US 20150285601A1

(19) **United States**

(12) **Patent Application Publication**

Knights et al.

(10) **Pub. No.: US 2015/0285601 A1**

(43) **Pub. Date: Oct. 8, 2015**

(54) **TAGGING SYSTEM**

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(21) Appl. No.: **14/401,102**

(22) PCT Filed: **May 15, 2013**

(86) PCT No.: **PCT/EP13/60087**

§ 371 (c)(1),
(2) Date: **Nov. 13, 2014**

(30) **Foreign Application Priority Data**

May 15, 2012 (GB) 1208530.4
Feb. 15, 2013 (GB) 1302699.2

Publication Classification

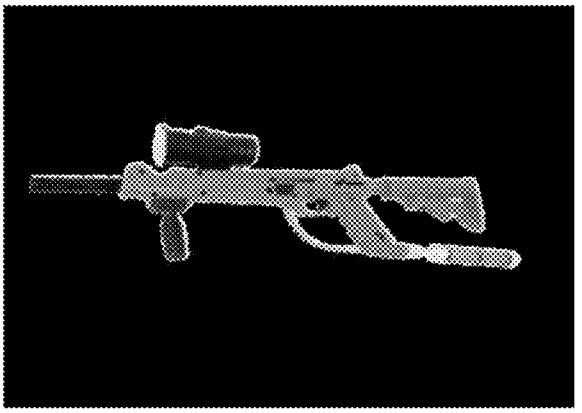
(51) **Int. Cl.**
F42B 12/40 (2006.01)

(52) **U.S. Cl.**
CPC ***F42B 12/40*** (2013.01)

(57) **ABSTRACT**

Provided is an apparatus for marking a target via projectile motion, comprising a capsule encapsulating a liquid having a marker suspended therein, the capsule being configured to rupture upon impact with a target.

Further provided is a device for remote tagging, which device comprises projectile delivery element configured to deliver a projectile to a remote target, wherein the projectile comprises a capsule with an outer casing surrounding a tagging agent, and wherein the projectile delivery element is configured to deliver the projectile at low velocity.



