COMPRESSED GAS PROJECTILE ACCELERATOR FOR EXPPELLING MULTIPLE PROJECTILES AT CONTROLLED VARYING VELOCITIES

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ABSTRACT

A compressed gas projectile accelerator that includes a velocity adjustment mechanism and/or method configured to allow the compressed gas projectile accelerator to expel a plurality of projectiles between a first velocity setting and a second velocity setting. The velocity adjustment mechanism and/or method includes a velocity controller configured to allow the selective selection of velocity settings falling between the first velocity setting and the second velocity setting. The first velocity setting comprises an upper or maximum velocity setting and the second velocity setting comprises a lower or minimum velocity setting.
Fig. 14
Fig. 24

START

- SEMI AUTOMATIC MODE
- BURST MODE
- RAMP MODE
- FULLY AUTOMATIC MODE

CONFIGURATION MODULE

- NO: SPREADER MODE
- YES: VELOCITY SPREAD SETTING

- YES: PROGRESSIVE MODE
- NO: PROGRESSIVE 626

END
START

DISTANCE READING MODULE 700

LOBBING ALGORITHM MODULE 702

INDICATOR CONTROL MODULE 704

FIRING MODULE 706

END

Fig. 25
COMPRESSED GAS PROJECTILE ACCELERATOR FOR EXPPELLING MULTIPLE PROJECTILES AT CONTROLLED VARYING VELOCITIES

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application is a continuation-in-part of U.S. application Ser. No. 12/069,086 filed on Feb. 7, 2008 entitled Compressed Gas Projectile Accelerator Having Multiple Projectile Velocity Settings, which is hereby incorporated by reference in its entirety.

BACKGROUND

[0002] The present invention relates generally to compressed gas projectile accelerators and more particularly, to compressed gas projectile accelerators configured to allow players to release a controlled salvo or volley of paintballs each traveling at a different respective controlled velocity from a respective compressed gas projectile accelerator.

[0003] In the sport of paintball, the maximum velocity at which projectiles are permitted to be expelled from the barrel of a paintball gun or marker is tightly controlled in both recreational and tournament play. Most tournaments and recreational paintball venues only permit a paintball marker to shoot paintballs at a maximum speed of 300 feet per second ("FPS"). All markers are subjected to testing by chronographs before and sometimes after a tournament or match. Some tournaments even randomly take chronograph readings of players' markers during actual tournament play. Shooting a hot marker, one that shoots paintballs at over 300 FPS, can subject a player or team to disqualification, a loss of points, or the player not being allowed on the field.

[0004] Current paintball markers provide various methods to adjust the speed at which a projectile is expelled from the marker. However, once the speed of the marker is adjusted to just below the maximum permitted velocity setting, the marker is not capable of being easily readjusted without the use of a tool, such as an allen wrench. Carrying tools that can be used to adjust marker velocity settings onto the field is strictly prohibited. As such, the paintball marker is only capable of being adjusted to operate on the field at one set velocity setting.

[0005] In the sport of paintball, firing modes are also controlled, even though the firing modes that are allowed will differ between various playing fields, events, or tournaments. Firing modes are the manner or method by which projectiles are expelled from a marker. An example of said manner or method would be the semi-automatic fire mode, where one pull of the trigger or one activation of the firing sequence expels one projectile from the marker. Many paintball markers offer allow the user the choice of several firing modes, such as semi-automatic, three shot burst, and full auto. Other paintball markers offer assisted trigger or enhanced trigger firing modes, often referred to as a ramp mode. The ramp mode might be defined as the combination of the semi-automatic fire mode, the burst fire mode and the full auto fire mode. An example of a ramp mode is when the paintball marker expels projectiles up to a set number of RPS (rounds per second) after a few trigger pulls or activations. Such as, for example, six to twelve trigger activations per second equals 12 RPS from the marker, the 12 RPS continues non-stop, like full auto mode, until the trigger activations dip below six trigger activations per second, where the marker is returned to semi-automatic fire mode.

[0006] Although the user might have the choice of different firing modes, the velocity is set to one velocity setting throughout the selection of the different fire modes and the velocity within a selected firing mode is set to one velocity setting, as described above. Generally, a properly tuned paintball marker firing within its functional RPS (rounds per second) capacity will expel projectiles at or near its one set velocity, regardless of the firing mode used.

[0007] The rate of fire of a paintball gun or marker is also tightly controlled at various playing fields, events, or tournaments. The rate of fire is referred to or measured in rounds per second (RPS). Again, most tournaments and recreational paintball venues only permit a paintball marker to shoot paintballs at or below a maximum RPS limit. While many paintball markers offered allow the user to set the maximum RPS limit; most if not all, do not offer a different RPS setting for the different fire modes, different RPS settings within a fire mode, and/or an efficient method for changing the RPS setting for the different fire modes during the play of a game.

SUMMARY

[0008] One embodiment of the present application discloses a compressed gas projectile accelerator that is capable of expelling a plurality of projectiles at a plurality of velocity settings that do not exceed a maximum allowed velocity setting. Other embodiments include unique apparatus, devices, systems, means, operational modes and/or methods for expelling projectiles from a compressed gas projectile accelerator at user selected and/or self selected varying velocities so that users are capable of lobbing projectiles at targets as well as shooting straight at targets. Further embodiments, forms, objects, features, advantages, aspects, and benefits of the present application shall become apparent from the detailed description and figures included herewith.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The figures are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the invention. Moreover, in the figures, like reference numerals designate corresponding parts throughout the different views.

