



**Description**

## CROSS-REFERENCE TO RELATED APPLICATIONS

**[0001]** Not Applicable

## STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH

**[0002]** Not Applicable

## FIELD OF THE INVENTION

**[0003]** The invention relates to cartridges for firearms that are designed for, or are temporarily or permanently modified to be used in, reality-based training exercises. In particular, the invention relates to a two-piece reduced energy cartridge.

## BACKGROUND OF THE INVENTION

**[0004]** Reduced energy cartridges for use in training or practice exercises are well known. Regardless of what application it is used in, an important characteristic of a firearm cartridge is its ability to cycle the slide on firearm. The forward momentum of a projectile creates recoil, or backward momentum, in the firearm. If the recoil is sufficient, the firearm is cycled. Projectiles of higher mass create more recoil than projectiles of lower mass, a result of the conservation of momentum. Training cartridges necessarily use low mass projectiles, and as a result, cycling is a problem.

**[0005]** One design used to solve the cycling problem in training cartridges is that of telescopically interfitted two-piece cartridges. After the explosive material is ignited in such a two-piece cartridge, the low-mass projectile, located in a first part of the cartridge, is expelled from the firearm by a portion of the gas created upon ignition. The remaining gas created during ignition of the explosive material is used to drive a second part of the cartridge rearwardly to cycle the firearm.

**[0006]** One objective in designing such a training cartridge is the minimization of cost. Another objective is minimization of explosive material in the cartridge. The quantity of explosive material must be sufficient to cycle the firearm, but also low enough to prevent the projectile from leaving the firearm at an unsafe velocity.

**[0007]** Information relevant to attempts to address these problems can be found in the following U.S. Patents and U.S. Patent Application Publications, the entire contents of each being incorporated herein by reference: 5,035,183; 5,359,937; 6,439,123; 6,575,098; and 2005/0183612. However, each one of these single-primer references suffers from one or more of the following disadvantages: the use of excessively large quantities of explosive material that damages the bolt-face of the firearm; complex component design; and/or complex component assembly.

**[0008]** The art referred to and/or described above is not intended to constitute an admission that any patent, publication or other information referred to herein is "prior art" with respect to this invention. In addition, this section should not be construed to mean that a search has been made or that no other pertinent information as defined in 37 C.F.R. §1.56(a) exists.

**[0009]** All U.S. patents and applications and all other published documents mentioned anywhere in this application are incorporated herein by reference in their entirety.

**[0010]** Without limiting the scope of the invention a brief summary of some of the claimed embodiments of the invention is set forth below. Additional details of the summarized embodiments of the invention and/or additional embodiments of the invention may be found in the Detailed Description of the Invention below.

**[0011]** A brief abstract of the technical disclosure in the specification is provided to comply with 37 C.F.R. 1.72.

## SUMMARY OF THE INVENTION

**[0012]** At least one embodiment of the present invention is directed toward a method of manufacturing a cartridge for use in a firearm. The method comprises providing a cartridge body wherein a first portion of the cartridge body defines a forward cavity and a second portion of the cartridge body defines a rearward cavity. An aperture interconnects the forward and rearward cavities. The cartridge body is configured to be disposed about at least a portion of a piston. The method further comprises providing a piston wherein the piston has a top end and a bottom end. A portion of the bottom end defines a primer retaining cavity. A portion of the piston defines a gas passageway extending from the primer retaining cavity to the top end of the piston. The method further comprises inserting a primer into the primer retaining cavity of the piston and securing the primer in the primer retaining cavity. The method further comprises placing a seal member around the piston, inserting the piston and seal member combination into the rearward cavity of the cartridge body, and crimping at least a portion of the second portion of the cartridge body to the piston.

**[0013]** At least one embodiment of the present invention is directed towards a cartridge for firearms. The cartridge includes a piston, a cartridge body, a primer, and a seal member. The piston has a top end and a bottom end. A portion of the bottom end of the piston defines a primer retaining cavity. And, a portion of the piston defines a gas passageway which extends from the primer retaining cavity to the top end of the piston. A first portion of the cartridge body defines a forward cavity and a second portion of the cartridge body defines a rearward cavity. An aperture interconnects the forward and rearward cavities. The cartridge body is configured to be disposed about at least a portion of the piston. At least a portion of the second portion of the cartridge body is crimped

about the piston. A seal member is arranged around the piston, forming a seal between the piston and an inner surface of the rearward cavity of the cartridge body. The piston has two positions: an unfired position and a fired position. In the unfired position the top end of the piston is adjacent the aperture. In the fired position the piston has sealingly slid rearward in the rearward cavity. A primer is arranged in the primer retaining cavity of the piston whereby upon firing, the gas created by the primer flows through the gas passageway. A portion of the gas flows through the aperture, and a portion of the gas fills the rearward cavity between the seal and the aperture, which causes the piston to sealingly slide rearward.

**[0014]** These and other embodiments which characterize the invention are pointed out with particularity in the claims annexed hereto and forming a part hereof. However, for further understanding of the invention, its advantages and objectives obtained by its use, reference should be made to the drawings which form a further part hereof and the accompanying descriptive matter, in which there is illustrated and described embodiments of the invention.

#### BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S)

**[0015]** A detailed description of the invention is hereafter described with specific reference being made to the drawings.

**[0016]** FIG. 1 is an exploded view of an embodiment of the present invention depicting the components of a cartridge.

**[0017]** FIG. 2 is cross-sectional view of an embodiment of the present invention depicting a cartridge in an unfired position.

**[0018]** FIG. 3 is a cross-sectional view of an embodiment of the present invention depicting a cartridge in a fired position.

**[0019]** FIG. 4 is a perspective cross-sectional view of an embodiment of the present invention depicting a cartridge body with a vent hole.