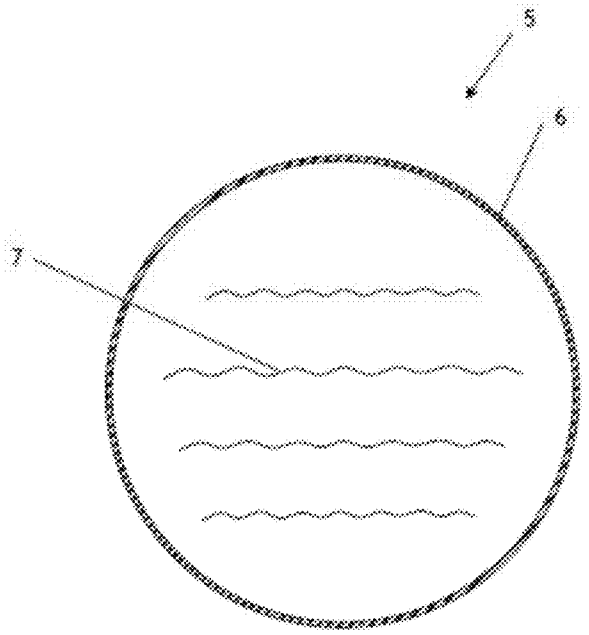


FIGURE 1

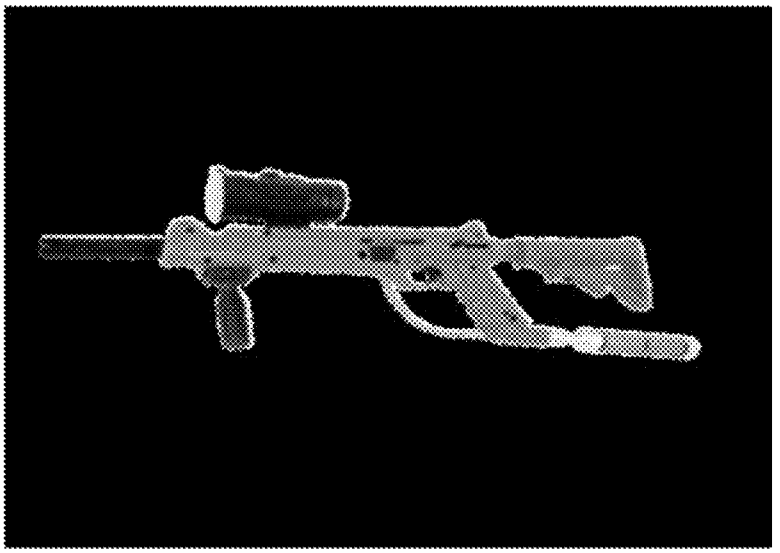


FIGURE 2

TAGGING SYSTEM

[0001] The present invention concerns devices, systems, kits and methods for tagging, and in particular the invention is concerned with tagging at a distance (remote tagging). The invention is of particular utility in the apprehension of suspects and enables a suspect to be marked for later identification. The invention may be used, for example, in tagging an escaping attacker, thief or other criminal to provide evidence for later prosecution.

[0002] In the past it has been known to use tagging as a method for obtaining evidence in a criminal investigation. Typically, an invisible tag is employed to prevent the tag being removed by the perpetrator before it can be identified. Tags that have been employed include invisible dyes that become visible under UV light (e.g. for tagging bank notes), and microdots with unique identifiers for marking personal property. More recently DNA has been employed having a unique code. DNA is particularly useful, since it is much smaller and more difficult to remove even than microdots; even one molecule can be plified to reveal its code, and therefore complete the identification process. Such a system is disclosed, for example, in published international application WO 2010/122159.

[0003] Typically these products and systems have been used to mark products rather than to mark the criminals themselves. However, systems are also known to identify people. Published international application WO 2009/112507 discloses a spray system linked to an intruder identification controller. When an unauthorised intrusion is detected, motion detectors identify where the intrusion is occurring, and a spray is activated to spray the intruder for later identification.

[0004] However, despite improvements in the various known systems, there are still problems in identifying individuals in certain situations, such as for example in a larger group or crowded environment, where identifying the perpetrator is difficult and detaining them may not be possible or practical. This may occur at public events where there is crowd trouble, such as concerts and sports matches, or even in a demonstration or riot situation. Often, such trouble can occur at night, when visual identification becomes difficult and CCTV may not be useful. Moreover, perpetrators may hide their faces with hoodies, scarfs, balaclavas and the like, which can prevent visual identification completely. In these situations, the perpetrator may remain at a distance from enforcement agents, and may later escape into the crowd to avoid detection.

[0005] Riot situations are of particular concern, especially in recent times. It is notable that modern public disorder situations are becoming easier to organise thanks to modern communications, in particular the use of social networks and mobile messaging facilities. The communication means available to rioters allow them to cause trouble in one location and then disperse to a second agreed location very quickly to regroup. In such situations, there may not be time for a police officer to detain rioters before they regroup or disperse.

[0006] Existing means of marking a suspect in riot situations include dye-marking projectiles, similar to paintballs, or hand-held sprays containing identifying markers. However, these systems lack uniqueness of tagging, and/or the ability to tag sufficiently accurately or remotely to be truly effective in identifying troublemakers sufficiently for successful prosecution. Accordingly, there is a need for tagging or marking such individuals at a distance.

[0007] This need is not simple to solve, not least due to the dangers inherent in action at a distance. The requirement to place a tag directly onto a remote individual, before he or she has moved significantly, requires some considerable speed. Projectile weapons act in this way to disable or kill an individual, but in a tagging situation it is unlikely that a device with risks similar to those of a projectile weapon would be acceptable.

[0008] It is an aim of the present invention to solve the problems associated with the known systems, in particular the problems set out above. Thus, it is an aim of the present invention to provide an apparatus or device for remote tagging, and particularly an apparatus or device which is safe to use in a crowd environment. It is also an aim of the present invention to provide a means of marking a suspect which allows them to be identified and linked to a scene or event at a later time and/or date, in order to increase the chances of successfully prosecuting the suspect.

[0009] Accordingly, the present invention provides an apparatus for marking a target via projectile motion, comprising a capsule encapsulating a liquid having a marker, tagging agent, or taggant suspended therein, the capsule being configured to rupture upon impact with a target.

[0010] Further provided is a device for remote tagging, which device comprises projectile delivery element configured to deliver a projectile to a remote target, wherein the projectile comprises a capsule with an outer casing surrounding a marker, tagging agent, or taggant and wherein the projectile delivery element is configured to deliver the projectile at low velocity.