[0010] FIG. 1 illustrates a player shooting projectiles at targets on a paintball playing field using a compressed gas projectile accelerator.

[0011] FIG. 2 is a cross-sectional view of an illustrative compressed gas projectile accelerator.

[0012] FIGS. 3a-3c set forth rear views of a compressed gas projectile accelerator including a velocity adjustment mechanism.

[0013] FIGS. 4a-4c illustrates side views of a compressed gas projectile accelerator including velocity adjustment mechanisms positioned at different locations.

[0014] FIG. 5 illustrates a portion of a compressed gas projectile accelerator having a velocity adjustment mechanism.

[0015] FIG. 6 illustrates a portion of a compressed gas projectile accelerator in cross-sectional form having a velocity adjustment mechanism.

[0016] FIG. 7 illustrates a portion of a compressed gas projectile accelerator in cross-sectional form having a velocity adjustment mechanism.
FIG. 8 illustrates a portion of a compressed gas projectile accelerator in cross-sectional form having a velocity adjustment mechanism.

FIG. 9 illustrates a portion of a compressed gas projectile accelerator in cross-sectional form having a velocity adjustment mechanism.

FIG. 10 illustrates a portion of a compressed gas projectile accelerator in cross-sectional form having a velocity adjustment mechanism.

FIG. 11 illustrates a portion of a compressed gas projectile accelerator in cross-sectional form having a velocity adjustment mechanism.

FIG. 12 illustrates a portion of a compressed gas projectile accelerator in cross-sectional form having a velocity adjustment mechanism.

FIG. 13 illustrates a portion of a compressed gas projectile accelerator in cross-sectional form having a velocity adjustment mechanism.

FIG. 14 illustrates a portion of a compressed gas projectile accelerator in cross-sectional form having a velocity adjustment mechanism.

FIGS. 15a-15c illustrate cross-sectional views of an adjustment dial of a velocity adjustment mechanism.

FIG. 16 illustrates a portion of a compressed gas projectile accelerator in cross-sectional form having a velocity adjustment mechanism.

FIG. 17 illustrates a portion of a compressed gas projectile accelerator in cross-sectional form having a velocity adjustment mechanism.

FIG. 18 illustrates a portion of a compressed gas projectile accelerator in cross-sectional form having a velocity adjustment mechanism.

FIG. 19 illustrates a player shooting projectiles at targets on a paintball playing field using a compressed gas projectile accelerator.

FIG. 20 illustrates a side view of an illustrative compressed gas projectile accelerator.

FIG. 21 is a partial cross-sectional view of an illustrative compressed gas projectile accelerator.

FIGS. 22a-22c set forth rear views of a compressed gas projectile accelerator including a velocity adjustment mechanism.

FIG. 23 illustrates representative executable modules of an electronic circuit board.

FIG. 24 illustrates representative executable modules of a lobbing mode module.

FIG. 25 illustrates representative executable modules of one form of the compressed gas projectile accelerator.

DETAILED DESCRIPTION

For the purposes of promoting an understanding of the principles of the invention, reference will now be made to the embodiment illustrated in the drawings and specific language will be used to describe the same. It will nevertheless be understood that no limitation of the scope of the invention is thereby intended, such alterations and further modifications in the illustrated device, and such further applications of the principles of the invention is illustrated therein being contemplated as would normally occur to one skilled in the art to which the invention relates.

Referring to FIG. 1, a user 10 is illustrated firing projectiles or paintballs at two respective targets 12a, 12b using a compressed gas projectile accelerator or paintball marker 14. User 10 is shooting at target 12a with a marker 14 that is set or configured to expel paintballs at target 12a at an upper velocity setting, which in this form comprises the maximum allowable velocity setting of 300 FPS. As illustrated, since user 10 is a substantial distance from target 12a, thus requiring the paintball to travel a greater distance (e.g.—200 feet), the paintball tends to travel along somewhat of an arced path after traveling a predetermined distance due to the force of gravity on the paintball.

As further illustrated, user 10 is somewhat closer to target 12b (e.g.—80 feet) who is hiding behind an obstacle 16, which is illustrated as a barrel for representative purposes only. If user 10 fires a paintball at target 12b with marker 14 set at the upper velocity setting, it would be extremely difficult, if not impossible, for user 10 to hit target 12b due to the fact that obstacle 16 is providing cover for target 12b. This is because the paintball will travel along a relatively straight path toward target 12b thereby causing the paintball to strike obstacle 16 and not target 12b. Despite the effect that gravity has on the paintball, at the maximum allowed velocity setting, paintballs are expelled from the marker 14 along a relatively straight path over short distances, which are the typical distances encountered on the field when shooting at a respective target 12a, 12b.