**[0020]** FIG. 5 is a perspective cross-sectional view of an embodiment of the present invention depicting a cartridge with a rupture disc.

**[0021]** FIG. 6 is a perspective cross-sectional view of an embodiment of the present invention depicting a cartridge with a rupture disc.

**[0022]** FIG. 7 is a perspective cross-sectional view of an embodiment of the present invention depicting a cartridge with a seal member integral to the piston.

**[0023]** FIG. 8 is a flowchart of an embodiment of the present invention depicting a method of making a cartridge.

#### DETAILED DESCRIPTION OF THE INVENTION

**[0024]** While this invention may be embodied in many different forms, there are described in detail herein spe-

cific preferred embodiments of the invention. This description is an exemplification of the principles of the invention and is not intended to limit the invention to the particular embodiments illustrated.

**[0025]** For the purposes of this disclosure, like reference numerals in the figures shall refer to like features unless otherwise indicated.

**[0026]** Embodiments of the present invention make use of telescopically interfitted two-part cartridges. The components are designed such that they can be easily produced and assembled at a lower cost than other designs.

**[0027]** At least one embodiment of the present invention is directed toward a firearm cartridge. Examples of the components to be assembled into a cartridge 10 are depicted in FIG. 1. The telescopically interfitted cartridge 10 of FIG. 1 is comprised of a cartridge body 20, a piston 25, a seal member 30, and a primer 35.

**[0028]** Referring to FIGS. 2 and 3, the cartridge body 20 has five primary design features: a forward cavity 40 that retains a projectile; a rearward cavity 45 (as best seen in FIG. 3) into which the piston 25 is inserted; a divider 50 which separates the forward and rearward cavities; an aperture 55 within the divider 50 interconnecting the forward and rearward cavities, the aperture 55 acting to limit the gas flow to a projectile thereby limiting the projectile's velocity; and a top chamfer 60 which aids in feeding cartridges into the magazine and the firearm. It should be noted that the top chamfer 60 is not required in all embodiments of the invention.

**[0029]** As mentioned above, the cartridge 10 also comprises a piston 25 wherein the piston has a top end 65 and a bottom end 70. A portion of the bottom end 70 defines a primer retaining cavity 75 for retaining the primer, as best seen in FIGS. 2 and 3. A portion of the piston defines a gas passageway 80 extending from the primer retaining cavity 75 to the top end 65 of the piston.

**[0030]** Still referring to FIGS. 2 and 3, the cartridge body 20 is configured to be disposed about at least a portion of the piston 25, thus forming a telescopically interfitted two-part cartridge 10. The inner diameter 85 of the cartridge body 20 and the outer diameter 90 of the piston 25 are configured to allow the piston body 25 to be inserted into the cartridge body 20.

**[0031]** The function of the piston before firing is to hold the seal member 30 and primer 35 in place. Referring now to FIG. 2, which depicts the cartridge 10 in an unfired state, the top end 65 of the piston is adjacent the divider 50. The piston 25 is almost completely contained within the rearward cavity 45 of the cartridge body 20. Furthermore, a portion 92 of the cartridge body is crimped to the piston 25. As best seen in FIG. 3, which depicts the cartridge 10 in a fired state, crimped portion 92 impacts protrusion 93 after firing. Because the inner diameter of the crimped portion 92 is less than the outer diameter of the protrusion 94, the piston and cartridge body do not physically separate after firing. Instead, after firing the piston slides rearwardly, remaining slidingly engaged to the car-

tridge body in a telescopic manner.

**[0032]** The seal member 30 provides a seal between the piston 25 and cartridge body 20 so that the entire travel of the piston, from an unfired position to a fired position, is sealed. Gases created upon firing escape only through the aperture 55. More specifically, upon initiation of the primer, gas travels through the gas passageway 80 and reaches the divider 50. The gas fills the portion of the rearward cavity between the cartridge body 20, the piston 25, and the seal member 30. The seal member 30 prevents the gas from escaping rearwardly.

**[0033]** In a primer-only embodiment, the term "primer" as used herein includes any detonating gas generator. In some embodiments, the present invention utilizes a gas generating primer that relies on heat to increase internal pressure: Gas is generated then heated. This creates an expansion of less gas to more volume than cooler systems. Information related to such a gas generating primer can be found in the pending U.S. Patent Application entitled "NON-TOXIC PERCUSSION PRIMERS AND METHODS OF PREPARING THE SAME", Attorney Docket No. A39.2B-13252-US01, the entire contents of which are incorporated herein by reference.

**[0034]** In some embodiments, the cartridge body 20 further includes a vent hole 96, as depicted in FIG. 4, in order to allow gases to escape and further reduce the energy available to the projectile. The vent hole 96 is desirably placed forward the top end 65 of the piston when the piston is in the fired position. A person of skill in the art will recognize that the size of the vent hole will vary, depending on the primer/propellant system used. However, in some embodiments the size of the vent hole is approximately 0.050 inches.

**[0035]** At least one embodiment of the present invention employs the use of a rupture disc 98 to regulate internal pressures, as shown in FIGs. 5 and 6. In FIG. 5 the rupture disc 98 is placed within the rearward cavity 45 and adjacent the aperture 55. Figure 6 depicts another embodiment of a rupture disc 98, with the disc 98 placed within the gas passageway 80. In some embodiments, the rupture disc 98 has a thickness of approximately 0.010 inches.

**[0036]** In at least one embodiment, the seal member 30 is an O-ring, as depicted in FIGs. 1 - 3. However, one skilled in the art will recognize that a number of other seal members may be used to accomplish the sealing effect created by the O-ring.

**[0037]** In another embodiment, the seal member is integral to the piston 25, as shown in FIG. 7. As seen in FIG. 7, the design of the piston 25 has eliminated the need for a separate seal member.