[0011] The marker, tagging agent, or taggant is not especially limited. Typically it is unique, such that it may uniquely identify the target when detected later. In some embodiments it need not be entirely unique to identify the target to sufficient likelihood for evidential purposes, and may thus be non-unique, although in such cases it is preferably at least uncommon. Typically the marker, tagging agent, or taggant comprises a nucleic acid, such as DNA. Alternatively the marker, tagging agent, or taggant may comprise a peptide, polypeptide, a rare earth or rare earth compound, or a metal or metal compound such as a metal oxide. The marker, tagging agent, or taggant may also be a mixture of one or more of the above. DNA, other nucleic acids, peptides and polypeptides may be specifically designed to be unique or uncommon, depending upon the degree of design in the DNA or ino acid sequence. A mixture of other compounds (such as a rare earth mixture, a rare earth compound mixture, a mixture of metals, a metal compound mixture, or a metal oxide mixture) may also be designed to be unique by selecting a unique combination, variety or blend of components and/or controlling the quantity of each individual component.

[0012] Advantageously, the present invention can be used to provide a mobile marking system, with a far superior range over spray systems, and wherein the marking capability is not affected by adverse weather conditions.

[0013] The present invention can also be used to mark vehicles, where there is insufficient opportunity to place a tracking device or otherwise mark the vehicle.

[0014] A batch of capsules, each containing a particular, unique DNA marker, can be withdrawn from a police armory, for example, and the identification of the person withdrawing the capsules and that person's intended deployment location recorded. This allows the time, place and person deploying the capsules to be determined for a particular situation,

thereby enabling a suspect being marked with said unique DNA marker to be uniquely linked to a scene or event.

[0015] In the context of the present invention low velocity is a sufficient velocity such that the outer casing ruptures on impact thus contacting the tagging agent with the target, and at sufficient velocity such that the projectile does not cause significant damage to the target. In preferred embodiments, low velocity is less than 330 feet per second (100.6 ms^{-1}), preferably less than 300 feet per second (91.5 ms^{-1}), preferably less than 280 feet per second (85.4 ms^{-1}), preferably less than 250 feet per second (76.2 ms^{-1}), preferably less than 225 feet per second (68.6 ms^{-1}), preferably from 150-250 feet per second (45.7-76.2 ms^{-1}), preferably from 175-225 feet per second (53.3-68.6 ms^{-1}) preferably about 200 feet per second (about 61.0 ms^{-1}).

[0016] The tagging agent is not especially limited, provided that it is capable of identification at a later time. In some embodiments, the liquid further comprises a colouring agent or dye, to allow the DNA marker to be visibly detected on a target it has impacted upon. However, preferably it is invisible. Further preferably it comprises an invisible marker, such as an ultra violet (UV) and/or an infra-red (IR) marker, and/or heat, to simplify locating it. When the liquid her comprises an ultra violet (UV) indicator, the DNA marker may be detected using an UV light source. When the liquid comprises an infra-red (IR) indicator, the DNA marker may be detected using IR detection equipment. When the liquid is configured to retain heat, the DNA marker may be detected using thermal imaging equipment.

[0017] The outer casing of the capsule is not especially limited. In some embodiments, it is not capable of damaging an individual at low velocity. Typically the outer casing is deformable, and or readily breakable on impact. The material from which it is formed is not especially limited, provided that it is capable of delivering the marker, or tagging agent. Typically the capsule casing is formed from a polymeric substance. Thus it may comprise one or more materials selected from gelatine, a gelatinous compound, polyethylene glycol (PEG), glycerine, sorbitol, water, a fatty acid, a starch, a surfactant, and an emulsifier. A suitable capsule may thus be similar to conventional paintball ammunition used in the sport of paintballing. In some embodiments, the capsule may comprise a plastic shell less than about 0.4 mm thick. It is, ideally, spherical. In these embodiments, the plastic shell of the capsule is preferably sufficiently thin walled such that the pressure of the liquid encapsulated within it will cause the walls of the capsule to rupture upon impact with a target. It typically also retains sufficient strength to be handled normally during storage and loading without unintended rupture.

