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(54) Title: ARROW GUN METHOD AND APPARATUS

(57) Abstract: A gun (100 and 400) for using compressed gas from a compressed gas cartridge (106) to propel an arrow (102). The gun includes a barrel (104) for receiving the arrow and a compressed gas storage chamber (122 and 422). The compressed gas storage chamber is adapted to receive and store compressed gas in an expanded state from the compressed gas cartridge for later release. The gun also includes a valve assembly (130 and 430) for selectively releasing the compressed gas stored in the compressed gas storage chamber within the barrel for propelling the arrow out the barrel.
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ARROW GUN METHOD AND APPARATUS

CROSS-REFERENCE TO RELATED APPLICATION

This application claims the benefit of U.S. Provisional Application No. 60/536,761, filed January 15, 2004, entitled Airbow, the disclosure of which is hereby expressly incorporated by reference, and priority from the filing date of which is hereby claimed under 35 U.S.C. § 119(e).

FIELD OF THE INVENTION

The present invention generally relates to methods and apparatuses for propelling arrows, and more particularly to methods and apparatuses for propelling arrows using compressed gas.

BACKGROUND OF THE INVENTION

Compressed gas has been used to propel objects from a gun since as early as 1886, when inventor Clarence Hamilton developed a gun that would propel a BB by compressed gas from a barrel, which would later become known worldwide as the DAISY BB gun. Since then, compressed gas has been used to propel other objects from a gun, such as harpoons, darts, and bolts. However, the ability to propel a standard length arrow from a gun by compressed gas has heretofore eluded those skilled in the art. Thus, there exists a need for a compressed gas gun able to project a standard length arrow.

Further, it has been found that in compressed gas guns using compressed gas cartridges as the compressed gas source, that the energy contained in the compressed gas is inefficiently transferred to the object being propelled. Moreover, it has been found that previously developed compressed gas guns expand the compressed gas contained in the cartridge directly from the compressed gas cartridge without first pre-expanding the compressed gas. Thus, the compressed gas must instantly expand from a minute volume in the compressed gas cartridge to a large volume as the compressed gas is released into the barrel to propel the object. It is found that this large expansion in volume of the gas and the time it takes the gas to travel from the compressed gas cartridge to the barrel results in an inefficient transfer of energy from the compressed gas to the object being propelled. Moreover, since the compressed gas must expand instantly and travel, a gradually increasing pressure front is exerted upon the object being propelled. Thus, the object being propelled begins moving out of the barrel before the maximum pressure exertable by the compressed gas from the cartridge has a chance to act upon the object.
This gradual increase in pressure significantly reduces the amount of energy able to be transferred to the object as the object is propelled along the length of the barrel.

Moreover, in an ideal compressed gas gun, the object being propelled is acted upon by the maximum pressure exertable by the compressed gas in the cartridge for the entire length of the barrel. In previously developed compressed gas guns, the object being propelled sees only a gradually increasing pressure as the object being propelled travels the length of the barrel, thereby resulting in a significant reduction in muzzle velocities and kinetic energy transferred to the object. Thus, there exists a need for a compressed gas gun able to exert a more instantaneous pressure front upon the object being propelled to increase the amount of energy imparted to the object being propelled.

Additionally, previously compressed gas guns fail to provide a means for the user to ascertain whether the compressed gas gun is charged with the compressed gas. Thus, injuries due to accidental discharges of the compressed gas and accidental firings are a problem. Thus, there exists a need for a compressed gas gun that indicates to the user whether or not the compressed gas gun is charged.

SUMMARY OF THE INVENTION

One embodiment of a gun formed in accordance with the present invention for using compressed gas from a compressed gas cartridge to propel an arrow is disclosed. The gun includes a barrel for receiving the arrow and a compressed gas storage chamber.

The compressed gas storage chamber is adapted to receive and store compressed gas in an expanded state from the compressed gas cartridge for later release. The gun also includes a valve assembly for selectively releasing the compressed gas stored in the compressed gas storage chamber within the barrel for propelling the arrow out the barrel.

An alternate embodiment of a gun formed in accordance with the present invention for using compressed gas to propel a standard length arrow is disclosed. The gun includes a barrel of a length about 22 inches or greater for receiving a standard length arrow within the barrel and a valve assembly. The valve assembly is used for selectively releasing a compressed gas from a compressed gas source into the barrel for propelling the standard length arrow out of the barrel.

One embodiment of a method performed in accordance with the present invention for propelling an arrow from a gun having a barrel, a trigger, and a compressed gas storage chamber is disclosed. The method includes placing an arrow in the barrel, discharging a compressed gas into the compressed gas storage chamber for storage
therein, and activating the trigger to cause the compressed gas to be released from the compressed gas storage chamber into the barrel to cause the arrow to be propelled from the barrel.

One embodiment of a fletching formed in accordance with the present invention for attaching to a proximal end of an arrow shaft is disclosed. The fletching aids in the propelling of the arrow shaft by compressed gas out of a barrel having an inner diameter defined by an inner surface of the barrel. The fletching includes an attachment member adapted to couple the fletching to a proximal end of an arrow shaft and an elongate body. The elongate body is coupled to the attachment member and has a sealing member. The sealing member has an outer diameter substantially equal to the inner diameter of the barrel such that the sealing member impedes at least a substantial portion of the compressed gas from flowing past the sealing member when the sealing member is in the barrel.

