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Abbott

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[54] **PROJECTILE AND CARTRIDGE ARRANGEMENT**

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[52] **U.S. Cl.** ..... **102/41,** 102/43 C, 102/43 P, 102/44, 102/53, 102/92, 102/92.7

[51] **Int. Cl.** **F42b 11/18,** F42b 11/36

[58] **Field of Search** 102/49.2, 53, 49.1, 102/56, 52, 41, 92.7, 92.1, 92.2, 92.3, 92.4, 92.6, 38, 91

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Primary Examiner—Robert F. Stahl

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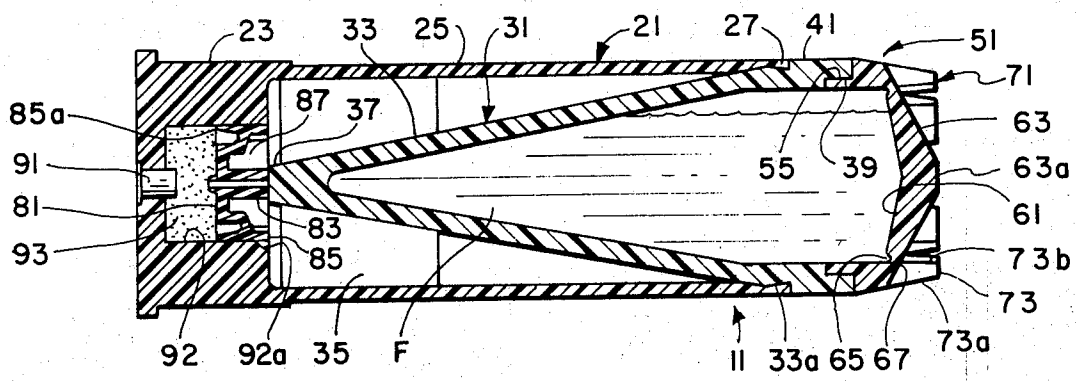
[57] **ABSTRACT**

A projectile having a guard ring of circumferentially spaced posts encompassing a convex nose rupture disc and web. The projectile is mounted in a case with the nose extending in exposed condition beyond the open case end. A dual diameter chamber high-low propellant firing and gas expansion arrangement is utilized in the cartridge in conjunction with the reduced diameter tapered and finned rear end of the projectile.