[0018] Any suitable size of capsule may be employed dependent on the mode of use and delivery system. Preferably, the capsule is about 0.68 caliber (about 18 mm diameter), has a maximum volume of approximately 3 ml and, when the encapsulated liquid is predominantly water, has a weight of approximately 3 g. When deployed, or fired, from a suitable launcher, such as a paintball marker (or paintball), the impact energy of the capsule via projectile motion is around 13 to 16 joules. This, preferably accompanied by a reduced velocity which lowers the impact energy still further, may be considered safe for use in crowd situations. In these embodiments, the effective range of a capsule fired from a paintball marker is, typically, between 0 to 25 m.

[0019] In preferred embodiments, the marker or tagging agent comprises a nucleic acid, preferably DNA. When the tagging agent is DNA, the outer casing of the capsule is typically selected such that the casing is not detrimental to the DNA itself (thus it does not react to degrade the DNA information), but remains deformable and/or readily breakable on impact, and not dangerous for use in crowds. Suitable materials for this have been described above.

[0020] The DNA in the marker is typically resistant to washing, should a suspect attempt to wash an item of marked clothing, and preferably is formulated such that it is capable of embedding into any target surface. The DNA marker can comprise naturally occurring DNA or synthesised DNA. In some embodiments, botanical DNA is used to create a unique DNA sequence, which is then used as the DNA marker. One way to form the unique DNA sequence, is to segment botanical DNA, before the segments are shuffled and reassembled to form the unique DNA sequence.

[0021] The encapsulated liquid is not especially limited, provided that it is compatible with the marker or tagging agent. Typically the encapsulated liquid comprises water or aqueous solution. Water, or aqueous solution, is preferred when the marker or tagging agent is DNA. Typically the encapsulated liquid is embedded with a custom DNA sequence, such as the SelectaDNA™ marker product developed and sold by Selectamark Security Systems plc.

[0022] The invention further provides a kit for remote tagging, which kit comprises:

[0023] (a) a device as defined above; and

[0024] (b) a set of projectiles, each projectile in the set comprising a tagging agent unique to that set.

[0025] Still further provided is a system for remote tagging, which system comprises:

[0026] (a) a device as defined above;

[0027] (b) a plurality of sets of projectiles, wherein each projectile in a set comprises a tagging agent unique to that set, and different from the tagging agent in every other set; and

[0028] (c) a database comprising information linking the identity of each unique tagging agent to the set to which it belongs.

[0029] Yet further provided is a method of tagging, comprising firing a projectile at a target, using the device, kit and/or system as defined above.

[0030] Yet further provided is a use of a device, kit and/or system as defined above to tag a target.

[0031] Yet further provided is a low velocity projectile for tagging a target, which projectile is a projectile as defined above.

[0032] According to the present invention there is also provided a method of marking a target, comprising deploying a capsule encapsulating a liquid having a unique DNA marker suspended therein at the target, the capsule being configured to rupture upon impact with the target, and later determining whether the unique DNA is present on the target.

[0033] Preferably, the encapsulated liquid er comprises an ultra violet (UV) indicator, and the step of determining involves exposing the target to a UV light source to identify the unique DNA. Further preferably, the encapsulated liquid further comprises an infra-red (IR) indicator, and the step of determining involves using IR detector equipment on the target to identify the unique DNA. Still further preferably, the capsule and liquid encapsulated therein is heated before deployment, and the step of determining involves using thermal imaging equipment on the target to identify the unique DNA. In some embodiments, the UV or IR indicator may

itself be unique or uncommon to aid in finding the marker. This may be achieved, for example, by employing a unique, or uncommon, proprietary UV (or IR) blend.

[0034] Preferably, the unique DNA marker of the capsule is recorded against a time, date and/or location of its deployment, so that a target identified as having contact with the unique DNA can be linked to a scene. Preferably capsules are provided in small batches all carrying the same unique marker. Such batches may be issued to a single user for firing from a single weapon during any one deployment thus ensuring maximum traceability. If a suspect is marked with that unique code it must have been fired from the single weapon by the relevant officer during that deployment. Ideally at the end of a deployment any remaining capsules from batches that were used may be disposed of, or alternatively kept as evidence.

[0035] The nature of the projectile delivery element, or weapon, is not significant provided that it is capable of delivering the capsule to the target with sufficient force to cause rupture most of the time. Indeed it could be fired from a device such as a catapult as well as launchers such as compressed gas powered guns. Typically the projectile delivery element comprises a pistol or a rifle, although other mechanisms of delivery may be envisaged by the skilled person. Some typical capsules and projectile delivery elements (weapons) for use in the present invention are shown respectively in FIG. **1** and FIG. **2**. The projectile delivery elements may advantageously be fitted with further evidence gathering equipment, if desired, including audio-visual equipment for capturing sound and/or pictures that may also aid in the identification process. Lights, and/or sights (such as laser sights) may also be included, if desired.