An alternate embodiment of a fletching adapted to be attached to a proximal end of an arrow shaft to aid in propelling the arrow shaft by compressed gas out of a barrel of a gun is disclosed. The fletching includes an elongate body adapted to be coupled to an arrow shaft and a plurality of fins. The fins extend outward from the elongate body to a selected distance from a centerline of the elongate body. The elongate body has a sealing member for blocking gas flow, the sealing member extending outward from the centerline to at least the selected distance for blocking gas flow.

Another embodiment of a fletching adapted to be attached to a proximal end of an arrow shaft to aid in propelling the arrow shaft by compressed gas out of a barrel of a gun is disclosed. The fletching includes an elongate body adapted to be coupled to an arrow shaft and a sealing member. The sealing member is attached to the elongate body for substantially impeding gas flow past the sealing member when the fletching is disposed in a barrel of a gun. The sealing member extends outward from a centerline of the fletching to a diameter of about 1/2 an inch or greater.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing aspects and many of the attendant advantages of this invention will become better understood by reference to the following detailed description, when taken in conjunction with the accompanying drawings, wherein:
FIGURE 1 is an elevation view of one embodiment of an arrow gun formed in accordance with the present invention with a portion of the arrow gun cut away to show some of the internal components of the arrow gun;

FIGURE 2 is a partial cross-sectional view of the arrow gun of FIGURE 1, the cross-sectional cut taken vertically through a centerline of the arrow gun of FIGURE 1 and a trigger shown prior to being pulled;

FIGURE 3 is a partial cross-sectional view of the arrow gun of FIGURE 1, the cross-sectional cut taken vertically through the centerline of the arrow gun of FIGURE 1 and the trigger shown after being pulled;

FIGURE 4 is partial perspective view of a portion of the arrow gun shown in FIGURE 2;

FIGURE 5 is an elevation view of an aft portion of one embodiment of an arrow formed in accordance with the present invention;

FIGURE 6 is a rear elevation view of the arrow shown in FIGURE 5;

FIGURE 7 is a cross-sectional view of the arrow of FIGURE 5, the cross-sectional cut taken substantially through section 7-7 of FIGURE 5;

FIGURE 8 is a partially exploded elevation view of an aft portion of an alternate embodiment of an arrow formed in accordance with the present invention;

FIGURE 9 is a rear elevation view of the arrow shown in FIGURE 8;

FIGURE 10 is a cross-sectional view of the arrow of FIGURE 8, the cross-sectional cut taken substantially through section 10-10 of FIGURE 8;

FIGURE 11 is a partial cross-sectional view of an alternate embodiment of an arrow gun formed in accordance with the present invention, the cross-sectional cut taken vertically through a centerline of the arrow gun and showing a trigger prior to being pulled; and

FIGURE 12 is a partial cross-sectional view of the arrow gun of FIGURE 11, the cross-sectional cut taken vertically through the centerline of the arrow gun and showing the trigger after being pulled.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

One embodiment of an arrow gun 100 formed in accordance with the present invention is depicted in FIGURE 1. The arrow gun 100 uses a compressed gas to propel a standard length arrow 102 from a barrel 104 of the arrow gun 100. Preferably, the compressed gas is provided by a compressed gas cartridge 106, such as a well known
CO₂ cartridge. The compressed gas cartridge 106 is received within a cartridge receiver 108 which is used in coupling the compressed gas cartridge 106 to a stock 110 of the arrow gun 100 and insulates the user from the freezing of the compressed gas cartridge 106 upon release of the compressed gas contained therein. The arrow gun 100 of the illustrated embodiment includes a scope 112, however a user may remove the scope and use a set of iron sights 114 of the arrow gun 100 if they so choose. The arrow gun 100 further includes a trigger 116, a trigger guard 118, and a safety 120. The arrow gun 100 is preferably used for propelling "standard length" arrows, which in accordance with the current use of the term in the trade, is an arrow having a length between about 23 inches to about 32 inches. Standard length arrows are distinguishable from bolts, which are sometimes referred to as arrows, but which have lengths of less than about 20 inches, typically around 16 to 18 inches, and are often used with crossbows.

Referring to FIGURE 2, the components of the arrow gun 100 will be described in greater detail. The arrow gun 100 includes a compressed gas storage chamber 122. The compressed gas storage chamber 122 is preferably substantially disposed within the stock of the arrow gun 100, however it should be apparent to those skilled in the art that the compressed gas storage chamber 122 may have a substantial portion extending outward of the stock. The compressed gas storage chamber 122 includes a connector 124 having male threads and a lance 125 for puncturing the gas cartridge 106. The male threads on the connector 124 are sized and configured to interface with female threads disposed on the receiver 108 to permit the receiver 108 to removably couple to the connector 124 and press the compressed gas cartridge 106 upon the lance 125 to release the compressed gas into the compressed gas storage chamber 122. Of note, once the compressed gas cartridge 106 is punctured by the lance, the compressed gas cartridge 106 becomes an extension of the compressed gas storage chamber 122. Although the connector 124 is illustrated and described as being adapted to accept threadless compressed gas cartridges 106, it should be apparent to those skilled in the art that the connector 124 may alternately be designed to accept compressed gas cartridges 106 having threads.

