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| [54] | NOSE OGIVE FOR NONLETHAL PROJECTILE | 3,067,680 | 12/1962 | Lahr..... | 102/41 X |
| | | 3,060,856 | 10/1962 | Dunn..... | 102/41 |
| | | 3,156,187 | 11/1964 | Batou..... | 102/41 |
| [75] | Inventor: Thurber W. Royer , Arcadia, Calif. | 3,245,349 | 4/1966 | Kerr..... | 102/41 |
| | | 3,289,585 | 12/1966 | Rudolph et al..... | 102/41 |
| [73] | Assignee: The United States of America as represented by the Secretary of the Army , Washington, D.C. | 3,604,355 | 9/1971 | Greenless..... | 102/39 |
| | | <i>Primary Examiner</i> —Robert F. Stahl | | | |
| [22] | Filed: May 25, 1971 | <i>Attorney</i> —Harry M. Saragovitz, Edward J. Kelly, | | | |
| [21] | Appl. No.: 146,767 | Herbert Berl & Jacob Ziegler | | | |

- [52] U.S. Cl.....102/41, 102/92.7
[51] Int. Cl.....F42b 9/20, F42b 13/20
[58] Field of Search.....102/41, 92.7

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[57] ABSTRACT

A munition assembly comprising a primer, propellant, fuze, chemical agents positioned in a cartridge case and projectile, said projectile fitted with a non-destructable polymeric impact-attenuating nose unit, said nose unit is designed to absorb the kinetic energy in the projectile to reducing the lethal potential of the projectile when fired and physically contacting personnel.

9 Claims, 2 Drawing Figures

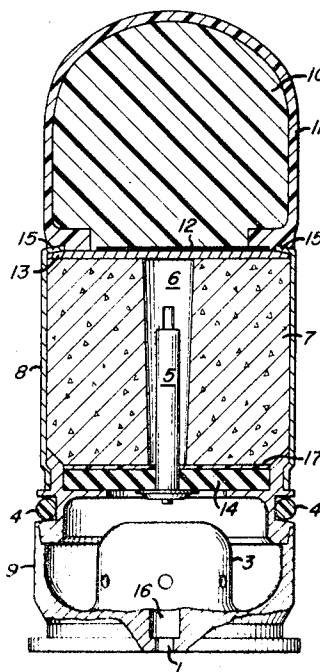


Fig. 1

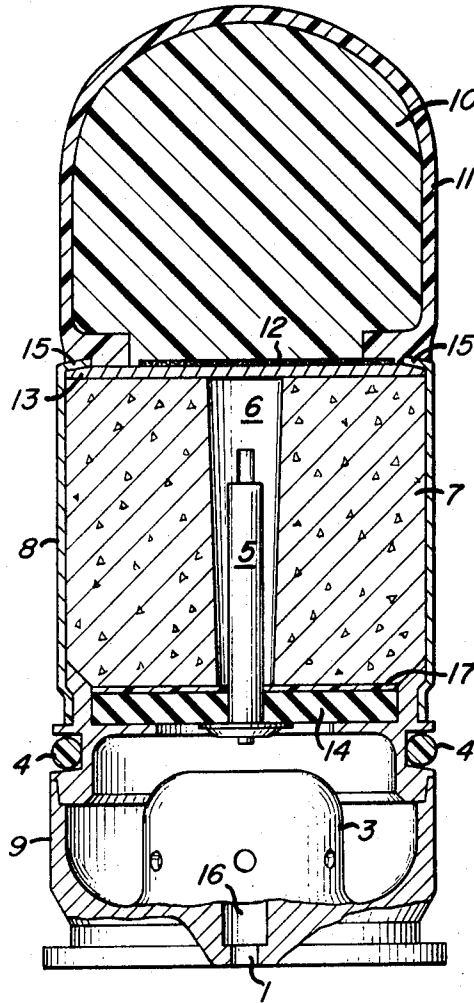
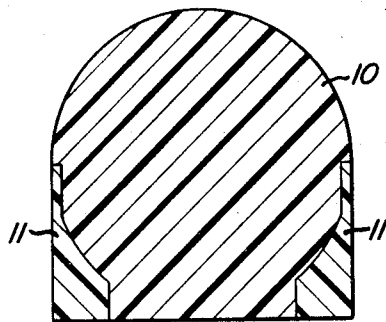


Fig. 2



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NOSE OGIVE FOR NONLETHAL PROJECTILE

DEDICATORY CLAUSE

The invention described herein may be manufactured, used, and licensed by or for the Government for governmental purposes without the payment to me of any royalty thereon.

