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[54] **SHOT SHELL AND IMPROVED WADDING THEREFOR**

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[58] **Field of Search** ..... 102/42 R, 42 C, 95

[56] **References Cited**

UNITED STATES PATENTS

3,055,031 9/1962 Miller et al. ..... 102/42 C

3,270,671 9/1966 Daubenspeck et al. 102/95

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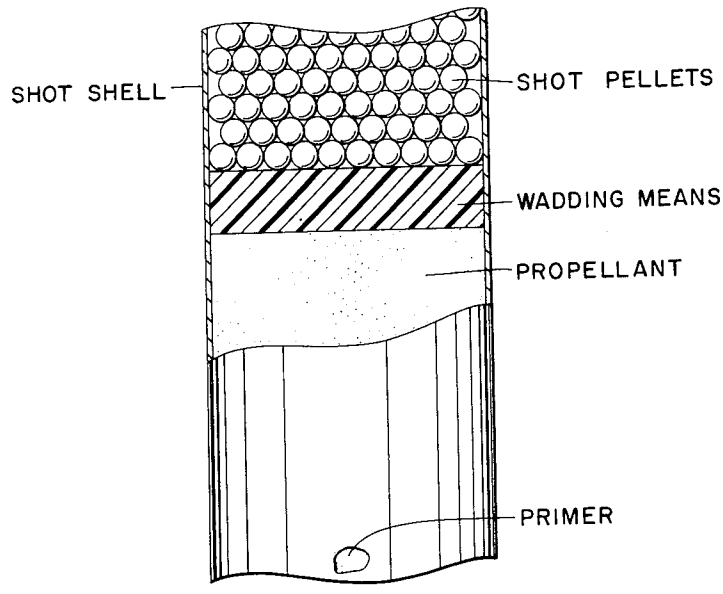
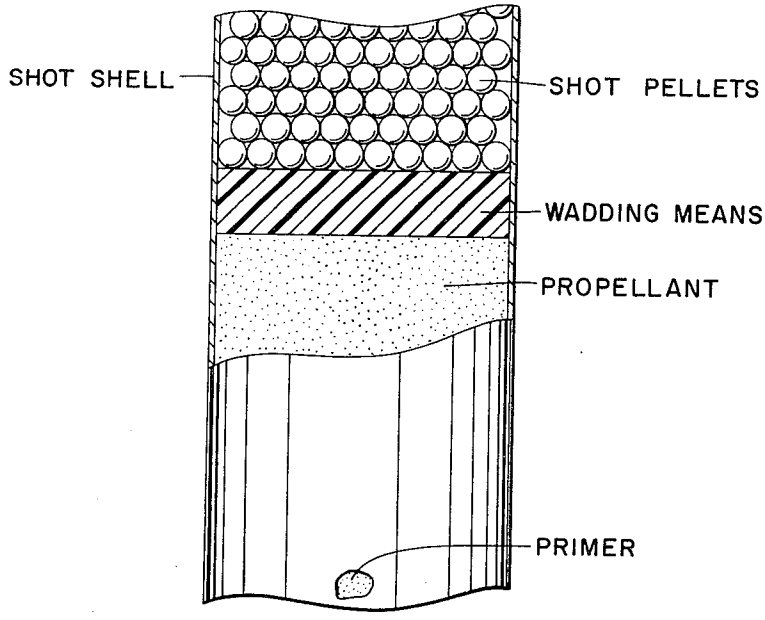
[57] **ABSTRACT**

Loaded shot shells, in which the wadding member is formed from a water soluble plastic material, and hence, when discharged from a gun into a water-containing environment it dissolves in the water to eliminate its presence as an environmental pollutant.

10 Claims, 1 Drawing Figure




SHOT SHELL
SHOT PELLETS
WADDING MEANS
PROPELLANT
PRIMER

SHOT SHELL AND IMPROVED WADDING THEREFOR

This invention relates to loaded shot shells containing improved wad members. In one aspect this invention relates to loaded shot shells containing a plastic wad member which, after the shot, is readily dissolved in water-, dew-, or rain-wet/environments including small streams, lakes, rivers and the like, and hence does not accumulate in the environment as a pollutant. Other aspects will be apparent in light of the accompanying disclosure and the appended claims.

Shot shell wads are disposed in the shot casing between the propellant and the shot to seal the hot propellant gases from the shot particles after the firing, and hence serve as a piston to drive the shot through the gun barrel. Although the wadding material has for many years been formed from cloth or paper, and more recently discs of fiber or felt, molded pliable plastic wads particularly those from polyethylene and polypropylene are now more generally used. The pliable plastic materials form a much improved gas seal, and when molded in form of a cup the wad also acts as a sleeve to protect the shot during passage through the barrel and contribute significantly to improve ballistic performance and pattern efficiency.