The volume of the compressed gas storage chamber 122, prior to coupling of the compressed gas cartridge, is preferably greater than the volume of the compressed gas cartridge 106. In one embodiment, the volume of the compressed gas storage chamber 122, once the compressed gas cartridge 106 is punctured and becomes part of the compressed gas storage chamber 122, is at least double of that of the compressed gas
cartridge 106. In other embodiments, the volume of the compressed gas storage chamber 122, once the compressed gas cartridge 106 is punctured, is between about two to twelve times that of the compressed gas cartridge 106. In another embodiment, the volume of the compressed gas storage chamber 122, once the compressed gas cartridge 106 is punctured, is between about five to nine times that of the compressed gas cartridge 106 with a preferred value of about seven times that of the compressed gas cartridge 106.

In one embodiment, the volume of the compressed gas storage chamber 122 is selected to result in about a 20% to 80% decrease in the pressure of the compressed gas contained in the compressed gas cartridge 106 once released into the compressed gas storage chamber 122. In another embodiment, the volume of the compressed gas storage chamber 122 is selected to result in about a 30% to 50% decrease in the pressure of the compressed gas contained in the compressed gas cartridge 106 once released into the compressed gas storage chamber 122, with a preferred value of about 40%.

The compressed gas storage chamber 122 includes a charge indicator 126 in communication with the compressed gas storage chamber, the charge indicator 126 having a raised position as shown in FIGURE 2 indicating a presence of the compressed gas in the compressed gas storage chamber 122 and lowered position as shown in FIGURE 3 indicating an absence of the compressed gas in the compressed gas storage chamber 122. The charge indicator 126 includes a poppet 125 biased to a retracted position by a biasing member, one suitable example being a spring 127. The charge indicator 126 is transitioned from the lowered position to the raised position by a pressure exerted upon the poppet 125 by the compressed gas in the compressed gas storage chamber 122 which overcomes the biasing force applied by the spring 127. Conversely, upon release of the compressed gas from the compressed gas storage chamber 122, the charge indicator 126 automatically retracts to its lowered position of FIGURE 3 by the biasing force of the spring 127. The charge indicator 126 thus indicates to a user when the compressed gas storage chamber 122 is holding a charge and when the arrow gun 100 is potentially able to fire an arrow 102 or release compressed gas by both a tactile means, as the user can feel the presence of the raised poppet 125, and also by visual means, as the user can see the raised position of the poppet 125 of the charge indicator 126.

The compressed gas storage chamber 122 includes an opening 128. The opening 128 is circular and/or cylindrical in shape and is coupled in communication with
the barrel 104 of the arrow gun 100. The opening 128 permits the release of the compressed gas stored in the compressed gas storage chamber 122 into the barrel 104 to propel the arrow 102 from the barrel 104.

Referring to FIGURE 4, the arrow gun 100 includes a valve assembly 130. The valve assembly 130 includes a sealing member 132 adapted to sealingly engage the opening 128 in the compressed gas storage chamber 122. The sealing member 132 is circular in shape and includes a seal 134 for sealing against an inner surface of the compressed gas storage chamber 122. The sealing member 132 in the illustrated embodiment is a well known O-ring, however it should be apparent to those skilled in the art that other seals are suitable for use with and are within the spirit and scope of the present invention.

The sealing member 132 is coupled to a cam 136. The cam 136 is rotatably coupled to a pivot pin 138. The cam 136 is able to rotate about the pivot pin 138 from a sealing position shown in FIGURE 4 in which the sealing member 132 sealingly engages the opening 128 of the compressed gas storage chamber 122 and a release position shown in FIGURE 3 wherein the sealing member 132 is displaced from the opening 128 such that the compressed gas stored in the compressed gas storage chamber 122 is released into the barrel 104 to propel the arrow 102 from the barrel 104. The cam 136 includes a catch 144 for "catching" a notch of the trigger 116 as will be described in more detail below.

Returning to FIGURE 4, the arrow gun 100 also includes a trigger assembly 140. The trigger assembly 140 includes the trigger 116, the trigger guard 118, and the safety 120 mentioned above, and a pivot pin 142 and a biasing member 146. The trigger 116 is rotatably coupled to the pivot pin 142. The trigger 116 may rotate about the pivot pin 142 between a cocked position shown in FIGURE 4 to a tripped or release position shown in FIGURE 3. In the cocked position, the catch 144 of the cam 136 engages a notch 148 on the trigger 116, the notch 148 adapted to releasably engage the catch 144. The notch 148 includes a cam follower 150, which in the illustrated embodiment is in the form of a roller, for following a cam surface 151 of the cam 136. The biasing member 146, which in the illustrated embodiment is a spring, biases the trigger 116 into the cocked position of FIGURE 4.

