A bullet jacket, and method of making a bullet jacket are disclosed, wherein bullets placed therein will, when fired, expand at low velocities, while maintaining high weight retention at higher velocities. The bullet jacket is preferably made of a copper based material, and comprises a solid base portion and an upper end portion defining a cavity therein, in which a bullet core material is located. The walls of the cavity decrease in width away from the base and curve inwardly to form an ogive shape. The length of the cavity section of the bullet jacket is between 58 to 61 percent of the total length of the bullet jacket, and the total weight of the solid base portion of the bullet jacket is between 48 to 52 percent of the total weight of the bullet jacket. The bullet core is made by using conventional means to seat and enclose the bullet core within the bullet jacket of the present invention. In manufacturing the bullet jacket, the jacket mouth or lip thickness is made to be between 0.025 to 0.060 of an inch. Four to 6 cuts are used to cut the jacket lip to a minimum depth of 0.015 inch to a maximum depth of 0.450 inch.
BULLET JACKET AND METHOD FOR THE MANUFACTURE THEREOF

[0001] The present invention relates generally to a bullet jacket for use in small arms ammunition used primarily for hunting small and big game. More specifically, the present invention provides for a bullet jacket and method of making the bullet jacket, wherein the bullet will expand upon impact, when being fired at low velocities, while maintaining a high weight retention when fired at higher velocities.

DESCRIPTION OF THE PRIOR ART

[0002] It has been previously proposed to provide a bullet jacket consisting of a solid base section and also a cavity section, which is filled with a core material. Normally, when hunting, bullets fired at lower velocities can be expected to expand in diameter as they penetrate game animals. Such bullets usually comprise an outer jacket of a copper base material that may be pure copper, or a copper alloy such as brass, and an inner core of lead. It is the peeling back or “mushrooming” of the outer jacket when the bullet strikes a game animal that produces the increase in diameter. Expansion of the bullet is desirable to slow the bullet and transfer more energy to the target during passage through soft animal tissue. If the bullet does not expand significantly and does not hit a bone or vital organ, it may pass through the animal without killing the animal or stopping the animal.

[0003] Further, while it is important that the bullet expand in diameter, it is also important that the bullet retain as much of its original weight as possible, to ensure adequate penetration. Some bullets, such as those of the soft nose variety, can lose as much as 45%, or more, of their total weight during the initial 6" to 8" of penetration, which greatly reduces their effectiveness. Most of the weight loss is due to the breaking off of the sections of jacket that peel towards the rear of the bullet when the bullet strikes a game animal. While maximum expansion of the bullet is desirable to maximize hemorrhaging and tissue damage, in order to maximize the lethality in game animals, if the bullet expands too much, the bullet will separate into segments which limits the penetration. Accordingly, to obtain significant depth of penetration, particularly if fired from a higher caliber weapon, a significant mass of the bullet must remain behind the bullet, since a bullet’s “stopping power” is directly related to its mass. Some bullets expand well at a low velocity but break apart at higher velocities. Other bullets can withstand high velocities but can have problems expanding when fired at lower velocities, such as the ones described in U.S. Pat. No 5,621,186 (Carter).

[0004] Additionally, accuracy with prior art bullets having a solid base is also a problem because of improper balancing due to a shallow frontal cavity. Great bullet accuracy is important because some rifle manufacturers, such as Weatherby, guarantee a 1½ inch grouping of 3 shots shot at a distance of 100 yards.

[0005] Accordingly, there is a need for a bullet jacket which can provide bullets placed therein that can expand well when fired at a low velocity, and which can withstand being fired at higher velocities without breaking apart, whilst still maintaining a high weight retention to ensure adequate penetration.

SUMMARY OF THE INVENTION

[0006] Thus, a primary object of the present invention is to provide an improved bullet jacket wherein a bullet manufactured using the bullet jackets of the present invention will expand on impact when fired at a low velocity, while maintaining a high weight retention when fired at higher velocities.

[0007] One aspect of the present invention provides a bullet jacket formed from a jacket material, the jacket comprising a solid base portion and an axially opposite end portion having an outer lip at an upper edge thereof. The end portion defines a cavity in the bullet jacket, wherein the cavity has an opening in a direction towards the end portion, and a length which comprises 45 to 70 percent of the total length of the bullet jacket.

[0008] Typically, the bullet jacket is formed from a single piece of material, although it is envisioned that more than one piece may be used. The outer lip preferably has a uniform thickness, ranging between 0.025 to 0.060 of an inch, and the cavity section is preferred to have a length which comprises 58 to 61 percent of the total length of the bullet jacket. Moreover, the bullet jacket commonly increases in hardness and strength from the upper edge of the lip to the base portion of the bullet jacket. A weighted core material may also be positioned in the cavity.