However, these plastic wad materials often accumulate in the firing area as pollutants in the environment and are particularly damaging to wildlife. One instance of such undesirable pollution effect arises in trap and skeet shooting areas in which after firing, the wads generally travel 20 to 40 feet from the muzzle of the gun and with continued heavy shooting they accumulate around the shooting station to present a serious litter problem. When these plastic wads are shot over water, ducks and geese endeavor to consume them but, in so doing, they are unable to swallow the plastic materials which then become lodged in the throat area to cause choking and ultimate death.

This invention is concerned with loaded shot shells in which the wadding is a pliable plastic affording the advantages of such materials heretofore without incurring the litter and pollution problems inherent in the use of those plastic materials in water environments.

In accordance with the invention, and as illustrated in the attached drawing, a loaded shot shell, including primer, propellant, wadding, and shot pellet components is provided in which the wadding is formed from a water-soluble plastic means which when discharged from a gun into a water containing environment dissolves in the water to eliminate its presence as an environmental pollutant.

Although any suitable water soluble plastic material can be utilized to form a wad member in the shot shell assembly of invention, hydroxypropyl cellulose, known commercially as "Klucel" is now preferred. The preferred hydroxypropyl cellulose (Klucel) can be prepared by mixing the cellulosic material, alkali, water and a water-miscible inert organic diluent, removing excess liquid from the resulting alkali cellulose, and then causing the alkali cellulose to react with propylene oxide. The water soluble plastic product (Klucel) is soluble in cold water, insoluble in hot water, soluble in polar organic solvents and is thermoplastic; and it has an M.S. of from 2–10, more often 3–5, by which term it is meant the average number of moles of reactant combined with the cellulose per anhydroglucose unit.

The thermoplastic hydroxypropyl cellulose product (Klucel), and its manufacture, are further described in U.S. Pat. No. 3,278,521, which for that purpose is incorporated herein by reference. Other suitable water soluble plastic wadding materials include polyvinyl alcohol, polyethylene oxide, methyl cellulose and hydroxypropyl methyl celluose.

The wadding is preferably formed by injection molding the water-soluble plastic material in shape and size to coaxially close the shell casing and produce a sufficiently close fit with the shell inner wall for the requisite seal to prevent escape of gas from the ignited propellant into the shot. Generally the wadding is loaded in the shell under compression sufficient for the required close fit but permitting the wad member to yield in response to axial force of the propellant gases for travel through the barrel in the requisite gas tight relationship therewith. Accordingly, the diameter of the wad member to be loaded into the gun is substantially the same as the bore of the gun barrel. Although the wadding members are generally formed by injection molding, they can be formed in accordance with any suitable procedure, such as by extrusion, vacuum forming, compression molding, and the like.

Often the shot shell wadding is cup-shaped, the open end facing, and encompassing the adjacent shot pellets in the shell. An exemplary cup-shaped wadding material for a 12- gauge shot shell has an outside diameter in order of three-fourth inch, a height of about 1¼ inch, a wall thickness of about one thirty-second inch, a depth of about three-fourths and is slightly tapered outwardly toward the open end. Although a cup-shaped wadding is generally preferred, the wadding material can be of any suitable shape often as a solid, elongated cylinder, or a disc, pressed into position.

Although a lubricant ingredient can often be advantageously incorporated into the wadding member during its formation, for deposition on the gun barrel walls to provide a lubricated barrel surface for the firing, such is generally unnecessary inasmuch as sufficient of the plastic wadding material generally deposits on the gun barrel wall for that purpose.

Fiber reinforcing materials are advantageously utilized as components of the water soluble plastic formulation when the latter is to be molded to form the wadding material. Exemplary of these fibrous molding materials are short staple cotton, rayon, polyester, polypropylene and fiberglass in lengths in the order of from about one-sixteenth to one-fourth inch. These materials have an insignificant effect on water solubility of the plastic wadding material unless they are hydrophilic, in which event they assist in break up of the wadding material in water. The reinforcing fibers assist in maintaining dimensional stability of the wadding material after molding, by minimizing stresses imparted to the molded wadding.

Often, an inert filler can be incorporated into the plastic wadding material for economic reasons without seriously impairing the antipollution function of the wadding material. For example, talc is advantageously utilized as an extender in molded Klucel waddings. When the Klucel wadding material dissolves in water, the residual talc particles, which are not harmful to wildlife, migrate into the ground. Cornstarch is exenplary of another such inert filler advantageously utilized in plastic wadding materials in practice of the invention.