[0036] A specific embodiment of the present invention will now be described, by way of example only, with reference to FIG. **1**, which shows a vertical cross-section through a capsule according to the present invention.

EXAMPLE

[0037] Referring to FIG. **1**, a spherical capsule **5** according to the present invention is shown comprising a shell **6** having a 0.68 Caliber (18 mm diameter) and a maximum volume of approximately 3 ml. The wall thickness of the capsule shell is less than about 0.4 mm. The capsule is sufficiently thin-walled that the pressure of the liquid encapsulated within it will cause the walls of the capsule to rupture upon impact with a target. The capsule encapsulates a liquid **7** in which is suspended a unique DNA marker. Together with the encapsulated liquid, the capsule has a weight of approximately 3 g.

[0038] When deployed, or fired, from a suitable launcher, such as a paintball marker (or paintball gun), the impact energy of the capsule via projectile motion is around 13 to 16 joules.

[0039] The effective range of a capsule fired from a paintball marker is, typically, between 0 to 25 m but the projectiles will fly further up to around 50 m.

[0040] The encapsulated liquid is, preferably, water in which is suspended a custom DNA sequence, such as the SelectaDNA™ marker product developed and sold by Selectamark Security Systems plc.

[0041] The liquid also contains one or more of a coloured dye marker, a UV dye marker or an IR dye marker.

[0042] In use, one or more capsule (which are preferably filled with identical markers) is to be loaded in the magazine of a projectile mechanism such as a paintball—usually powered by compressed air. These are then to be deployed by firing the capsules at targets in order to mark them for later forensic analysis and DNA sequencing. Batches (having a suitable number of identical capsules) can be issued to a person operating a gun so that by suitable record keeping, the batch may be clearly linked to a single weapon and incident to provide evidence for later conviction.

1. Apparatus for marking a target via projectile motion, comprising a capsule encapsulating a liquid having a marker suspended therein, the capsule being configured to rupture upon impact with a target.

2. An apparatus according to claim **1**, wherein the marker comprises a unique marker.

3. An apparatus according to claim **1**, wherein the marker comprises a substance selected from: a nucleic acid, a peptide, a polypeptide, a rare earth or rare earth compound, a metal or metal compound such as a metal oxide, or a mixture of one or more of the above; preferably the marker comprises DNA, such as botanical DNA and/or synthetic DNA.

4. An apparatus according to claim **1**, wherein the liquid is water or an aqueous solution.

5. An apparatus according to claim **1**, wherein the liquid further comprises a colouring agent or dye.

6. An apparatus according to claim **1**, wherein the liquid further comprises a UV indicator.

7. An apparatus according to claim **1**, wherein the liquid further comprises an infra-red indicator.

8. An apparatus according to claim **1**, wherein the liquid is configured to retain heat.

9. An apparatus according to claim **1**, further comprising a projectile weapon adapted to propel the capsule toward a target.

10. An apparatus of claim **8**, wherein the projectile weapon is powered by compressed gas.

11. An apparatus according to claim **1**, which apparatus comprises a projectile delivery element configured to deliver the capsule to a remote target, wherein the capsule comprises an outer casing surrounding the marker, and wherein the projectile delivery element is configured to deliver the projectile at low velocity.

12. An apparatus according to claim **11**, wherein low velocity is a sufficient velocity such that the outer casing ruptures on impact thus contacting the marker with the target, and at sufficient velocity such that the capsule does not cause significant damage to the target.

13. An apparatus according to claim **11**, wherein low velocity is less than 330 feet per second (100.6 ms^{-1}), preferably less than 300 feet per second (91.5 ms^{-1}), preferably less than 280 feet per second (85.4 ms^{-1}), preferably less than 250 feet per second (76.2 ms^{-1}), preferably less than 225 feet per second (68.6 ms^{-1}), preferably from 150-250 feet per second (45.7-76.2 ms^{-1}), preferably from 175-225 feet per second (53.3-68.6 ms^{-1}) preferably about 200 feet per second (about 61.0 ms^{-1}).