23 Claims, 7 Drawing Figures



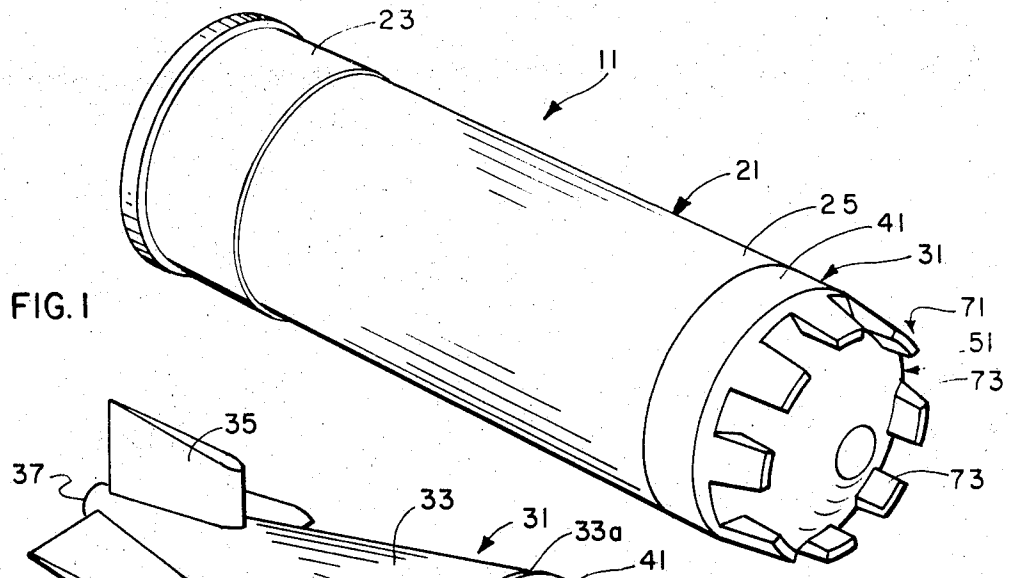


FIG. 1

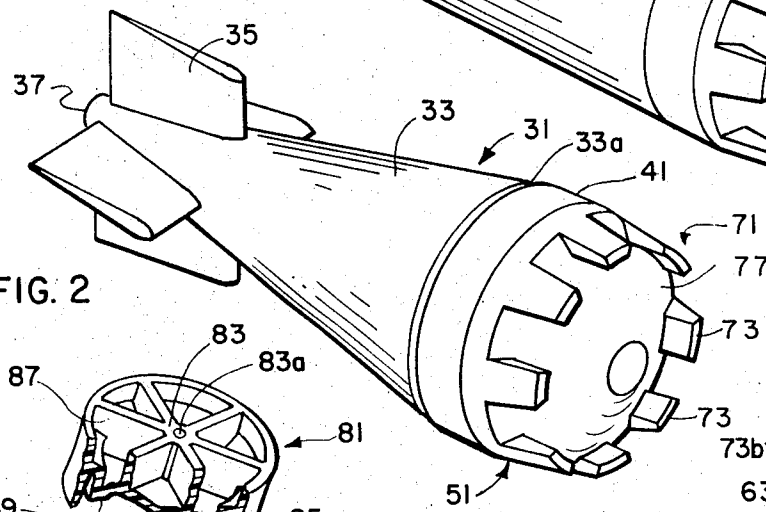


FIG. 2

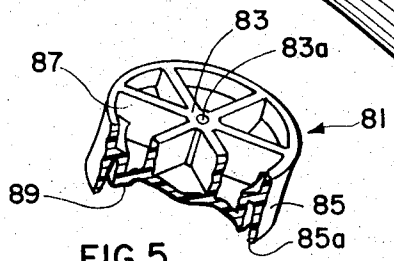


FIG. 5

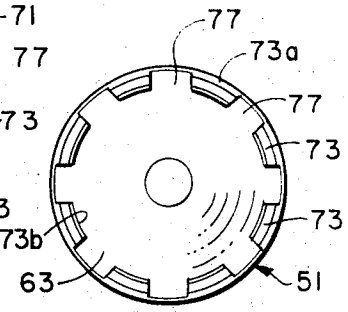


FIG. 3

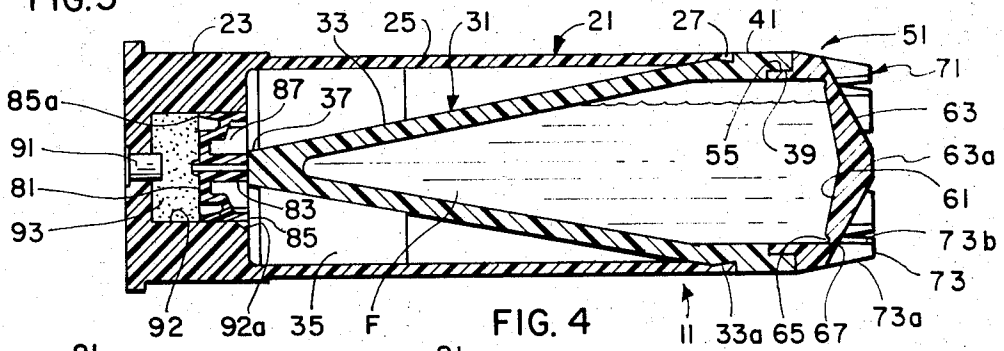


FIG. 4

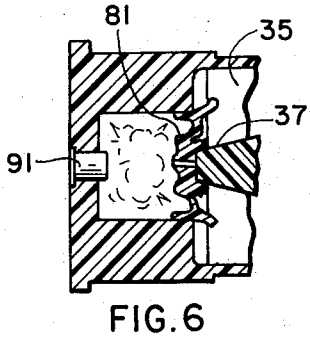


FIG. 6

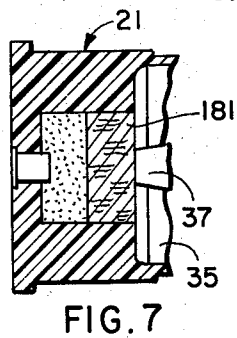


FIG. 7

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PROJECTILE AND CARTRIDGE ARRANGEMENT

This invention relates to an improved cartridge and projectile arrangement which is of particular value in enabling the handling, firing and effective target impacting of projectiles which may desirably carry a flowable charge of material, and particularly a liquid agent. Various aspects of the invention are also useful in enabling the improved firing of other projectiles.