The invention relates broadly to ordnance items fitted with a polymeric impact-attenuating material, which is shape retaining, rigid, nondestructable during firing cycle and trajectory, surrounding the nose and ogive areas to decrease physical injury to people in a mixed group, for example, combatants and noncombatants, fired upon by either tactical or riot control units and subsequently struck with the projectile while in terminal flight.

All previous devices for establishing clouds of riot control agent were bulk type system, i.e., the agent itself was projected without a container or the agent was contained in a pyrotechnic agent which could cause fires. This method of dissemination precluded the projection of the bulk agent to any great distance. The new device permits longer range and more accurate employment of the agent into an enclosure without causing physical harm to the inhabitants or damage to the premises.

Previous ordnance items were fabricated with an all metallic exterior.

It is the object of this invention to provide a munition assembly which is equipped with shape retaining, crushable impact-attenuating synthetic materials which are not disintegrating during conditions of a firing cycle and terminal flight while maintaining an aeroballistic configuration, which would permit direct impact on personnel without serious injury. The impact force of the projectile is absorbed in the crushable synthetic materials rather than by target personnel.

A further object of this invention is that the munition assembly contains a non-lethal chemical agent to cause temporary incapacitation of target personnel.

A further object of this invention is that the polymeric impact-attenuating nose unit is applicable to other families of riot control munitions launched into high density population areas.

The instant invention results from my investigation for a nonlethal riot control munition which will minimize injury in the event of a direct hit. It is a function of riot control agents to briefly incapacitate an individual and not to cause serious or permanent injury.

A projectile fitted with a completely unshielded or exposed crushable material nose, for example, a projectile of about 1.60 inch diameter, weighing about 150 grams and traveling at a velocity of about 150 ft/sec. exhibits some unacceptable properties. When the crushable material had sufficient crush resistance to almost completely absorb the impact energy when hitting a hard object like a steel plate, said material was so structurally firm that it would not crush when it struck a simulated human head; when using a weaker crushable material the crush resistance was reduced to where it would collapse on contacting a simulated head, the crushable material was too weak to absorb sufficient energy to reduce the projectile's velocity to practically zero by the time complete crushing had taken place. Any forward momentum of the projectile after complete crushing of the nose results in a peak

force when the solid projectile is stopped almost instantaneously.

By surrounding, shielding or encapsulating the aforesaid weaker, crushable material, for example, foamed polyurethane, with a non-foam flexible polymeric material, I found the following unexpected and unobvious results: (1) In spite of the fact that the initial crush resistance was not increased appreciably, confinement of the crushable material caused better pulverization and more efficient impact energy absorption as crushing progressed; (2) the encapsulated material mushroomed out, for example, from a diameter of about 1.60 inch to about 2.50 inches diameter contact area, thus reducing pressure in psi (pounds per square inch) applied to any given force by more than 50 percent; and (3) the flexible mushroomed nose unit would better conform to the contours of a human head and thereby reduce local pressure.

A partially enclosed nose unit illustrated in FIG. 2, performed almost as well, for the same reasons, as the completely shielded unit, FIG. 1.

Test data indicate a peak contact pressure of over 26,000 psi for a projectile fitted with a nylon nose. A projectile of the same configuration, weight and velocity replacing the nylon nose with the crushable impact attenuating nose unit according to this invention had a peak contact pressure of about 240 psi.

FIG. 1 is an axial section through a munition assembly embodying a completely encapsulated synthetic impact-attenuating nose unit.

FIG. 2 is an alternate design of a partially enclosed nose unit.

The synthetic resins employed in preparing the impact-attenuating nose unit in accordance with the present invention is directed to a flexible non-foam polyurethane, elastomer, covering rigid or high density foam polyurethane. Processes of preparing foam or cellular and non-foamed polyurethanes are well established in the art and involve the general reaction of a polyisocyanate with compounds containing reactive hydrogens in the presence of a reaction catalyst. Typical hydrogen containing compounds include polyesters, castor oils, glycols, amines, carboxylic acids and water. The catalyst can be tertiary amines, triethylamine, antimony compounds, antimony caprylate. The foaming of the polymer is prepared by adding foaming or blowing agents such as carbon dioxide generated when water reacts with isocyanate or by using volatile agents such as fluorocarbon 11 or methylene chloride which is vaporized by the exothermic heat of the polyisocyanate. Rigid or high density foams are generally produced by utilizing lower molecular weight polyols with a high degree of branching.