The safety 120 of the trigger assembly 140 may be depressed by the user so as to engage the trigger 116, thereby preventing the trigger 116 from rotating from the cocked
position. Pulling out the safety 120 permits the trigger 116 to be rotated from the cocked position to the tripped position by the user applying finger pressure to the trigger 116. Although one embodiment of a safety 120 is illustrated and described relative to the illustrated embodiment, it should be apparent to those skilled in the art that other embodiments are within the spirit and scope of the present invention.

The arrow gun 100 further includes a receiver 152. The receiver 152 couples the compressed gas storage chamber 122 to the barrel 104 of the arrow gun 100 and is coupled to both the valve assembly 130 and the trigger assembly 140. In the illustrated embodiment, the receiver 152 is horizontally split, forming a lower half 154 and an upper half 156 of the receiver 152 which are removably coupled to one another to aid in the installation and maintenance of the arrow gun 100.

Turning to FIGURES 5-7, this detailed description will now focus upon one embodiment of a fletching 200 formed in accordance with the present invention suitable for use with the arrow gun 100 described above. The fletching 200 is adapted to transfer the power contained in the compressed gas to an arrow shaft 103 and to stabilize the arrow 102 during flight. The fletching 200 is made from a rigid or semi-rigid material, a few suitable examples being plastic, metal, resin based materials, carbon fiber based materials, etc.

Referring to FIGURE 5, the fletching 200 includes an elongate body 204 extending between a forward end 206 and an aft end 208. Disposed at the forward end 206 of the fletching 200 is an attachment member 210 adapted to couple the fletching 200 to the arrow shaft 103. In the illustrated embodiment, the attachment member 210 is a post which is secured within a bore of the arrow shaft 103 by a suitable means or combination of means, such as by an interference fit, adhesives, mechanical fasteners, etc.

The elongate body 204 flares outward in a bell shape from the forward end 206 to the aft end 208 of the elongate body 204 to form a sealing member 202 at the aft end 208 of the fletching 200. The sealing member 202 is adapted to have an outer diameter which is substantially equal to an inner diameter of the barrel of the arrow gun such that the sealing member 202 substantially seals the barrel. In one embodiment, the sealing member 202 has an outer diameter which is slightly less than the inner diameter of the barrel such that the sealing member 202 may slide along the barrel with minimal friction losses and so that a small amount of the compressed gas may slip past the sealing
member 202 to provide an air cushion for the arrow to ride upon within the barrel during shooting of the arrow. In one embodiment, the inner diameter of the barrel is more than about 0.005 of an inch greater than the outer diameter of the sealing member 202. In another embodiment, the inner diameter of the barrel is more than about 0.010 of an inch greater than the outer diameter of the sealing member 202. In a preferred embodiment, the inner diameter of the barrel is more than about 0.012 of an inch greater than the outer diameter of the sealing member 202.

In another embodiment, the sealing member extends radially outward from a centerline of the fletching 200 a selected distance. For instance, the sealing member may extend outward from the centerline to have a diameter greater than about a 1/2 inch, greater than about 6/10 of inch, or greater than about 7/10 of inch. In another embodiment, the sealing member extends outward from the centerline to extend at least as far outward from the centerline as a set of fins 212 disposed on the elongate body 204. In other words, the fins 212 preferably do not extend substantially radially outward past the outer perimeter of the sealing member 202. Preferably, the sealing member 202 has a circular outer perimeter and prevents gases from flowing past the sealing member 202 inward of the sealing member's outer perimeter.

Referring to FIGURES 5 and 7, extending radially outward at 90 degree intervals from the elongate body 204 are four fins 212, although it should be apparent to those skilled in the art that other arrangements and numbers of fins are within the spirit and scope of the present invention. The fins 212 help to stabilize the arrow 102 during flight. Preferably the fins 212 are disposed in a helical pattern upon the outer surface of the elongate body 204 so that the fins 212 are inclined slightly relative to a longitudinal axis 216 of the fletching 200 to impart rotation of the arrow during flight.

More specifically and as best shown in FIGURE 5, a longitudinal axis 218 of each of the fins 212 is inclined relative to the longitudinal axis 216 of the fletching 200 by a predetermined angle 220 as the fins wrap around the elongate body 204. In the illustrated embodiment, the fins 212 are inclined relative to the longitudinal axis 216 of the fletching 200 by an angle 220 selected to result in the arrow 102 rotating about its longitudinal axis during flight a selected rate, such as one revolution per 30 inches of travel. In one embodiment, the fins 212 are included relative to the longitudinal axis 216 by an angle greater than 0 degrees but less than 10 degrees. In another embodiment, the fins 212 are angled between greater than 0 degrees and less than 5 degrees. In another
embodiment, the fins 212 are angled between greater than 0 degrees and less than 3 degrees. Although a specific rate of rotation and angle of the fins is illustrated and described, it should be apparent to those skilled in the art that alternate rates and angles, either higher or lower than described above, are within the spirit and scope of the present invention.