The invention is illustrated with reference to the following examples.

EXAMPLE 1

Each of two Klucel powders, (A) and (B), having the following respective formulations was injection molded to form a plurality of shot gun wadding members:

Formulation A	Parts by Weight
Klucel (molecular weight 300,000. M.S. = 3.8–4.1)	50
Talc	50
TiO_2	2.5
Propylene Glycol	0.5
Glycerol Monostearate	0.5
Antioxidants	0.4

Formulation B	Parts by Weight
Klucel (molecular weight 50,000. M.S. = 3.6–3.7)	100
Propylene Glycol	0.5
Glycerol Monostearate	0.5
Antioxidants	0.4

Each molded wad was cup-shaped, and was loaded together with a primer, propellant, and shot pellets, as the wad component, in a 12gauge shell casing. Each loaded shell was fired from a 12-gauge shot gun, and an excellent shot pattern was obtained in each instance.

The above wadding members, after immersion in water, collapse and lose their physical form within one hour, and completely dissolve in the water within a period of from 2–4 hours, thereby being readily soluble in environmental water with which they come into contact to avoid accumulation in such environments as litter or as potential danger to wildlife, and particularly water fowl.

EXAMPLE 2

The procedure of Example 1 was repeated except for the two Klucel powder formulations which were Formulations C and D, as follows:

Formulation C	Parts by Weight
Klucel (molecular weight 750,000. M.S. = 3.9–4.1)	50
Talc	50
Propylene Glycol	0.2
Glycerol Monostearate	0.5
TiO_2	3.0
Antioxidants	0.4

Formulation D	Parts by Weight
Klucel (molecular weight 750,000. M.S. = 3.9–4.1)	50
Talc	50
Propylene Glycol	0.2
Glycerol Monostearate	0.5
Carboxymethylcellulose	5.0
Ethylene Vinyl Acetate Latex	5.0
Antioxidants	0.4

In addition to the shot pattern and water solubility characteristics of Example 1, the wad members exhibited improve physical integrity upon firing, as a function of the higher molecular weight of the Klucel.

The following formulations, all in parts by weight, are further exemplary of Klucel powders from which the wadding elements of the invention can be formed, preferably by injection molding:

	E	F	G	H	I	J	K	L
Klucel Molecular Wt.								
50,000 (M.S. = 3.6–3.7)	50	40	.....	.....	.....	.....	.....	.....
300,000 (M.S. = 8–4.1)	.....	.....	50	40	30	.....	.....	.....
750,000 (M.S. = 3.9–4.1)	.....	.....	.....	.....	.....	50	40	25
Starch	45	.....	50	50	.....	55	65	
Talc	.....	55	.....	.....	65	50	.....	
Rayon Fiber (1/16")	5	5	.....	10	5	.....	5	10
Glycerol Monostearate	2	2	2	2	2	2	2	2
Propylene Glycol	2	.....	2	.....	.....	.....	.....	.....
Linear Polyethylene Wax	.....	2	2	2	2	.....	2	3
Polyethylene Glycol Molecular Wt.								
400	.....	3	.....	3	3	3	3	3
4000	.....	5	.....	7	7	5	5	7
Butylated Hydroxytoluene	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Lauryl Thiodiproprionate	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

What I claim and desire to protect by Letters Patent is:

1. In a shot shell, including propellant, primer, wadding, and shot pellet components, said wadding formed from a water soluble plastic wadding means which, when discharged from a gun into a water containing environment, dissolves in the water to eliminate its presence as an environmental pollutant.

2. A shot shell of claim **1** wherein said wadding is formed by molding said plastic material.

3. A shot shell of claim **2**, wherein said wadding is cup-shaped.

4. a shot shell of claim **1** wherein said wadding is formed from a hydroxypropyl cellulose having an M.S. of from 2–10.

5. A shot shell of claim **4**, wherein said M.S. is within the range of from 3–5.

6. A shot shell of claim **4**, wherein said wadding is formed by molding said hydroxypropyl cellulose.

7. A shot shell of claim **5**, wherein said wadding material is formed by injection molding said hydroxypropyl cellulose.

8. A shot shell of claim **7** wherein said wadding material is cup-shaped.

9. A shot shell of claim **8** for firing from a 12-gauge shotgun.

10. A shot shell of claim **2**, wherein said plastic contains a fiber reinforcing material.

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