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(54) Composition of a gelatin capsule in a target marking projectile

(57) A paintball projectile capable of marking a target comprises a soft elastic gelatin capsule shell encapsulating a liquid fill, and comprises a silicone oil content in at least one of the capsule shell and the liquid fill.

Advantage: reduction of embrittlement of capsule wall.

Furthermore, there is provided a method of manufacturing a projectile of this type which comprises mixing a silicone oil with at least one of the capsule shell or the liquid fill during manufacture, and further facilitating diffusion of the silicone oil across the capsule shell/fill boundary resulting in a silicone oil content retained in both the capsule shell and the fill.

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Description

TECHNICAL FIELD AND BACKGROUND ART

The present invention relates to a projectile of the type comprising a soft gelatin capsule enclosing a liquid fill and, more particularly, relates to such a projectile which is rapidly accelerated by subjection to a percussive force. Usually, the percussive force is supplied by a blast of high pressurized gas supplied to the projectile in the barrel of a gun. Such projectiles are intended to break on hitting a target to release the liquid fill.

Typically, projectiles of this type are used primarily for marking targets, where on impact with the target the gelatin capsule will break and deposit its liquid fill on the target. Usually the liquid fill will comprise a paint or coloured dye to clearly and visibly mark the target. The marking method may be used, for example, for the marking of trees or other inanimate objects, or for use in "war games" whereby the projectiles are used, instead of bullets, to indicate a hit on an opponent.

Gelatin capsules of this type are well known and usually comprise a soft gelatin capsule (or shell), formed with a plasticiser into a sealed sphere, to hold a liquid fill material such as paint, as discussed in British Patent No. 1,268,635 (GIARGER). However, a disadvantage of known projectiles of this type is that the contents of the capsule can absorb water from the gelatin, causing embrittlement of the capsule which can result in the capsule breaking under the normal percussive forces applied to it when fired from a gun. In addition, should the capsule become cold then expansion and even solidification (freezing) of the liquid fill contents can take place which again can cause the capsule to split and break, or produce areas of weakness in the capsules which again fail when subject to the normal percussive forces when fired from a gun.

It is an object of the present invention to provide a projectile for withstanding high acceleration by a percussive force applied thereto by which the aforementioned disadvantages may be alleviated in a very simple and inexpensive manner.

STATEMENT OF INVENTION AND ADVANTAGES

According to the present invention there is provided a projectile for withstanding high acceleration by a percussive force applied thereto, comprising a soft elastic gelatin capsule shell and liquid fill, in which at least one of the capsule shell and fill comprises a silicone oil. Preferably, both of the capsule shell and fill will comprise a silicone oil content.

The inclusion of silicone oil in the capsule shell serves to alleviate the effects of absorption of water from the capsule into the liquid fill which helps reduce the embrittlement of the capsule. If water is removed from the capsule shell then the soft elastic gelatin becomes more brittle and subject to failure and so by alleviating the effects of this water absorbtion out of the capsule shell serves to maintain the flexibility of the capsule. In addition, a silicone oil content in the liquid fill serves to reduce both the expansion co-efficient of the liquid fill and the associated freezing point of the liquid fill. Where the projectiles are submitted to low temperatures, as may be experienced when such projectiles are used during the winter, then the reduced expansion co-efficient of that liquid fill, due to the silicone content, means that this liquid will not expand to such an extent (compared to a fill not containing silicone oil) when the temperature falls, thus reducing stress applied to the gelatin capsule shell. Also by including silicone oil in the fill to reduce the fill freezing point means that the liquid fill will be able to withstand lower temperatures before freezing and is less likely to freeze solid at average winter temperatures, whereby freezing of the fill would result in further expansion of the capsule contents, creating additional stress on the capsule shell, possibly causing the capsule to rupture.

Preferably, the capsule shell weight will be between 40 and 1000mg, with the fill weight between 60 and 4000mg. In its preferred form, the capsule shell itself will comprise gelatin, a plasticiser (or plasticisers) such as sorbitol and, usually, will further comprise a colouring agent and an opacifier. The colouring agents are used to provide capsule shells of different colours so that different colours can identify projectiles for different operating conditions or having different contents of the projectile, or to simply identify the colour of the fill.

In its preferred form, the capsule shell will comprise 0.01% to 20% by weight of silicone oil, with the liquid fill comprising 0.01% to 30% by weight of silicone oil. Usually this silicone oil will comprise either dimethylpolysiloxane or methylphenylpolysiloxane. In an alternative form, the silicone oil may make up all of the liquid fill.

