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(54) Title: PHOTO-LUMINESCENT SHOTGUN PROJECTILES

(57) Abstract: Disclosed and claimed are pellets for a shotgun shell which are covered with a light transmissive coating that contains pigments which photo-luminesce visible light, of selectable wavelength (color), in response to excitation by long wave ultra-violent light ("black light"). The trajectory of such pellets during flight is able to be visualized and captured on camera during night, indoors or under shooting conditions where ambient light is low. When lodged in a target the visibility of the pellets can be enha nced by illumination by black light, thereby facilitating the task of locating shot pellets, for removal from the target, scoring or other purposes. By assigning several shooters shotgun shells having pellets which photo-luminesce a color which is distinctive to each, one is also able, by visual inspection of the pellets lodged in a target, to determine which of said shooters struck a target and other information relating to the accuracy of each shooter's efforts.

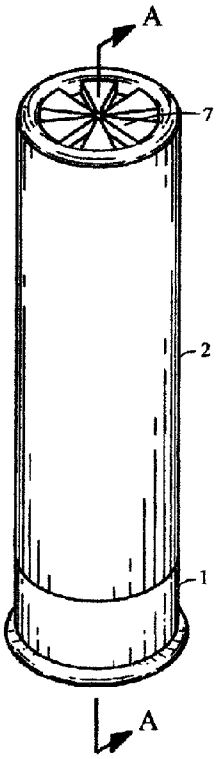

FIG. 1

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PHOTO-LUMINESCENT SHOTGUN PROJECTILES

Background of the Invention:

1. Field of Invention:

Disclosed and claimed are pellets for a shotgun shell which are covered with a light transmissive coating that contains pigments which photo-luminesce visible light, of selectable wavelength (color), in response to excitation by long wave ultra-violent light ("black light"). The trajectory of such pellets during flight is able to be visualized and captured on camera during night, indoors or under shooting conditions where ambient light is low. When lodged in a target the visibility of the pellets can be enhanced by illumination by black light, thereby facilitating the task of locating shot pellets, for removal from the target, scoring or other purposes. By assigning several shooters shotgun shells having pellets which photo-luminesce a color which is distinctive to each, one is also able, by visual inspection of the pellets lodged in a target, to determine which of said shooters struck a target and other information relating to the accuracy of each shooter's efforts.

2. General Background:

There have been previous attempts to make the trajectory of shotgun pellets visible in flight. Most have involved indirect means such as utilization of ballistic tracer platform, such as seen in U.S. Pat. No. 7,228,801 to *Dunnam* et al, to accompany the pellets. Various means have been proposed for making the tracer platform visible in flight, including igniting means, electrically powered means (such as light emitting diode) or chemi-luminescent means. At least in theory the tracer platform will at least generally follow the trajectory of the pellets, at least for a distance, thereby giving the shooter at least some, albeit indirect, indication of the trajectory of the pellets.

Other attempts to make the trajectory of shotgun pellets visible in flight have generally involved attempts to modify the pellets themselves to make their path more visible. U.S. Pat. No. 3,760,735 to *Schmitt* suggests the attachment of tails which have high

visibility. This is expensive and has the disadvantage of slowing the pellets, not only rendering them unsuitable for hunting but presenting the shooter of a distorted picture of the trajectory normal pellets will take. U.S. Pat. No. 4,389,939 to *Ofuji* suggests the shot pellets be coated with ignitable agent. It is believed ignition is unreliable and when it occurs these type of pellets can present a fire hazard. U.S. Pat. No. 4,080,899 to *Luban* suggests the shot pellets be coated with a white coating which, if it works at all, has limited utility where there are objects in the background which would be illuminated by lighting directed towards the shot pellets.

None of the above mentioned art discloses use shotgun pellets which are covered with a light transmissive coating that contains pigments which photo-luminesce visible light, of selectable wavelength (color), in response to excitation by long wave ultra-violent light ("black light"), the trajectory of which said pellets may not only be seen and captured by camera during flight but when lodged in a target are more easily visualized for removal, scoring or other purposes.