**[0038]** In some embodiments of the present invention, a propellant 94 is further included in the piston 25, as shown in FIG. 2. One of skill in the art will recognize that there are a variety of materials that can be used as a propellant, such as single or double based propellants. In at least one embodiment, the propellant 94 is placed within the gas passageway 80 of the piston.

**[0039]** As mentioned above, in some embodiments, the cartridge 10 is also manufactured with a projectile 95. In at least one embodiment, the projectile 95 is comprised of a cup 100, a marking material 105, and a cap 110, as depicted in FIG. 1. In one embodiment, the projectile 95 is inserted into the forward cavity 40 of the cartridge body 20. After firing, as gas escapes from the rearward cavity 45 to the forward cavity 40 through the aperture 55, the projectile 95 is forced from the forward cavity and out the barrel of the firearm.

**[0040]** It should be noted that in other embodiments, the projectile 95 is comprised of a rubber bullet, a blank, or oleoresin capsicum spray. One of ordinary skill should recognize that there are a number of other projectiles that can be substituted for any of the above examples.

**[0041]** At least one embodiment of the present invention is directed toward a method of manufacturing the cartridge described above, as depicted in the flowchart in FIG. 8. The method comprises the step 200 of providing a cartridge body 20 and a piston 25, as described above.

**[0042]** The method further comprises the step 210 of priming the piston 25. This step involves inserting a primer 35 into the primer retaining cavity 75 of the piston.

**[0043]** After the primer 35 has been inserted into the piston 25, the method further comprises the step 215 of securing the primer in the primer retaining cavity 75. One of skill in the art will recognize that there are a number of ways the primer may be secured within the primer retaining cavity. In one embodiment, securing the primer to the piston involves staking the piston. One method of staking the piston may entail using a machine to push inwardly portions of the piston material surrounding the primer. Once sufficient material has been pushed inwardly, the primer will be securely retained within the primer retaining cavity.

**[0044]** After the primer is staked, the method further comprises the step 225 of placing a seal member 30 around the piston.

**[0045]** Next, the method further comprises the step 230 of inserting the piston and seal member combination into the rearward cavity 45 of the cartridge body 20. As stated above, the inner diameter 85 of the cartridge body 20 and the outer diameter 90 of the piston 25 are configured to allow the piston 25 to be inserted into the cartridge body 20.

**[0046]** Still referring to FIG. 8, the method further comprises the step 235 of crimping at least a portion 92 of the cartridge body 20 to the piston 25. In one embodiment, the crimped portion 92 is located as close to the bottom end 70 of the piston as possible, thus allowing the greatest amount of travel.

**[0047]** In some embodiments, the step 235 of crimping is performed by two partially annular jaws. The cartridge is placed within jaws and as they are brought together by a predetermined force, through a predetermined distance, or some other measurement used by those skilled in the art, a portion of the cartridge body is compressed onto the piston.

**[0048]** In at least one embodiment, the step 235 of crimping comprises crimping the bottom portion of the cartridge body so that the inner diameter 85 of the rearward cavity in the crimped portion is less than the inner diameter 85 of the rest of the rearward cavity 45, as seen in FIG. 2.

**[0049]** As a non-limiting example, some embodiments of cartridge bodies before crimping have an outer diameter of approximately 0.359 inches and after crimping have an outer diameter of approximately 0.350 inches. These dimensions will vary with other embodiments because the size of the firearm may dictate larger or small cartridges, however this ratio as proved to be sufficient to secure the cartridge body and the piston.

**[0050]** In at least one embodiment, the method further includes the step 240 of inserting a projectile 95. The step of inserting a projectile may comprise inserting a cup 100 into the forward cavity 40 of the cartridge body. Then, a marking material 105, such as ink or some other agent for marking known by those skilled in the art, is distributed into the cup 100. Although amounts may vary depending on the size of the cartridge and the amount of marking material desired, an amount of material in some embodiments is 1.5 grains. A cap 110 is then inserted into the cup 100 and marking material combination.

**[0051]** The step 240 of inserting the projectile 95 can be performed at various stages of manufacture. In some embodiments, the step of inserting the projectile is performed prior to the step 230 of inserting the piston and seal member combination into the cartridge body. In such an embodiment, it may be desirable to further include a step 245 of inverting the cartridge body and projectile combination prior to the step 230 of insertion of the piston and seal member combination. Also, it may be desirable in such an embodiment to further include a vent 125 in cup 100, as depicted in FIG. 1. The vent 125 may prevent the projectile from becoming dislodged from the forward cavity 40 during the step of piston insertion into the cartridge body.

**[0052]** In at least one embodiment, the method also comprises the step 250 of inspecting the piston for damage. In one embodiment, the inspection step 250 is performed immediately after the step 215 of securing the primer in the primer retaining cavity. The inspection step 250 ensures that the primer has not been damaged during securement. Additionally, the inspection step 250 ensures that the primer has been fully secured to the piston.

**[0053]** In some embodiments, a first machine performs the steps of primer insertion, primer securement, and piston inspection. A second machine performs the steps of placing the seal member, inserting the piston and seal member combination into the cartridge body, and crimping the cartridge body.

**[0054]** In some embodiments, after the primer and piston combination leaves the first machine, it may be placed into a feeder bowl of the second machine. The second machine may stretch a seal member, drawn from another

feeder bowl, and place it over a piston. Also, the second machine may draw a cartridge body from a feeder bowl, draw a cup from another feeder bowl, and insert the cup into the forward cavity of the previously drawn cartridge body. A marking material is then distributed into the cup by the second machine, and a cap is drawn from a feeder bowl and inserted into the cup and marking material combination.