Projectiles have been employed which carry liquid agents for dissemination at a target. In one such arrangement, a projectile is provided which is frangible and is fired from a cartridge case, the projectile being protected at its forward end by enclosure within the forward open end of the case. While this is a satisfactory arrangement for some weapons, particularly those which employ relatively small cartridges and which have sufficient room in the cartridge-receiving chamber to enable the projectile to be satisfactorily fired from within the case and to effectively ride down the bore of the barrel, this nose-encompassing arrangement is not practical in all circumstances, and particularly in the larger gauge rounds, such as in rounds for existing large-caliber hand-held gas guns (e.g., 37- and 38-millimeter) and 40-millimeter grenade launchers. In such cases it is desirable that the bore-riding section of the projectile closely approximate the outside diameter of the cartridge case, in order to accommodate the various diametral conditions of barrel bore and cartridge-receiving chamber in which these rounds may be fired. However, if the projectile extends beyond the cartridge case and is made frangible in its nose area, it will be apparent that the cartridge will be subject to undesirable breakage during handling, as particularly when the cartridge is inadvertently dropped onto a hard surface. It is accordingly a feature of the invention to provide a cartridge and projectile arrangement and a projectile which will enable the projectile to be adequately protected when such is exposed and dropped.

It is a further object of the invention to provide an improved projectile arrangement which not only affords improved drop protection for its rupturable nose section but which also is of advantage in affording desirable rupture characteristics on contact with a target, including hard targets struck flat on or at an angle, as well as the ground or other softer target struck flat on or at an angle.

It is a further object of the invention to provide a projectile arrangement which affords a relatively flat trajectory with limited range, and which thereby enables its use under more controlled conditions in circumstances where extended range is not desirable, such as police work.

Still a further object of another aspect of the invention is the provision of a cartridge and projectile arrangement utilizing a high-low dual chamber propellant firing and gas expansion system in conjunction with an appropriately reduced rear end diameter projectile so as to afford adequate combustion of the propellant and adequate protection of the rear end of the projectile as may be required, while enabling the utilization of simple and inexpensive construction and parts.

Still other objects, features and attendant advantages will become apparent to one skilled in the art from a reading of the following detailed description of a preferred embodiment of the invention, taken in conjunction with the following drawings, wherein:

FIG. 1 is a perspective view of a cartridge according to the invention.

FIG. 2 is a perspective view of a projectile according to the invention and contained in the cartridge of FIG. 1.

FIG. 3 is an end view of the projectile of FIG. 2.

FIG. 4 is a longitudinal section view of the cartridge of FIG. 1.

FIG. 5 is a perspective view, partly broken away, of a wad employed in the cartridge of FIG. 4.

FIG. 6 is a fragmentary longitudinal section view diagramatically illustrating the operation of the wad during firing of the propellant in the cartridge of FIG. 5.

FIG. 7 is a fragmentary longitudinal section view of a modification of the cartridge case arrangement according to the invention.

Referring now in detail to the figures of the drawing, a cartridge 11 is illustrated in FIGS. 1 and 4 having a case 21 in which is secured a projectile 31, the nose 51 of which extends beyond the open forward end of the case 21. The case 21 has a closed base end 23 which houses a charge of propellant, as will be more particularly hereinafter described, for propelling the projectile 31 from the case and through the bore of a weapon barrel.