14. An apparatus according to claim **11**, wherein the projectile delivery element comprises a weapon, such as a pistol or a rifle.

15. An apparatus according to claim **11**, wherein the outer casing of the capsule is deformable.

16. An apparatus according to claim **11**, wherein the outer casing of the capsule, comprises one or more materials selected from gelatine, polyethylene glycol (PEG), glycerine, sorbitol, water, a fatty acid, a starch, a surfactant, and an emulsifier.

17. An apparatus for remote tagging, which apparatus comprises projectile delivery element configured to deliver a projectile to a remote target, wherein the projectile comprises a capsule with an outer casing surrounding a tagging agent, and wherein the projectile delivery element is configured to deliver the projectile at low velocity.

18. An apparatus according to claim **17**, wherein low velocity is a sufficient velocity such that the outer casing ruptures on impact thus contacting the tagging agent with the target, and at sufficient velocity such that the projectile does not cause significant damage to the target.

19. An apparatus according to claim **17**, wherein low velocity is less than 330 feet per second (100.6 ms^{-1}), preferably less than 300 feet per second (91.5 ms^{-1}), preferably less than 280 feet per second (85.4 ms^{-1}), preferably less than 250 feet per second (76.2 ms^{-1}), preferably less than 225 feet per second (68.6 ms^{-1}), preferably from 150-250 feet per second (45.7-76.2 ms^{-1}), preferably from 175-225 feet per second (53.3-68.6 ms^{-1}) preferably about 200 feet per second (about 61.0 ms^{-1}).

20. An apparatus according to claim **17**, wherein the tagging agent comprises a substance selected from: a nucleic acid, a peptide, a polypeptide, a rare earth or rare earth compound, a metal or metal compound such as a metal oxide, or a mixture of one or more of the above; preferably the tagging agent comprises DNA, such as botanical DNA and/or synthetic DNA; and/or preferably the tagging agent is a unique tagging agent.

21. An apparatus according to claim **17**, wherein the projectile delivery element comprises a weapon, such as a pistol or a rifle.

22. An apparatus according to claim **17**, wherein the outer casing of the capsule is deformable.

23. An apparatus according to claim **17**, wherein the outer casing of the capsule, comprises one or more materials selected from gelatine, polyethylene glycol (PEG), glycerine, sorbitol, water, a fatty acid, a starch, a surfactant, and an emulsifier.

24. A kit for remote tagging, which kit comprises:

(a) an apparatus as defined in claim **1** or **17**; and

(b) a set of projectiles, each projectile in the set comprising a tagging agent or marker unique to that set.

25. A system for remote tagging, which system comprises:

(a) an apparatus as defined in claim **1** or **17**;

(b) a plurality of sets of projectiles, wherein each projectile in a set comprises a tagging agent or marker unique to that set, and different from the tagging agent or marker in every other set; and

(c) a database comprising information linking the identity of each unique tagging agent or marker to the set to which it belongs.

26. A method of tagging, comprising firing a projectile at a target, using the apparatus as defined in claim **1** or **17**.

27. Use of an apparatus as defined in claim **1** or **17** to tag a target.

28. A low velocity projectile for tagging a target, which projectile comprises a capsule as defined in claim **17**.

29. A method of marking a target, comprising:

(a) deploying a capsule encapsulating a liquid having a unique DNA marker suspended therein at the target, the capsule being configured to rupture upon impact with the target; and

(b) later determining whether the unique DNA is present on the target.

30. A method according to claim **29**, wherein the encapsulated liquid further comprises an ultra violet (UV) indicator, and wherein the step of determining involves exposing the target to a UV light source to identify the presence of the unique DNA.

31. A method according to claim **29**, wherein the encapsulated liquid further comprises an infra-red (IR) indicator, and wherein the step of determining involves using IR detector equipment on the target to identify the presence of the unique DNA.

32. A method according to claim **29**, wherein the capsule and liquid encapsulated therein is heated before deployment, and wherein the step of determining involves using thermal imaging equipment on the target to identify the presence of the unique DNA.

33. A method according to claim **29**, further comprising the step of recording the unique DNA marker of a capsule together with a time, date and/or location of its deployment, such that a target identified as having contact with the unique DNA can be linked to a scene and/or an event.

34. A method according to claim **29**, in which marker DNA recovered from a suspect is sequenced or fingerprinted to identify it.

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