**[0055]** In at least one embodiment, the second machine then inverts the cartridge and projectile combination. At this point, the second machine may then insert the piston into the cartridge body and the second machine crimps the cartridge body to the piston, after which the cartridge is placed in a tray as a finished unit.

**[0056]** The above description should make clear the advantages of the present inventive methods of manufacturing a cartridge. The components, in particular the cartridge body and the piston, are designed such that they can be easily produced and assembled. At least one embodiment of the present invention eliminates complicated piston and cartridge body alignment requirements. Furthermore, at least one embodiment of the present invention uses less primer than that required by other designs, thereby reducing or eliminating damage to the gun's bolt face while still having enough energy to cycle the firearm.

**[0057]** The above disclosure is intended to be illustrative and not exhaustive. This description will suggest many variations and alternatives to one of ordinary skill in this art. The various elements shown in the individual figures and described above may be combined or modified for combination as desired. All these alternatives and variations are intended to be included within the scope of the claims where the term "comprising" means "including, but not limited to".

**[0058]** Further, the particular features presented in the dependent claims can be combined with each other in other manners within the scope of the invention such that the invention should be recognized as also specifically directed to other embodiments having any other possible combination of the features of the dependent claims. For instance, for purposes of claim publication, any dependent claim which follows should be taken as alternatively written in a multiple dependent form from all prior claims which possess all antecedents referenced in such dependent claim if such multiple dependent format is an accepted format within the jurisdiction (e.g. each claim depending directly from claim 1 should be alternatively taken as depending from all previous claims). In jurisdictions where multiple dependent claim formats are restricted, the following dependent claims should each be also taken as alternatively written in each singly dependent claim format which creates a dependency from a prior antecedent-possessing claim other than the specific claim listed in such dependent claim below.

**[0059]** This completes the description of the embodiments of the invention. Those skilled in the art may recognize other equivalents to the specific embodiment de-

scribed herein which equivalents are intended to be encompassed by the claims attached hereto.

## Claims

### 1. A cartridge comprising:

a piston, the piston having a top end and a bottom end, a portion of the bottom end defining a primer retaining cavity, and a portion of the piston defining a gas passageway extending from the primer retaining cavity to the top end of the piston;

a cartridge body, a first portion of the cartridge body defining a forward cavity and a second portion of the cartridge body defining a rearward cavity, the forward and rearward cavities being interconnected by an aperture, the cartridge body configured to be disposed about at least a portion of the piston;

a primer arranged in the primer retaining cavity; a seal member arranged around the piston and forming a seal between the piston and an inner surface of the rearward cavity of the cartridge body;

the piston having two positions, an unfired position wherein the top end of the piston is adjacent the aperture, and a fired position wherein the piston has sealingly slid rearward in the rearward cavity;

wherein at least a portion of the second portion of the cartridge body is crimped about the piston, and whereby upon firing, the gas created by the primer flows through the gas passageway, a portion of the gas flows through the aperture, and a portion of the gas fills the rearward cavity between the seal and the aperture, which causes the piston to sealingly slide rearward.

### 2. The cartridge of claim 1, further comprises a propellant.

### 3. The cartridge of claim 2, wherein the propellant is distributed within the gas passageway.

### 4. The cartridge of claim 1, further comprising a projectile.

### 5. The cartridge of claim 4, wherein the projectile comprises a marking material.

### 6. The cartridge of claim 4, wherein the projectile is selected from the group consisting of a rubber bullet, a blank, and oleoresin capsicum spray.

### 7. The cartridge of claim 1, wherein the crimped portion

of the cartridge body is crimped so that the inner diameter of the rearward cavity in the crimped portion is less than the inner diameter of the rest of the rearward cavity.

### 8. The cartridge of claim 1, wherein the cartridge body further comprises a chamfer.

### 9. The cartridge of claim 1, wherein the cartridge body further comprises at least one vent hole.

### 10. The cartridge of claim 1, wherein the cartridge body further comprises at least one rupture disc.

### 11. A method of manufacturing a cartridge for use in a firearm, the method comprising:

(a) providing a cartridge body, a first portion of the cartridge body defining a forward cavity and a second portion of the cartridge body defining a rearward cavity, the forward and rearward cavities being interconnected by an aperture, the cartridge body configured to be disposed about at least a portion of a piston;

(b) providing the piston, the piston having a top end and a bottom end, a portion of the bottom end defining a primer retaining cavity, and a portion of the piston defining a gas passageway extending from the primer retaining cavity to the top end of the piston;

(c) inserting primer into the primer retaining cavity of the piston;

(d) securing the primer in the primer retaining cavity;

(e) placing a seal member around the piston;

(f) inserting the piston and seal member combination into the rearward cavity of the cartridge body; and

(g) crimping at least a portion of the second portion of the cartridge body to the piston.

### 12. The method of claim 11, further comprising inserting a projectile into the forward cavity of the cartridge body.

### 13. The method of claim 12, wherein inserting the projectile comprises:

(a) inserting a cup into the forward cavity;

(b) distributing a marking material into the cup; and

(b) inserting a cap into the cup and marking material combination.

### 14. The method of claim 13, wherein inserting the projectile is performed prior to the inserting the piston and seal member combination into the cartridge body.