The foamed polyurethanes include Uralane 1,723 (Furane Plastics Incorporated) or high density polyurethane foams disclosed in U. S. Pat. No. 3,400,085 of Kujawa et al.

The Uralane is a general purpose polyurethane foaming resin system with material characteristics of 2-3 minutes work life and variable densities of 6 and 20 pounds per cubic foot. By thoroughly mixing 100 parts by weight of Uralane 1723-6A resin and 90 parts by weight of Uralane 1723-6B curing agent using a high speed blade with maximum blending and shear action, stirring rapidly for 20 to 40 seconds and pour. Foaming will commence in approximately 2 to 3 minutes at 70° F. Physical properties are as follows: (a) density of

foam average 6 pounds/cubic foot (actual density will depend upon the amount of confinement at the time the material is foamed) with test method ASTM-D-1622; (b) compressive strength 130 psi (at 5 percent deflection) with test method ASTM-D-1621; (c) tensile strength 225 psi with test method ASTM-D-638; and (d) water adsorption (1 week at 100 percent R.H.) 3.0 percent with test method ASTM-D-570. The curing cycle of approximately 30 minutes is required to obtain a tack free firm product; when used in molds, post cure for 45 minutes; full strengths are obtained in 24 to 48 hours when cured at 75° F.

Kujawa, U.S. Pat. No. 3,400,085, discloses the preparation of polyurethane foam having a density in a range of about 4 to 30 pounds per cubic foot is prepared by mixing a hydroxyl-containing polymer having a hydroxyl number between about 25 to 900, and a secondary phosphonate that is non-reactive in the urethane reaction and reacting with a polyaryl-polyisocyanate in the presence of a foaming agent to produce a polyurethane foam having a uniform cell structure.

A foamed polyurethane or polystyrene having a density range of 6 to 13.2 pounds/cubic foot gave satisfactory results.

The polyurethane elastomers which are stretchable or flexible coverings for the exterior surfaces of a foamed polyurethane nose unit in accordance with this invention are resins of Uralane 8309 or Uralane 5715 (Furane Plastics Incorporated). Uralane 5715 is a two component urethane resin system capable of forming tough, high tear strength elastomeric products and may be poured and cured at room temperature. This material is formed by mixing 100 parts by weight of Uralane 5715-A and 34 parts by weight of Uralane 5715-B-40 (black) thoroughly for 1 to 2 minutes. To facilitate defoaming, 2 drops of AF-2 anti-foamer are added per pound at the time of mixing. For bubble-free castings, use vacuum for 3-5 minutes, before pouring. Pot life is approximately 40-50 minutes. Cure at least three days at room temperature before placing into service; heat cure at 150° F for 2-3 hours will expedite cure and permit removing of parts from the mold. The typical physical properties: (a) cured density of 1.16 gm/cc; (b) resin viscosity at 75° F of 3,000-6,000 cps; (c) mixed viscosity after 10 minutes at 75° F is 4,000-8,000 cps and after 30 minutes at 75° F is 40,000-60,000 cps; (d) cured Durometer A Hardness at 48 hours at room temperature is 70-80 and at 16 hours at room temperature plus 3 hours at 200° F is 75-85; and (e) tear strength cured is 200 lb/in. By mixing 100 parts by weight of Uralane 5715-A and 34 parts by weight of Uralane 5715-B produce a product having the following physical properties: (a) 48 hours at 75° F with Shore A Hardness of 73/70, with a tensile strength for 300 percent elongation of 1,000 psi, with an ultimate tensile strength of 1,000 psi and with percent elongation of 340 percent; (b) 3 hours at 200° F with Shore A Hardness of 82/81, with a tensile strength for 300 elongation of 2,100 psi, with an ultimate tensile strength of 2,400 psi and with a percent elongation of 360 percent; and (c) 24 hours at 200° F with Shore A Hardness of 84/82, with a tensile strength for 300 percent, elongation of 3,000 psi, with an ultimate tensile strength of 3200 psi and with a percent elongation of 350 percent. By mixing 100 parts by weight Uralane 5715-A and 30 parts by weight Uralane 5715-B-40 (low cure agent) produce a product having the following physical proper-

ties: (a) 48 hours at room temperature with Shore A Hardness of 76/74, with an ultimate tensile strength 1,100 psi and with a percent elongation of 300 percent; and (b) 24 hours at 300° F with Shore A Hardness of 88/86, with an ultimate tensile strength of 2,700 psi, and with a percent elongation of 320 percent. By mixing 100 parts by weight Uralane 5715-A and 38 parts by weight Uralane 5715-B-40, excessive cure agent produce a product with the following physical properties: (a) 48 hours at room temperature with a Shore A Hardness 69/65, with an ultimate tensile strength 800 psi, and with a percent elongation 400 percent; and (b) 24 hours at 300° F with a Shore A Hardness 86/85, with an ultimate tensile strength 2,300 psi and with a percent elongation 430 percent.

