ABSTRACT

A center fire cartridge case for high pressure cartridges has a plastic body and a metallic head. The head is assembled solely from inexpensive, easily manufactured components which positively interlock to maintain the structural integrity of the cartridge case. Interaction of head components forms an extractor groove without the need for a turning operation.

7 Claims, 7 Drawing Figures
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PLASTIC CARTRIDGE CASE FOR HIGH PRESSURE CENTER FIRE AMMUNITION HAVING MULTI-COMPONENT STAMPED METAL HEAD

This invention relates to cartridges for firearms and more particularly to cartridges having plastic body casings with metal heads attached to the breech ends thereof and the method of manufacturing the metal heads and attaching them to the plastic body casings.

It is well known that ammunition cartridges with body casings made from synthetic polymeric compositions offer numerous advantages over casings made from brass or other conventional metal alloys. Some obvious and salient advantages are reduced weight, lower material costs, ease of fabrication and, of course, conservation of critical metals.

Although shotgun shells made of biaxially oriented plastic materials, as shown in U.S. Pat. No. 3,103,170 issued to Covington et al. on Sept. 10, 1963, have been on the market for about ten years, very little has been accomplished in the use of thermoplastic materials, either injection molded or cold worked, in high-powered rifle or other center fire ammunition. Probably the main reason for this is that explosive pressures generated in center fire ammunition are much greater than in shotgun shells, e.g., about 50,000 psi as compared to 10-11,000 psi for shotgun shells.

One cartridge case of this type is disclosed in U.S. Pat. No. 3,745,924, issued on July 17, 1973, in the name of John J. Scanlon and assigned to the assignee of this invention. This patent discloses a plastic casing having a rearwardly projecting skirt which is held in substantial compression between a machined metal head member and a metal battery cup. The radial forces generated serve to hold the components of the head on the plastic casing.

Multi-segment metallic head assemblies are also well known but have not heretofore been adaptable for use in high pressure center fire ammunition. One such construction is shown in U.S. Pat. No. 91,818 issued to Edward Mannier Boxer on June 29, 1869. This patent discloses a cartridge wherein a paper or metal body has a turned-over end positioned in a thin metal cup. A metallic wad is placed in the body over the body end and a metal "cap chamber" is passed through a metal disk, positioned at the base of the cup, and through the cup and the wad. Sufficient force is then applied to the cap chamber to cause significant compression and deformation of the wad resulting in axial and radial forces which serve to maintain the structural integrity of the cartridge case.

In accordance with this invention, a cartridge case capable of withstanding repeated uses at high temperatures and pressures is formed with one piece plastic body and a metallic head. The head is assembled from a plurality of inexpensively produced stamped parts which positively interlock with each other and with the plastic body in a manner which maintains the structural integrity of the cartridge case throughout the high temperature and pressure operation inherent in ammunition used in modern high-powered center fire guns and makes a high degree of reliability for the cartridge case possible. The positive interlocking of parts avoids the need for compressive stresses or friction to hold components of the cartridge case together, as found in prior art structures.

A steel reinforcing sleeve of the metallic head assembly has its rear end portion contoured so that it forms an extractor groove in cooperation with an extraction rim positioned rearwardly thereof. This interaction of parts avoids the necessity and expense of the machining or turning operation which is required in prior art center fire cartridges.

It is an object of this invention to provide a plastic bodied cartridge which has sufficient strength to withstand the handling, storing and firing requirements of modern center fire ammunition.

It is an additional object of this invention to provide a plastic-bodied cartridge which is suitable for use in modern high-powered center fire rifles.

It is a further object of this invention to provide a plastic-bodied cartridge for high-powered center fire ammunition which has a metallic head constructed entirely of inexpensive, easily produced parts.

It is a still further object of this invention to provide a plastic-bodied cartridge which has a metallic head having components which interact to provide an extractor groove without the requirements of a turning operation.

It is another object of this invention to provide a plastic-bodied cartridge having a metallic head having components which positively interlock with each other and with the plastic body to maintain the structural integrity of the cartridge regardless of the level of compressive stress in the cartridge components.

These and other objects and advantages of this invention will be apparent from the specification when read in conjunction with the appended drawings, wherein:

FIG. 1 is a fragmentary sectional view of a rifle containing a chambered cartridge, only partially sectioned, having a cartridge case in accordance with this invention;

FIG. 2 is a fragmentary sectional view of the cartridge case of FIG. 1;

FIG. 3 is an exploded perspective view illustrating assembly of the cartridge case of FIG. 1;

FIG. 4 is a cross-sectional view of a flanged cup member for use in the cartridge case of FIG. 1;

FIG. 5 is a cross-sectional view of a reinforcing sleeve for use in the cartridge case of FIG. 4;

FIG. 6 is a cross-sectional view of equipment used to flare a tubular extension of the flanged cup of FIG. 3, and

FIG. 7 is a cross-sectional view of an alternate embodiment of the flanged cup member of FIG. 4.