[0009] A further aspect of the present invention provides a method of manufacturing a bullet jacket. The method of the invention comprises the steps of placing one or more lengths of forming material in a forming die; and forming the bullet jacket from the forming material, wherein the bullet jacket is formed to comprise a solid base portion and an axially opposite end portion having an outer lip at an upper edge thereof, the end portion defining a cavity having an opening directed towards the end portion and a length which comprises 45 to 70 percent of the total length of the bullet jacket.

[0010] The present method may further include the forming of a plurality of cuts in the outer lip of the jacket, for example between 4 and 6 cuts, each cut having a minimal depth of 0.016 of an inch to a maximum depth of 0.450 of an inch. Additionally, the method may include a step of placing a weighted core material in the cavity.

[0011] A still further aspect of the present invention provides a bullet which comprises a bullet jacket as defined by the present invention, and filled with a core material. Such a bullet will commonly expand on impact when fired at low velocity, and maintain a high weight retention when fired at a high velocity.

[0012] The length of the cavity of the bullet jacket of the present invention is typically between 58 to 61 percent of the total length of the bullet jacket. In addition, the weight of the solid base section of the bullet jacket is, preferably, from between 48 to 52 percent of the total weight of the bullet jacket. In a further embodiment of the present invention, the thickness of the jacket mouth or lip is from 0.025 to 0.060 of an inch, and the ratio of weight of the lip thickness to the bottom cavity wall thickness is between 0.21 to 0.295.

[0013] The jacket wall thickness at the bottom (or base) of the cavity hole in the jacket for a .308 bullet manufactured using the bullet jackets of the present invention, for example, is 0.112 of an inch. For this same .308 bullet, the bullet jacket of the present invention will have a cavity bottom hole diameter of 0.084 of an inch, and the diameter at the top of the cavity hole is 0.239 of an inch.
The bullet jacket of the present invention is preferably made out of pure copper. However, it is alternatively possible to substitute pure copper with an alloy of copper, aluminum, or an alloy of aluminum, iron, or steel. Further, the core material placed in the cavity formed in the bullet jacket can be formed from lead, alloys of lead, tin, alloys of tin, zinc, antimony, metal particles and rubber matrix, metal particles and polymer matrix, or any other material having a specific gravity greater than 0.5 gram per cubic centimeter. The core material placed in the cavity may be bonded to the walls of the cavity either by heat, or by an adhesive.

In manufacturing the bullet jacket of the present invention, a length of copper tubing of a particular weight and wall thickness is placed in a forming die where it is swaged at a minimal internal pressure of 222680 PSI. Using this amount of minimal internal pressure ensures that the bullet jacket will form completely, whereby, for example, the solid portion of the bullet jacket will be air tight. The tubing is then compressed and takes the form and dimensions of the external punch, forming die and internal punch used to form the bullet jacket. Alternatively, solid copper rods may be used instead of copper tubing.

In a preferred embodiment, it is preferable that a boat-tail base design be provided to the bullet jacket (to ensure better ballistic co-efficient and easier bullet insertion during ammunition manufacturing) and therefore, it is preferable that the forming die will have the boat-tail dimensions reamed or cut within its cavity to impart the boat-tail base design upon the bullet jacket as it is being formed. However, it is also possible that the bullet jacket base could be a flat-base design. In addition, it is also preferable that the external punch used in forming the bullet jacket shall have a plurality of sharpened edges, more preferably 4 to 6, that cut the jacket mouth or lip to a minimal depth of 0.015 of an inch to a maximum depth of 0.450 of an inch during the swaging or forming operation. It is important to note that these cuts cut the jacket mouth or lip cleanly through from the inside to the outside of the jacket.

On impact against a medium such as water, ballistic gelatin or living tissue, a bullet used in conjunction with the bullet jacket of the present invention will expand to double its diameter relatively quickly at an impact velocity of 1675 FPS. It has been determined by experimentation that these cuts to the jacket mouth (or lip) ensure that bullets made using these jackets will expand at low velocities, while maintaining a high weight retention when fired at a high velocity. For example, tests conducted at Norma Precision AB labs in Sweden recently indicated that, at velocities in the range of 1750 FPS up to 1975 FPS, projectiles having tip diameters in the order of 0.140 of an inch (and cuts to the jacket mouth of at least 0.010 to 0.050) demonstrated better penetration, expansion and % mass retention than any other combination. Thus, a bullet used in conjunction with the bullet jacket of the present invention will, upon impact, demonstrate double diameter expansion, greater penetration and weight retention of about 83% of its total mass, even at an impact velocity of 3300 FPS, whilst maintaining structural integrity up to 3400 FPS. Furthermore, the accuracy of, for example, a .30 caliber bullet manufactured using this jacket will maintain a 5 shot grouping of 0.75 inch shot at a distance of 100 yards. By contrast, some bullets that are designed to expand at lower velocities, such as the Nosler Ballistic Tip™ and Swift Scirocco™, do not maintain high weight retention at higher velocities, and penetration is compromised due to the lack of mass. For example, the Nosler Ballistic Tip™ bullet may lose as much as 50% of its mass when shot at a velocity of 3100 FPS (Shooting Times magazine, July 2003, page 38).