Referring to FIGURE 6, extending radial inward at 90-degree intervals from the elongate body 204 at its aft end 208 are four strengthening webs 214. The four strengthening webs 214 are coupled to a securing member 217 disposed along a longitudinal center line of the fletching 200. Turning to FIGURE 5, the securing member 217 is adapted to interface with an arrow holding assembly 160 coupled to the receiver for interfacing with the securing member 217 to hold the arrow 102 within the barrel even should the barrel be inclined downward such that gravity acts on the arrow shaft 103 to draw the arrow from the barrel. The securing member 217 may receive an O-ring 162 of the arrow holding assembly 160 upon the outer cylindrical surface of the securing member 217, such as illustrated in FIGURE 5. Alternately, the securing member 217 may receive an O-ring within the securing member 217 such that the O-ring grips an inner cylindrical surface of the securing member 217 to hold the arrow 102 within the barrel until propelled therefrom by compressed gas as shown with regard to the alternate embodiment of a fletching 300 and arrow holding assembly 488 shown in FIGURE 8 and as will be described in more detail below.

Turning to FIGURES 8-10, this detailed description will now focus upon an alternate embodiment of a fletching 300 formed in accordance with the present invention suitable for use with the arrow gun described above. The fletching 300 includes an elongate body 304 extending between a forward end 306 and an aft end 308. Disposed at the forward end 306 of the fletching 300 is an attachment member 310 adapted to couple the fletching 300 to an arrow shaft 103. In the illustrated embodiment, the attachment member 310 is a post which is secured within a bore of the arrow shaft 103 by a suitable means or combination of means, such as by an interference fit, adhesives, mechanical fasteners, etc.

The elongate body 304 is substantially cylindrical in shape. A sealing member 302 is removably secured to the aft end 308 of the fletching 300 by a sealing member retaining assembly 328. In the illustrated embodiment, the retaining assembly 328 includes a female receptacle 324 disposed in the aft end 308 of the elongate
body 304 for removably receiving a cooperatively shaped male connector 326 of the retaining assembly 328 disposed on the sealing member 302. The female receptacle 324 and the male connector 326 are adapted to cooperatively interact with one another to lightly hold the sealing member 302 to the elongate body 304 such that even if the barrel is inclined downward, such that gravity acts on the arrow 102 to pull the arrow from the barrel, the elongate body 304 will remain attached to the sealing member 302. However, once the arrow 102 leaves the barrel, air resistance acting upon the sealing member 302 separates the sealing member 302 from the elongate body 304. Although the female receptacle 324 is shown disposed on the elongate body 304 and the male connector 326 is shown disposed on the sealing member 302, it should be apparent to those skilled in the art that the female receptacle 324 may alternately be located on the sealing member 302 and the male connector located on the elongate body 304.

As best shown in FIGURE 9, the sealing member 302 is adapted to have an outer diameter which is substantially equal to an inner diameter of the barrel of the arrow gun such that the sealing member 302 substantially seals the barrel. In one embodiment, the sealing member 302 has an outer diameter which is slightly less than the inner diameter of the barrel such that the sealing member 302 may slide along the barrel with minimal friction losses and so that a small amount of the compressed gas may slip past the sealing member 302 to provide an air cushion for the arrow to ride upon within the barrel during shooting of the arrow. In one embodiment, the inner diameter of the barrel is more than about 0.005 of an inch greater than the outer diameter of the sealing member 302. In another embodiment, the inner diameter of the barrel is more than about 0.010 of an inch greater than the outer diameter of the sealing member 302. In a preferred embodiment, the inner diameter of the barrel is more than about 0.012 of an inch greater than the outer diameter of the sealing member 302.

In another embodiment, the sealing member 302 extends radially outward from a centerline of the fletching 300 a selected distance. For instance, the sealing member may extend outward from the centerline to have a diameter greater than about a 1/2 inch, greater than about 6/10 of inch, or greater than about 7/10 of inch. In another embodiment, the sealing member extends outward from the centerline to extend at least as far outward from the centerline of a set of fins 312 disposed on the elongate body 304. Preferably, the sealing member 302 has a circular outer perimeter and prevents gas flow
from flowing past the sealing member 302 inward of the sealing member's outer perimeter.

Extending radially outward at 120 degree intervals from the elongate body 304 are three fins 312, although it should be apparent to those skilled in the art that other arrangements and numbers of fins are within the spirit and scope of the present invention. The fins 312 help to stabilize the arrow 102 during flight. Preferably the fins 312 are disposed in a helical pattern upon the outer surface of the elongate body 304 so that the fins 312 are inclined slightly relative to a longitudinal axis of the fletching 300 to impart rotation of the arrow during flight as described above for the embodiment of FIGURES 5-7. However, to simplify the drawings, the fins 312 in this embodiment are shown in a non-helical arrangement running parallel with a longitudinal axis of the fletching 300.