Referring now to the drawings, FIG. 1 illustrates a portion of a rifle 1 having a barrel 2 and a chamber 3 for holding a round of ammunition. A bolt assembly 4 includes a firing pin 5 for firing the round, an extractor claw 6 for withdrawing the fired cartridge case from the chamber 3, and an ejector 7 and ejector spring 8 for propelling the cartridge case from the rifle 1. A loaded round of ammunition 10 is shown in the chamber and includes a cartridge case 11 having a primer 12 in a breech end thereof, a projectile 14 which is secured by a force fit or any other conventional manner into a necked-down mouth portion 15 of the cartridge case 11. The cartridge case 11 is filled with a suitable propellant 16.

The main body of the cartridge case 11 is an elongated body casing 17 which is made of a suitable plastic material which may be polycarbonate, polysulfone, high density polyethylene, alloy mixtures of polyethylene and polycarbonate, or other suitable materials such as those disclosed in the above-indicated U.S. Pat. No.
The casing 17 includes the necked-down mouth portion 15 and has, at the breech end thereof, an inwardly directed transverse wall 19 defining an opening or flash hole 19a (FIG. 2). The transverse wall 19 preferably has a generally frusto-conical chamfered surface 19b at the forward side of the transverse wall 19, peripherally of the flash hole 19a. Integrally formed with the transverse wall 19 is a rearwardly projecting thin wall annular skirt or flange member 20. As shown in the above-mentioned patent, the casing 17 may be initially formed by injection molding and subsequently drawn and necked down to provide the desired shape.

A metallic head assembly 21 is best described with reference to FIGS. 2-5 and preferably comprises a flanged cup member 22, an extraction rim 24 and a reinforcing sleeve 25.

The flanged cup member 22 (FIG. 4) is preferably stamped from carbon steel and has a primer retaining cup 26 with a rigid anvil supporting forward end wall 26a. A tubular extension 27 is preferably cylindrical in shape, extends forwardly from the primer retaining cup 26, and is preferably coaxially aligned therewith. The primer retaining cup 26 has an outer wall 28, a rear end portion of which is bent radially outward to form a peripheral flange 29.

The extraction rim 24 (FIG. 3) is preferably stamped from carbon steel or aluminum in the form of a ring having a central circular opening 30 therein. A recess 31 is preferably provided circumferentially of the opening 30 at a rear face of the rim 24.

The reinforcing sleeve 25 (FIG. 5) is preferably stamped from steel and has a generally cylindrical forward portion 25a, a generally frusto-conical central portion 25b and a generally cylindrical rear portion 25c of reduced diameter. An inner surface 32 is contoured and dimensioned to firmly engage an outer surface of the skirt 20 of the casing 17. An outer surface 34 preferably has a contour and diameter at the forward portion 25a matching that of the casing 17 (see FIG. 2) and is generally the same in diameter as the extraction rim 24. The configuration of the reinforcing sleeve 25 is also ideally suited to other low cost mass production techniques such as stamping, cold forming and others which involve working in an axial direction without the radial movements required in turning operations. A cold worked reinforcing sleeve 25 may, if desired, be formed as shown in FIG. 1.

Assembly of the metallic components of the head assembly 21 onto the casing 17 will now be described, the order and relationship of the components during assembly being best illustrated in FIGS. 2 and 3. The reinforcing sleeve 25 is placed over the skirt 20 of the casing 17 in close fitting relation thereto. Due to its strength and interaction with other components, the sleeve provides the necessary radial reinforcement which enables the breech end of the cartridge case 11 to withstand the high pressures generated during the firing of high-powered center fire ammunition. The extraction rim 24 is placed rearwardly of the skirt 20, preferably in a position abutting and preventing removal of the sleeve 25 and positioned in axial alignment with the casing 17. The extraction rim 24 also provides rear support for the skirt 20.