If user 10 was able to lower the velocity at which paintballs are expelled from the barrel of marker 14 to say, for example, 180 FPS, as well as adjust the angle of the barrel of marker 14 upward at a predetermined angle, the likelihood of user 10 being able to strike target 12b behind obstacle 16 with a paintball is greatly improved. This is because the paintball will travel along a substantially arc shaped path 18 as a function of the speed at which the paintball exits the barrel and the angle of the barrel. Therefore, as illustrated in FIG. 1, user 10 is capable of "lobbing" a paintball onto target 12b thereby eliminating the player, which is illustrated as target 12a.

Referring to FIG. 2, a representative paintball marker 50 is illustrated that includes an on the fly velocity adjustment mechanism 52. Velocity adjustment mechanism 52 is operably configured to allow user 10 to manually and selectively adjust the velocity at which paintballs are expelled from a barrel 54 of the marker 50. Marker 50 is configured to expel projectiles from marker 50 at a range of velocities ranging from an upper velocity setting to a lower velocity setting. In one form, the upper velocity setting corresponds to the maximum velocity at which a paintball is allowed to be expelled from barrel 54, which may be 300 FPS for example. Further, in one form, the lower velocity setting corresponds to the lowest possible velocity setting at which marker 50 is capable of expelling a paintball from barrel 54. As those skilled in the art would recognize, different user preferred upper and lower velocity settings may be utilized in various other forms of the present invention.

In one form, marker 50 includes a housing or frame body 56, a grip frame rail 58, a grip or grip frame 60, a trigger mechanism 62, and a feed tube 64 for a projectile or paintball hopper 63 (See FIG. 1). As illustrated, body 56 is connected with grip frame rail 58 or alternatively grip frame rail 58 may be an integral part of body 56 or grip frame 60. Barrel 54 is connected with one respective end of body 56 and, in this illustrative form, velocity adjustment mechanism 52 is connected with the opposite end of body 56. Feed tube 64, which is a paintball hopper (not shown) is removably connected with and feeds paintballs to marker 50, is also connected with or formed as part of body 56. Trigger mechanism 62 is movably
connected with grip frame rail 58 and is configured to, with each trigger pull, expel a paintball from barrel 54 (at least in semi-automatic firing mode). In automatic firing mode, a plurality of paintballs are expelled from barrel 54.

[0041] In another representative form, an electro-pneumatic marker 50 is disclosed that includes an electronic circuit board 66 and a power source 68. Although illustrated as being housed in grip frame 66, it should be appreciated that circuit board 66 and power source 68 may be housed in other locations of marker 50. Power source 68 is connected with circuit board 66 and provides power to circuit board 66. Electro-pneumatic marker 50 includes a trigger sensor 70 that is connected with circuit board 66. A velocity or speed sensor 72 and a solenoid valve 74 are also connected with circuit board 66. Speed sensor 72 could comprise a laser, an optical eye, a LED speed sensor, or any other suitable type of speed sensor. As set forth in greater detail below, in this form, a velocity controller 76 is also connected with circuit board 66.

[0042] Referring collectively to FIGS. 3a–3c, a rear view of marker 50 is depicted to better illustrate one form of velocity adjustment mechanism 52. In this form, velocity adjustment mechanism 52 includes a main velocity adjustor 80. Main velocity adjustor 80 is configured to adjust a velocity setting of marker 50. In particular, main velocity adjustor 80 is configured to adjust marker 50 so that marker 50 cannot expel paintballs above a predetermined upper or maximum velocity setting, which, for illustrative purposes only, is at or below 300 FPS. In this illustrative example, main velocity adjustor 80 comprises an allen head screw configured to adjustably control the upper velocity setting of marker 50. For example, adjustment of main velocity adjustor 80, by tightening or loosening main velocity adjustor 80, increases or decreases the maximum velocity setting of marker 50.

[0043] Velocity adjustment mechanism 52 includes an adjustment device or member 82 that is connected with main velocity adjustor 80. In this form, adjustment device 82 comprises a lever selector that is secured to main velocity adjustor 80 with a retention member or set screw 84. Adjustment device 82 includes an aperture 85 that fits around an outside diameter of main velocity adjustor 80. Once main velocity adjustor 80 is set to cause marker 50 to function at the user preferred or authorized upper velocity setting, which is just below 300 FPS in this example, lever selector 82 is positioned about a dial 86 in the user selected position and then set screw 84 is used to tightly secure lever selector 82 to main velocity adjustor 80. In this example, as illustrated in FIG. 3a, user 10 has selected a twelve o'clock position for lever selector 82 as the setting for the maximum or upper velocity setting.

[0044] In order to prevent user 10 from being able to turn lever selector 82 clockwise, thereby increasing the velocity at which a projectile may be expelled, lever selector 82 must be restricted. As previously discussed, any velocity above the upper or maximum velocity setting would cause marker 50 to be viewed as a “hot marker” as understood by those skilled in the art. In this example, dial 86 includes a plurality of apertures 88 that are positioned around a circumference or perimeter of dial 86. A blocking pin 90 is positioned or placed in a respective aperture 88 immediately next to lever 82 to prevent lever selector 82 from being rotated any further in the clockwise direction. As such, this prevents user 10 from being able to adjust the velocity setting of marker 50 above the upper velocity setting. This is an important feature as user 10 would not be allowed to use marker 50 if he/she was capable of adjusting marker 50 to shot above the maximum allowed velocity setting by simply moving lever selector 82.

