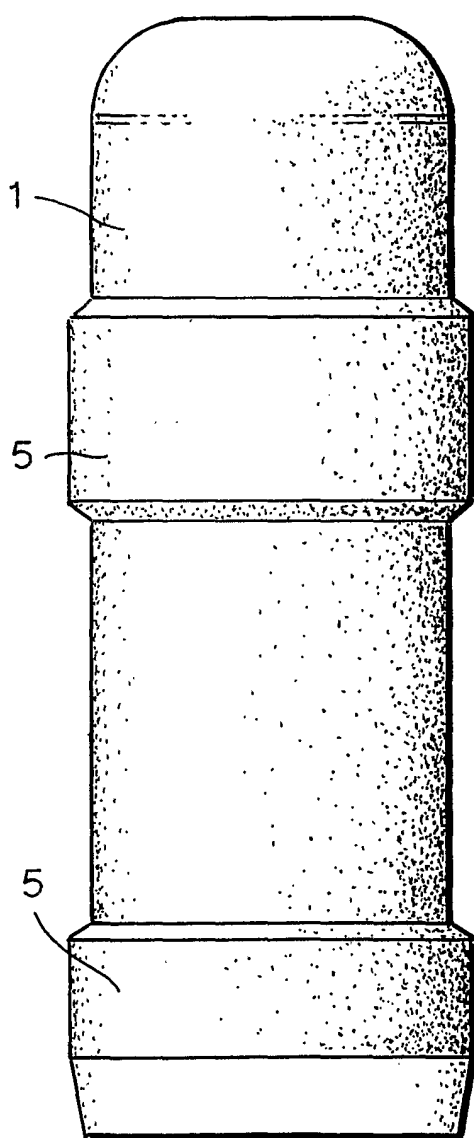


Fig.2.

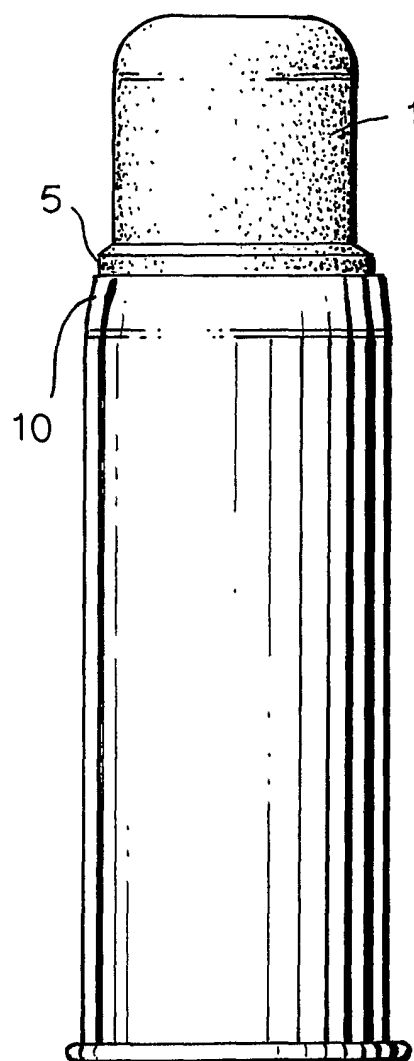


Fig.3.