In addition to the specific synthetic resins described above other non-destructable, castable and foamable materials may be utilized provided they possess similar physical characteristics by not disintegrating during conditions of a firing cycle and terminal flight while maintaining an aeroballistic configuration. The function of the flexible polymeric non-foam elastomer is to confine the polymeric foamed material after impact with the target.

In the fabrication of the impact-attenuating nose unit, a stretchable outer cover is prepared in a shaped male/female mold with the castable polymeric material being inserted into the mold and over-cured, the time and temperature for curing is dependent upon the particular polymeric resin. The male position of the mole is removed leaving a cavity inside the stretchable outer cover which is still in the female portion of the mold. The crushable nose is made by inserting the foamable polymeric material into the cavity of the stretchable outer cover which was previously prepared; the foamable polymer is cured and the complete impact-attenuating nose unit is removed from the female mold with the excess foamed polymer removed in order to make a flat surface for attachment to the projectile body.

The non-lethal chemical compositions which the inventive munition may be fitted are well known to those who are familiar with the art of making riot controlling compositions, for example, irritating or lachrymatory compositions such as α -chloroacetophene and o-chlorobenzilidene malononitrile alone or in combination with pyrotechnic constituents blended in accordance with approved military standards are used as munition fills.

In preparing the following riot control material comprising a dry mixture and binder solution, the components are placed in the mixing bowl in the order listed since a spontaneous combustion reaction can occur when an oxidizer, potassium chlorate, and a reducing agent, sugar, are placed in intimate contact. The proportions of each component are expressed in parts by weight unless stated to the contrary. A dry mixture comprising mixing in a receiver containing (1) 30.0 ± 2.0 potassium chlorate, (2) 40.0 ± 2.0 orthochlorobenzilidene malononitrile, (3) 9.0 ± 2.0 magnesium carbonate, and (4) 18.0 ± 2.0 sugar. Add to the dry mixture a binding solution comprising 8.0 ± 1.0 nitrocellulose (cellulose nitrate) and 92.0 ± 2.0 acetone with the nitrocellulose equal to 3.0 ± 0.2 percent total weight of dry mixture on a solid basis. Additional acetone may be added if necessary to preserve doughlike consistency. In addition to the above riot

controlling composition other similar functioning standardized compositions may be utilized as set forth with the specifications of Military Standards 576 and 579.

The inventive munition can be ejected from the M79 Launcher which is described in Launcher, Grenade, 40-MM: M79, Headquarters, Department of the Army, June 1966, coupled with the handling, loading and firing as with the HE, high explosive, round from said launcher or other launching means sized for the munition in the military arsenal. The munition may be launched or directed to a desired impact area from a hand-held weapon, shoulder-fired or motorized mounted weapon system.

When the firing pin in the launcher strikes the primer in the cartridge, the primer fires and ignites the propellant powder in the propellant chamber; the burning propellant powder simultaneously ignites the pyrotechnic fuze and the projectile begins to travel through the launcher barrel; the fuze at the end of its time delay period, which may vary depending upon the desired lapse of time, ignites a payload of a pyrotechnic mixture comprising an irritant and disseminates the payload; on munition collision, the impact attenuating projectile's nose reduces the impact energy level to a non-physical injury value.

Referring to FIG. 1, numerals 9 and 8 designate the cartridge case and projectile body, respectively. The bottom of the case is provided with a primer 1 which communicates with the interior of the cartridge case 9 through a suitable opening 16 provided in the bottom of the case. The primer is 1 and the propellant burning chamber 3 housing a propellant powder, which is not shown, is arranged in case 9 communicating with opening 16. Rotating band 4 is in a recess on the exterior surface of the case. The base of the projectile body is provided with a rubber diaphragm 14 having an aperture which communicates with a central cavity 6 of the projectile body. Fuze 5 is positioned in cavity 6 through the apertures of diaphragm 14 and ring 17; said ring is bonded to said diaphragm. Ring 17 is a water-repellant polyester film of polyethylene terephthalate, for example, Mylar. The forward portion of the metallic projectile body 8 is provided with a closure plate 13 which is held in place by crimped sections 15. Chemical agent 7 is contiguous with plate 13, ring 17 and surrounding cavity 6. The nose unit comprises an elastomeric flexible non-foam polymeric material 11 covering all the exterior surfaces of the foamed polymeric material 10 which is secured with a bonding agent 12 to the closure plate 13.