The flanged cup member 22 is positioned with the tubular extension 27 rearwardly directed and is inserted through the opening 30 in the extraction rim 24. When the flanged cup member 22 is in its proper position, the tubular extension 27 extends through the flash hole 19a in the transverse wall 19, thus providing a metallic lining for the flash hole, and the primer retaining cup 26 is seated with its forward end wall 26a against the transverse wall 19 and with the outer wall 28 of the primer retaining cup 26 snugly seated within the skirt 20. The flange 29 is seated within the recess 31 which surrounds the opening 30 of the extraction rim 24 and thus maintains the proper alignment of the rim 24 and holds it firmly against removal.

To secure the head assembly 21 to the casing 17, the tubular extension 27 of the flanged cup member 22 must be outwardly flared to grasp the transverse wall 19. This positive interlocking action, in conjunction with the interlocking of the components of the head assembly 21 as previously described, produces a complete cartridge case 11. Although the positive interlocking of parts avoids any necessity of subjecting portions of the plastic casing 17 to other components to high compressive stresses, as found in the prior art, it should be noted that the existence of any voids between the components of the head assembly 21 and the transverse wall 19 or skirt 20 would be highly undesirable. Therefore, to provide adequate sealing, the reinforcing sleeve 25 flanged cup member 22 are preferably maintained in a press fitting relationship with the casing 17.

It can be seen that, due to the shape of the central portion 25b and rear portion 25c of the reinforcing sleeve 25, the extraction rim and reinforcing sleeve interact to provide an extractor groove for the cartridge case 11, having a shape essentially the same as that provided by a turning operation on prior art center fire cartridge cases. Optimum extraction and ejection characteristics are thus provided for the cartridge case 11, although no machining is required to produce the groove.

Flaring of the tubular extension 27 may be accomplished by a flaring tool assembly 33, a simple embodiment of which is illustrated in FIG. 6. The flaring tool assembly 33 has a base 35 and a raised pedestal 36 for supporting the extraction rim 24 and flanged cup member 22. Cooperating with base 35 is a movable flaring tool 37 which is generally cylindrical in shape and designed to be inserted into the casing 17. The outer diameter of the flaring tool 37 is preferably just less than the inner diameter of the necked-down mouth portion 15 of the casing 17. This size relationship permits the flaring tool 37 to be inserted into the casing 17 and aids in the alignment of the cartridge case 11 for final securement. It should be noted that, due to the design of the head assembly 21 of this invention, it is possible to scale down the flaring tool 37 so that this plastic-steel cartridge case design may be used for generally any caliber center fire cartridge desired, even those having extremely small mouth openings.

The lower end of tool 37 has a tip 39 of reduced diameter which passes through the metal lined flash hole 19a. The tip 39 is further modified by a chamfered shoulder 40 which angularly coincides with the chamfer 19a at the forward end of flash hole 19a.

The flaring tool 37 may be actuated in a number of ways such as by hydraulic or pneumatic actuators. According to the illustrated embodiment, the flaring tool 37 is actuated by a locking sleeve 41 which is connected to the rod end of an actuator (not shown).

Prior to the flaring step, a sliding sleeve 42, biased by a compression spring 43, is urged against the casing 17
to assure a snug fit against the extraction rim 24 and flanged cup member 22. The flaring tool 37 is then further actuated downward causing the shoulder 40 to outwardly flare the tubular extension 27 firmly against the transverse wall 19 while the casing 17 is kept firmly against extraction rim 24 by the sleeve 42 and the compression spring 43 so that the metal components are mechanically locked to each other and to the plastic casing without risk of subsequent loosening.

When a round of ammunition 10 incorporating a cartridge case 11, in accordance with this invention, is fired, the pressure within the cartridge case will generally reach a level in excess of 50,000 psi. The cartridge case 11, and particularly the head assembly 21, must be able to withstand such pressure without gas leakage and without endangering the structural integrity or extractability of the cartridge case.

The plastic casing 17, while unable by itself to support such pressures, expands against the wall of the chamber 3 which supports the casing 17 so that it can withstand the pressure without damage. It should be noted that even if the casing 17 should remain expanded against the chamber wall after firing, instead of recovering as would a brass cartridge case, it will cause no extraction problem because of the pliability of the plastic and the low frictional engagement between the plastic casing and the metal chamber.

The effects of the high chamber pressure on the components of the head assembly 21, and thus their strength and structural requirements, may vary substantially. The extraction rim 24 must have sufficient strength to provide rear support for the skirt 20 and the reinforcing sleeve 25, even if there is excessive clearance between the rim 24 and the bolt 34 which might otherwise permit rearward bulging of the skirt 20. The flanged cup member 22, while subjected to chamber pressure, is radially supported against deformation by the extraction rim 24. The high pressure applied to the tubular extension 27 tends to further flare the tubular extension 27 against the chamfer 19b on the transverse wall 19 so that assembly of the parts is either unaltered or made easier when the chamber is fired. The forward portion 25a of reinforcing sleeve 25, as can be seen in FIG. 1, is in a position which allows it to be supported by the wall of the chamber 3 during firing. The remainder of the reinforcing sleeve is unsupported and must be able to withstand the pressures applied.

