

United States Patent

[11] **3,613,587**

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|------|-----------|---|
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| [21] | Appl. No. | 13,403 |
| [22] | Filed | Feb. 24, 1970 |
| [45] | Patented | Oct. 19, 1971 |
| [73] | Assignee | Hercules Incorporated
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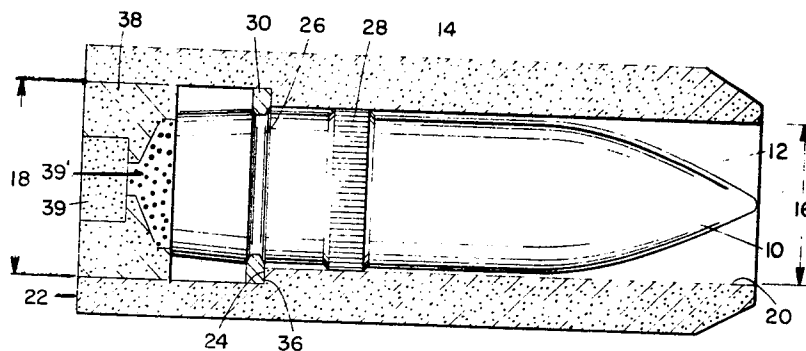
Primary Examiner—Robert F. Stahl
Attorney—Michael B. Keehan

- [54] PROJECTILE RETENTION SYSTEM FOR
CASELESS AMMUNITION
6 Claims, 5 Drawing Figs.**

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| [52] | U.S. Cl. | 102/40,
102/DIG. 1 |
| [51] | Int. Cl. | F42b 5/18 |
| [50] | Field of Search | 102/38, 40,
DIG. 1, 43 |

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|-----------|---------|------------------------------|
| [56] | | References Cited |
| | | UNITED STATES PATENTS |
| 3,345,945 | 10/1967 | Quinlan et al. |
| 3,482,516 | 12/1969 | Farmer et al. |

ABSTRACT: A projectile retention system is provided for caseless ammunition in which the projectile is at least partially housed within the axial cavity extending throughout the propellant charge. The projectiles employed have a groove about the circumference of the projectile. A consumable ring having a greater outside diameter than the projectile is secured in the projectile groove. The surface area of the snapping extending beyond the outside diameter of the projectile provides a bearing surface for the projectile. A second bearing surface is provided within the propellant charge. The projectile assembled with the consumable ring is moved through the axial cavity in the charge until the two-bearing surfaces make contact and restrict movement of the projectile. This retention system prevents the projectile from coming loose when the caseless round is subjected to high-deceleration forces encountered in rapid fire weapons but releases the projectile as a result of initiation of the primer of the caseless round.