In FIG. 2, the flexible non-foam polymeric material 11 partially enclosing the foamed polymeric material 10 which is directly exposed to the atmosphere.

A conventional fuze may be the one employed in XM-16 Canister, TM3-1325-232-12, Headquarters, Department of the Army, September 1968. A state of the art propellant composition comprising nitrocellulose 57.75 ± 1.50 percent, nitroglycerin 40.00 ± 1.50 percent, potassium nitrate 1.50 ± 0.50 percent and ethyl centralite. An art recognized primer composition comprising basic lead styphnate 53.0 ± 2.0 percent, antimony sulfide 10.0 ± 1.0 percent, barium nitrate 22.0 ± 1.5 percent, aluminum powder atomized 10.0 ± 1.0 percent, and tetraen 5.0 ± 0.5 percent.

It is also within the contemplation of this invention to utilize other functional internal conventional elements employed in ordnance items with my inventive impact-

attenuating unit, for example, primers, propellants, and fuzes functioning with time (delay), proximity, command, rotational spin with the exception that a nose impact fuze should not be used with any advantage since it would defeat the purpose of the impact-attenuating unit.

The nose unit can be shaped into any configuration in order to achieve desired ballistic properties.

The metallic portion of the munition may be fabricated from substances conventionally employed in military hardware, for example, steel, aluminum, magnesium, or alloys.

The bonding agents may be epoxy adhesives or other agents for maintaining the adhesion between metal and rubber or synthetic components and between rubber and synthetic components which will be structurally integral under the conditions of use.

The rotating bands may be constructed from rubbery material such as Buna N, which is prepared by the polymerization of acrylonitrile with butadiene, Buna N covered with tetrafluoroethylene, or polyurethane rubber impregnated molybdenum disulfide.

The munition assembly may have either a bonded or unbonded projectile body to the cartridge case joints.

The cartridge case to projectile body interface may have a slip fit with no bonding. In employing a bonding agent, the projectile is bonded to the inner surface of the cartridge utilizing various known adhesives for this purpose as in the standard HE, high explosive, 40 MM cartridge.

The advantages of this invention are in greater safety and in wider sphere of usefulness for riot controlling devices.

I claim

1. In a munition assembly comprising a cartridge case containing primer and propellant means the improvement in combination therewith composed of a projectile having a cylindrical load bearing housing terminated at one end by a substantially solid coaxially protruding kinetic energy dissipating substantially ogive shaped nose, said nose composed of solid crushable cellular polymer material circumferentially covered on at least a portion of the longitudinal extent thereof by a flexible polymer material whereby upon impact said flexible polymer material serves to elastically confine the crushed cellular polymer material while contemporaneously allowing for dimensional changes of the nose when conforming to the impact surface.

2. The munition of claim 1 wherein the load is a chemical fill selected from the group consisting of chloroacetophone, O-chlorobenzilidene malononitrile and pyrotechnic mixtures thereof.

3. The munition of claim 2 wherein the load includes a fuse means.

4. The munition of claim 1 wherein the cellular polymer material is foamed polyurethane having a density of between 6-13.6 pounds per cubic foot.

5. The munition of claim 4 wherein the flexible polymer is a non-foam polyurethane elastomer.

6. The munition of claim 1 wherein the flexible polymer completely covers the projectile exterior composed of the crushable cellular polymer material.

7. A munitions projectile for use with munition launching means comprising a payload container having an impact exterior portion composed of a solid mass of kinetic energy dissipating crushable cellular polymer material at least partially enveloped with a

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flexible covering of polymer material, whereby upon impact the major portion of the kinetic energy is absorbed by the crushing action on the cellular material while contemporaneously the crushed mass is elastically confined by the flexible covering of polymer material as said mass conforms to the impact surface.

8. The invention of claim 7 wherein the cellular polymer material is foamed polyurethane having a density

of 6 to 13.2 pounds per cubic foot and the flexible polymer is a polyurethane elastomer.

9. The invention of claim 7 wherein the flexible polymer material completely envelopes the exterior portion of the container defined by the said mass of crushable cellular material.

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