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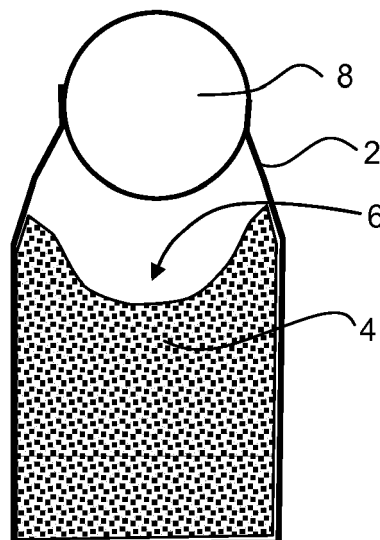
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(54) **Projectile**

(57) A projectile comprises a jacket (2) of a malleable metal containing a pressed powder matrix (4) and holding at a forward end thereof a solid body (8) configured such that, in use, on impact of the projectile with a target, the solid body is forced rearwardly relative to the direction of travel of the projectile into the matrix, thereby causing

the matrix to break down into powder and causing the jacket to deform to break open while remaining in one piece, the powder being ejected from the deformed jacket with sufficient energy to cause trauma in the target while none of the components of the projectile has sufficient energy to escape from the target.



**Fig 1**

## Description

### Field of the Invention

[0001] This invention relates to a projectile configured to maximise internal damage to a target while minimising the risk of over-penetration and any fragments of the projectile escaping from the target to cause injury to others nearby.

### Background to the Invention

[0002] In counter terrorism or other special operations law enforcement officers are constrained from the use of firearms because of the risk of harm to bystanders, for example in public places, or where hostages are involved. This is especially the case in aircraft where there is not only the risk of harm to others in the aircraft, but also the risk of damage to the aircraft, in turn endangering all on board. The use of weapons of reduced power will not be a solution, because there is still no guarantee that over-penetration - i.e. the projectile passing through the target and continuing with sufficient energy to do harm - will not occur, but there is a greater likelihood that the target will not be sufficiently disabled to prevent them from doing harm to others.

### Summary of the Invention

[0003] According to the invention, there is provided a projectile comprising a jacket of a malleable metal containing a pressed powder matrix and holding at a forward end thereof a solid body configured such that, in use, on impact of the projectile with a target, the solid body is forced rearwardly relative to the direction of travel of the projectile into the matrix, thereby causing the matrix to break down into powder and causing the jacket to deform to break open while remaining in one piece, the powder being ejected from the deformed jacket with sufficient energy to cause trauma in the target while none of the components of the projectile has sufficient energy to escape from the target.

[0004] Preferably, the powder is a micronised powder, more preferably a mixture of tungsten and bismuth. It has been found that the inclusion of bismuth prevents clumping of the powder, ensuring that it disperses fully on impact. The preferred proportion of bismuth is 50% by weight, but up to 70% is usable.

[0005] The jacket is formed of soft copper, for example copper with a minor proportion of zinc, preferably less than 5% by weight, and more preferably 1 % by weight.

[0006] The solid body is suitably a polymeric material, for example polypropylene, and is preferably coated with metal powder during manufacture so as to render the body detectable by X-ray apparatus. In this way, all the components of the projectile are X-ray detectable.

[0007] The solid body is suitably crimped into the open end of the jacket.

[0008] The matrix suitably comprises a depression therein facing the solid body, which may be in the form of a ball.

### Brief Description of the Drawings

[0009] In the drawings, which illustrate one exemplary embodiment and its use:

- 10 Figure 1 is a diagrammatic enlarged longitudinal cross-section of a 9mm projectile;
- Figure 2 is a photograph of a gelatine block showing the initial impact of the projectile when fired from a hand gun at a distance of 5m from the block; and
- 15 Figure 3 is a photograph of the same block showing the final cavity profile created by the projectile.

### Detailed Description of the Illustrated Embodiment

- 20 [0010] Referring first to Figure 1, the projectile comprises a copper jacket 2 having a thickness of <0.5mm, containing a charge 4 of powder pressed into a matrix having a depression 6 in the forward (relative to direction of firing) face thereof. The powder is an approximately
- 25 1:1 mixture by weight of micronised tungsten and bismuth. A spherical polypropylene ball 8 is held in position above the matrix 4 by crimping in the open end of the jacket 2, which is initially in the form of a cylindrical tube closed at one end. The projectile will be mounted in a
- 30 cartridge in conventional manner so as to be able to feed through the magazine of a weapon.

- [0011] In use, when the projectile strikes its target it has enough energy to pass through clothing and organic materials, but the impact on the ball forces it rearwardly, relative to the direction of flight of the projectile, into the powder matrix 4, causing the matrix to break down into powder form. This in turn causes the copper jacket to start to fail by opening out, but the copper is selected to be sufficiently malleable to remain as a single piece after
- 35 deformation. For example, a composition of 99% by weight copper and 1 % zinc has been found to be suitable. The bursting of the jacket 4 releases the powder to disperse outwardly, creating a trauma cavity within the target, thereby incapacitating the target. However, the components of the projectile all remain within the trauma cavity and do not escape from the target, thereby ensuring that there is no risk of stray shrapnel to cause injury to bystanders, even if very close to the target. The ball 8, for example, remains intact and, because of its metal
- 40 coating, can be detected along with the other components in the target by X-rays.