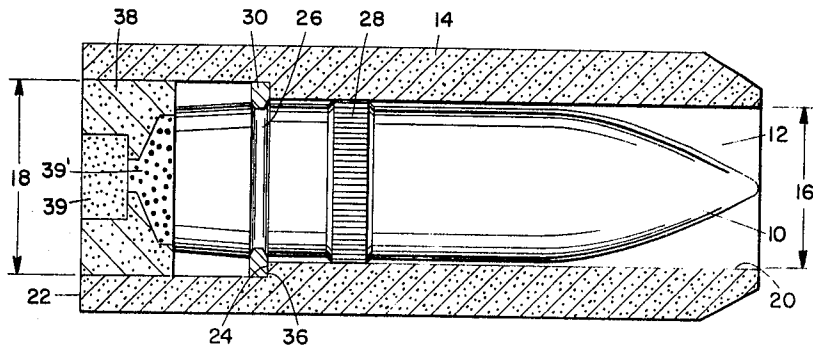


FIG. 1

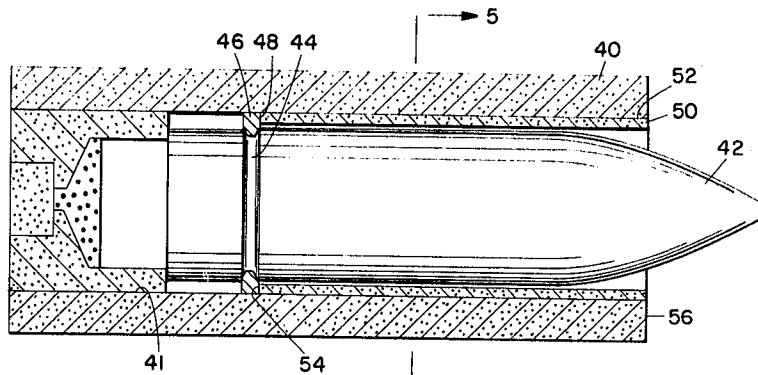


FIG. 4

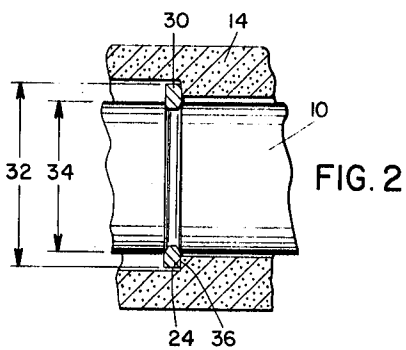


FIG. 2

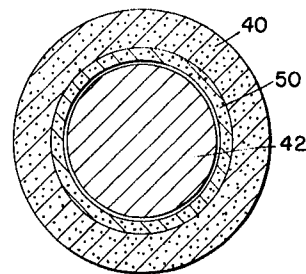


FIG. 5

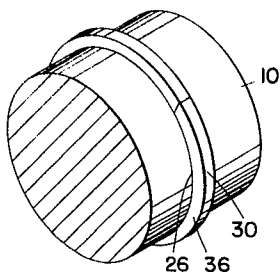


FIG. 3

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PROJECTILE RETENTION SYSTEM FOR CASELESS AMMUNITION

This invention relates to a projectile retention system for a round of caseless ammunition. More particularly, this invention relates to a projectile retention system for a round of caseless ammunition in which the projectile is at least partially housed within an axial cavity which extends throughout the length of the propellant charge of the caseless round. The retention system of this invention retains the projectile in its loaded position when the round of caseless ammunition is subjected to high-deceleration forces encountered in rapid fire weapons.

Caseless ammunition for manual, semiautomatic and automatic guns has been developed in which the projectile is at least partially and is oftentimes completely housed within an axial cavity which extends throughout the length of the propellant charge. Caseless ammunition in which the projectile is fully housed in the propellant charge is described in U.S. Pat. No. 3,482,516 to Farmer et al. It has been found that retention of the projectile within the propellant charge of caseless ammunition of this type can be a critical problem. The retention means for holding the projectile must have sufficient strength to withstand the forces to which the round is subjected during normal handling operations. More importantly, however, the retention means must be designed to hold the projectile firmly in place when the caseless rounds are subjected to high-deceleration forces when the rounds are being fed from a magazine into the chamber of the gun during a rapid fire sequence. The deceleration load on the projectile retention system is usually the most severe force that the system must withstand. The retention system must also be designed to release the projectile nearly instantaneously under the action of a propellant primer or primer-booster combination charge. Over retention of the projectile results in decreased ballistic performance of the caseless rounds. The adverse results of over retention of the projectile is most notable for the telescoped caseless rounds since over retention permits excessive loss of propulsive gas ahead of the projectile prior to the projectile becoming seated within the barrel of the gun in which it is fired.

In accordance with this invention a projectile-retention system for caseless ammunition in which the projectile is at least partially housed within an axial cavity which extends throughout the length of the propellant charge is provided, said projectile retention system having in combination, a projectile with a circumferential groove, a consumable snapping housed within the groove said snapping providing a first bearing surface said bearing surface comprising that portion of the snapping extending outwardly from the circumferential groove beyond the surface of the projectile, and a second bearing surface within the propellant charge of the caseless round. The second bearing surface located within the propellant charge restricts forward movement of the projectile assembled with snapping through the axial cavity in the propellant charge when the first bearing surface of the snapping is moved into engaging relationship with the second bearing surface within the propellant charge.

While not bound by any theory, it appears that in the firing of a caseless round employing the projectile retention system of this invention that the snapping is deformed by the propulsive force of the propellant initiating charge and that through the combination of high pressure generated by the initiating charge and the burning action of the charge on the snapping that nearly instantaneous release of the projectile is achieved.