Embodiments of the present invention will be further described with reference to the accompanying drawings, in which:

**FIG. 1** is a top view of the metal tubing or metal rod used to form the bullet jacket of the present invention;

**FIG. 2** is a side view of an external punch to be used in manufacturing the bullet jacket of the present invention, which illustrates the sharp hardened edges on the external punch that are to cut the jacket mouth or lip of the bullet jacket;

**FIG. 3** is a cross-sectional diagram illustrating the metal tubing or rod being swaged in a forming die, by the internal and external punches, to form the bullet jacket of the present invention;

**FIG. 4** is a cross-sectional diagram of the bullet jacket of the present invention, which illustrates the finished jacket of the present invention, with the swaged core material positioned inside the jacket cavity;

**FIG. 5** is a top view of an embodiment of the bullet jacket manufactured in accordance with the present invention, which illustrates the proper positioning of cuts made to the jacket mouth or lip of the jacket during the swaging or forming operation.

**FIG. 6** is a top view of another embodiment of the bullet jacket manufactured in accordance with the present invention, which illustrates the proper positioning of cuts made to the jacket mouth or lip of the jacket during the swaging or forming operation, which, in this illustrated embodiment, comprises 6 (six) cuts; and

**FIG. 7** is a cross-sectional diagram of a finished bullet using the bullet jacket of the present invention, and which illustrates the swaged core material bonded inside the jacket cavity.

Detailed Description of the Drawings

Illustrated in **FIG. 1** is a metal tube (1) or metal rod (3), wherein a length of the metal tubing, or rod, (having a particular weight and wall thickness) is placed in a forming die, where it is swaged and formed at a minimal internal pressure of 222680 PSI. Alternatively, solid copper rods or copper tubing may also be used.

As previously noted, the tubing, (or rod) is compressed and takes the form and dimensions of the external punch, forming die and internal punch used to form the bullet jacket of the present invention. **FIG. 2** illustrates a preferred embodiment of the present invention, whereby the external punch (5) shall have 4 to 6 sharpened edges (7) that are to cut the jacket mouth or lip of the bullet jacket (not shown) to a minimal depth of 0.015 of an inch to a maximum depth of 0.450 of an inch during the swaging or forming operation.
[0028] Referring to FIG. 3, this figure expands further upon the embodiment of the present invention introduced in FIG. 2, wherein the bullet jacket (9) of the present invention is shown being compressed by the external punch (5), forming die (11) and internal punch (13). The forward edge of the external punch (15) compresses the tubing or rod so as to define a cavity (14) with the bullet jacket, while, at the same time, the sharp hardened edges (7) of the external punch (5) cut the jacket mouth or lip of the bullet jacket (9). As can be seen in FIG. 3, the bullet jacket (9) increases in hardness and strength from an upper end portion of the bullet jacket to the base portion of the jacket (17). Essentially, the shape of the cavity (14) resembles a truncated cones with tapered side walls.

[0029] Referring to FIG. 4, there is illustrated the bullet jacket of the present invention, after the forming process. Once the bullet jacket has been removed from the external punch and internal punch, the cavity (14) of the bullet jacket (9) is filled with a core material (21). The base portion of the jacket (17) may further comprise a boat-tail base design (19), which is provided to the bullet jacket (9) to ensure better ballistic coefficient and easier bullet insertion during ammunition manufacturing.

[0030] Illustrated in FIG. 5 is a top view of an embodiment of the present invention, which clearly shows the core material (21) in place, and wherein the jacket lip (23) of the bullet jacket (9) has been cut (25) by the external punch at four (4) equally spaced locations around the upper end of the bullet jacket. As noted previously, the jacket mouth or lip is cut to a minimal depth of 0.015 of an inch to a maximum depth of 0.450 of an inch during the swaging or forming operation.

[0031] FIG. 6 refers to a top view of an embodiment of the present invention, which clearly shows the core material (21) in place, and wherein the jacket lip (23) of the bullet jacket (9) has been cut (25) by the external punch at six (6) equally spaced locations around the upper end of the bullet jacket.