15. The method of claim 14, further comprising inverting the cartridge body prior to inserting the piston and seal member combination into the cartridge body.
16. The method of claim 11, wherein securing the primer in the primer retaining cavity comprises staking the piston. 5
17. The method of claim 11, wherein crimping is performed by two partially annular jaws. 10
18. The method of claim 11, wherein crimping comprises crimping the bottom portion of the cartridge body so that the inner diameter of the rearward cavity in the crimped portion is less than the inner diameter of the rest of the rearward cavity. 15
19. The method of claim 11, wherein (c) and (d) are performed by a first machine and (e) thru (g) are performed by a second machine. 20
20. The method of claim 11, further comprising inspecting the piston for damage.
21. The method of claim 20, wherein inspecting the piston is performed immediately after securing the primer in the primer retaining cavity. 25
22. The method of claim 21, wherein (c) and (d), and inspecting the piston are performed by a first machine and (e) thru (g) are performed by a second machine. 30
23. A method of manufacturing a cartridge for use in a firearm, the method comprising: 35
- (a) providing a cartridge body, a first portion of the cartridge body defining a forward cavity and a second portion of the cartridge body defining a rearward cavity, the forward and rearward cavities being interconnected by an aperture, the cartridge body configured to be disposed about at least a portion of a piston; 40
  - (b) providing the piston, the piston having a top end and a bottom end, a portion of the bottom end defining a primer retaining cavity, and a portion of the piston defining a gas passageway extending from the primer retaining cavity to the top end of the piston; 45
  - (c) inserting primer into the primer retaining cavity of the piston; 50
  - (d) securing the primer in the primer retaining cavity;
  - (e) inspecting the piston for damage;
  - (f) placing a seal member around the piston; 55
  - (g) inserting a projectile into the forward cavity of the cartridge body;
  - (h) inserting the piston and seal member com-
- ination into the rearward cavity of the cartridge body; and  
(i) crimping at least a portion of the second portion of the cartridge body to the piston.