Projectile 31 has a bore-riding section 41 which is cylindrical in external shape, and a hose 51 which has a circumferential forwardly extending guard ring generally indicated at 71, formed by a plurality of spaced guard posts 73 which extend forwardly of their base connections with the remaining portion of the nose. The nose 51 also has a rupture disc 61 surrounded by an annular rupture web 67 formed by reducing the thickness of the nose as by the employment of an annular groove 65, as indicated in FIG. 4. The rupture web is disposed inboard of the base of the guard ring posts 73, thereby enabling the rupture disc 61 to be ruptured either forwardly or rearwardly relative to the posts 73. The forward end of the projectile nose 51 is formed by the frontal surface 63 of the rupture disc 61, which frontal surface is convex, and of a forward extent corresponding to the forward extent of the posts 73, although the forwardmost face 63a may extend slightly forwardly of the posts within the impact yield limits of the nose material, and may extend rearwardly of the posts as may be desired. The guard ring 71 formed by posts 73 thus serves to provide a substantial measure of protection to the rupture disc 61 due to inadvertent dropping of the cartridge 11 or projectile 31 on its nose and, while enabling the rupture disc 61 to be ruptured on projectile impact at high velocities as may be encountered when the projectile is fired in the normal manner from the cartridge case 21.

The guard ring 71 is externally inwardly tapered in the forward direction, including the convex external surfaces of the posts 73, as well as the external surface of the base portion therefor forward of the bore-riding section 41 of the projectile. This is advantageous in affording not only good mold release of this part, but also in aiding in loading of the cartridge in a chamber and in providing a degree of streamlining of the nose 51, while still affording a desirable degree of projectile retardation and limiting of flight range. In addition, the tapering of the posts 73 tends to aid in penetration of some targets, thereby affording better barricade penetration and dissemination of the material F within the projectile upon impact and rupture of the nose section

and other portions of the projectile body. The posts **73** are also preferably outwardly tapered on their internal surfaces **73***b*, and this also aids in target penetration, as well as affording better mold release of the part and more free forward rupture motion for the rupture disc **61** in those instances where forward motion of the rupture disc may take place on target impact, such as for instance when the target is impacted at an angle and the momentum of the fill material F in the projectile tends to effect a forward rupture of the disc **61.** The rupture disc **61** may take various shapes and configurations, as may the rupture web **67** associated therein, a preferred embodiment being as shown with a concave-shaped internal surface and a convex-shaped external surface **63, 63***a*.

The nose **51** is formed separately from the rear section of the projectile, including the bore-riding section **41** and a tapered rear section **33** having fins **35** thereon. The projectile has a filling of flowable material F, which may preferably be a partial charge of highly volatile liquid agent which will form minute particles upon impact release from the projectile **31.** An air space is desirable within the projectile, to accommodate thermal expansion of the liquid F and the vapor pressure therefrom. or such other flowable or otherwise disseminable material F as may requite such expansion space, such as some powdered materials having a high coefficient of thermal expansion. The entire projectile **31** is preferably formed of frangible relatively rigid plastic material, which has sufficient strength to withstand the launch pressures encountered when the cartridge is fired, and which is sufficiently chemically inert to the fill material F to afford adequate storage life. In addition, it is desirable that the material of the projectile **31** be capable of adequate bonding to afford a hermetic sealed condition for the fluid or other agent F therein, it being preferable that the plastic material be capable of welding, as by spin-welding or ultrasonic techniques. A suitable construction for spin-welding is afforded by the complementary stepped shoulders **39** and **55** on the nose and rear sections of the projectile respectively. If desired, other suitable joint or sealing connections may be employed for a particular embodiment.

Particular plastics which may be suitable for construction of the entire projectile **31,** utilizing conventional injection molding techniques, are glass-filled nylon, (e.g., 30 percent glass-filled Type 6/6 nylon), and acetal resin (e.g., such as marketed under the trademarks Delrin and Celcon). In addition, it is feasible to form the projectile or portions thereof from other materials, such as tempered glass or metal (e.g, zinc, aluminum, lead alloys, etc.) of suitable strength characteristics to accommodate the forces and pressures encountered and as may be readily calculated for a given construction and conditions of anticipated use.

As noted above, the rear section of the projectile rearward of the annular bore-riding section **41** is tapered as indicated at **33,** and has tapered fins **35** extending from its surface, the fins **35** being preferably canted to afford spin stabilization, and also to afford a rotational motion to the projectile **31,** including its fill meterial F, which may aid in dissemination of the fill material at impact through the action of the angular momentum of the fill material.