[0045] In this form, as user 10 rotates lever selector 82 counterclockwise, the velocity at which paintballs are expelled from barrel 54 of marker 50 begins to decrease. For example, at the setting illustrated in FIG. 3b, marker 50 is set to expel paintballs at approximately 215 FPS. The further lever selector 82 is adjusted counterclockwise, the velocity at which paintballs are expelled from marker 50 decreases until, as illustrated in FIG. 3c, lever selector 82 reaches a lower velocity setting. In FIG. 3c, the lower velocity setting is controlled by placement of a blocking pin 92 in another user selected aperture 88 of dial 86.

[0046] During operation, lever selector 82 will hit or bump against pins 90 and 92, which do not allow lever selector 82 to be adjusted any further beyond the upper and lower velocity settings. Selector 82 may also include a detent mechanism, which is a detent 94 in this example, that is located in alignment with apertures 88 on dial 86 to help temporarily secure the selector 82 in place once a velocity setting is chosen by user 10. Pins 90, 92 may comprise standard pins, set screws, or any other type of equivalent device that will restrict movement of lever selector 82 beyond the upper and lower velocity settings. Apertures 88 may be threaded and in one form, dial 86 is connected to body 56 of marker 50 and in another form, dial 86 is formed as an integral part of body 56 or other components of marker 50 disclosed herein.

[0047] Referring to FIG. 4a, a side view of one illustrative form of marker 50 is illustrated showing velocity adjustment mechanism 52 located directly on marker 50. In this form, velocity adjustment mechanism 52 is illustrated as being located or positioned at the back or rear of body 56; however, those skilled in the art should appreciate that velocity adjustment mechanism 52 may be located at several other positions on marker 50. Marker 50 includes a compressed gas source 100, which may contain compressed air, CO2, nitrogen, or any other type of suitable compressed gas, which is removably connected with a tank adapter 102 of marker 50. The compressed gas stored in source 100 is used to selectively expel projectiles from barrel 54 of marker 50.

[0048] In this illustrated form, a gas line 104 connects an output of tank adapter 102 to a pressure regulator 106. Compressed gas from compressed gas source 100 is in communication with pressure regulator 106. Pressure regulator 106 prevents gas pressures from rising above a predetermined threshold level before entering marker 50, to prevent damage of the internal components of marker 50. Pressure regulator 106 includes an adjustment knob 108 that provides for adjustment of one or more operating parameters of pressure regulator 106.

[0049] Referring to FIG. 4b, in this representative form, velocity adjustment mechanism 52 is configured as an integral part of pressure regulator 106. As such, movement of selector 82 on regulator 106 between an upper set point and a lower set point will cause marker 50 to expel projectiles from barrel 54 between a maximum or upper velocity setting and a minimum or lower velocity setting.

[0050] Referring to FIG. 4c, in this representative form, velocity adjustment mechanism 52 has been incorporated as a component of tank adapter 102. Movement of selector 82 on tank adapter 102 between an upper set point and a lower set point will cause marker 50 to expel projectiles from barrel 54 between an upper velocity setting and a lower velocity set-
ting. All of the features discussed above with reference to FIGS. 3a-3c are hereby incorporated by reference into the representative forms set forth in FIGS. 4b and 4c.

[0051] Referring to FIG. 5, in this representative form, velocity adjustment mechanism 52 is mounted on a side of marker 50. Selector 82 is illustrated as being set at the maximum velocity setting. In this form, rotation of selector 82 clockwise causes main velocity adjustor 80 to block a gas passage in marker 50 thereby allowing user 10 to incrementally reduce the velocity of paintballs that are expelled from barrel 54. For the sake of brevity, those skilled in the art should recognize that the remaining features of marker 50 and velocity adjustment mechanism 52 are the same as those set forth with respect to FIGS. 3a-3c.

[0052] Referring to FIG. 6, another representative form of marker 50 is illustrated that includes a velocity adjustment mechanism 110. In this representative example, marker 50 includes a bolt 112 that travels back and forth along a longitudinal axis in a bolt chamber or bore 114 inside body 56 of marker 50. Bolt 112 includes a gas passage 116 through which compressed gas passes in order to expel paintballs from barrel 54. As bolt 112 travels forward, a gas port 118 in bolt 112 reaches a valve passage 120. During operation, once trigger mechanism 62 is pressed, trigger mechanism 62 releases a hammer 122 that travels forward under the pressure or force provided by a hammer spring 124. After traveling a predetermined distance, hammer 122 strikes a respective end of a valve 126, thereby actuating valve 126.

[0053] Actuation of valve 126 causes compressed gas, which is stored in a compressed gas storage chamber 128 on an opposite side of valve 126, to vent through valve passage 120 into gas passage 116 of bolt 112 through gas port 118. It should be appreciated that bolt 112 and hammer 122 move together and gas port 118 is positioned on bolt 112 such that gas port 118 is aligned with valve passage 120 when hammer 122 strikes valve 126. A bolt and hammer connecting pin 127 is used to connect bolt 112 with hammer 122. As such, compressed gas is permitted to travel from compressed gas storage chamber 128 to valve passage 120 and then into gas passage 116 of bolt 112 via gas port 118. This compressed gas is then used to expel a paintball from the barrel 54. After compressed gas is expelled from chamber 128, a spring 129 connected to an end of valve 126 forces valve 126 shut or closed, thereby stopping the flow of compressed gas through valve passage 120. At the same time compressed gas is passed through passage 120, compressed gas is also directed to a hammer chamber 131, which causes hammer 122 and bolt 112 to recoil for another shot.