The following drawings and description will more fully illustrate this invention. Like symbols are used for like parts where applicable.

FIG. 1 is a longitudinal view partly in section illustrating an embodiment of the projectile retention system of this invention employed with a telescoped round of caseless ammunition.

FIG. 2 is a detail showing the engagement of the bearing surface of the consumable snapping and the bearing surface in the propellant charge illustrated in FIG. 1.

FIG. 3 is an enlarged perspective detail illustrating the assembly of the consumable snapping in the circumferential groove of the projectile of FIG. 1.

FIG. 4 is a longitudinal view partly in section illustrating another embodiment of the projectile retention system of this invention.

FIG. 5 is a cross section taken along line 5—5' of FIG. 4.

In FIG. 1 a round of caseless ammunition is shown. In this round the projectile 10 is in its loaded position and is fully housed within an axial cavity 12 in the propellant charge 14. This round of caseless ammunition is defined as a telescoped round. The axial cavity 12 in propellant charge 14 has a minor diameter 16 and a major diameter 18, the minor diameter 16 defining the size of the axial cavity in the forward end 20' of the propellant charge 14 and the major diameter 18 defining the size of the axial cavity in the aft end 22 of the propellant charge 14. A bearing surface 24 is defined at the point in the propellant charge 14 where minor diameter 16 of cavity 12 changes to the major diameter 18. The area of this propellant surface is equal to the difference in surface area of circles having these respective major and minor diameters. Projectile 10 has a circumferential groove 26 aft of rotating band 28. A resilient and consumable snapping 30 is seated in circumferential groove 26.

As illustrated in FIG. 2 snapping 30 has an outside diameter 32 which is larger than the outside diameter 34 of projectile 10. Snapping 30 is split for ease of assembly. The surface area of snapping 30 extending beyond the projectile surface provides a bearing surface 36.

In assembly of the telescoped caseless round of FIG. 1, the projectile 10 is inserted through the axial cavity 12 in the aft end 22 of propellant charge 14 and moved forward through cavity 12 until the bearing surface area 36 provided by snapping 30 is in engaging relationship with the bearing surface 24 of the propellant charge 14. A propellant plug 38 is inserted into the cavity 12 in the aft end 22 of the propellant charge 14 and prevents rearward movement of the projectile 10. A primer charge 39 and a booster charge 39' is secured within propellant plug 38.

In FIG. 3 the consumable snapping 30 is shown seated in circumferential groove 26 of the projectile 10. The surface area provided by snapping 30 extending beyond the surface of projectile 10 provides the first bearing surface 36 for retaining projectile 10 when the projectile is assembled in the propellant charge for the caseless round.

In FIG. 4 another embodiment of the projectile retention system of this invention is shown for a round of caseless ammunition in which the propellant charge 40 has an axial cavity 41 throughout its length. Projectile 42 has a circumferential groove 44 in its surface. A consumable and resilient snapping 46 having an outside diameter greater than the outside diameter of the projectile is assembled within circumferential groove 44. The surface area of snapping 46 extending beyond the outside surface of projectile 10 provides a first-bearing surface 48 for the projectile-snapping assembly. A consumable sleeve 50 such as a cylindrical sleeve of sheet propellant is receivable in the axial cavity of the propellant charge 40. The outside surface 52 of consumable sleeve 50 is contiguous with the inner surface of the propellant charge 40 defined by cavity 41 through the propellant charge 40. Consumable sleeve 50 is secured within cavity 41 by any suitable means such as an adhesive. Consumable sleeve 50 is of sufficient thickness to provide a bearing surface 54 within propellant charge 40 which will cause restriction of the forward movement of projectile 42 assembled with snapping 46 through axial cavity 41 of the propellant charge 40 when the first bearing surface 48 of snapping 46 comes into engaging relationship with bearing surface 54 of sleeve 50 referred to sometimes as the second bearing surface. The position of the second-bearing surface 54 provided by sleeve 50 within propellant charge 40 and the position of circumferential groove 44 and snapping 46 in projectile 42 determine if projectile 42 will extend beyond the forward surface 56 of propellant charge 40. The position of the projectile in the propellant charge when the projectile as-

sembled with snapping is restricted from forward movement through the axial cavity in the charge is defined as the loaded position of the projectile.