The projectile **31** is retained in the cartridge case **21** through the medium of a snap-ring lip and groove connection formed by an annular internally protruding lip **27** on the open end of the cartridge case wall **25,** and a complementary groove **33***a* formed immediately rearward of the bore-riding cylindrical surface **41** adjacent he nose end of the projectile. Thus, the outer surface of the case wall **25** may advantageously be of the same or approximately the same diameter as the bore-riding cylindrical section **41** of th projectile **31.**

Wall **25** may be formed of suitable thickness to provide the necessary cohesive strength to withstand the stresses encountered during firing of the cartridge within a given cartridge-receiving chamber in a weapon, it being understood that some weapon cartridge-receiving chambers are slightly oversize and require sufficient strength, ductility and/or elasticity to enable the case to expand, while other cartridge-receiving chambers are more close-fitting and require less strength, ductility and/or elasticity for the cartridge case.

It is desirable that the cartridge case be formed of a sufficiently tough and ductile material to enable the satisfactory release of the projectile from the case upon firing of the cartridge. In the particular illustrative embodiment as illustrated, suitable injection moldable materials for the case **21** include thermoplastic resins such as polycarbonate, polyethylene, polyurethane, polypropylene and impact-grade polystyrene. In addition, the case may be formed of other materials, such as metal, including brass, aluminum, steel, etc., as well as tougher impact-grade rubber formulations and other elastomers of adequate strength and ductility.

The external shape of the cartridge case **21** may be formed as may be required to enable placement in a given cartridge-receiving chamber for firing, and may include a stepped enlarged rear section and a conventional rim at the base section **23** thereof, or may have other external configurations as may be appropriate for a given desired utilization.

Disposed within the base **23** of the cartridge case **21** is a percussion primer **91** which enables the ignition firing of a suitable propellant mix **93** which is enclosed within a reduced diameter bore **92,** with a bore-restricting wad **81** across the entrance of the reduced diameter bore **92** and effectively forming a restricted volume chamber for initial holding of the propellant charge **93** and for subsequent restriction and time-delayed release of the propellant and propellant gases during firing, as will be more particularly described. While various propellant formulations may be employed, a suitable propellant formulation has been afforded by propellant marketed under the name of WC Blank, a particular quantity of approximately one gram having been sufficient to afford adequate firing and launching of a projectile of approximately 67 grams weight and an outer diameter of approximately 37 millimeters at the bore-riding diameter formed by the section **41.**

The wad **81** in the illustrative and preferred embodiment of FIG. **4,** takes the form of a cylinder having an outer ring wall **85,** engaging in frictional press fit relation within the bore **92,** and having an obturating lip **85***a* formed thereon in interfacing relation to the propellant powder charge **93.** A collapsible folding lateral wall **89** extends between a central stem or post **83** and the outer ring wall **85,** with radial reinforcing webs **87.** The central stem or post **83** may have an axial bore **83***a* formed therein to aid in insertion of the wad **81** within the bore **92,** allowing air to escape during insertion, and

a chamfer **92***a* may be formed on the forward edge of the bore **92** to likewise aid in insertion of the wad **81** within the bore **92.** It is desirable that the granule size of the propellant mix **93** be sufficient to prevent exit of any material quantity thereof through the axial bore **83***a*, or that the bore otherwise be effectively closed by the contact and with the protruding rear end **37** of the projectile **31.** By making the hole **83***a* very minute, or otherwise by sacrificing the air equalization characteristic as by elimination of the bore **83***a*, the small cross sectional rearmost end **31** of the projectile may be slightly spaced from the central stem or post **83** if so desired, or as may be encountered in the course of manuacture on a production basis. The wad **81** may be formed of various materials which may be deformable under pressure, including various thermoplastic resins such as nylon, polyethylene, etc. The material is also preferably frangible in shear, as is afforded by these thermoplastic materials.