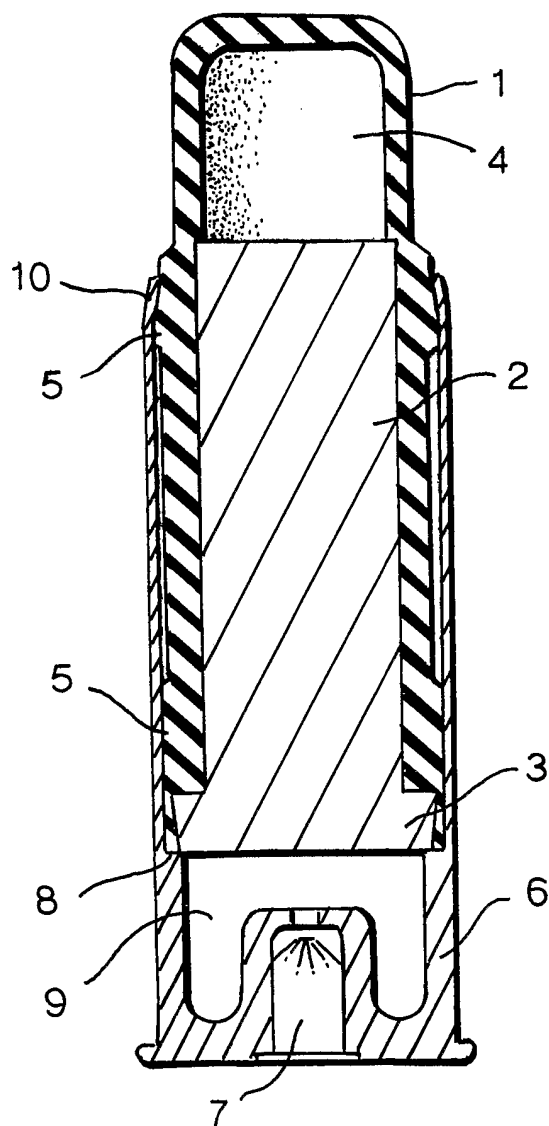
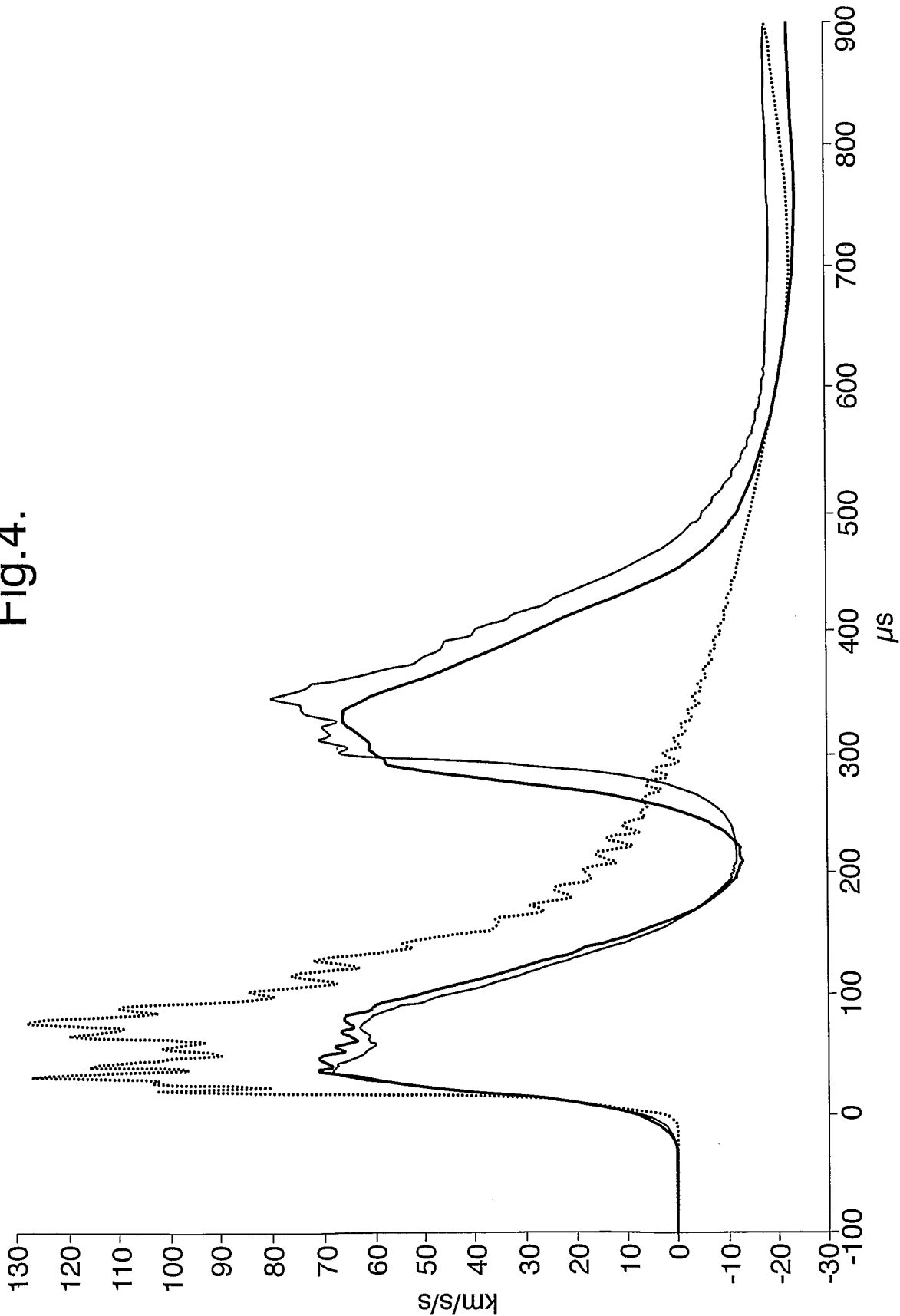


Fig.4.



PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference P1412/WOD	FOR FURTHER ACTION see Form PCT/ISA/220 as well as, where applicable, Item 5 below.	
International application No. PCT/GB2006/001387	International filing date (day/month/year) 18/04/2006	(Earliest) Priority Date (day/month/year) 16/04/2005
Applicant THE SECRETARY OF STATE FOR DEFENCE		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 8 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

a. With regard to the **language**, the international search was carried out on the basis of:

- ☒ the international application in the language in which it was filed
- ☐ a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))

b. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. ☒ **Certain claims were found unsearchable** (See Box No. II)

3. ☒ **Unity of invention is lacking** (see Box No III)

4. With regard to the **title**,

- ☒ the text is approved as submitted by the applicant
- ☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

- ☐ the text is approved as submitted by the applicant
- ☒ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority

6. With regard to the **drawings**,

- a. the figure of the **drawings** to be published with the abstract is Figure No. 3
- ☒ as suggested by the applicant
- ☐ as selected by this Authority, because the applicant failed to suggest a figure
- ☐ as selected by this Authority, because this figure better characterizes the invention
- b. ☐ none of the figures is to be published with the abstract

INTERNATIONAL SEARCH REPORT

International application No.