As best shown in FIGURES 8 and 9, the sealing member 302 may have a retention assembly 350 for interfacing with an arrow retaining assembly to hold the arrow 102 in the barrel, as similarly described for the fletching shown in FIGURES 5-7. The retention assembly 350 includes a cylindrical shaped bore 352 disposed along a central axis of the sealing member 302. The cylindrical shaped bore 352 is adapted to receive an O-ring 490 of an arrow holding assembly 488. The O-ring is used to apply a sufficient amount of friction against the bore 352 such that the arrow 102 will be retained in the barrel even when the distal end of the barrel is tilted down from a horizontal position. The friction exerted against the bore 352, however, is preferably not an excessive amount, such that the arrow 102 can be easily disengaged from the arrow holding assembly 488 without a significant loss of energy once the compressed gas is released from the compressed gas storage chamber.

Referring to FIGURE 2 and in light of the above description of the structure of the arrow gun 100, the operation of the arrow gun 100 will now be described. First, the safety 120 is depressed locking the trigger 116 in the cocked position. The compressed gas cartridge 106 is placed within the cartridge receiver 108. The cartridge receiver 108 is screwed into the connector 124, resulting in the compressed gas stored in the compressed gas cartridge 106 being released into the compressed gas storage chamber 122. In one working embodiment, the compressed gas cartridge 106 is a well known 12 gram CO₂ compressed gas cartridge containing the CO₂ at a pressure of approximately 800 psi. Once the CO₂ is released into the compressed gas storage...
chamber 122, the pressure of the compressed gas decreases to a pressure between about 200 psi to 400 psi, with a preferred value of 300 psi, since the volume of the compressed gas cartridge 106 is approximately 14% of the volume of the compressed gas storage chamber 122. (As noted above, the volume of the compressed gas storage chamber 122 includes the volume of the compressed gas cartridge 106 once the compressed gas is released from the compressed gas cartridge 106.)

The pressure of the compressed gas upon the charge indicator 126 causes the charge indicator to transition from its lowered position shown in FIGURE 3 to its raised position shown in FIGURE 2, thereby indicating to the user that the compressed gas storage chamber 122 is charged with a compressed gas.

Releasing the compressed gas from the compressed gas cartridge 106 into the compressed gas storage chamber 122 permits the compressed gas to pre-expand prior to release into the barrel 104. It has been found that by allowing the compressed gas to partly expand and settle before releasing into the barrel, a higher average pressure is exerted upon the arrow 102 as the arrow travels the length of the barrel, resulting in an increase of the transfer of energy from the compressed gas to the arrow 102, resulting in higher muzzle velocities, increased accuracy, increased distances, and the arrow exiting the barrel 104 with an increased level of kinetic energy resulting in increased damage to a target impacted by the arrow 102.

Although the illustrated embodiment is described as using compressed gases of a specific pressure, it should be apparent that compressed gases of other pressures, either higher or lower, are suitable for use with and are within the spirit and scope of the present invention. Further, although a specific gas, namely CO₂, is mentioned, it should be apparent to those skilled in the art that any number of compressed gases may be used, a few suitable examples being air and nitrogen. Additionally, although the illustrated and described embodiment is described as using compressed gases stored in a compressed gas cartridge, it should be apparent to those skilled in the art that the arrow gun 100 may use any suitable compressed gas source, such as bulk sources, a few suitable examples being compressed air obtained from an air compressor or a portable pressure tank.

Referring to FIGURES 4 and 8, once the compressed gas is released into the compressed gas storage chamber 122, the arrow 102 may be inserted into the barrel 104 with the fletching 300 located aft and the point of the arrow 102 facing forward toward a tip of the barrel 104. The fletching 300 is engaged with the arrow holding assembly 488
to aid in holding the arrow 102 in the barrel 104 even when the distal end of the barrel 104 is tilted down from a horizontal position.

The arrow gun 100 is pointed in a safe direction and the safety 120 pulled or pushed outward to the safety off position. The user's finger then enters the finger guard 118 and engages the trigger 116. When the user wishes to discharge the arrow 102 from the arrow gun 100, the user pulls with steady pressure upon the trigger 116 thereby overcoming the biasing pressure of the trigger biasing member 146 and causing the trigger 116 to rotate about the pivot pin 142. Rotation of the trigger 116 continues until the notch 148 of the trigger 116 disengages from the catch 144 of the cam 136. At this point, the pressure exerted by the compressed gas in the compressed gas chamber 122 forces the rapid rotation of the cam 136, and thus the rapid unseating of the sealing member 132 from the opening 128 of the compressed gas storage chamber 122. As the cam 136 rotates, the cam follower 150 follows along the cam surface 151 of the cam 136. Once the sealing member 132 is unseated from the opening 128, the pre-expanded compressed gas acts upon the fletching 300, propelling the arrow 102 from the barrel 104 at a very high velocity and with a large amount of kinetic energy.

Due to the clearance between the outer perimeter of the fletching 300 and the inner perimeter of the barrel 104, a small amount of the compressed gas released into the barrel passes past the fletching 300 through the clearance gap. The compressed air passing through the clearance gap helps promote an air bed for "floating" the fletching 300 along the length of the barrel 104 with only minimal friction losses.