[0032] Illustrated in FIG. 7 there is illustrated a cross-sectional view of an embodiment of a finished bullet to be used in conjunction with the formed bullet jacket of the present invention. This figure clearly shows the cavity (14) of the bullet jacket (9) filled with a core material (21), and the nose portion (27) of the bullet, which in this embodiment is illustrated as an “open tip” bullet. The base portion of the jacket (17) further comprises a boat-tail base design (19), provided to the bullet jacket (9).

[0033] The foregoing are exemplary embodiments of the present invention and a person skilled in the art would appreciate that modifications to these embodiments may be made without departing from the scope of the invention as defined in the appended claims.

1. A bullet jacket formed from a jacket material, the jacket comprising a solid base portion and an axially opposite end portion having an outer lip at an upper edge thereof, said end portion defining a cavity in the bullet jacket wherein said cavity has an opening in a direction towards the end portion and a length which comprises 45 to 70 percent of the total length of the bullet jacket.

2. The bullet jacket according to claim 1, wherein the length of the cavity comprises 58 to 61 percent of the total length of the bullet jacket.

3. The bullet jacket according to claim 1, wherein the outer lip has a uniform thickness, and the bullet jacket increases in hardness and strength from the upper end of the bullet to the base portion of the bullet jacket.

4. The bullet jacket according to claim 1 wherein the jacket material is selected from the group consisting of copper, alloys of copper, aluminum, alloys of aluminum, iron, steel, and combinations thereof.

5. The bullet jacket according to claim 4, wherein the jacket material is copper.

6. The bullet jacket according to claim 1, wherein a weighted core material is positioned in the cavity.

7. The bullet jacket according to claim 6, wherein the weighted core material is selected from the group consisting of lead, alloys of lead, tin, alloys of tin, zinc, antimony, metal particles and rubber matrix, metal particles and polymer material, and any other material having a specific gravity greater than 0.5 grams per cubic centimeters.

8. The bullet jacket according to claim 6, wherein the weighted core material is bonded to walls of the cavity using heat or an adhesive.

9. The bullet jacket according to claim 1, wherein the solid base portion has a weight ranging from approximately 48 percent to 52 percent of a total weight of the bullet jacket.

10. The bullet jacket according to claim 1, wherein the outer lip has a thickness ranging from approximately 0.025 of an inch to 0.06 of an inch, and a ratio of the outer lip thickness to a bottom cavity wall thickness is between 0.21 to 0.295.

11. The bullet jacket according to claim 1, wherein the solid base portion has a boat-tail base design or a flat-base design.

12. The bullet jacket according to claim 1, wherein the outer lip has a plurality of cuts formed therein, said cuts extending from an inner side of the bullet jacket to an outer side of the bullet jacket and having a depth ranging from approximately 0.015 of an inch to approximately 0.450 of an inch.

13. A method of manufacturing a bullet jacket comprising the steps of placing one or more lengths of forming material in a forming die; and forming the bullet jacket from the forming material, wherein the bullet jacket is formed to comprise a solid base portion and an axially opposite end portion having an outer lip at an upper edge thereof, the end portion defining a cavity having an opening directed towards the end portion and a length which comprises 45 to 70 percent of the total length of the bullet jacket.

14. The method according to claim 13, wherein the cavity is formed to have a length comprising 58 to 61 percent of the total length of the bullet jacket, and the solid base portion is formed to have a weight ranging from approximately 48 percent to 52 percent of a total weight of the bullet jacket.

15. The method according to claim 13, wherein the forming is performed at an internal pressure of approximately 2226080 PSI or greater.

16. The method according to claim 13, wherein the forming material used is in the form of tubing or solid rods.

17. The method according to claim 13, wherein the forming die has boat-tail dimensions formed within its cavity and imparts a boat-tail base design upon the bullet jacket as it is being formed.
18. The method according to claim 13, wherein an external punch is used in forming the bullet jacket, said external punch having a plurality of sharp hardened edges which cut the outer lip of the bullet jacket from an inner side of the bullet jacket to an outer side of the bullet jacket at a depth ranging from approximately 0.015 of an inch to approximately 0.450 of an inch.

19. A bullet comprising a bullet jacket as defined in claim 1, and filled with a weighted core material.

20. The bullet according to claim 19, wherein said bullet is capable of expanding on impact when fired at low velocity, and maintains a high weight retention when fired at a high velocity.

21. The bullet according to claim 19, wherein the weighted core material is metal particle and rubber matrix, and the bullet jacket of the bullet expands to approximately double its diameter upon impact at an impact velocity of about 1675 FPS or greater, and the bullet retains about 83% or more of its total mass upon impact at an impact velocity of up to approximately 3500 FPS.