SHOTGUN SHELL WITH SLUG

Inventor: Jeremy Millard, Grand Island, NE (US)

Correspondence Address:
Langlotz Patent Works, Inc.
Bennet K. Langlotz
Patent Attorney
P.O. Box 759
Genoa, NV 89411 (US)

Assignee: Hornady Manufacturing Company

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ABSTRACT

A firearm shell has a hull with a hull chamber and a rear end containing a primer. A hull side wall extends forward from the rear end to a front end. A powder charge is contained within the hull at the rear end. A sabot is positioned forward of the powder charge, and has a base and forwardly extending side portions defining a cup. A projectile has a forward end and a rear end received in the cup. A cushion is provided in the hull, rearward of the bullet. The cushion may be an elastomer such as silicone, and may be positioned immediately behind the bullet, forward of the base of the sabot.
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FIELD OF THE INVENTION

[0001] This invention relates to firearms ammunition, and more particularly to shotgun cartridges containing a single projectile.

BACKGROUND AND SUMMARY OF THE INVENTION

[0002] While shotguns are normally used for firing shot shells containing multiple projectiles, certain shotgun shells fire only a single large projectile. Such projectiles are known as “slugs” (as are sometimes the shells themselves.) The shell consists of a hollow hull with a base containing a primer, and an open forward end that is crimped to enclose the contents, and to open upon firing. The rear of the hull is filled with gunpowder. A disc-shaped gas seal element is positioned forward of the powder to provide a barrier in the hull. An elongated cup-like plastic sabot is positioned forward of the gas seal, and contains the bullet or slug. The sabot is open at the forward end, with elongated slits extending to the forward end to define “petals,” so that the petals open and the sabot falls away from the slug after it exits the muzzle of the shotgun. The shotgun has a rifled barrel to generate rotation of the sabot and slug, so that the slug is stabilized in flight.

[0003] To provide additional projectile velocity or energy without increasing chamber pressures above reasonable limits, prior art slug shells have employed “cushions” between the gas seal and the sabot. Such cushions have been made of a compressible material such as felt or cardboard. Cushions for slug shells and absorb some of the initial spike of pressure that occurs immediately upon firing, and return this absorbed energy well before the projectile exits the muzzle. Thus, the energy is preserved, but the initial pressure spike is reduced, allowing more energetic powder loads than would otherwise be possible while complying with a maximum pressure threshold. Essentially, the cushion allows the lighter gas seal to move forward as the cushion is compressed, providing slightly greater volume even as the heavier slug’s inertia resists movement and expansion.

[0004] While effective in some applications and for certain combinations of bullet weight, type, and powder load, the existing cushions are limited in effectiveness for certain other slug designs, yielding poor accuracy. Moreover, the location of the cushion between the gas seal and the sabot prevents the integration of these components. In addition, the exposure of the cushion edge to the barrel limits material cushion choices (to avoid barrel fouling), and limits materials to those that do not flow outward against the barrel wall when compressed.

[0005] The present invention overcomes the limitations of the prior art by providing a firearm shell. The shell has a hull with a hull chamber and a rear end containing a primer. A hull side wall extends forward from the rear end to a front end. A powder charge is contained within the hull at the rear end. A sabot is positioned forward of the powder charge, and has a base and forwardly extending side portions defining a cup. A projectile has a forward end and a rear end received in the cup. A cushion is provided in the hull, rearward of the bullet. The cushion may be an elastomer such as silicone, and may be positioned immediately behind the bullet, forward of the base of the sabot.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. 1 is a sectional side view of a shotgun slug shell according to a preferred embodiment of the invention.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

[0007] FIG. 1 shows a shotgun slug shell 10 having a hull 12 containing a charge of powder 14, with a gas seal element 16 forward of the powder, a sabot 20 forward of the seal, and a slug 22 contained in the sabot. A cushion 24 is positioned in the sabot to the rear of the slug, and the sabot includes a driver element 25 to the rear of the cushion.

[0008] The hull 12 is a conventional hull, with a brass rear portion 26 having a flat rear face 30 defining a primer pocket 32 receiving a primer 34. A cylindrical skirt sidewall 36 of the brass portion extends forward from the rear face 30. A plastic cylindrical tube 36 extends forward from the brass portion to define a cylindrical chamber in which the other components are received. The tube has a inward crimp 40 at the forward end to secure the components, and the crimp is opened upon discharge of the shell. In the illustrated embodiment, the hull and other components are shown sized for a 12-gauge shell, but any other gauges may be employed.