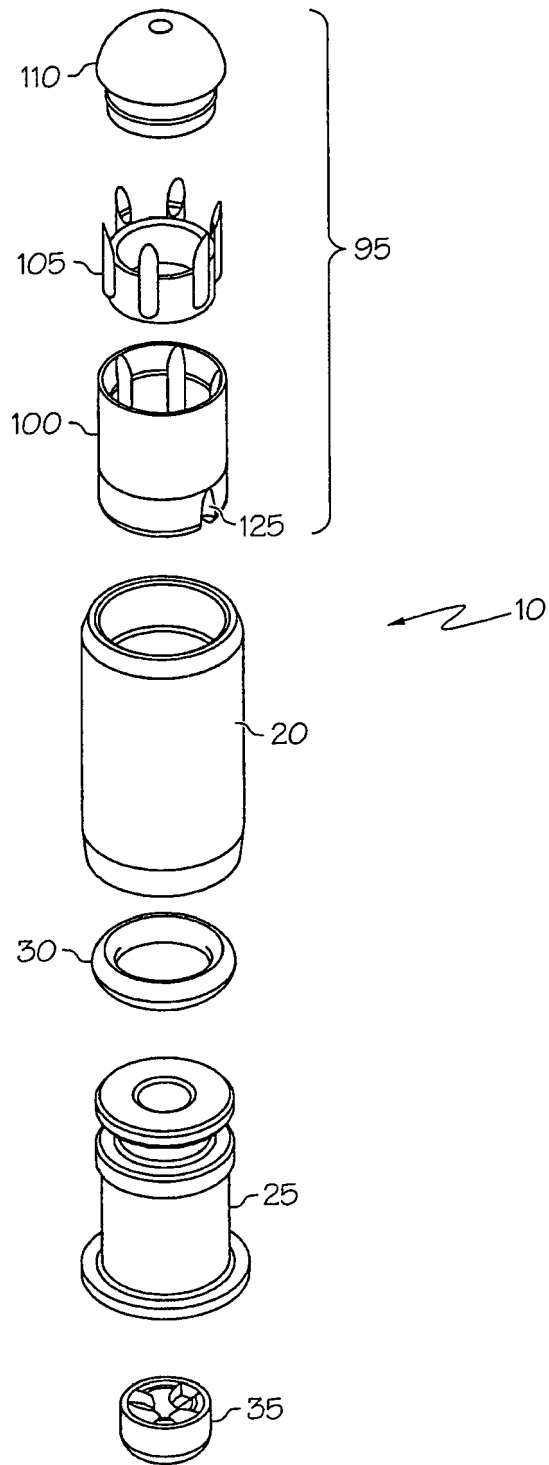


FIG. 1

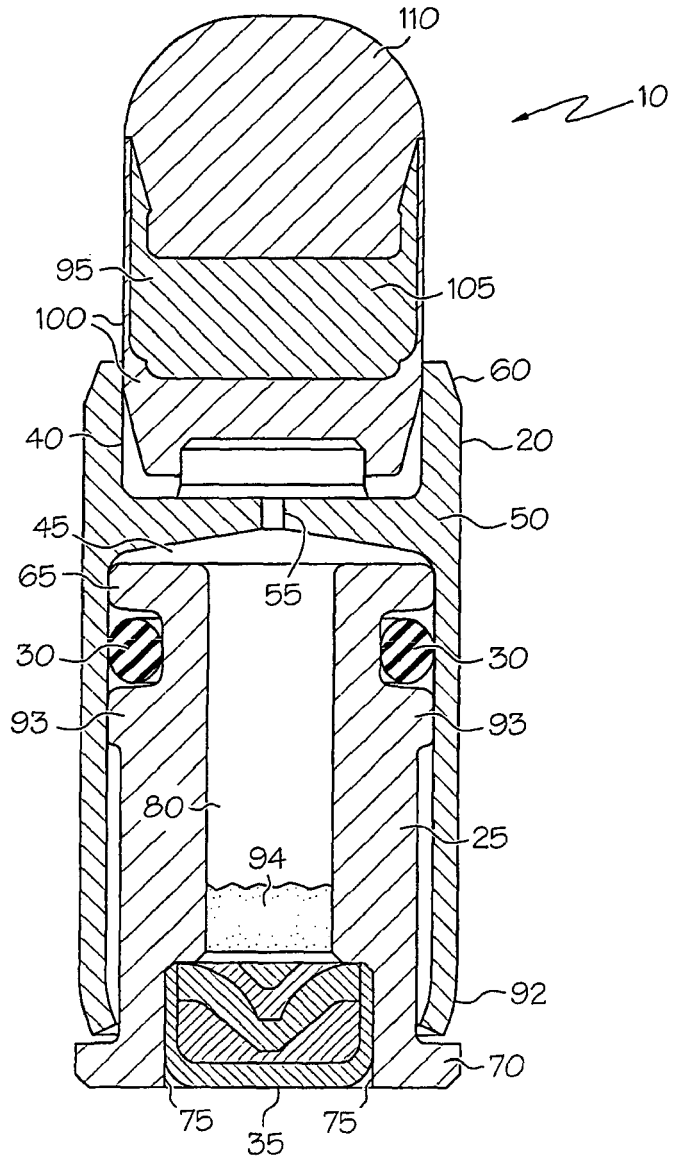


FIG. 2

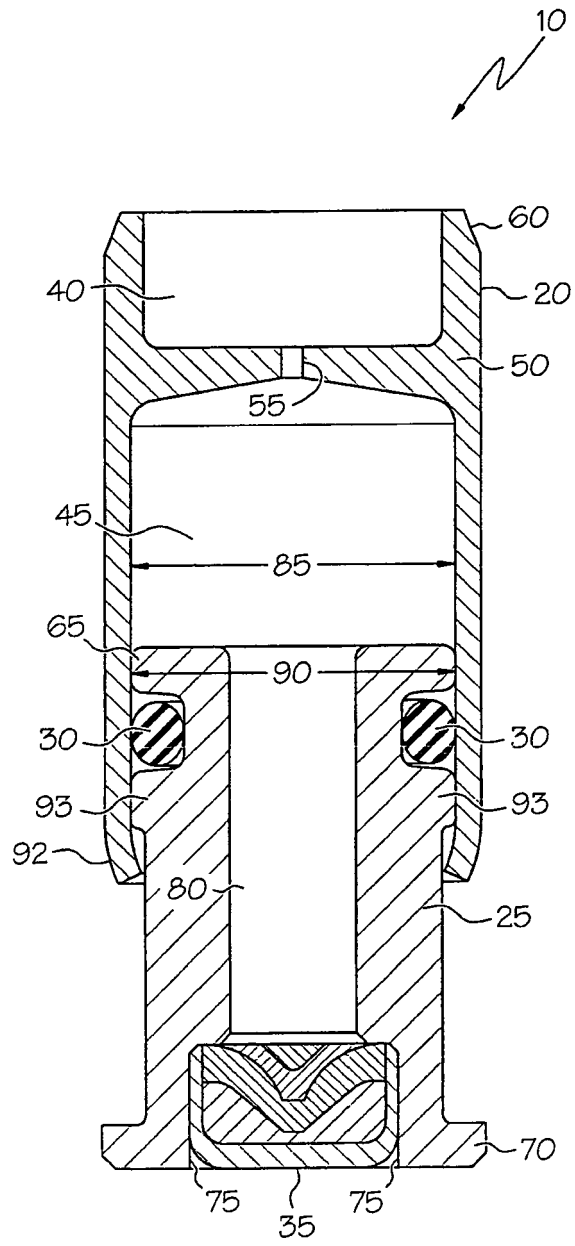