In firing the cartridge to propel the projectile **31** therefrom, the primer **91** is percussively fired as by a conventional firing pin (not shown) to thereby ignite the propellant mix **93**, as schematically indicated in FIG. **6**, this ignition of the propellant mix creating gases which increase the gas pressure within the chamber encompassing the burning propellant mix. This gas pressure exerts a forward motion force on the wad **81**, tending to fold or otherwise move forwardly the collapsible folded lateral wall **89** and to collapse the central stem or post **83** against the small diameter end **37** of the projectile **31.** The outer ring wall **85** is likewise moved forward under this gas pressure and is deformed and/or sheared by its contact with the rear end of the substantially stronger fins **35** on the projectile **31.** The wad **81** may ultimately be deformed to the point of complete segmenting into smaller sheared sections by its contact with the fins **35**, although this may not occur in all instances, particularly where a smaller effective charge of propellant is utilized for a given projectile mass per unit aa condition. In any event, as shown in FIG. **6**, the retention of the projectile within the case **21**, as well as the inertia of the projectile mass, serves in conjunction with the interfacing contact made between the small reduced diameter rear **37** of the projectile and the wad **81** to retain the wad in the reduced diameter bore **92** over a period of time to aid in affording adequate burning of the propellant **93**, thereby enabling the desirable utilization of a propellant which requires higher than atmospheric pressure for effective burning. The wad **81** will ultimately be moved in deformed condition into the chamber void area formed by the enlarged bore section of the case wall **25** surrounding the fins **35** and the tapered reduced diameter rear section **33** of the projectile **31**, thereby enabling the full application of a reduced propellant gas pressure to the external rear body section of the projectile. At some point during this propellant firing and gas expansion cycle, the forwardly exerted force on the projectile **31** will be sufficient to overcome the restraining force thereon by the snap ring connection **27, 33***a* between the case and the projectile **31** as well as the inertial force of the projectile and fill material therein. A desirable mode of operation is afforded when the case/projectile retention and projectile inertial forces are overcome after complete expulsion of the wad **81** from the reduced diameter bore **92**, although this precise timing is not critical, as a degree of forward motion of the projectile may be initiated by the direct forces exerted on its rear end **37** through wad stem **83**, while the wad is in process of its short term time-delayed volume restricting and release action relative to the propellant chamber bore **92.** It will be noted in this respect that the reduced diameter end **37** of the projectile enables this deformed expulsion of the wad **81**, without requiring that the projectile be moved forward to enable this expulsion. It will be appreciated that this overall dual diameter bore, wad, and reduced diameter projectile arrangement affords a unique and advantageous high-low propellant firing arrangement which affords adequate propellant burning while providing for reduced pressures on the external exposed rear surface of the projectile, and thereby enabling the projectile body to be of lesser strength than would otherwise be required if the full burning pressure for and burning action of the propellant were exerted directly on the hollow wall portion of the projectile.

The deformable and frangible wad or wadding **81** may take other forms within this aspect of the invention, a modifications being illustrated in FIG. **7** in which the wad **181** takes the form of a disc of cork, preferably a composition of particulate cork adhesively bonded into a common substantially disintegrable mass which may have frangible sheets of paper or the like on its front and rear surfaces for ease of handling and prefiring self-integrity of shape and form. Cork wadding of this type is commercially available under the name Sacork, and the thickness may be varied to obtain a desired degree of gas-pressure retention capability before break-up and/or crushing sufficient to afford pressure release of the propellant gases into the expansion chamber formed by the nlarged bore of case wall **25.**

While the invention has been described with respect to illustrative physical embodiments in accordance with various aspects thereof, it will be apparent that various modifications and improvements may be made without departing from the scope of the invention. Accordingly it is to be understood that the invention is not to be limited by the illustrative physical embodiments but only by the scope of the appended claims.

I claim:

1. A cartridge comprising

a case open at one end,

a projectile disposed in said case and having a portion thereof protruding through and beyond said open end of said casing,

said protruding portion having a central frontal zone surrounded by a forwardly protruding guard ring extending forwardly beyond the forward end of said central frontal zone to protect said central frontal zone,

said guard ring comprising a plurality of circumferentially disposed forwardly extending protrusions with individually free forward ends.

2. A cartridge according to claim **1**,

said forwardly extending protrusions forming discrete cantilever form posts with free protruding ends.

3. A cartridge according to claim **2**,

said discrete cantilever form posts being circumferentially spaced apart at their forward ends.

4. A cartridge according to claim **3**,

the external surface of said discrete posts being forwardly inwardly tapered.

5. A cartridge according to claim **4**,

the internal surfaces of said discrete posts disconnected at their forward ends being forwardly outwardly tapered.

6. A cartridge according to claim **5,**
said external and internal surfaces being respectively convex and concave in frontal view.