[0054] As illustrated in FIG. 6, an adjustable relief valve 130 is a venting mechanism connected with an exposed end of bolt 112. Adjustable relief valve 130 is used to control or limit the pressure that is supplied from the flow of compressed gas utilized to expel paintballs from barrel 54. As such, when compressed gas is introduced to gas passage 116 of bolt 112, compressed gas travels forward to expel a paintball from barrel 54 and backwards towards venting mechanism on end 134 of bolt 112. Depending on the desired velocity setting, a predetermined amount of compressed gas will vent through velocity adjustment mechanism 110. Adjustable relief valve 130 includes an adjustment mechanism 136, a knob or wheel in this illustrative example, that allows user 10 to adjust velocity settings between the maximum or upper velocity setting and the minimum or lower velocity setting.

[0055] Referring to FIG. 7, in yet another illustrative form, marker 50 includes a velocity adjustment mechanism 110 located on body 56. In particular, velocity adjustment mechanism 110 is a venting mechanism located at an end 150 of barrel 54. In this form, bolt 112 does not travel completely to end 150 of barrel 54. As such, a gap exists between an end 152 of bolt 112 and end 150 of barrel 54 during a firing operation such that a seal is not formed between barrel 54 and bolt 112. Body 56 includes a gas port 154 that is connected with a venting mechanism, which is an adjustable relief valve 156 in this form. As with the previous forms, during a firing operation, compressed gas travels through gas passage 116. A predetermined amount of this compressed gas is redirected into gas port 154 and is vented through adjustable relief valve 156. Velocity adjustment mechanism 110 includes a knob 158 that is used by user 10 to control the amount of compressed gas that is released from adjustable relief valve 156. Adjustable relief valve 156 is thus capable of allowing marker 50 to expel projectiles between a maximum or upper velocity setting and a minimum or lower velocity setting.

[0056] Referring to FIG. 8, in yet another form, bolt 112 includes a gas passage 116 that includes input port 118 and an output port 160, in addition to a port 162 used to expel paintballs from barrel 54. Body 56 includes a gas port 164 that aligns with output port or vent 160 of bolt 112 during a firing operation and redirects a predetermined amount of compressed gas to a venting mechanism. As with the previous forms, marker 50 includes a velocity adjustment mechanism 166, which comprises an adjustable relief valve 168 that acts as functions as the venting mechanism. In this form, velocity adjustment mechanism 166 is located behind feeder 64 in body 56. Adjustable relief valve 168 includes a knob 170 that is used by user 10 to control the amount of compressed gas that is released from adjustable relief valve 168. Adjustable relief valve 168 is thus capable of allowing marker 50 to expel projectiles between a maximum velocity setting and a minimum velocity setting.

[0057] Referring to FIG. 9, a portion of another representative marker 50 is illustrated that includes a velocity adjustment mechanism 180. In this representative form, a hammer spring end cap 182 is connected with an end 184 of body 56. Hammer spring end cap 182 is threadably connected with body 56 or friction fit with body 56. A threaded end 185 of a main velocity adjustor 186 is secured in a threaded aperture 188 of hammer spring end cap 182. Main velocity adjustor 186 has an unthreaded end 190 that extends from the end 185 into the body 56 of marker 50 and includes a spring retention collar 192. An end 194 of hammer spring 124 fits around unthreaded end 190 of main velocity adjustor 186 and rests against collar 192. A portion of main velocity adjustor 186 fits within a retention aperture 196 of end cap 182.

[0058] In this form, main velocity adjustor 186 is used to set the maximum or upper velocity setting by adjustment of main velocity adjustor 186 in end cap 182. Main velocity adjustor 186 is used to adjust the tension on hammer spring 124. The more tension that is applied to hammer spring 124 (i.e., by screwing main velocity adjustor 186 further into end cap 182), the harder hammer 122 strikes valve 126 during a firing operation. The harder hammer 122 strikes valve 126, the longer valve 126 is activated and a greater volume of compressed gas is released from valve 126, thereby expelling paintballs from barrel 54 at a higher velocity. Likewise, loosening main velocity adjustor 186, which lessens the tension applied to hammer 122 by spring 124, causes hammer 122 to
strike valve 126 with less force during a firing operation. This causes a quicker activation of valve 126 and a release of a lesser gas volume during a firing operation, thereby expelling paintballs from barrel 54 at a lower velocity.

As with the form illustrated in FIGS. 3a-3c, this form may include an adjustment device 82 (e.g.—a selector lever). Once main velocity adjustor 186 has been set to expel projectiles at an upper velocity level or setting, selector 82 may be connected with or adjusted on main velocity adjustor 186. Although dial 86 is not included in this form, it could be connected with end cap 182. In this form, end cap 182 includes apertures 88. As with the forms disclosed in FIGS. 3a-3c, pins or set screws 90 and 92 may be positioned in apertures 88 to ensure that selector 82 cannot be adjusted above the upper velocity setting or below the minimum or lower velocity setting. See FIGS. 3a-3c. Set screw 84 is used to secure selector 82 to main velocity adjustor 186.