PCT/GB2006/001387

Box No. IV Text of the abstract (Continuation of item 5 of the first sheet)

A less lethal projectile formed of resilient material, for use as a deterrent or in situations where behaviour modification of an individual or individuals is necessary. The projectile incorporates a crushable zone in its nose portion, advantageously comprising a hollow chamber (4), which deforms on impact with a hard surface such as the skull but which does not deform when striking an area of soft tissue such as the abdomen. This provides that the projectile will cause sufficient pain in a target to act as a deterrent, whilst carrying a much lower risk of causing severe or permanent injury when compared with solid projectiles.

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2006/001387

A. CLASSIFICATION OF SUBJECT MATTER
INV. F42B12/34 F42B5/067 F42B8/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F42B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 012 395 A (SAXBY) 11 January 2000 (2000-01-11)	1-4, 21-23, 26, 27, 29, 30, 34
Y	column 1, line 1 - line 10 column 2, line 8 column 2, line 31 - line 36 column 2, line 43 - line 50 column 1, line 54 - line 62; claim 1; figure 1 column 4, lines 34-39 column 4, line 19 - line 2; claim 17 ----- -/-	5-15, 17, 18, 24, 25

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- *Z* document member of the same patent family

Date of the actual completion of the international search

3 August 2006

Date of mailing of the international search report

16/08/2006

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Authorized officer

Beaufumé, C

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2006/001387

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 732 821 A (ROYER T,US) 15 May 1973 (1973-05-15)	32-34
Y	column 1, line 8 - line 13 column 5, line 32; claims 1,5,7,8; figure 1	5-7
X	US 3 865 038 A (BARR) 11 February 1975 (1975-02-11)	34
Y	column 2, line 28 - line 40; figure 1	8-15,17, 18
X	US 2003/183114 A1 (WIDENER CHARLES D) 2 October 2003 (2003-10-02)	32-34
Y	paragraphs [0004], [0008], [0025], [0026], [0046], [0049], [0076], [0077], [0091], [0092]; figures 1,3,4,14	24,25
X	US 6 041 712 A (LYON) 28 March 2000 (2000-03-28) column 1, line 4 - line 5; claims 1-3; figures 1-10 column 3, line 37 - line 39 column 4, line 60 column 5, line 6 - line 11 column 5, line 27 - line 30 column 2, line 44 - line 60	1,16,19, 20,31,34
X	US 3 714 896 A (YOUNG R,US) 6 February 1973 (1973-02-06)	1,28
A	column 1, line 3 - line 5; claims 1,11; figures 1-3 column 1, line 23 - line 25 column 1, line 40 - line 42 column 1, line 52 - line 61 column 2, line 40 - line 44 column 3, line 3 column 3, line 27 - line 29 column 3, line 43 - line 51 column 4, line 12	7
X	US 2002/088367 A1 (MACALEESE GREGORY B ET AL) 11 July 2002 (2002-07-11) paragraphs [0003], [0025]; figure 1	1-4,19, 20,34
X	US 2003/136293 A1 (TORSTEN WERNER) 24 July 2003 (2003-07-24) paragraphs [0001], [0009], [0020], [0030], [0033]; figures 1-8	32,33

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 35,36

These claims do not comply with Article 6 and Rule 6.2(a) PCT.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.5), should the problems which led to the Article 17(2) declaration be overcome.

INTERNATIONAL SEARCH REPORT

International application No.
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Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.: 35, 36
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
see FURTHER INFORMATION sheet PCT/ISA/210
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-31,34

Non-lethal projectile made of resilient material.

2. claims: 32,33

Non-lethal projectile cartridge.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2006/001387

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6012395	A	11-01-2000	AT 169996 T 15-09-1998 AT 232598 T 15-02-2003 AU 683474 B2 13-11-1997 AU 7003594 A 17-01-1995 CA 2166212 A1 05-01-1995 DE 69412622 D1 24-09-1998 DE 69412622 T2 24-12-1998 DE 69432126 D1 20-03-2003 EP 0706637 A1 17-04-1996 ES 2122294 T3 16-12-1998 WO 9500815 A1 05-01-1995 HK 1013327 A1 19-05-2000 JP 10504635 T 06-05-1998 RU 2134401 C1 10-08-1999 ZA 9404636 A 16-03-1995
US 3732821	A	15-05-1973	NONE
US 3865038	A	11-02-1975	NONE
US 2003183114	A1	02-10-2003	NONE
US 6041712	A	28-03-2000	NONE
US 3714896	A	06-02-1973	NONE
US 2002088367	A1	11-07-2002	AU 7328400 A 12-12-2000 EP 1190205 A2 27-03-2002 WO 0071965 A2 30-11-2000
US 2003136293	A1	24-07-2003	AU 5072701 A 07-11-2001 CA 2406760 A1 01-11-2001 EP 1277023 A1 22-01-2003 WO 0181854 A1 01-11-2001