7. A cartridge comprising
a case open at one end,
a projectile disposed in said case and having a portion thereof protruding through and beyond said open end of said casing,
said protruding portion having a central frontal zone surrounded by a forwardly protruding guard ring extending forwardly to protect said central frontal zone,
said central frontal zone being outwardly convex and said guard ring extending forward about said convex central frontal zone,
said guard ring comprising a plurality of circumferentially disposed forwardly extending protrusions,
said forwardly extending protrusions forming discrete posts,
said discrete posts being circumferentially spaced apart,
said projectile having a cavity containing a charge of flowable material,
said central frontal zone including a weakened rupture zone for enabling rupture of said central frontal zone and release of said charge of flowable material therethrough when said projectile strikes a target at a sufficient velocity to effect rupture of said weakened zone and/or one or more of said posts while said posts enable an effective measure of protection of said central frontal zone at lower velocity inadvertent handling impacts.

8. A cartridge comprising
a case open at one end,
a projectile disposed in said case and having a portion thereof protruding through and beyond said open end of said casing,
said protruding portion having a central frontal zone surrounded by a forwardly protruding guard ring extending forwardly to protect said central frontal zone,
said central frontal zone being outwardly convex and said guard ring extending forward about said convex central frontal zone,
said projectile having a cavity containing a charge of flowable material,
said central frontal zone including a weakened rupture zone for enabling rupture of said central frontal zone and release of said charge of flowable material therethrough when said projectile strikes a target at a sufficient velocity to effect rupture of said weakened zone and/or said guard ring, while said guard ring enables an effective measure of protection of said central frontal zone at lower velocity inadvertent handling impacts.

9. A cartridge according to claim **8,**
said case and projectile having a snap-ring and groove connection therebetween at the forward central section of said projectile forward of said tapered rear section and at the forward open end of said case,
and said projectile having a bore-riding section extending beyond said snap-ring and groove connection and being of a diameter greater than the interior of said case open end to enable such to snugly fit in a barrel bore of diameter closely complementary to the diameter of said case.

10. A cartridge according to claim **8,**
and said projectile having a bore-riding section extending beyond said snap-ring and groove connection and being of a diameter greater than the interior of said case open end to enable such to snugly fit in a barrel bore of diameter closely complementary to the diameter of said case.

11. A cartridge comprising
a case open at one end,
a projectile disposed in said case and having a portion thereof protruding through and beyond said open end of said casing,
said protruding portion having a central frontal zone surrounded by a forwardly protruding guard ring extending forwardly to protect said central frontal zone,
said projectile having a cavity containing a charge of flowable material,
said central frontal zone including a weakened rupture zone for enabling rupture of said central frontal zone and release of said charge of flowable material therethrough when said projectile strikes a target at a sufficient velocity to effect rupture of said weakened zone and/or said guard ring, while said guard ring enables an effective measure of protection of said central frontal zone at lower velocity inadvertent handling impacts.

12. A cartridge according to claim **11,**
said projectile being formed of relatively rigid frangible cured resin and said charge of flowable material being a volatile liquid agent,
said projectile having a tapered rear section with stabilizing fins thereon.

13. A cartridge according to claim **12,**
said open end of said case being formed of a tough impact grade resin.

14. A cartridge according to claim **12,**
said projectile resin being glass-filled nylon.

15. A cartridge according to claim **12,**
said projectile resin being acetal resin.

16. A cartridge according to claim **12,**
said case and projectile having a snap-ring and groove connection therebetween at the forward central section of said projectile forward of said tapered rear section and at the forward open end of said case,
and said projectile having a bore-riding section extending beyond said snap-ring and groove connection and being of a diameter greater than the interior of said case open end to enable such to snugly fit in a barrel bore of diameter closely complementary to the diameter of said case.