Referring to FIG. 10, in this form, marker 50 includes a velocity adjustment mechanism 200 that adjusts the tension applied by spring 129 to valve 126. As those skilled in the art would recognize, the velocity adjustment mechanism 200 can be configured additionally on marker 50 with or without the above described main velocity adjustor 186. Velocity adjustor 202 is positioned in a valve spring retention member 204. Retention member 204 is connected with body 56 and is positioned in chamber 128. Velocity adjustor 202 includes a threaded end 206, a sealing member 208, an extension member 210, and a collar 212. Threaded end 206 is threaded into an internally threaded aperture 214 of retention member 204 and transitions into sealing member 208. Sealing member 208 includes one or more seals 216 that form a fluid tight seal between sealing member 208 and an internal bore 218 of retention member 204. Extension member 210 extends away from sealing member 208 inside internal bore 218 and transitions into collar 212. An end 220 of spring 129 is connected with collar 212 and an opposite end 222 of spring 129 is connected with an end of valve 126.

Velocity adjustment mechanism 200 works in conjunction with hammer 122 in this form. Velocity adjustment mechanism 200 is used to adjust the force applied to the end of valve 126. The force that is applied to valve 126, the faster valve 126 shuts after being struck by hammer 122. As such, as threaded end 206 is tightened into retention member 204, more force is applied to valve 126 by spring 129. Likewise, as threaded end 206 is loosened from retention member 204, less force is applied to valve 126. The faster valve 126 closes, the less volume of compressed gas is allowed to pass through valve 126 to expel projectiles from barrel 54 of marker 50. As such, adjustment of threaded end 206 to a predetermined location or setting allows user 10 to set an upper velocity setting. As with the previous embodiments, velocity adjustment device 82 may then be used to raise and lower the velocity at which paintballs are expelled from barrel 54. All other features of this form remain the same as previously set forth with respect to FIGS. 3a-3c and 9.

Referring to FIG. 11, in this form, marker 50 includes a velocity adjustment mechanism 250 that adjusts the volume of gas and the tension on spring 129 to control the force at which a paintball is expelled from barrel 54. Velocity adjustment mechanism 250 includes a velocity adjustor 252 that is threaded into body 56 of marker 50. In particular, velocity adjustor 252 is threaded into chamber 128 of marker 50. Velocity adjustor 252 includes a threaded segment 254, an extension segment 256, and a spring receiving segment 258. Threaded segment 254 is threaded into an internally threaded segment 260 of bore 253.

Extension segment 256 extends away from threaded segment 254 a predetermined distance into bore 253. At an opposite end of extension segment 256 is a spring receiving segment 258. Spring receiving segment 258 includes an aperture 262 that receives a first end 264 of spring 129. A second end 266 of spring 129 is connected with or engages an end 268 of valve 126. At least one seal 278 is positioned between spring receiving segment 258 and bore 253 to provide a fluid tight seal for chamber 128, which is defined by bore 253, spring receiving segment 258 and valve 126.

In this form, chamber 128 comprises a compressed gas storage chamber that is refilled with compressed gas after each shot. The compressed gas has a predetermined pressure level, which is controlled by regulator 106, and a predetermined volume. While the pressure level does not change, velocity adjustment mechanism 250 is configured to change the volume or amount of compressed gas that is stored in chamber 128. In addition, the tension on spring 129 is also adjusted which, in turn, changes the amount of force applied to end 266 of spring 129.

During setup, velocity adjustor 252 is configured to allow marker 50 to expel paintballs from barrel 54 at a maximum or upper velocity setting. As with the previous forms, adjustment device or selector 82 allows user 10 to adjust operation of marker 50 between the upper velocity setting and the lower velocity setting. Tightening, or screwing in velocity adjustor 252, increases the tension on spring 129, thereby causing valve 126 to close faster when hammer 122 strikes valve 126, as well as decreases the volume of chamber 128.

Loosening velocity adjustor 252 decreases the force placed on valve 126 and increases the volume of chamber 128 (i.e.—thereby allowing more compressed gas into chamber 128), which allows paintballs to be expelled from barrel 54 at a higher or increased velocity. Movement of adjustment device 82 tightens and loosens velocity adjustor 252, thereby allowing adjustment of marker 50 between the upper velocity setting and lower velocity setting. As with the representative form set forth with respect to FIGS. 3a-3c and 9, movement of adjustment device 82 is prevented from occurring above or below the upper velocity setting and lower velocity setting.

Referring to FIG. 12, yet another form of marker 50 is illustrated that includes a velocity adjustment mechanism 300. In this form, a first velocity adjustor 302 is used to set marker 50 to operate at the maximum or upper velocity setting. This is accomplished by adjusting the tension or force applied to hammer 122 by spring 124 similar to the manner described above. During this adjustment, velocity adjustment mechanism 300 is positioned such that a gas chamber blocker 304 is located in a fully closed or forward position. The outer diameter of gas chamber blocker 304 includes a seal 306 that forms a fluid tight seal with a rear gas chamber 308 in bolt 112.