The chamber pressure is applied to the transverse wall 19 and, through the wall, to the skirt 20. As previously indicated, the tubular extension 27 is forced against the transverse wall 19 by this pressure. This action helps prevent the presence of voids between the flanged cup member 22 and the skirt 20 which could permit extremely high pressures to be applied directly against an unsupported region, such as the rear portion 25c of the reinforcing sleeve 25, possibly severely damaging the cartridge or causing a substantial gas leak.

A substantial portion of the pressure applied to the transverse wall 19 and the skirt 20 is absorbed by interaction of the plastic with the forward wall 26a of the flanged cup member 22 and with the frusto-conical central portion 25b of the reinforcing sleeve 25 so that the pressure present at the rear end portion of the skirt 20 is substantially reduced from the pressure the forward portion of the transverse wall 19. The pressure applied against the central portion 25a of sleeve 25 forces a rear surface 44 (FIG. 5) firmly against the extraction rim 24. This results in a firm frictional engagement between these parts which helps the unsupported portion of the sleeve resist the outward pressures applied thereto. In this manner, the reinforcing sleeve 25 may be made sufficiently resilient to permit the forward portion 25b to expand to the wall of the chamber 3 without damage and still be sufficiently strong to withstand the radial forces applied to the unsupported portions 25b and 25c during firing.

Variations in the structure of the metal components of the head assembly 21 may be accomplished without departing from the spirit and scope of this invention. For example, as shown in FIG. 7, an alternate embodiment of flanged cup member 122 may be constructed having an extraction rim 124 formed integrally therewith. If desired, the extraction rim may be formed by folding over the outer portion of a radially elongated flange 129, as shown, or the extraction rim 124 may be a thickened metal portion integrally formed peripherally of the flange 129.

1. A cartridge case for a high-powered center fire cartridge comprising a plastic casing with a rearward end, a transverse wall defining a flash hole, and a rearwardly extending skirt, a metallic tubular reinforcing sleeve positioned around the skirt, a metallic extraction rim having a central opening and positioned against the rearward end of the casing for holding the reinforcing sleeve against removal from the casing, and a metallic cup member having an outwardly directed peripheral flange at a rear end portion and a tubular extension at a forward end portion and being positioned within the skirt and the central opening of the extraction rim with the tubular extension extending through the flash hole and the peripheral flange holding the extraction rim against removal, the tubular extension being outwardly flared to abut the transverse wall in interlocking relationship.

2. A cartridge case as in claim 1 wherein said reinforcing sleeve has a rear end portion of reduced diameter and the rear end portion and said extraction rim form an extractor groove for the cartridge case.

3. A cartridge case as in claim 2 wherein said reinforcing sleeve is a steel stamping.

4. A cartridge case as in claim 1 wherein said extraction rim has a peripheral groove around said central opening for containing the peripheral flange of said cup member.

5. A cartridge case as in claim 1 wherein said reinforcing sleeve has a rear surface and said extraction rim abuts said rear surface in lateral engaging relationship.

6. A cartridge case for a high-powered center fire cartridge comprising a plastic casing with a rearward end, a transverse wall defining a flash hole, and a rearwardly extending skirt, a metallic tubular reinforcing sleeve positioned around the skirt, and a metallic cup member having an outwardly directed peripheral flange at a rear end portion and a tubular extension at a forward end portion, a portion of the flange being folded over to form an extraction rim, said cup member being positioned within the skirt with the tubular extension extending through the flash hole and the extraction rim holding the reinforcing sleeve against removal from the casing, the tubular extension being outwardly flared to abut the transverse wall in interlocking relationship.
7. A method of manufacturing a cartridge case having a plastic body with a transverse wall and rearwardly extending skirt formed therein, the method comprising the steps of positioning a reinforcing sleeve around the skirt, positioning an extraction rim having a central opening rearwardly of the skirt and reinforcing sleeve, moving a flanged cup member through the central opening of the extraction rim to a position within the skirt so that its flanged portion abuts the extraction rim and a tubular extension protrudes through a flush hole in the transverse wall, and outwardly flaring the tubular extension thereby positively interlocking the rim, sleeve and cup to the plastic body.