3. Objects of the Invention:

The principal object of the invention disclosed and claimed herein is to provide a means whereby under conditions which can created the trajectory of shotgun pellets during flight may be seen and/or captured by camera but does not impair the utility of the pellets for normal uses such as for game and/or target shooting. Yet another object of the invention is to provide a means by which visibility of shot gun pellets lodged in a target may be enhanced, so as to facilitate locating said pellets for removal, scoring or other purposes. Still another object of the invention relates to provide shotgun pellets which may be caused to photo-luminesce any selected color thereby providing a means which by assigning shooters shot gun shells having pellets which photo-luminesce a color (or plurality of colors) distinctive to each shooter, a shot pellet found lodged in a target may be associated with the shooter who fired the shell containing the pellet. Other objects and advantages of the invention will become clear from the following description of a preferred embodiment of the invention.

Summary of the Invention:

All of the above objects of the invention are accomplished by providing pellets for a

shotgun shell which are covered with a light conductive coating which contains pigments which photo-luminesce visible light, of selectable wavelength (color), in response to excitation by long wave ultra-violent light ("black light"). Brightness and color the pellets photo-luminesce is influenced by selection of pigment, density of pigment, under-coating and transparency of the medium which carries the pigments.

Description of the Drawings:

For further understanding of the nature and objects of the present invention, reference should be made to following description of the preferred embodiment of the invention taken in conjunction with the accompanying drawings, in which like parts are given like reference numerals, and wherein:

FIG. 1 is an isometric view of the exterior of a shotgun shell of the present invention.

FIG. 2 is a cross sectional view of the shotgun shell along A - A of FIG. 1.

Description of the Preferred Embodiment of the Invention:

While the present invention will be described with reference to preferred embodiments, it will be understood by those who are skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. It is therefore intended that the present invention not be limited to the particular embodiments disclosed as the best mode contemplated for carrying out this invention, but that the invention will include all embodiments and legal equivalents thereof.

The shotgun pellets 6 herein disclosed and claimed may be used in an conventional shotgun shell such as seen in FIGS 1 and 2. In general such shotgun shells will have head 1, casing 2, primer 3, powder charge 4, wad 5, projectiles 6, closed end 7 and optionally liner 8. So as to maximize the kinetic energy the contain at velocity pellets 6 are conventionally made of a heavy metal, such as lead, but other metals, such as steel are required by certain regulations and the use of different metal alloys, either as the base metal or as a metal plating is known. In addition use of other materials, such as polymers (sometimes called "plastics") and ceramics to name a few, are also know.

The invention disclosed and claimed herein relates to provision of a coating to the

surface of shotgun pellets such as illustrated by numeral 6 of the FIGURES. The coating is the dried or cured residue of a liquid medium and pigment particles which emit light ("luminesce") which is visible to the human eye (namely having a wavelength of about 400 to 750 nanometers) in response to stimulation by long wave ultra-violet (namely light having a wavelength of about 320 to 400 nanometers, which is commonly referred to as "UVA region" or "black light"). In simple embodiment of the invention this will involve application of a commercially available paint (which includes photo-luminescent pigments in appropriate water, alcohol or hydrocarbon based medium) which photo-luminesces a selected color in response to stimulation by black light to pellets 6 and permitting (or causing) the paint to cure (dry), resulting in the non-volatile residue of the medium, and included pigments, adhered to the surface of pellets 6. Such paints are commercially available from many sources, including Wildfire, Inc. in Torrance, California, United States of America and Glow, Inc. in Severn, Maryland, United States of America.

Alternatively, instead of application and drying of commercially available paints having the characteristics described above to pellets 6 one might choose to obtain commercially available photo-luminescent pigments separately (available from many sources including the sources mentioned above) or fabricate their own photo-luminescent pigments and mix said pigments with a medium of their own choosing, whether water, alcohol, hydrocarbon or resin medium (including but not limited to epoxide medium).

In selection of medium it should be appreciated that visibility of the pellets will influenced by transparency of the medium residue to both black light and to visible light of appropriate wavelength be used. In general the more transparent the residue of the medium is to black light, the more black light will strike pigment particles included in the residue and cause the pigment particles to photo-luminesce. Likewise the more transparent the medium is to visible light the more visible light which is emitted from pigment particles which have been stimulated by black light will escape from the media and will be able to be seen by human viewers. It should also be appreciated that adherence to the shop pellets, durability, toxicity and environmental factors will also bear upon choice of medium. Use of an adherent, durable, non-toxic, water based, acrylic and environmentally friendly medium is preferred in most circumstances.