Referring to FIGURES 11 and 12, this detailed description will now focus on an alternate embodiment of an arrow gun 400 formed in accordance with the present invention. The arrow gun 400 of FIGURES 11 and 12 is substantially similar to the arrow gun 100 of FIGURES 1-4. Therefore, for the sake of brevity, this detailed description will focus only upon where the alternate embodiment of FIGURES 11 and 12 differs from that of the embodiment of FIGURES 1-4.

The arrow gun 400 includes a compressed gas storage chamber 422 for storing a compressed gas substantially as described above. However, the valve assembly 430 and trigger assembly 440 of the arrow gun 400 for selectively releasing a compressed gas from the storage chamber 422 differ from the valve assembly and trigger assembly of the previously described embodiment.
The trigger assembly 400 includes a trigger 416 and a cam 436. When the trigger 416 is pulled, the trigger 416 rotates about a pivot pin 442 thereby disengaging a notch 448 of the trigger 416 from a catch 444 of the cam 436, thereby permitting the cam 436 to rotate clockwise from a cocked position shown in FIGURE 11 to a release position shown in FIGURE 12. The cam 436 includes a second catch 472 for engaging and holding a piston 474 of the valve assembly 430 in a sealing position as will be described in greater detail below.

The valve assembly 430 includes a piston assembly 470 and a piston guide assembly 476. The piston assembly 470 includes a sealing member comprised of a dome shaped piston 474 and a seal 478. The piston 474 and seal 478 sealing engage an opening 428 in the compressed gas storage chamber 422. A stem 480 is coupled to the piston 474 and a biasing member 482, one suitable example being a spring, is disposed about the stem for biasing the piston 474 in sealing engagement with the opening 428.

The stem 480 is received by the piston guide assembly 476. Moreover, the piston guide assembly 476 includes an elongate bore 484 disposed within a guide body 486. The elongate bore 484 is sized and configured to slidingly receive the stem 480 of the piston assembly 470. The stem 480 may slide within the bore 484 between an extended position shown in FIGURE 11, wherein the biasing member 482 presses the piston 474 against the opening 428 in the compressed gas storage chamber 422 and a retracted position shown in FIGURE 12, wherein the piston 474 is displaced from the opening 428 such that a compressed gas stored in the compressed gas storage chamber 422 may be released to propel a standard length arrow from the arrow gun 400.

When the trigger assembly 440 is in the cocked position shown in FIGURE 11, the second notch 472 of the cam 436 engages a distal end of the stem 480, thereby retaining the piston 474 against the opening 428 of the compressed gas storage chamber 422. When the trigger assembly 440 is in the release position shown in FIGURE 12, the cam 436 has rotated such that the biasing member 482 is overcome by the pressure of the compressed gas acting on the piston 474 and the piston 474 is displaced from the opening 428 as the stem 480 slides within the bore 484, moving the piston 474 to its retracted position. When the pressure is released from the compressed gas storage chamber 422, the biasing member 482 drives the piston 474 back to its extended position where the piston 474 is in sealing engagement with the opening 428 of the compressed gas storage chamber 422 as shown in FIGURE 11. Likewise, the
cam 436 is biased to rotate back to its cocked position such that the second notch 472 of the cam 436 engages the distal end of the stem 480, holding the piston 474 in sealing engagement with the opening 428.

Referring to FIGURE 12, the piston guide assembly 476 includes an arrow holding assembly 488 coupled to a forward end of the elongate guide body 486. The arrow holding assembly 488 includes an O-ring 490 sized and configured to be received within the securing member 217 of the fletching 200 of FIGURES 5 and 6 or within the securing member 352 of the fletching 300 of FIGURES 8 and 9. The O-ring 490 is used to apply a sufficient amount of friction against the securing member such that the arrow will be retained in the barrel even when the distal end of the barrel is tilted down from a horizontal position. The O-ring 490 is selected so that it does not apply an excessive amount of friction against the securing member, such that the arrow can be disengaged from the arrow holding assembly 488 without a significant loss of energy once the compressed gas is released from the compressed gas storage chamber 422.

While the preferred embodiment of the invention has been illustrated and described, it will be appreciated that various changes can be made therein without departing from the spirit and scope of the invention.
The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A gun for using compressed gas from a compressed gas cartridge to propel an arrow, the gun comprising:
   (a) a barrel for receiving an arrow;
   (b) a compressed gas storage chamber adapted to receive and store compressed gas in an expanded state from a compressed gas cartridge for later release; and
   (c) a valve assembly for selectively releasing the compressed gas stored in the compressed gas storage chamber within the barrel for propelling the arrow out the barrel.

2. The gun of Claim 1, wherein the compressed gas storage chamber has a volume which exceeds a volume of the compressed gas cartridge by between about two to about twelve times.

3. The gun of Claim 1, further including a charge indicator in communication with the compressed gas storage chamber, the charge indicator having a raised position indicating a presence of the compressed gas in the compressed gas storage chamber and a lowered position indicating an absence of the compressed gas in the compressed gas storage chamber.

4. The gun of Claim 3, wherein the charge indicator is automatically transitioned from the lowered position to the raised position by a pressure exerted upon the charge indicator by the compressed gas.