A rear portion of bolt 112 includes an aperture 310 running from an open end 312 of bolt 112 to rear gas chamber 308. A rod 314 is connected with gas chamber blocker 304 and runs through the rear end of bolt 112 out of open end 312. A portion 316 of the rear end of bolt 112 contains internal threads and a portion 318 of the end of rod 314 contains external threads. An adjustment knob 320 is connected with the exposed end of rod 314.
Adjustment knob 320 is used to screw rod 314 in and out of bolt 112. When adjustment knob 320 is in the fully closed position, gas chamber blocker 304 blocks or closes off chamber 308. As adjustment knob 320 is unscrewed or adjusted outwardly, more of chamber 308 becomes exposed thereby increasing the total volume of gas passage 116. In this form, during a firing operation, valve 126 is configured to release a set amount of compressed gas at a set pressure. As the bolt air chamber, or total size of gas passage 116, increases with the rearward adjustment of rod 314, moving gas chamber blocker 304 further back into gas chamber 308, the velocity of the paintball during a firing operation decreases. This allows user 10 to adjust marker 50 to expel paintballs between the upper velocity setting and a lower velocity setting through the adjustment of knob 320.

Referring to FIG. 13, yet another representative marker 50 is disclosed that includes a velocity adjustment mechanism 350. This form is similar to that disclosed with respect to FIG. 12 except that instead of the volume adjustment occurring in connection with bolt 112, it takes place with respect to valve 126. Once the upper velocity setting is set using first velocity adjustor 302, as described above, velocity adjustment mechanism 350 can be used to adjust the velocity setting between the upper velocity setting and the lower velocity setting. In this form, a forward end of body 56 includes a longitudinal bore 354 that houses valve 126.

A valve plug 356 is secured in bore 354 that defines a rear gas chamber 358b and a forward gas chamber 358a, which together define a gas storage chamber. In this form, valve plug 356 includes an outer threaded portion 360 that is threaded into an internally threaded portion 362 of bore 354. Valve plug 356 also includes a spring retention member 364 that includes an aperture 366. An end 368 of spring 129 rests against a respective surface of spring retention member 364. At least one seal 369 is used to provide a fluid tight seal between bore 354 and valve plug 356. A valve 370, which may comprise a solenoid valve, is used to selectively supply compressed gas to the rear gas chamber 358b and forward gas chamber 358a.

Velocity adjustment mechanism 350 includes a velocity adjustor 352. Velocity adjustor 352 includes an outer threaded portion 372 that engages an inner threaded portion 374 of valve plug 356. Velocity adjustor 352 includes a gas chamber blocker 376. An outer diameter of gas chamber blocker 376 includes a seal 378 that forms a fluid tight seal between gas chamber blocker 376 and an inner wall of rear gas chamber 358b. Velocity adjustor 352 also includes an adjustment knob 380 that extends or is positioned outwardly from the end of valve plug 356.

When marker 50 is being adjusted for use or play, velocity adjustor 352 is secured or screwed all the way into rear gas chamber 358b as far as possible. Valve plug 354 includes a gas supply aperture 382 that is in alignment with a gas supply passage 384. In this example, gas chamber blocker 376 is in approximate alignment with gas supply aperture 382. Once velocity adjustor 352 is in the forward most position, first velocity adjustor 302 is used to set the upper velocity setting of marker 10.

During play, user 10 can lower the velocity setting of marker 50 by unscrewing or adjusting the position of velocity adjustor 352. Adjusting the position of velocity adjustor 352 outwardly by turning knob 380, increases the volume of rear gas chamber 358b. Since compressed gas is supplied to the gas storage chamber, which as previously set forth comprises rear gas storage chamber 358b and forward gas storage chamber 358a, at a set pressure and set volume, increasing the volume of the gas storage chamber causes a decrease in velocity of paintballs that are expelled from barrel 54.

Referring to FIG. 14, a portion of yet another form of marker 50 is illustrated that includes another representative form of a velocity adjustment mechanism 400. Velocity adjustment mechanism 400 includes a dial selector, which in this form comprises an adjustable gas passage blocker 402 positioned in a slot 404 of body 56. Valve 126 includes a valve body 406 that includes a gas port 408. Adjustable gas passage blocker 402 is positioned in slot 404 of body 56 on a swivel pin 410. As set forth in greater detail below, as gas passes from chamber 128 through port 408 of valve 126, the gas also passes through adjustable gas passage blocker 402 before entering input port 118 of gas passage 116 in bolt 112.

Referring to FIGS. 15a-c, which depicts top cross sectional views of marker 50 along hash A-A in FIG. 14, a more illustrative view of adjustable gas passage blocker 402 is illustrated. A portion of gas passage blocker 402 protrudes outwardly from a side 412 of body 56. Adjustable gas passage blocker 402 includes a plurality of passages 414 positioned about a circumference or perimeter of adjustable gas passage blocker 402. Each passage 414 has a different diameter or size. Main velocity adjustor 302 (see FIG. 12) is used to set the upper velocity setting of marker 50 and adjustable gas passage blocker 402 is used to lower the velocity setting to different settings as a function of which passage 414 is selected.