FIG. 3

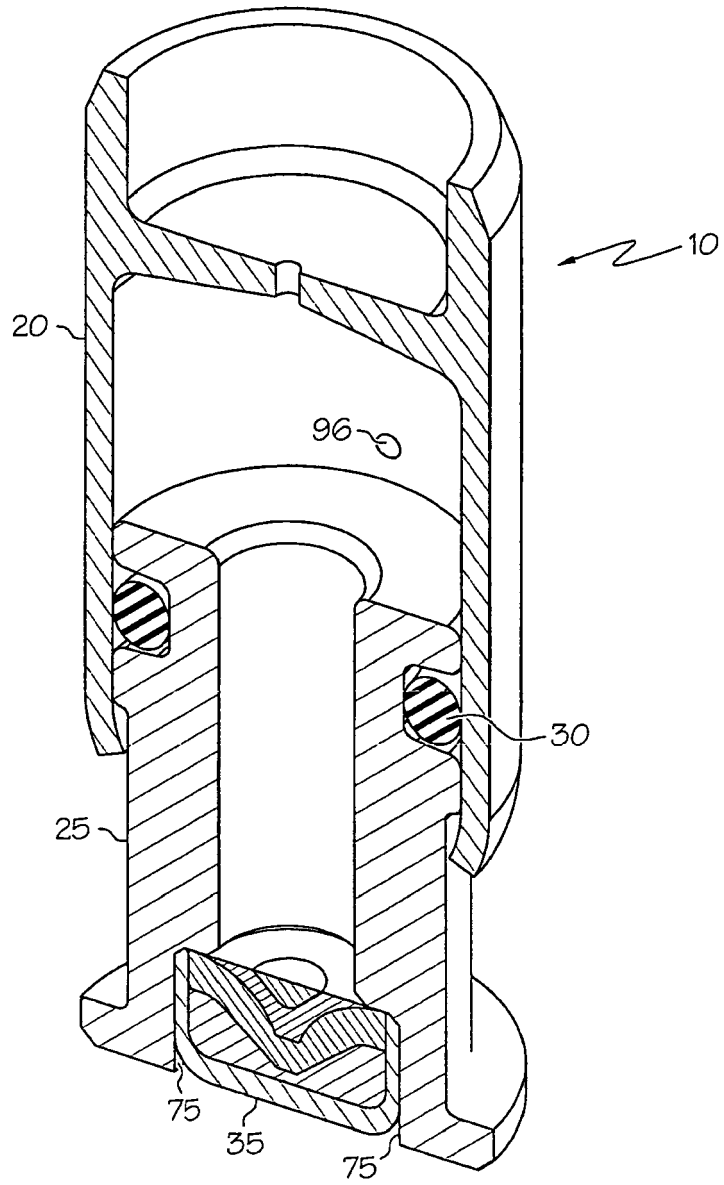


FIG. 4

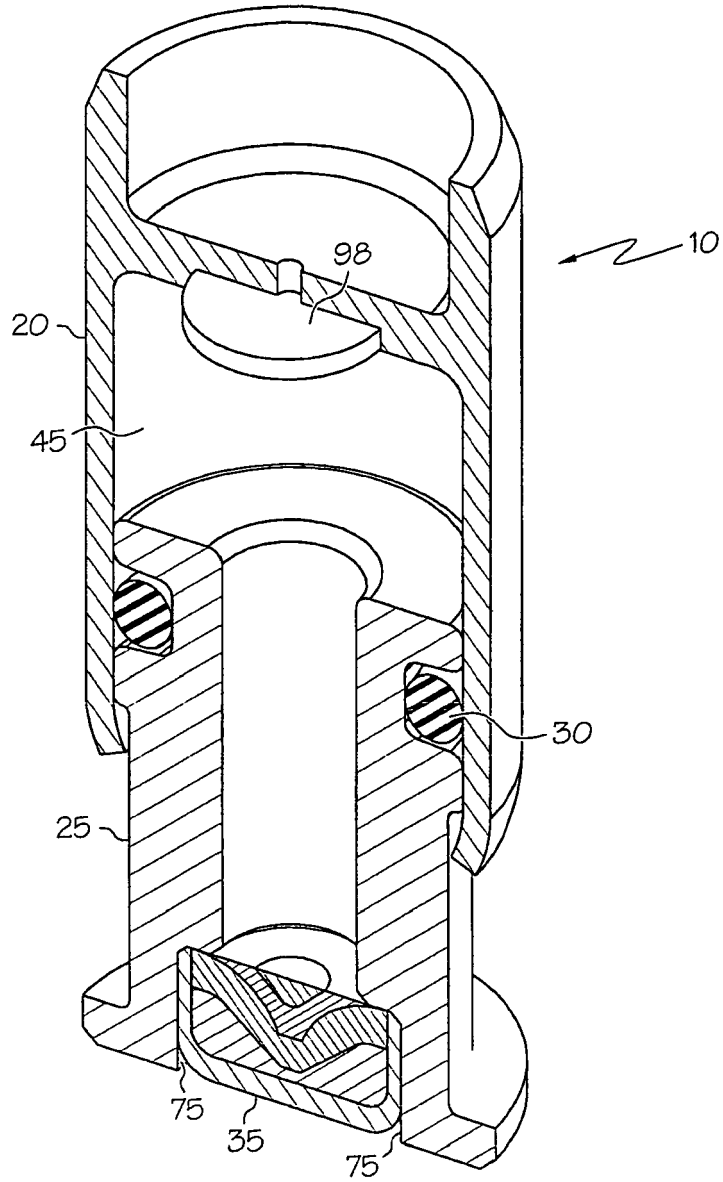


FIG. 5