The silicone oil employed in this present invention usually has a viscosity of between 0.5 and 10,000 centistokes and preferably, between 1 and 100 centistokes. Projectiles of this type may also comprise a colouring agent in the fill which will usually be bright and readily distinguishable from a distance. Usual colouring agents will include oil based paints or dyes. When the projectiles hit a target the capsule shell will rupture to emit the liquid fill which can identify that its projectile has hit its target. Different coloured fills can be used to distinguish different "players" in a war game or, where used to mark objects, to identify different conditions.

The projectiles of this type will be substantially spherical, although it will be appreciated elongated shapes may be employed. However, spherical projectiles allow for ease of loading within a gun since they do not need to be orientated in any particular way, and these spherical projectiles usually have a diameter between 1 and 3cm. Preferably, the capsule shell wall will have a thickness between 1 and 2mm which provides sufficient strength to withstand the percussive force when fired from a gun but rupture easily when the fire

projectile encounters a target.

Further according to the present invention there is provided a method of manufacturing a projectile of the type previously described in the statement of invention, which comprises the steps of mixing a silicone oil with at least one of a gelatin capsule shell mixture and said liquid fill, forming said gelatin capsule shell mixture into a film to form the (at least two) parts of a capsule shell and enclosing said fill in said gelatin capsule shell and sealing said capsule. Preferably, the projectile manufactured by this method will have silicone oil retained in both the capsule shell and the liquid fill whereby the method comprises mixing the silicone oil with one or the other of the gelatin capsule shell mixture or the liquid fill to facilitate diffusion of the silicone oil across a capsule shell/fill boundary to obtain an equilibrium of silicone oil across this boundary. By this method, silicone oil may be injected as or into the liquid fill which is then encapsulated within the capsule shell to allow diffusion of the silicone oil into the gelatin capsule shell to obtain a residual silicone oil content in the capsule shell and liquid fill. In its simplest form, the silicone oil makes up substantially all of the fill and is mixed directly with the gelatin capsule shell.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

The present invention concerns projectiles having a soft elastic gelatin capsule enclosing a liquid fill. Several techniques and processes for making such elastic gelatin capsule shells are well known, and basically include forming a substantially fluid gelatin mass and moulding this mass into sheets of flexible gelatin, forming these sheets into two halves of a capsule shell which then encapsulate a liquid fill material and are sealed together. The method of forming capsules of this type and encapsulating the liquid fill are well known, and will not be discussed in detail in this specification. Basically, however, one process of manufacturing capsules of this type involves mixing together gelatin, glycerin and/or sorbitol and water which are melted (usually under vacuum) to produce a substantially fluid gelatin mass. Solid or liquid dyes or paint may be added to this mixture to generate capsules of a desired colour. This fluid mass may then be used for making capsules in the usual manner. The fill material used in this invention may consist solely of silicone oil, optionally with a colourant, or of any suitable liquid, often based on oils or other lipophilic liquids, or a fill based on polyethylene glycols. An example of a mixed fill will comprise polyethylene glycol, colourant, opacifier and water. The colourants used may be varied to produce fills of different colours. The gelatin mass in sheet form may then be used to encapsulate the liquid fill material, and solidified to form a soft elastic gelatin shell about the fill material. It is to be understood that the particular methods used for making the soft elastic gelatin shell is not considered part of the invention herein but may incorporate one of a number of any known techniques. However, it is preferred that the technique used produces substantially spherical sealed gelatin shells. Spherical shells have the benefit of ease of manufacture and are easier to load into guns during war games, since no orientation of the projectile will be required. However, the invention is readily adapted to projectiles having capsules of any shape.

It has been found that in conventional soft gelatin capsule shells the fill can absorb water from the capsule shell itself, causing embrittlement of this shell which is then more likely to break or rupture during handling or storage. The capsules are often subject to rough handling in use and any embrittlement can cause premature failure of the capsule to release the fill at an undesirable time. Furthermore, the capsules described herein are often designed for use in target shooting "war games". These capsules are designed to be fired from a gun utilizing compressed air power to project the capsule from the gun at a target (such as a fellow competitor) and the capsule shells are designed to break on impact with the target to release the fill which is clearly indicative that the target or person has been hit. As such, the capsule shells have an apparent problem whereby they must be of such a composition to shatter upon impact but to be of sufficient strength to stand up to both the impact of the percussive force of compressed air from the gun in use and also the rough handling during transportation to and during the "game". An additional problem is that such games occur outdoors often in cold, unpleasant weather conditions whereby the polyethylene glycol contents of the fill may either expand or, occasionally, freeze due to the cold conditions. This expansion can result in undue stress being applied to the capsule shell which may either rupture or produce stressed areas of weakness which are more prone to rupture during the handling of the capsules.