[0009] The gas seal element 16 is a disc of low density polyethylene or other suitable plastic, with a concave rear face 42. The gas seal skirt expands to fill the hull chamber, so that it operates like a gas piston when the powder burns, containing the combustion gases, and pushing the sabot and slug forward. The gas seal has a diameter of 0.730 inch, an overall thickness of 0.275 inch, and a thickness at the middle of 0.188 inch.

[0010] The sabot 20 has generally cylindrical form, with a flat circular base 44 from which a generally tubular side wall 46 extends in a forward direction. The side wall is slit into four sections or petals by elongated slits 50 parallel to the sabot axis. The slits extend to the forward rim 52 from an intermediate position 54 along the length of the sabot toward the base. The sabot is formed of a flexible high-temperature low-friction thermoplastic material such as low density polyethylene or other suitable material and has a diameter of 0.735 at the base, which has a thickness of 0.180 inch. Forward of the base, the sabot defines a cylindrical lozenge-shaped pocket 56 with a diameter of 0.600 inch and a depth or thickness of 0.150 inch. Forward of the pocket 56, the petals define a cylindrical interior diameter of 0.500. Thus, the sidewall thickness of the sabot is thinnest (0.068 inch) at the pocket 56 (contrast the petal thickness of 0.117). This facilitates the “blooming” of the sabot petals on its exit from the muzzle, as the thin sections provide a hinge or bending point at which the petals tend to easily flex. The slits that define the petals extend back to the thin pocket section, so that their termination 54 is aligned with the forward limit of the pocket 56.

[0011] The pocket 56 in the rear of the cup formed by the sabot is fully filled by the driver disc. The driver disc is a flat, rigid disc of polycarbonate that serves to transmit and distribute the force of powder discharge from the gas seal to the bullet. It has a diameter of 0.600 inch, and a thickness of
0.150 inch, with the circular edges at each face radiused with a radius of 0.015 inch. The radiused edges prevent sharp edges from cutting into the sabot material in discharge, which can in extreme instances sever the base of the sabot from the petals. The disc has a small axial hole for the purpose of mold orientation. The use of a relatively rigid driver disc provides the benefits of even force transmission, while allowing the use of a flexible, low-friction sabot material to facilitate petal blooming, and low-friction engagement of the rifled barrel bore employed for shooting the shell of the illustrated embodiment.

[0012] The cushion is a disc of silicone rubber or other suitable elastomer or polymer. The cushion has a thickness of 0.125, and a diameter of 0.500, with a radiused edge having a radius of 0.015. The cushion has flat, parallel sides, with one side resting directly on the driver disc. The smooth driver disc face and flat face of the cushion provide good adhesion to each other under the pressure of firing and to facilitate the impartation of torque to the bullet as the sabot angularly accelerates due to being advanced down the rifled barrel bore. The cushion is formed of silicone rubber with a durometer hardness in the range of 40-60 on the Shore-A scale. In the preferred embodiment, a hardness of 50 is used, with the range of 40 to 60 being considered the ideal range. In this range, the cushion is hard enough to withstand the forces of firing without excess deformation (which could allow the slug to cant off axis, impacting accuracy). Also, the selected cushion material is compliant enough to grip the slug, and to provide the desired energy absorption that allows more energetic powder loads as discussed in the background above. Outside of the 40-65 range, the cushion lacks these functional advantages. In alternative embodiments, the optimum hardness may vary depending on the gauge, and the slug configuration.

[0013] The slug is a copper-clad lead-cored bullet with a hollow point filled with a plastic nose to provide an aerodynamic tip with a curve that follows the curved ogive 60 of the forward end of the slug. In the preferred embodiment, for 12-gauge shells, it has a weight of 300 grains, although this may vary widely depending on the need. A slug for a 20 gauge shotgun may weigh 250 grains, for instance. The slug has an essentially flat base 62, with sharply radiusd corners 64 at the periphery of the base. The rear portion of the slug from the base to the ogive is a straight cylinder with a diameter of 0.500 inch, the same as that of the petal bore and the cushion. The slug is secured during storage, transport, and during the recoil of firing prior shells by a rib 66 on the interior surface of each sabot petal, just forward of the cylindrical slug portion, to closely receive the ogive. Thus, the rear of the slug is retained closely against the cushion for firing.

[0014] The close fit of the slug and cushion in the petal bore ensures that the cushion is not merely distorted during firing, but is compressed in volume. If the cushion were placed between the rear of the sabot and the front of the gas seal, it would extrude outward unpredictably, possibly in an eccentric manner. If the cushion were sized to the diameter of the sabot and gas seal, it would press outward, generating friction, and likely fouling the barrel as the outwardly-extruded elastomer rubbed against the barrel. In the preferred embodiment, the cushion is entirely isolated from the interior of the hull and the barrel bore by the sabot petals.

[0015] Upon firing, the primer is struck, causing the powder to burn, generating propellant gases. The initial expansion of these gases pushes the gas seal forward (flaring the rear rim outward to maintain a seal and to avoid gas leakage). This directly pushes the sabot forward. Initially, the forward motion of the sabot compresses the cushion as the heavy slug’s inertia resists movement. This allows the initial gas pressure spike to be significantly reduced to desired levels improving the efficiency of the propellant. The sabot accelerates under the gas pressure, sliding forward in conjunction with the gas seal until it has burst through the cramped portion of the hull at the forward end. Upon departure from the hull and entry into the barrel, the sabot’s cylindrical outer surface (as well as that of the gas seal) engages the rifling of the barrel. This generates an impulse of rotation, which accelerates as the sabot and slug gain velocity while proceeding through the barrel. Under the force of the expanding gases, the slug receives pressure through the cushion that adheres the slug base to the cushion (and the cushion to the driver disc and thereby sabot). This pressure and adhesion allows the cushion to efficiently transmit the torque to the slug, so that the initial impulse of torque does not disrupt the position of the slug, but is transmitted over a more extended period, reducing stresses and the prospect of disruption of slug orientation. Alternative materials such as plastic, fiberboard, and felt do not provide this adhesion. However, in alternative embodiments, such materials and any other compressible material may be suitable for use as a cushion immediately to the rear of the bullet. Similarly, elastomeric materials may be employed as cushions between a gas seal and sabot.

[0016] While the above is discussed in terms of preferred and alternative embodiments, the invention is not intended to be so limited. For instance, the gas seal may be molded as an integral part of the sabot, which is not possible with a cushion positioned in the conventional position therebetween.

1. A firearm ammunition component comprising:
   a hull defining a hull chamber;
   the hull having a rear end containing a primer, and a hull side wall extending forward from the rear end to a front end;
   a powder charge within the hull at the rear end;
   a sabot forward of the powder charge;
   the sabot having a base and forwardly extending side portions defining a cup;
   a projectile having a forward end and a rear end received in the cup;
   a compressible cushion element received between the base of the sabot and the rear of the projectile.
2. The firearm ammunition component of claim 1 wherein the cushion is a flat disc.
3. The firearm ammunition component of claim 1 wherein the cushion is an elastomer.
4. The firearm ammunition component of claim 1 wherein the cushion is formed of silicone.
5. The firearm ammunition component of claim 1 wherein the cushion has a hardness of greater than 40 on the Shore-A scale.
6. The firearm ammunition component of claim 1 wherein the cushion has a hardness of less than 65 on the Shore-A scale.

7. The firearm ammunition component of claim 1 wherein the cushion has a hardness in the range of 40 to 65 on the Shore-A scale.

8. The firearm ammunition component of claim 1 wherein the sabot includes a driver element in the base, wherein the driver element is formed of a first material and the sabot is formed of a second material, and wherein the first material is more rigid than the second material.

9. The firearm ammunition component of claim 8 wherein the driver is a planar element having a width greater than the diameter of the projectile.

10. The firearm ammunition component of claim 8 wherein the driver is a disc having peripheral radiused edges.

11. A firearm ammunition component comprising:

   a hull defining a hull chamber;

   the hull having a rear end, and a hull side wall extending forward from the rear end to a front end;

   a powder charge within the hull at the rear end;

   a sabot forward of the powder charge;

   the sabot having a base and forwardly extending side portions defining a cup;

   a projectile received in the cup; and

   an elastomeric cushion element in the hull, rearward of the projectile.

12. The firearm ammunition component of claim 11 wherein the cushion is formed of silicone.

13. The firearm ammunition component of claim 11 wherein the cushion has a hardness of greater than 40 on the Shore-A scale.

14. The firearm ammunition component of claim 11 wherein the cushion has a hardness of less than 65 on the Shore-A scale.

15. The firearm ammunition component of claim 11 wherein the cushion has a hardness in the range of 40 to 65 on the Shore-A scale.

16. The firearm ammunition component of claim 11 wherein the cushion and projectile have diameters sized to be closely received in the cup.

17. The firearm ammunition component of claim 11 wherein the cushion is peripherally constrained by a portion of the sabot.

18. A firearm ammunition component comprising:

   a projectile;

   a sabot having a base and a plurality of petals extending forward from the base to define a cup;

   a compressible cushion received in the cup adjacent to the base; and

   the projectile being received within the cup with the rear end of the projectile against the cushion.

19. The firearm ammunition component of claim 18 wherein the cushion includes an elastomeric material.

20. The firearm ammunition component of claim 18 wherein the cushion has a hardness in the range of 40 to 65 on the Shore-A scale.