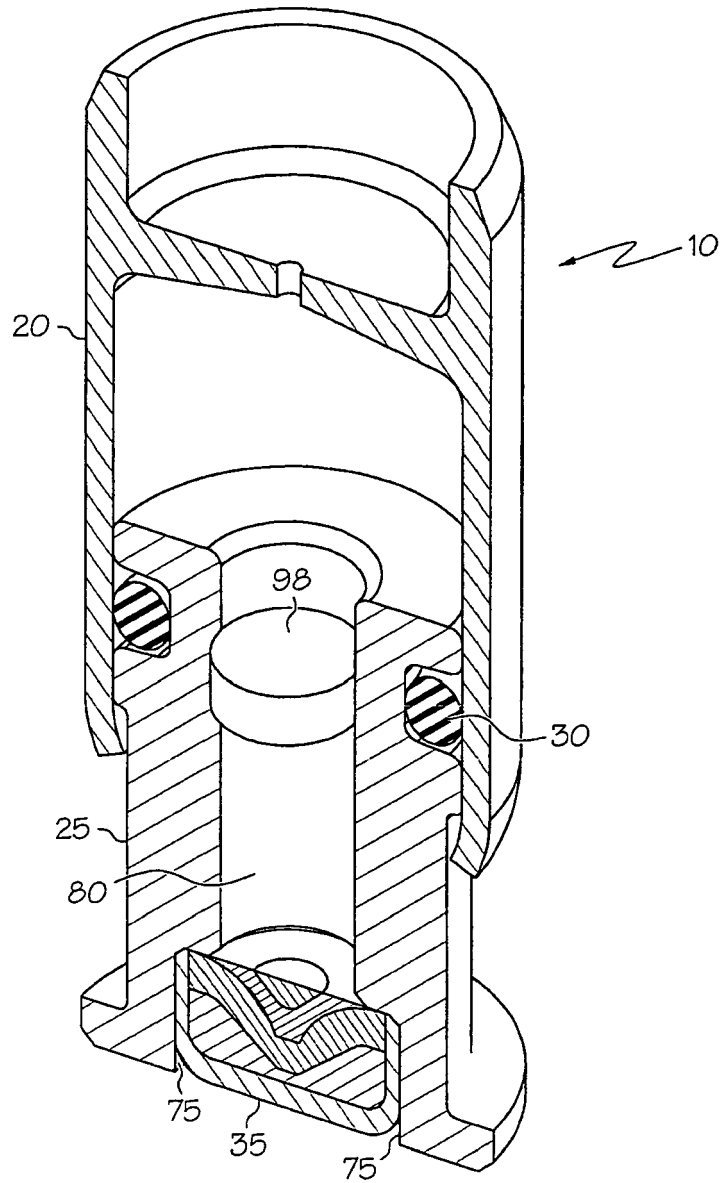


FIG. 6

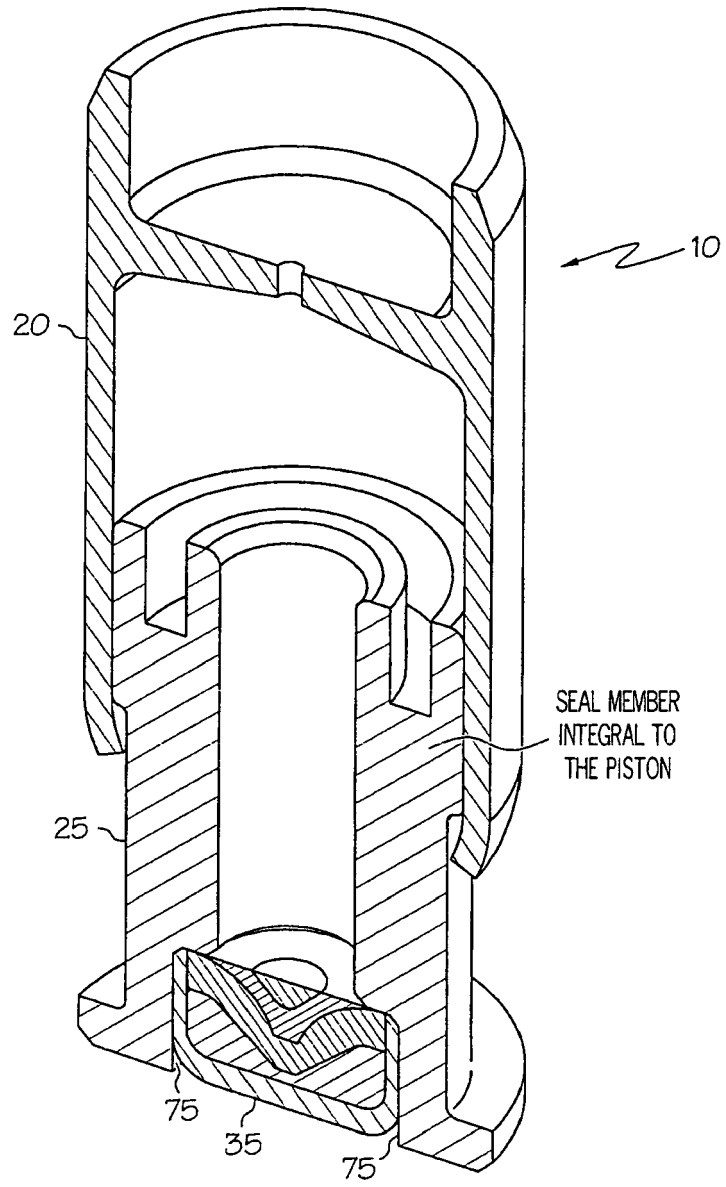


FIG. 7

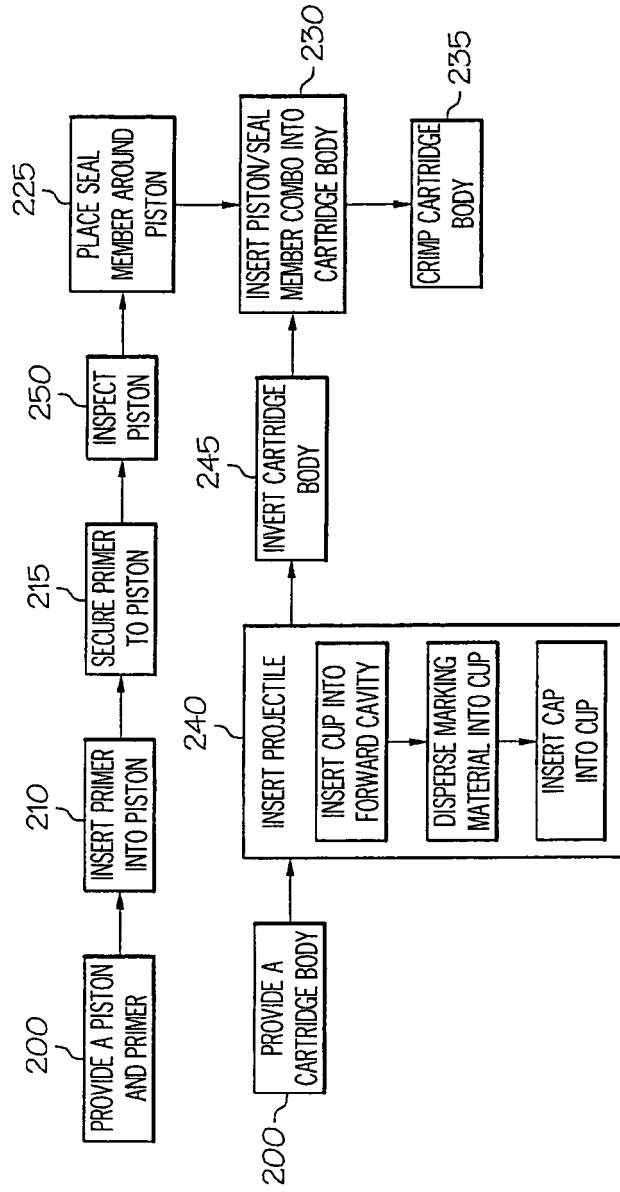


FIG. 8