In selection and application of pigments several matters should be appreciated. For instance, it should be appreciated that pigments which photo-luminesce visible light of selected color when stimulated by black light generally fall into one of two categories, pigments which are described as "fluorescent" and those which are described as "phosphorescent". In general pigments which are described as fluorescent photo-luminesce only when being actively stimulated by black light and those which are described as phosphorescent continue to emit visible light of decaying intensity for a period of time, sometimes hours, even days after being stimulated ("charged") by black light.

While use of both of these types of pigments is embraced within the scope of the invention herein disclosed and claimed, each has advantages and disadvantages. For instance when fluorescent pigments are employed in practicing the invention, the pellets 6 need not be "charged" by stimulating them with black light shortly before being fired. However the field across which the pellets 6 are to be fired must be illuminated by black light when the pellets 6 are fired (in order to cause the pellets 6 moving through the field to photo-luminesce). This is not difficult to do, but provision must be made to appropriately illuminate the firing range with black light when pellets 6 having a coating which includes photo-fluorescent pigment are to be viewed. It should also be appreciated that when using pellets 6 having a coating which includes photo-fluorescent pigment the direction from which the black light illuminates firing field is material to the ability of a viewer to view the trajectory of the pellets 6 in flight; namely the black light should generally come from the direction from which the shooter or other observer is to view the pellets 6 so that visible light coming from the pellets 6 is projected back toward the viewer rather than projected away from the viewer. It should also be appreciated that the intensity of the black light has is material to the brilliance which pellets 6 photo-luminesce, if the pellets 6 are illuminated by black light of low intensity they may photo-luminesce too dimly to be visualized in flight. It should also be appreciated that in order to successfully be able to view the trajectory of pellets 6 in flight contrast must be provided between pellets 6 and the background against which there are to be viewed. The pellets 6 are, at least in flight, best viewed at night against a dark sky, indoors having low ambient lighting against a dark background and other low ambient lighting conditions where dark background is present. Photo-luminescent

pellets 6 cannot generally be seen in flight in the presence of sun light. When stationary photo-luminescence of the pellets 6 can usually be seen under the influence of black light under normal indoor lighting conditions.

If on the other hand phosphorescent employing phosphorescent pigments to practice the invention also has certain advantages and disadvantages. The major advantage of using phosphorescent pigments is the firing range not be illuminated by black light when the projectiles are fired (presuming the pigments have been charged with ultra-violet light sufficiently short time before firing that they are still "glowing" a sufficient intensity to be seen when fired). On the other hand the necessity of charging pellets 6 with ultra-violet light a short time before they are fired constitutes a disadvantage to use of phosphorescent pigments. Nevertheless it can be done, either by charging the pellets 6 before they are loaded into a shotgun shell, or afterward if casing 2 if sufficiently conductive (transparent or translucent) to long wave ultra-violet light ("black light") to permit charging of pellet 6 through casing 2. Casings 2 made of various polymers ("plastic") are available which will permit the passage of black light. It should, however be appreciated that if charging of the pellets 6 after they are loaded into a shotgun shell is to be accomplished the side of pellets 6 facing the axis of the shell and pellets 6 which are shielded by pellets 6 around outer diameter of the shell may not receive adequate "charge" of black light to be seen in flight. It should however be appreciated that charging can nevertheless be accomplished in this manner, because its is not necessary that all of the surface of the pellets or all pellets 6 need be visualized in flight, only some of them need be visualized to provide a shooter that missed a target useful information as to whether his or her aim was too high, too low, too far to the left or to the right.

Pigments which photo-luminesce different colors are readily available commercially (including the above mentioned commercial sources) or may be fabricated. Generally pigments of different colors may be mixed to form other colors. As those familiar with coloring systems will know by mixing differing quantities of pigments of three primary colors any other color can be formed. Accordingly by appropriate choice of photo-luminescent pigments (or paints containing photo-luminescent pigments) the pellets 6 of the invention may be made to photo-luminesce any selected color. This ability brings with it the ability to

associate pellets 6, whether in flight or whether lodged in a target with the shooter who fired those pellets. Accordingly, by assigning different shooter shotgun shells which have pellets 6 which photo-luminesce a color distinctive to each, multiple shooter may fire at the same target, yet be able to tell which shooter struck the target, which shooter struck the target first, and by inspection of pellets 6 lodged in the target under black-light, determine how many times each shooter may have struck the target, where on the target each pellet struck and other information relative to the quality of each shooter's efforts.