[0012] The cartridge is selected such that the projectile has sufficient velocity for accurate target engagement while being controlled to instigate failure on impact.

- 55 [0013] Figures 2 and 3 illustrate the experimental firing of a 9mm round incorporating the projectile of the invention into a Ballistic Gelatine block. Figure 1 illustrates the initial impact, showing the creation of a significant trauma

cavity within the target, but with limited depth of penetration. Typical depth of penetration has been found to be approximately 140mm, but with a large diameter trauma cavity. Figure 3 shows the final cavity profile, with a minor amount of depth penetration compared to the size of the cavity. The entry hole was observed to be small. A test attaching a ballistic gelatine block to a seat and firing the projectile into the block yielded no physical damage to the seat, confirming that all the energy of the projectile is contained within the target. Firing trials through the backs of the seats (fired through the seat into gelatine) resulted in penetration of the seat material and construct of the seat, and displaced an identical trauma cavity in ballistic gelatine to that of normal use.

**[0014]** A further test was carried out by placing a water melon 1 m in front of a paper target and firing the projectile at the melon from a distance of 10m. The melon fragments were observed not to have hit the paper target, indicating that the projectile had dissipated all its energy into the soft target melon.

8. A projectile according to any preceding claim, wherein the solid body is formed from a plastics material.
9. A projectile according to Claim 8, wherein the plastics material is polypropylene.
10. A projectile according to any preceding claim, wherein the solid body is a ball.
11. A projectile according to any preceding claim, wherein the solid body is crimped into the open end of the jacket.
12. A projectile according to any preceding claim, wherein the matrix is formed with a depression therein facing the solid body.

## Claims

1. A projectile comprising a jacket of a malleable metal containing a pressed powder matrix and holding at a forward end thereof a solid body configured such that, in use, on impact of the projectile with a target, the solid body is forced rearwardly relative to the direction of travel of the projectile into the matrix, thereby causing the matrix to break down into powder and causing the jacket to deform to break open while remaining in one piece, the powder being ejected from the deformed jacket with sufficient energy to cause trauma in the target while none of the components of the projectile has sufficient energy to escape from the target.
2. A projectile according to Claim 1, wherein the powder is a micronised powder.
3. A projectile according to Claim 1 or 2, wherein the powder comprises a mixture of tungsten and bismuth.
4. A projectile according to Claim 3, wherein the powder comprises from 35% to 70% by weight of bismuth.
5. A projectile according to any preceding claim, wherein the jacket comprises copper.
6. A projectile according to Claim 5, wherein the jacket comprises more than 95% copper and less than 5% zinc, by weight.
7. A projectile according to Claim 6, comprising 99% copper and 1% zinc, by weight.

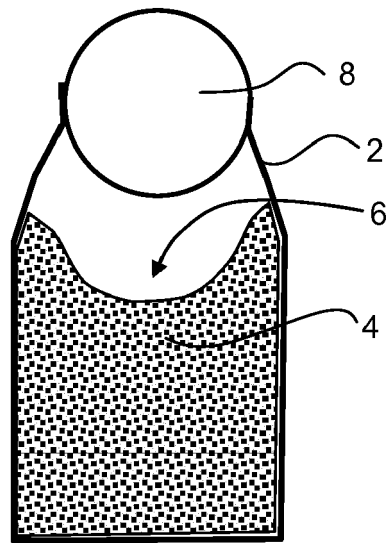


Fig 1

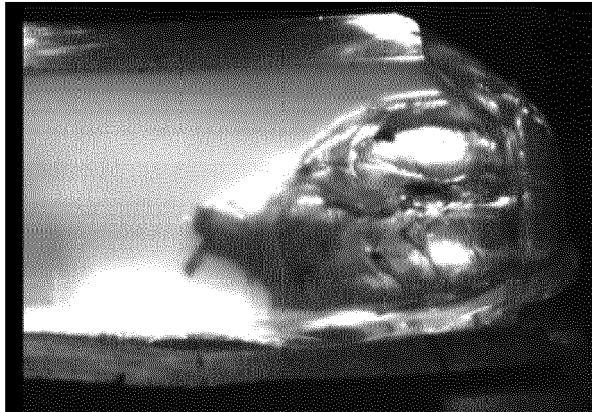


Fig 2

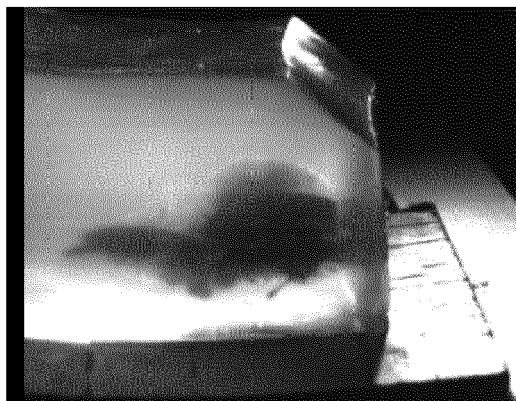


Fig 3



## EUROPEAN SEARCH REPORT

Application Number  
EP 14 17 8237

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 11 September 2014	Examiner Lahousse, Alexandre
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document	



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Application Number  
EP 14 17 8237

DOCUMENTS CONSIDERED TO BE RELEVANT			
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<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ..... &amp; : member of the same patent family, corresponding document</p>			

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**ANNEX TO THE EUROPEAN SEARCH REPORT  
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