FIG. 5 is a cross section of the round of caseless ammunition taken along line 5—5' of FIG. 4, illustrating the cylindrical configuration of consumable sleeve 50.

The following examples further illustrate the projectile retention system of this invention. The retention means are evaluated by dropping fully assembled rounds of caseless ammunition from a height of 8 feet to a ½-inch thick pad of polyurethane having a Shore A hardness of 60. The 8-foot drop of the round to the polyurethane pad simulates the deceleration force to which a round of caseless ammunition is subjected during chambering in a gun in a rapid fire sequence. The propellant charges employed in the examples which follow are prepared from molded granules of smokeless powder having the same formulation, weight and configuration.

EXAMPLES 1-10

Consumable and resilient snaprings are prepared from pressboard paper (Federal Specification UU-P-701 J) having an inside diameter of 0.920 inch, an outside diameter of about 1.095 inches, and a thickness of 0.023 inch. The snaprings are slit to aid in seating of the snaprings into the grooves of the projectiles. Grooves are machined to a depth of 0.032 inch and widths of 0.025 inches, 0.050 inch, 0.075 inch and 0.100 inch in ten projectiles. Snaprings as described are seated in the projectile grooves. Each projectile assembled with a snapping is moved forwardly through the cavity in the aft end of a propellant charge until the snapping-bearing surface and propellant-bearing surface are in engaging relationship as shown in FIG. 1. The axial cavity in each propellant charge has a major diameter (aft end) of 1.095 inches and a minor diameter of 1.035 inches. A propellant plug is inserted in the cavity in the aft end of the propellant charge to prevent rearward movement of the projectile and to hold a primer and booster charge for the round. Caseless rounds assembled as heretofore described are subjected to drop tests to evaluate the effectiveness of the retention system. Data on each of the rounds and results of the drop tests are set forth in table I.

TABLE I

Example:	Projectile* outside diameter (inches)	Projectile groove width (inches)	Snap ring		Results of 8' drop- test
			(Width, inches)	Numbers	
1-----	0.984	.025	.023	1	Failure.
2-----	0.984	.025	.023	1	Do.
3-----	0.984	.050	.023	2	Do.
4-----	0.984	.050	.023	2	Do.
5-----	0.984	.050	.023	2	Do.
6-----	0.984	.075	.023	3	Projectile retained.
7-----	0.984	.075	.023	3	Do.
8-----	0.984	.075	.023	3	Do.
9-----	0.984	.100	.023	4	Do.
10-----	0.984	.100	.023	4	Do.

*25 mm. projectile.

As can be seen from table I, three and four snaprings assembled in projectiles having circumferential grooves of 0.075 inch and 0.100 inch wide respectively, satisfactorily retain the projectile in its loaded position within the propellant charge when the rounds are subjected to the 8-foot drop test.

EXAMPLES 11-15

Five additional rounds are prepared and assembled with three snaprings having projectile groove dimensions and snapping dimensions as set forth in Example 6. The rounds are subjected to the 8-foot drop test. All projectiles are held within the propellant charge. These rounds are then fired. Ballistic results are satisfactory. No residue is detected in the gun chamber or on the ground following firing of the rounds indicating substantially complete consumability of the snaprings.

The consumable snaprings of this invention can be prepared from any material which is consumable under the conditions existing in the chamber of a weapon firing caseless ammunition and which have sufficient resiliency to withstand assembly into the projectile groove without breaking. By "consumable" as the term is used herein is meant that substantially no residue from the snapping remains in the chamber of a gun after a firing. The snap ring of this invention is preferably a split ring for purposes of easy assembly into the projectile groove. Particularly suitable materials for use as snaprings include pressboard paper, Kraft paper containing from 0 to about 70 percent PETN (pentaerythritol-tetranitrate), sheet propellant, and the like.