It might also be mention that a shotgun shell need not be loaded with pellets 6 that photo-luminesce the same color. For novelty or perhaps other purposes, shotgun shells may be loaded with pellets 6 that photo-luminesce two, three or even more distinctive colors.

Several other things should be appreciated about the invention herein disclosed and claimed. Not only do photo-luminescent pigments have different color that may be selected, they also have different brightness that may also be selected. While choice of color is largely a matter of preference, it cannot be said that it is entirely so, the human eye is more sensitive to certain colors (such as those in middle part of visible spectrum, generally the yellows, greens and oranges) of same brightness than it is to other colors (near the end of the visible spectrum, generally the purples and reds). Thus it will generally be necessary to utilize greater quantity of pigments to produce purple and red light of same visibility of colors in the mid-range of the spectrum of human visible light. I should also be appreciated that while one might wish to use the brightest pigments possible, these are generally more expensive than those of less brightness, thus appropriate compromises may have to be made between cost, density of pigments and color of pigments to produce pellets 6 of acceptable visibility in flight. Pigments which photo-luminesce at least 3000 millicandelas per square meter are preferred for night time skeet or trap shooting under low ambient light conditions against a dark sky. It should be appreciated that in low ambient light conditions the clay target cannot be seen unless it too is marked with a paint that is also photo-luminescing.

It should also be appreciated that use of a highly reflective undercoating will enhance the efficiency of the photo-luminescent coating to direct visible light towards the viewer. While no claim is made to exactly why that is so, it is at least suspected that it occurs

because of two factors, one being at least some of the black light which falls on a pellet 6 does not strike a pigment particle but a space in between pigment particles and a highly reflective coating redirects at least some of the ultra-violet light that might otherwise be wasted back to pigment particles which photo-luminesce in response to this redirected black light and the converse may also be true, some of the visible light which is emitted by stimulated pigment particles is not initially directed toward the viewed but back toward the undercoating where at least some of it is reflected back to the user. While use of a white undercoating is reflective of all visible colors of light it is actually not necessary that the undercoating be white, so long is the undercoating is highly reflective of the color light that the photo-luminescent pigment is to emit light, an undercoating of that color could be used (for instance if a pigment which photo-luminesces "green", namely visible light of about 505 nanometer wavelength, then a "green" undercoating, which is highly reflective of light of about 505 nanometer wavelength could be used).

Yet another thing that should be appreciated about the invention is photo-luminescent pigments and paints containing such pigments are sometimes categorized as "visible" and "invisible". In the context use invisible means when the pigment is not stimulated by black light the color of light that it will emit is not apparent. Paints containing these pigments tend to be either clear or appear to be white under ordinary (visible light). On the other hand, used in the context of photo-luminescent pigments, pigments which are classified as visible appear to be of approximately the same color whether stimulated by black light or not (although said pigments are brighter when stimulated by black light). For purpose of viewing trajectory of pellets 6 in flight it generally makes no difference whether visible, invisible or both are employed. Use of visible pigments may be advantageous for other purposes, namely locating pellets 6 lodged in targets and if color of pellets 6 is distinctive to each of several shooters, identifying which of shooters fired a pellet located without the necessity of having to view the pellet in black light (or under conditions where photo-luminescence is not very effective, such as in bright sunlight). Accordingly the use of visible pigments is preferred.

It will be appreciated from the above description that pellets 6 of the invention have a variety of advantages not brought forth by prior art, including but not necessarily limited to

without impairing conventional use of shotgun projectiles for either hunting or target practice, providing a way to track (and be able to capture on camera) the trajectory of shot pellets 6 in flight, enhance the ability of locating the pellets 6 that are lodged in a target, and, by assigning several shooters shotgun shells having pellets which photo-luminesce a color which is distinctive to each, be able to determine, by visual inspection of the pellets lodged in a target, which of said shooters struck a target and other information relating to the accuracy of each shooter's efforts.