17. A cartridge comprising
a case open at one end,
a projectile disposed in said case and having a portion thereof protruding through and beyond said open end of said casing,
said protruding portion having a central frontal zone surrounded by a forwardly protruding guard ring extending forwardly to protect said central frontal zone,
said projectile having a cavity containing a charge of flowable material,

said central frontal zone including a weakened rupture zone for enabling rupture of said central frontal zone and release of said charge of flowable material therethrough when said projectile strikes a target at a sufficient velocity to effect rupture of said weakened zone and/or one or more of said posts while said posts enable an effective measure of protection of said central frontal zone at lower velocity inadvertent handling impacts,

said case and projectile having a snap-ring and groove connection therebetween at the forward central section of said projectile forward of said tapered rear section and at the forward open end of said case,

and said projectile having a bore-riding section extending beyond said snap-ring and groove connection and being of a diameter greater than the interior of said case open end to enable such to snugly fit in a barrel bore of diameter closely complementary to the diameter of said case.

18. A cartridge comprising

a case open at one end,

a projectile disposed in said case and having a portion thereof protruding through and beyond said open end of said casing,

said protruding portion having a central frontal zone surrounded by a forwardly protruding guard ring extending forwardly to protect said central frontal zone,

said projectile having a cavity containing a charge of flowable material,

said central frontal zone including a weakened rupture zone for enabling rupture of said central frontal zone and release of said charge of flowable material therethrough when said projectile strikes a target at a sufficient velocity to effect rupture of said weakened zone and/or one or more of said posts while said posts enable an effective measure of protection of said central frontal zone at lower velocity inadvertent handling impacts,

and said projectile having a bore-riding section extending beyond said snap-ring and groove connection and being of a diameter greater than the interior of said case open end to enable such to snugly fit in a barrel bore of diameter closely complementary to the diameter of said case.

19. A cartridge comprising

a case having a projectile therein,

said projectile having a tapered rear section with stabilizing fins thereon,

said case having a first bore section containing said tapered rear section with stabilizing fins thereon,

said case having a second bore section rearwardly of and smaller in diameter than said first bore section,

a charge of ignitable propellant powder in said second bore section,

and a frangible bore-restricting wad disposed in said second bore section and between said charge of propellant powder and the tapered finned rear end of said projectile,

said tapered rearmost end of said projectile being smaller in its rear end cross section than said second bore section and being disposed closely adjacent the effective forward surface of said wad.

20. A cartridge according to claim **19,**

said fins extending outwardly from said tapered rear section and across the forward end of said second bore in the zone forward of said wad.

21. A cartridge according to claim **19,**

said first bore section having voids therewithin in the zones between said fins and the exterior of said tapered rear section.

22. A cartridge comprising

a case having a projectile therein,

said projectile having a forward section and a reduced diameter rear end,

said case having a first bore section containing said reduced diameter section and at least a portion of the larger section forward thereof,

said case having a second bore section rearwardly of and smaller in diameter than said first bore section,

a charge of ignitable propellant powder in said second bore section,

and a bore-restricting frangible blow-out wad removably disposed in said second bore section and between said charge of propellant powder and the reduced diameter rear end of said projectile,

said reduced diameter rear end of said projectile being smaller in its rear end cross section than said second bore section and wad and being disposed closely adjacent the effective forward surface of said wad.

23. A cartridge comprising

a case having a projectile therein,

said projectile having a forward section and a reduced diameter rear end,

said case having a first bore section containing said reduced diameter section and at least a portion of the larger section forward thereof,

said case having a second bore section rearwardly of and smaller in diameter than said first bore section,

a charge of ignitable propellant powder in said second bore section,

and a bore-restricting frangible blow-out wad removably disposed in said second bore section and between said charge of propellant powder and the reduced diameter rear end of said projectile,

said reduced diameter rear end of said projectile being disposed closely adjacent the effective forward surface of said wad.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 3,776,137

DATED : December 4, 1973

INVENTOR(S) : David D. Abbott

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, Line 27, change "hose" to ---nose---,

Column 2, Line 65, change "pener" to ---penetr---.

Column 3, Line 25, "." to ---,--- ,

Column 3, Line 26, "requite" to ---require---,

Column 3, Line 62, "meterial" to ---material---.

Column 5, Line 14, "nuacture" to ---nufacture---,

Column 5, Line 40, change "aa" to ---area---.

Column 6, Line 21 "modifications" to ---modification--- ,

Column 6, Line 34, change "nlarged" to ---enlarged---.

Signed and Sealed this

Thirteenth Day of *January 1981*

[SEAL]

Attest:

SIDNEY A. DIAMOND

Attesting Officer ***Commissioner of Patents and Trademarks***

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