In the foregoing examples the consumable means providing the second bearing surface which prevents forward movement of the projectile is an interior shoulder of propellant within the propellant charge. Such a bearing surface is readily provided in a propellant charge having an axial cavity throughout its length by machining the axial cavity in the aft end of the propellant charge to the desired depth and diameter. The consumable means providing the second bearing surface can also consist of a consumable sleeve which is secured within the axial cavity of the propellant charge. Such a sleeve can consist of a sheet-propellant cylinder or a series of sheet-propellant strips providing a second-bearing surface, said sleeve or strips having sufficient strength to securely hold the projectile when subjected to the deceleration forces encountered in rapid fire feed systems for caseless ammunition. Other materials which are consumable within the chamber of a weapon and will retain the projectile under accelerating and decelerating forces can also be employed.

The bearing surface of a snapping, the snapping width, the depth of the groove in the projectile surface and the bearing surface within the propellant charge are all factors which must be carefully considered and evaluated in employing the projectile-retention system of this invention. Projectile size and the accelerating and decelerating forces to which the projectile in any given gun system will be subjected will be determinative of the design requirements for each component of the retention system of this invention. These design requirements or factors can be readily evaluated by one skilled in the art to produce a satisfactory snapping retention system for a projectile of a caseless round as defined herein without adversely affecting ballistics by following simple testing and evaluation procedures similar to those described in the foregoing examples. It is understood that the position of the snapping and the groove in the projectile surface for receiving the snapping can be changed along the length of the projectile as necessary to best accommodate the design of the projectile.

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

1. In a round of caseless ammunition, a system for retaining a projectile in a loaded position when the round is subjected to deceleration forces, said round of caseless ammunition having a propellant charge with an axial cavity throughout its length and a projectile being at least partially housed in the axial cavity, said retention system having in combination (a) a projectile with a circumferential groove, (b) a consumable snapping being seated in the groove of said projectile said snapping having an outside diameter greater than the outside diameter of the projectile the surface area of the snapping extending beyond the surface of the projectile providing a first bearing surface and (c) a consumable means providing a second bearing surface within the axial cavity of the propellant charge of the caseless round said second bearing surface restricting forward movement of the projectile with assembled snapping, through the axial cavity in the propellant charge when the first and second bearing surfaces come into engaging relationship.

2. The projectile-retention system of claim 1 wherein the propellant charge axial cavity is defined by a minor diameter at the forward end and a major diameter at the aft end of the propellant charge and the consumable means providing a second bearing surface area within the axial cavity of the

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propellant charge is the propellant surface area defined at the point within the axial cavity where the cavity major diameter changes to the cavity minor diameter.

3. The projectile retention system of claim 2 wherein the consumable means providing a second bearing surface is comprised of a cylindrical sleeve of sheet propellant having an outside surface, inside surface and a bearing surface said cylindrical sleeve of sheet propellant being secured within the axial cavity of the propellant charge, the outside surface of said sleeve being contiguous with the inside surface of the propellant

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lant charge and the bearing surface of the cylindrical sleeve comprising the second bearing surface of the retention system.

4. The projectile retention system of claim 2 wherein the projectile is completely housed in the axial cavity in the propellant charge.

5. The projectile retention system of claim 4 wherein the consumable snapping is prepared from pressboard.

6. The projectile retention system of claim 4 wherein the consumable and resilient snapping is prepared from Kraft paper containing up to about 70 percent PETN.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,613,587 Dated October 19, 1971

Inventor(s) Elliott L. King

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

Col. 1, line 38 of Printed Patent, Specification page 3, line 1
--after "rounds" INSERT--, in which the
projectile is fully housed within the axial
cavity in the propellant charge,--;

Col. 2, line 25 of Printed Patent, Specification page 4,
line 28 -
"3o" should read --30--

Col. 4, line 47 of Printed Patent, Specification page 10,
line 26 -
"snapping" should read --snapring--

line 61 of Printed Patent, Specification page-Claim 1,
line 10 - a comma should be inserted after
"projectile";

Col. 4, line 65 of Printed Patent, Specification, Claim 1,
line 14 - "round" should read --round,--

line 67 of Printed Patent, Specification, Claim 1,
line 15 - "snapring," should read --snapring--

Signed and sealed this 25th day of April 1972.

(SEAL)

Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents