Dec. 22, 1964 C. E. MILLER 3,162,124

PLASTIC CARTRIDGE

Filed April 2, 1962

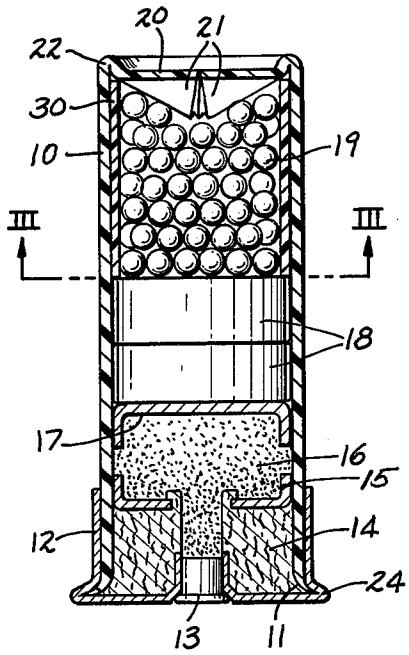

FIG - 1

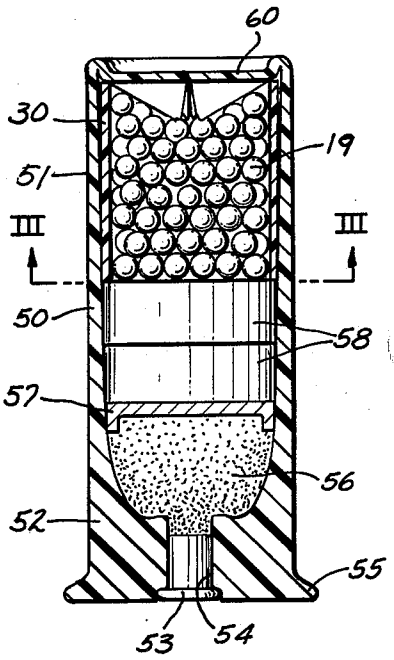

FIG - 2

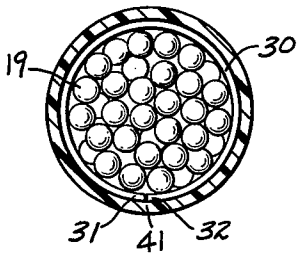

FIG - 3

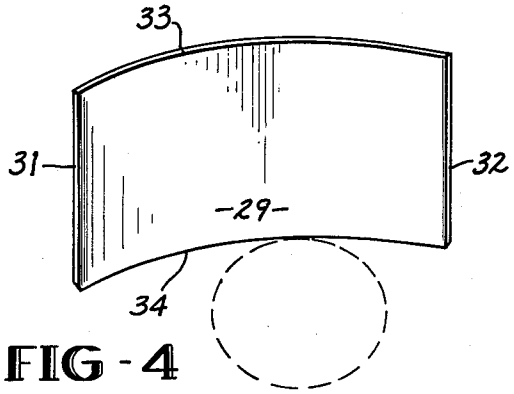

FIG - 4

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PLASTIC CARTRIDGE

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This invention relates to ammunition and more specifically to new and improved cartridges for shotguns.

Shotgun sheels, with a conventional brass-headed tubular paper case are well known. Shotgun shell cases of light metal and those molded of resinous plastic such as ethyl cellulose, ethyl actate, plasticized polyvinyl chloride and polyethylene have also been proposed. No matter what the tubing in which it is incased, a shot shell is a rather special container which must function not only for storing its charge including priming, wadding, powder and shot without deterioration, but also for initiating the powder and for projecting shot acceptably through an end closure. Despite firing, the case must not come apart, and the closure must be adapted not only to hold the charge with controlled confinement, but also be adapted to open readily in a consistent manner when the powder is ignited to release the shot.

Some shooters then frequently insist that the cartridges when spent be reloadable with components to the shooters own specifications and be reusable at least once before discard. Each time such a shotgun cartridge is fired, it remains desirable that the shot load continue to be projected with a desired pattern according to an acceptable degree of shot dispersion without too much lateral scattering of the shot and without too much longitudinal scattering to avoid giving too rarefied a string of shot. A resinous plastic shot shell is desirable wherein the fired case remains intact as long as possible and is reuseable as often as possible before any defect develops to prevent reuse.

The strength and flexibility inherent in a crystalline plastic such as rigid linear polyethylene, forming the cartridge side wall preferably as disclosed in the copending applications noted hereinafter, is promising for the purpose because it resists the tendency of the end of the shell being blown off, but the tendency of such a polyolefinic tube to fray and distort at the cartridge closure has been found to place considerable limitation on not only the reuseability of the plastic shell, but also on the pattern realized with use of such a shot shell.

By fraying and distortion is meant excessive irregularity such as edge splitting, edge scalloping, out-of-roundness, and in-curling of the closure adjacent its edge at the mouth; these irregularities make the fired case altogether unfit for reuse.

It has been found according to this invention that the combination of a rigid polyolefinic tubular side wall in the shot shell, shot and an intervening sleeve of special relative soft polyolefinic composition and construction, a cup wad, an evanescent integral end closure results not only in the highest initial pattern improvement, but also in improvement in the durability of the shot gun cartridge case so that these can be reloaded and fired again and again and give a satisfactory pattern after the initial use. While this combination has been found to be generally effective, it is the particular combination of a certain type of sleeve forming a pad about the shot column that helps make the combination of advantage not only with standard soft shot but particularly with hard shot too and with resin shell tubes or cases comparable to the rigid linear polyethylene type of tube or case.

In accordance with this invention, there is provided a rigid crystalline plastic shotgun cartridge having an axially or longitudinally slit and circumferentially fitted layer

of shot-absorbing and self-lubricating material of polyolefinic character extending initially almost all the way axially down its length between the interior of the tubular side wall of the cartridge and the outer shot pellets of the load of shot. The layer is of such softness relative to the rigid plastic of the case and of such thickness that any indentation of the case is rendered temporary and harmless at the mouth of the shell.

The layer extends over the shot column length in a single thickness of strip which is preferably press-fitted when loaded in the shotshell case to assume the form of a C-shaped band and thereby preferably prestressed to impart a bias giving the band a tendency to uncurl open out of its substantially closed ring shape as soon as it is free of the constraint of the shotgun bore. The band is a layer plastically deformable by shot indentation and formed from a strip of suitable synthetic plastic material of a sufficient length, thickness and pliancy for the purpose.

A layer of high pressure relatively soft and self-lubricating grade of polyethylene or other similar olefinic polymer for the purpose is contemplated in the form of a band curled to a split-ring shape when constrained in combination with a shot shell case, especially of the type having an evanescent end closure and self-sealing flanged gun wad as disclosed in United States Patent Nos. 2,582,124 and 2,582,125.

A suitably soft grade of polyethylene or any equivalent self-lubricating grade of olefinic polymer or co-polymer is contemplated in a thickness of not much less than about the radius of the indentation of the smallest shot used, i.e., not much less than about 0.010 of an inch, but not more than about 0.030 of an inch. This forms a plastically indentable pad movable with the shot and therefore forms part of the projectile load until ejection from the shot gun muzzle. During passage of the projectile load, the outer shot become absorbed partially by not only plastically indenting the layer, but also by extruding parts of it up between them as the acceleration is applied to the load in the bore. Exteriorly of the barrel, the shot and the collar become free of each other.

The open ended partition member or collar is preferably made of an elastolene such as a normally tough, solid, but pliable polymer of ethylene of the type formed at high pressure and temperature as disclosed in U.S. Patent Nos. 2,153,553 and 2,188,465 or 2,343,400. These materials of relatively low molecular weight and of self-lubricating character are particularly suited for the purpose of this invention in combination with a relatively rigid resinous plastic side wall in the shell case. The collar materials generally are of a molecular weight not less than about 10,000 while the case material is preferably a high density linear polyethylene, preferably oriented or otherwise strengthened. A case of polypropylene is also contemplated.

The plastic takes the form of a suitable length of a rectangular strip bent round and with its extremities in abutment in order to fit snugly within the standard cartridge cavity as a seamed collar, but having sufficient "memory" characteristics so as to tend gently to uncoil free from the shot column upon emergence from the muzzle. The extremities must not be joined. The length must not interfere with contiguity of the shot and the evanescent end closure.

Other suitable resinous materials are compounds of polyvinyl chloride, ethyl cellulose, cellulose acetate, polyethylene terephthalate and the like, if lubricated and if of a suitable grade for the purpose. At the aforenoted thickness, a collar of solid high pressure polyethylene of relatively low molecular weight having a Shore durometer hardness of from about 50 to about 75 and preferably not in excess of about 65 measured on the "C" scale, is contemplated to offer the necessary degree of deformability,

lubricity, and outward curlback without having undesired resilience.

The plastic cartridge case is shaped of a relatively rigid polyolefin, such as polypropylene of high isotacticity and preferably of polyethylene characterized by a high degree of linearity and crystallinity and by a high molecular weight above about 100,000 and preferably as high as from about 350,000 to above about 1,000,000. The polyethylene used in the tubular sidewall of the shell of FIGURE 1 and in the sidewall and integral base of the shell of FIGURE 2 are those produced by any one of various processes under relatively low temperatures and low pressures of polymerization using suitable catalysts in admixture. These have very high density and molecular weights and a high degree of linearity of the polymer chains. These polyethylenes, as compared to high pressure polyethylenes, have high softening or melting points and are characterized by such an increase in tear, tensile and yield strengths as to be classified as rigid polyethylenes.

The tube of FIGURE 1 or the shell case of FIGURE 2 may be simply molded of such linear polyethylenes. Tubes of linear low pressure polyethylene may be further treated by stretching to obtain orientation for development of added strength. The shell of FIGURE 2 may be formed by compression acording to copending patent application Serial No. 135,569 filed September 1, 1961.

According to Serial No. 135,569 the tensile strength in tubular parts of crystalline thermoplastic, such as an olefinic polymer, is more than doubled as compared to the undeformed thermoplastic. Specifically, compressive deformation of crystalline polyolefins done below the crystalline melt temperature produces at least a threefold increase in the strength as compared with the strength of the undeformed most rigid form of the plastic available by injection molding. With such polyolefins an increased strength from 3 to 5 times that of the undeformed material is obtained. For example, with rigid polyethylenes, i.e. low pressure, high density linear polyethylenes, tensile strengths of from 16,000 to 22,000 p.s.i. are produced according to Serial No. 135,569 in parts shaped by such compressive deformation.

The polyethylenes used in the shot encircling or partition member, however, are the relatively soft, low molecular weight low density types formed at high temperature and pressure as disclosed in aforenoted U.S. Patent No. 2,153,553, for example. Molecular weights below 40,000 are contemplated.

Therefore, one object of this invention is to provide a novel shotgun cartridge having a high tensile strength in a resinous plastic case, preferably of a polyolefinic character, and which gives an excellent shot pattern and the case of which lasts such a long time that it can be reused.

Another object is to provide a polyethylene cartridge case arrangement which will better resist side wall deterioration and distortion adjacent the shot column and end closure without adversely affecting the pattern. Still another object is to provide a plastic shot shell having a novel shot band in combination with other features of the shell. These and other objects may be more completely understood from the following description of specific embodiments of the invention when taken with the accompanying drawing in which:

FIGURE 1 is an elevational view in longitudinal cross section of one embodiment of shotshell according to this invention;

FIGURE 2 is another elevational view showing a second embodiment also in cross section;

FIGURE 3 is a sectional view taken across either embodiment on line III—III; and

FIGURE 4 is a perspective view of the shot encircling member before assembly in the cartridge.

In FIGURE 1, a rigid linear polyethylene tube **10** is staked at one end in a cup-shaped metallic head **12** with the aid of a convolutely wound paper base wad **14** compressed into the head sufficiently to press and lock the end **11** of the side wall of the tube into extractor rim **24** of the metal head. Both head **12** and wad **14** are centrally orificed for the reception of the primer **13** for ignition of the charge of propellant smokeless powder **16** disposed between the flanged overlay wad **15** and the flanged overpowder wad **17** of the expansible type shown in U.S. Patent No. 2,582,124 to Holmes preferably. Other types of expansible wads may be used as, for example, wads of the type shown in U.S. Patent No. 2,920,563 to De Caro, preferably recessed to provide a cup-shaped wad or one of H-configuration.

A metallic head like **12** may be provided around the base of the shell of FIGURE 2.

The cavity of the cartridge case is charged above wad **17** with one or more compressible wads **18** compressed snugly against the tubular side wall **10**. Against the peripheral edge of wad column **18**, there is forcefully inserted a strip **29** of the type shown in FIGURE 4 after being coiled-up to form a collar **30**. This is stress-fitted against tube **10** to form preshaped band **30** as shown in FIGURE 3 with a pair of opposite extremities **31** and **32** in coplanar juxtaposition or abutment as shown at **41**.

The dimension of strip **29** between the leading and trailing edges **33** and **34** extends over substantially all of the length or height of the shot column **19**.

At the end of the tube opposite the head **12**, there is an evanescent closure **20** formed of contiguous circular plastic sectors folded in pie-cut crimps **21** forming tapering re-entrant folds all integral with tube wall **10** and folded in around the shell at **22**.

When the cartridge is fired in the chamber of any shotgun barrel the split collar **30** acts as a tubular pad or mat upon and in which the column of shot **19** slides out of the shot shell and the barrel. The shot impressed mat also blocks the shot pellets in place in the moving column while minimizing impact.

The recovery character of strip **29** may be varied in the band **30** by providing it in the form of a flat piece or a one with a natural curvature as shown in FIGURE 4. In any event, only enough restoration is desired to give the band a tendency to open outwardly and avoid fluttering against the shot column or excessive spring snap.

The surface of the mat becomes heated during passage of the load to inhance the unctuous character of the plastic.

In the shell of FIG. 1, the open-ended tube **10** may be a piece of linear polyethylene having a density of at least 0.94 and having a bidirectionally oriented molecular structure made by drawing under-sized tubing over an over-sized mandrel by means of a draw die adapted to stretch the tubing.

In the embodiment of FIG. 2, there is provided a one-piece cap shaped thermoplastic casing **50** of crystalline plastic material such as linear high density polyethylene or the like either directly molded to shape or preferarbly compression formed from a blank as taught in copending patent application Serial No. 135,569 filed September 1, 1961, or the continuation-in-part thereof filed February 7, 1962. According to this copending continuation-in-part application, now Serial No. 171,729, now abandoned tensile yield strengths axially or longitudinally of the tubing in the range of about 19,000 to about 35,000 p.s.i. are regularly obtained. By working the mouth of the tubing to a greater degree than the base section, the strength is increased progressively from head to mouth. The thermoplastic mouth is thereby thinned and further rigidified preparatory to formation of the closure, preferably by in-folding and sealing integrally with the tubular part as shown in the accompanying drawing and/or in Holmes U. S. Patent 2,582,124. In the shell the thin walled tubular portion **51** is integral with the finished cup-shaped head or base **52** having a rim **55** and an inserted primer **53** held in the base orifice **54**. The case is loaded above the primer in seriatum with propellant

charge 56, the expansible cup wad 57, the filler wads 58 and the shot 19 encircled as before by the member 30. As in FIG. 1, the end closure 60 is of the evanescent type as set forth in the aforenoted patents of R. S. Holmes to complete the combination.

The circumferential relationship of the shell wall, slippery partition collar 30 and the shot is shown in FIG. 3.

The combination described herein has been found to be particularly advantageous in combination with the shotshell arrangement having end closures of the folded-in integral type shown and the expansible self-sealing flanged wad. Advantages are realized, however, with this arrangement having other types of evanescent closures such as where the top edge of the sidewall is rolled in to form a crip holding a top wad of the readily frangible type. Advantage is realized from the differential in the rigidity, strength and lubricity realized from this novel combination of linear and non-linear polyethylene in the type of ammunition cartridge described.

It will be understood by those skilled in the art that the foregoing is a description of embodiments now being preferred but that further changes and modifications may be made without departing from the spirit and scope of this invention as is set forth in the appended claims.

What is claimed is:

1. A reloadable ammunition cartridge comprising a casing including a relatively thick base closure and integral relatively thin side wall, said side wall having a decreasing wall thickness from the base to an opposite end of said casing and an increasing tensile strength from the base to said opposite end, said base and side wall being a one piece unit formed from a linear high density polyethylene, a propellant charge in said casing, a shot charge arranged in a column in said casing, wad means positioned between said charges, said wad means including an expansible flanged portion positioned next to said propellant charge, said opposite end terminating in a generally round opening for releasing said shot charge on firing of said propellant charge, said end having a longitudinal tensile strength at least 3–5 times the tensile strength of said base, said opening having a tendency to curl inwardly permanently after said firing, a member having at least one split in a sidewall thereof positioned in said tubular side wall to encircle said column, and a yieldable end closure formed by folding in said end of said casing over said shot charge to normally retain said shot charge, said member having extremities constrained by contact with said side wall of said casing to form a collar open ended at least at the edge adjacent said end closure and being effective to expand outwardly and separate from said shot charge when said shot charge is projected from a shotgun, said collar being effective with said shot charge to cause said end closure to yield and reform said end into a generally round opening substantially free from said tendency to curl and substantially free of mutilation rendering said opening fully open and round thereby providing access for reloading.

2. The cartridge of claim 1 in which said hollow member is a strip of relatively soft plastic material compared to said sidewall folded into a tubular configuration with the margins of said strip unjoined to form a slit extending longitudinally from end to end.

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SAMUEL FEINBERG, *Primary Examiner.*

SAMUEL BOYD, *Examiner.*