5. The gun of Claim 1, further including an arrow holding assembly for releasably holding an arrow within the barrel prior to release of the compressed gas within the barrel and for releasing the arrow once the compressed gas is released within the barrel.

6. A gun for using compressed gas to propel a standard length arrow:
   (a) a barrel of a length about 22 inches or greater for receiving a standard length arrow within the barrel; and
(b) a valve assembly for selectively releasing a compressed gas from a compressed gas source into the barrel for propelling the standard length arrow out of the barrel.

7. The gun of Claim 6, wherein the barrel is about 28 inches or greater in length.

8. The gun of Claim 6, wherein the barrel is about 30 inches or greater in length.

9. The gun of Claim 6, further including a compressed gas storage chamber for receiving and storing the compressed gas from the compressed gas source for later release by the valve assembly into the barrel.

10. The gun of Claim 9, wherein the compressed gas source is a compressed gas cartridge of a selected volume, and wherein the storage chamber has a volume exceeding the selected volume of the compressed gas cartridge such that the compressed gas is permitted to expand and be held in an expanded state prior to being released into the barrel by the valve assembly.

11. A method of propelling an arrow from a gun having a barrel, a trigger, and a compressed gas storage chamber, the method comprising:
   (a) placing an arrow in the barrel;
   (b) discharging a compressed gas into the compressed gas storage chamber for storage therein; and
   (c) activating the trigger to cause the compressed gas to be released from the compressed gas storage chamber into the barrel to cause the arrow to be propelled from the barrel.

12. The method of Claim 11, wherein the arrow is 22 inches or greater in length.

13. The method of Claim 11, further including discharging the compressed gas from a compressed gas cartridge into the compressed gas storage chamber.
14. The method of Claim 13, wherein a volume of the compressed gas storage chamber exceeds a volume of the compressed gas cartridge by about two to about twelve times.

15. A fletching adapted to be attached to a proximal end of an arrow shaft to aid in the propelling of the arrow shaft by compressed gas out of a barrel having an inner diameter defined by an inner surface of the barrel, the fletching comprising:
   (a) an attachment member adapted to couple the fletching to a proximal end of an arrow shaft; and
   (b) an elongate body coupled to the attachment member, the elongate body having a sealing member having an outer diameter substantially equal to the inner diameter of the barrel such that the sealing member impedes at least a substantial portion of the compressed gas from flowing past the sealing member when the sealing member is in the barrel.

16. The fletching of Claim 15, wherein the sealing member is non-removably coupled to the attachment member.

17. The fletching of Claim 15, wherein the sealing member is removably attached to the attachment member such that during flight, the sealing member is adapted to separate and fall off from the attachment member by air resistance forces acting on the sealing member.

18. The fletching of Claim 15, wherein the sealing member is substantially dome shaped.

19. The fletching of Claim 15, wherein the sealing member has a substantially round outer perimeter.

20. The fletching of Claim 15, wherein an outer perimeter of the sealing member has a diameter that is a predetermined distance less than the inner diameter of the barrel so that a selected portion of the compressed gas may pass by the outer perimeter of the sealing member during use.

21. The fletching of Claim 15, further including a plurality of fins coupled to the elongate body, wherein the plurality of fins are helically disposed upon the elongate
body so that the plurality of fins cause the fletching to rotate about a center axis of the fletching during flight.

22. A fletching adapted to be attached to a proximal end of an arrow shaft to aid in propelling of the arrow shaft by compressed gas out of a barrel of a gun, the fletching comprising:
   (a) an elongate body adapted to be coupled to an arrow shaft;
   (b) a plurality of fins extending outward from the elongate body to a selected distance from a centerline of the elongate body; and
   (c) wherein the elongate body has a sealing member for blocking gas flow, the sealing member extending outward from the centerline to at least the selected distance for blocking gas flow.

23. The fletching of Claim 22, wherein the sealing member is adapted to separate and fall off from the arrow shaft by air resistance forces acting on the sealing member during flight of the arrow shaft.

24. The fletching of Claim 22, wherein the sealing member is substantially dome shaped.

25. The fletching of Claim 22, wherein the plurality of fins are helically disposed upon the elongate body.

26. A fletching adapted to be attached to a proximal end of an arrow shaft to aid in propelling of the arrow shaft by compressed gas out of a barrel of a gun, the fletching comprising:
   (a) an elongate body adapted to be coupled to an arrow shaft; and
   (b) a sealing member attached to the elongate body for substantially impeding gas flow past the sealing member when the fletching is disposed in a barrel of a gun, the sealing member extending outward from a centerline of the fletching to a diameter of about 1/2 an inch or greater.

27. The fletching of Claim 26, wherein the sealing member is adapted to separate and fall off from the arrow shaft by air resistance forces acting on the sealing member during flight of the arrow shaft.
28. The fletching of Claim 26, wherein the sealing member is substantially dome shaped.

29. The fletching of Claim 26, wherein the plurality of fins are helically disposed upon the elongate body.

30. The fletching of Claim 26, wherein the diameter of the fletching is about 7/10 of an inch or greater.