It has been found that the addition of silicone oil, such as dimethylpolysiloxane or methylphenylpolysiloxane, either to the gelatin capsule shell or, if appropriate, to the liquid fill material of the capsule (or both) can reduce the associated problems relating to water absorbtion and the resultant embrittlement of the capsule shell and also the expansion or solidification of the liquid contents at low temperature.

The silicone oil content in the gelatin capsule shell reduces the effects of water absorbtion from the capsule shell thus reducing the embrittlement of the capsule shell whereas the silicone content in the fill reduces both the freezing point of fill liquid and the expansion coefficient of the fill. Therefore the content of silicone oil in both the shell and the liquid fill is desirable and it has been found that the silicone oil content will diffuse across the capsule shell/liquid fill boundary in order to seek an equilibrium of silicone oil across this boundary with the result that there is a residual silicone oil content retained in both the capsule shell and in the fill, even if the silicone oil is only added directly to one or other of

the capsule shell or the fill.

The silicone oil content may be mixed directly with the gelatin shell composition and separately mixed with the liquid fill content in the desired concentrations or, alternatively, the silicone oil may either form substantially all of the liquid fill or may be mixed solely with the liquid fill of the projectile and then encapsulated by the gelatin shell i.e. by enclosing it in a thin gelatin shell formed from two sheets of gelatin. The resultant diffusion of the silicone oil from the liquid fill to the capsule shell will result in a desired silicone oil content in the shell being obtained in a very simple manner. Further, the silicone oil may simply be added to the gelatin shell mixture during the manufacturing stage of the capsule with resultant diffusion of the silicone oil from the capsule shell into the liquid fill resulting in the desired residual silicone oil content being obtained in both the capsule shell and the liquid fill. In this manner, it will be appreciated that it is not necessary to alter standard gelatin capsule manufacture techniques to obtain silicone oil in the gelatin shell, simply adding the silicone oil in liquid form to the liquid fill of the capsule will achieve this result. This avoids any possible effects of silicone oil on the solidification characteristics of the gelatin capsule shell mix during its manufacture. The silicone oil is able to diffuse from the liquid fill into the already solidified gelatin capsule shell.

The grade of silicone oil is chosen so as not to markably effect the conventional properties of the liquid fill and will normally have viscosity of 0.5 to 10,000 centistokes and, most preferably, between 1 and 100 centistokes. The quantity of silicone oil added to the capsule shell and liquid fill is sufficient to provide an equilibrium content of silicone oil in the capsule of between 0.01% and 20% of the dry actual weight of the capsule shell (i.e. not including water driven off during the normal processing and drying out of the capsule after capsulation). In one option, the liquid fill contains between 0.1 to 30% silicone oil depending on the other ingredients and their propensity to expand or become solid as the temperature drops. In another option, the liquid fill comprises up to 100% silicone oil, with no other ingredients except colourants.

The increased content of silicone oil in the liquid fill will substantially reduce its freezing point.

EXAMPLE

An example of the composition for manufacturing projectiles for use in target shooting is as follows:-

Gelatin (wet) comprising:- gelatin content of 85 kilograms, glycerol 17 kilograms, sorbitol (70%) 19 kilograms, silicone oil 4 kilograms and water 80 kilograms; with the liquid fill comprising polyethylene glycol 950 kilograms, glycol 15 kilograms, silicone oil 50 kilograms, colourant 18 kilograms, opacifier 3 kilograms and water 30 kilograms. This composition will then be used to provide projectiles with the liquid fill of approximately 2,800mgs in a shell of approximately 450mgs. This example incorporates the inclusion of silicone oil in both the gelatin shell and the liquid fill although it will be appreciated by simply omitting the silicone oil in the gelatin whilst increasing the silicone oil content in the liquid fill it would produce the same resultant capsule following the migration of the silicone oil into the gelatin capsule.

However, it will be appreciated that the capsule shell weight may vary between 40 and 1,000mgs with the associated fill weight between 60 and 4,000mgs. Furthermore, the glycerine and sorbitol incorporated in the above example will be considered to act as plasticisers for the gelatin, whereas the colouring agent and the opacifier are simply for cosmetic appearances to provide colour to the capsule. For example, many of these capsules are often used in war games whereby each side in the game may be allocated a different coloured projectile in order to ascertain which team has scored a hit as a result of observing the colour of the fill from a capsule which has shattered on impact. The colour of the capsule shell will then reflect the colour of the fill (alternatively, the capsule shell may be opaque to show the fill colour).