While the above description contains certain specifics, these should not be construed as limitations on the scope of the invention, but rather as an exemplification of one preferred embodiment thereof. Accordingly, the scope of the present invention should be determined not by the embodiment(s) illustrated, but by such claims and their legal equivalents as may be granted upon the disclosure herein made.

CLAIMS

What is claimed is:

1. Shotgun pellets comprising:

a photo-luminescent coating encapsulating the shot pellets to permit tracking of the pellets' trajectory to the target situs, the coating being the residue of a liquid mixture comprising a pigment which photo-luminesces visible light of a selected color in response to excitation by black light and a carrier medium which adheres to the surface of the pellets and is transmissive of black light and light of said selected color.

2. The shotgun pellets of Claim 1 further comprising an adherent undercoating, disposed between the surface of shotgun pellets and said photo-luminescent coating, which is highly reflective of black light.

3. The shotgun pellets of Claim 1 further comprising an adherent undercoating, disposed between the surface of shotgun pellets and said photo-luminescent coating, which is highly reflective of light of said selected color.

4. The shotgun pellets of Claim 2 wherein said undercoating is also highly reflective of light of said selected color.

5. The shotgun pellets of Claim 2 wherein said undercoating is white.

6. The shotgun pellets of Claim 3 wherein said undercoating is white.

7. The shotgun pellets of Claim 1 where said medium has a volatile component comprised of water.

8. The shotgun pellets of Claim 1 where said medium has a volatile component comprised of petroleum based solvents.

9. The shotgun pellets of Claim 1 where said medium is comprised of a catalytically cured resin.

10. The shotgun pellets of Claim 9 where the resin is an epoxy resin.

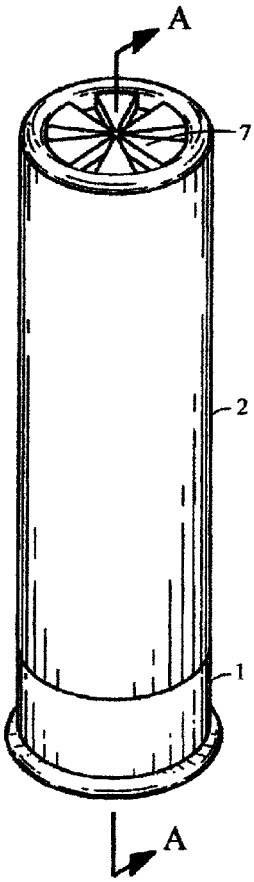

FIG. 1

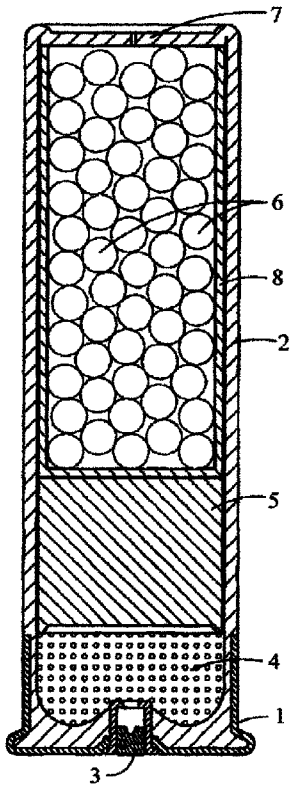

FIG. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2010/053173

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - A63B 71/02 (2010.01)
USPC - 102/513
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)
IPC(8) - A63B 71/02 (2010.01)
USPC - 102/501, 502, 513, 514, 517, 529

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 practicable, search terms used)
Patbase, Google Scholar

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 5,415,151 A (FUSI et al) 16 May 1995 (16.05.1995) entire document	1 --- 2-10
Y	US 2004/0031474 A1 (CIESIUN) 19 February 2004 (19.02.2004) entire document	2-6
Y	US 2008/0229964 A1 (CRANOR) 25 September 2008 (25.09.2008) entire document	7-10
A	US 6,048,280 A (PALMER et al) 11 April 2000 (11.04.2000) entire document	1-10
A	US 5,228,697 A (GULICK et al) 20 July 1993 (20.07.1993) entire document	1-10

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

* 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 application or patent 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
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
02 December 2010	08 DEC 2010
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774