It has also been found that the addition of silicone oil remarkably reduces the amount of breakage and leakage from the seam of two halves of a gelatin capsule shell. A particular test to which the capsules are often subjected by participants in "war games" is the so-called "bounce test", where capsules are dropped from a height of approximately two metres onto a hard surface. The addition of silicone oil to these projectiles has been found to significantly reduce the numbers of capsule shells breaking in this test.

It will be appreciated that this basic description of the invention is by way of example only whereby the invention is not restricted to the specific silicone oils referred to, nor to any one known encapsulation process for making soft gelatin capsule shells with a liquid fill. Furthermore, this invention is to be typically applied to projectiles used for firing from an air powered gun although other types of projection may be employed to rapidly accelerate the projectile without breaking it during this acceleration. Typically, the projectiles of this type are spherical with a diameter of approximately 1.5cm with the capsule wall thickness approximately 1 to 2 mm. However, this invention may be applied to the manufacturing projectile of a wide variety of different sizes and shape, having different wall thicknesses and liquid fill contents. Furthermore, it will be appreciated that other plasticizers, other than glycerine and sorbitol, may be employed. The manufacture of soft gelatin capsules is well known to those in the trade whereby the exact composition of each gelatin mix may vary for different techniques, the resultant gelatin capsules simply meeting the requirement that they do not break when subject to the pressurized gas source when firing and are capable of breaking when hitting the target.

Claims

1. A projectile for withstanding high acceleration by a percussive force applied thereto, comprising a soft elastic gelatine capsule shell and liquid fill, in which at least one of the capsule shell and fill comprises a silicone oil.

2. A projectile as claimed in Claim 1, wherein both said capsule shell and said fill comprises a silicone oil.

3. A projectile as claimed in any one of the preceding Claims having a capsule shell weight between 40 and 1000mg.

4. A projectile as claimed in any one of the preceding Claims having a fill weight between 60 and 4000mg.

5. A projectile as claimed in any one of the preceding Claims in which said capsule shell comprises 0.01% to 20% by weight of silicone oil.

6. A projectile as claimed in any one of the preceding Claims in which said fill comprises 0.01% to 100% by weight of silicone oil.

7. A projectile as claimed in any one of the preceding Claims in which said fill comprises 0.01% to 30% by weight of silicone oil.

8. A projectile as claimed in any one of the preceding Claims in which said silicone oil comprises either dimethylpolysiloxane or methylphenylpolysiloxane.

9. A method of manufacturing a projectile according to Claim 1, comprising the steps of mixing a silicone oil with at least one of a gelatine capsule shell mixture and said liquid fill, forming said gelatine capsule shell mixture into at least two parts of a capsule shell and enclosing said fill in said gelatine capsule and sealing said capsule.

10. A method of manufacturing a projectile as claimed in Claim 9, wherein said silicone oil is retained in both said capsule shell and said liquid fill, comprising mixing said silicone oil with one of said gelatine capsule shell mixture or said liquid fill to facilitate diffusion of said silicone oil across a capsule shell/fill boundary to obtain an equilibrium of silicone oil across said boundary.

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EUROPEAN SEARCH REPORT

Application Number
EP 97 30 0052

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Y	US 4 656 092 A (F. HAMAN) * column 2, line 45-60; claim 1 * ---	1,3-5,8	F42B12/40
Y	US 3 653 934 A (F. ROLLE) * column 1, line 4-10 * * column 1, line 61 - column 2, line 10 * * column 3, line 16-31 * * column 4, line 53-61 * ---	1,3-5, 8-10	
Y	US 5 353 712 A (C. OLSON) * column 3, line 58 - column 4, line 19; figure 1 * ---	9,10	
D,A	GB 1 268 635 A (R. SCHERER) * the whole document * ---	1	
A	US 5 063 057 A (J. SPELLMAN) ---		
A	US 5 393 054 A (M. ROUFFER) ---		
A	PATENT ABSTRACTS OF JAPAN vol. 15, no. 92, 6 March 1991 & JP 23 006913 A (TOKAI KAPUSERU), 20 December 1990, * abstract * -----		TECHNICAL FIELDS SEARCHED (Int.Cl.6) F42B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	8 April 1997	Van der Plas, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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