As set forth above, gas passage blocker 402 includes passages 414 that are sized according to the amount of restriction that is desired. For example, in FIG. 15a, the largest diameter passage 414 is aligned with gas port 408 or valve 126. As such, marker 50 is set at the upper velocity setting. FIG. 15b represents a middle setting and FIG. 15c represents the lower velocity setting. An adjustment member 416 protrudes outwardly from gas passage blocker 402. A cutaway or slot 418 is located in body 56 that provides a passageway for adjustment member 416 to travel through.

Referring to FIG. 16, in yet another form, marker 50 includes a velocity adjustment mechanism 450 that comprises a bolt passage blocker 452 that is designed to partially block port 118 of bolt 112. Bolt passage blocker 452 is connected with a rod 454 that fits within an aperture 456 in bolt 112. Bolt passage blocker 452 fits within a retaining aperture 458 bored in bolt 112. An end portion 460 of rod 454 includes an externally threaded portion 462 that engages an internally threaded portion 464 of bolt 112. The end of rod 454 is connected with an adjustment knob 466.

Bolt passage blocker 452 is configured to block port 118 of bolt 112 such that gas is restricted from flowing into passage 116 of bolt 112. As knob 466 is screwed in and out, bolt passage blocker 452 adjusts to either increasingly or decreasingly block port 118. As a result, the velocity at which paintballs are expelled from barrel 54 can be adjusted between a maximum velocity setting and a minimum velocity setting. The maximum velocity setting may be configured on marker 50 by using main velocity adjustor 302, as previously set forth. When the maximum velocity is set, bolt passage blocker 452 is set in a fully retracted state or position so that user 10 cannot increase the velocity while on the field to an excessive velocity setting.

Referring to FIG. 17, another representative form of marker 50 is illustrated that includes a velocity adjustment
mechanism 500. In this form, the position of bolt 112 is adjusted such that, during a firing operation, port 118 of bolt 112 is misaligned with gas passage 120. As such, the misalignment of port 118 restricts the flow of compressed gas to passage 116, thereby slowing down the velocity of paintballs being expelled from barrel 54. The bolt and hammer connecting pin 127 is positioned in aperture 510 in bolt 112. One end of a rod 502 is connected with bolt and hammer connecting pin 127. Another end of rod 502 is connected with a knob 506. Rod 502 is positioned in an aperture 504 in bolt 112. An end portion 508 of rod 502 includes external threads that mate with internal threads in aperture 504. With bolt and hammer connecting pin 127 joined to hammer 122, rotation of rod 502 with knob 506 repositions bolt 112 back and forth along a longitudinal axis in bolt chamber or bore 114 inside body 56 of marker 50. The maximum velocity is ready to set when knob 506 is fully unscrewed and bolt 112 is in the forward most position. Then maximum velocity setting is configured on marker 50 using main velocity adjustor 302, as previously set forth.

[0081] As knob 506 is screwed in, bolt 112 moves rearward, thereby causing port 118 to become misaligned with passage 120. The more port 118 becomes misaligned with passage 120, by adjustment of bolt 112 on the bolt and hammer connecting pin 127 through knob 506, the lower the velocity of paintballs expelled from barrel 54 will be. In addition, when bolt 112 is misaligned with passage 120, some compressed gas will be vented through feed tube 64, thereby also lowering the velocity of the paintball.

[0082] Referring to FIG. 18, another representative form of marker 50 is illustrated that includes a velocity adjustment mechanism 550. In this form, velocity adjustment mechanism 550 creates controllable separation between a paintball 566 and bolt 112. Velocity adjustment mechanism 550 comprises a paintball repositioning member 552 that pushes paintballs further into barrel 54 during a firing operation. Paintball repositioning member 552 is connected with a knob 554 that passes through gas passage 116 and an aperture 556 in bolt 112. An end 558 of bolt 112 includes an internally threaded portion 560 and an end 568 of rod 554 includes an externally threaded portion 562 that threads into internally threaded portion 560. A knob 568 is connected to end 568 of rod 554 and allows adjustment of ball repositioning member 552.

[0083] Ball repositioning member 552 is configured to push a paintball 566 into barrel 54 at various depths. The further paintball 566 is pushed out of the breech into barrel 54, the greater the separation from said bolt 112, thereby the slower or less velocity paintball 566 will be expelled from barrel 54 during a firing operation. Knob 568 allows user 10 to adjust the depth at which paintball 566 is pushed into barrel 54, thereby allowing adjustment of the velocity at which paintball 566 is expelled from barrel 54 between an upper velocity setting and a lower velocity setting. As those skilled in the art would recognize, the ball repositioning member 552 is for the controllable separation of the paintball 566 from the compressed gas forces of compressed gas passage 116, of bolt 112.

[0084] Referring to FIG. 2, in yet another form of the present invention, an electronic projectile accelerator 50 is disclosed that includes an electronic velocity adjustment mechanism. Electronic projectile accelerator 50 includes an electronic controller, which in this form comprises an electronic circuit board 66 connected with a power source 68. A velocity controller 76, which may comprise a push button control, a dial control, or any other suitable type of control, is connected with the electronic circuit board 66 for allowing a user to selectively set a velocity setting at which projectiles are expelled from a barrel 54.

[0085] In one form, the velocity setting is not permitted to go above a predetermined maximum value. A solenoid or solenoid valve 74 is connected with the electronic circuit board 66. The electronic circuit board 66 is configured to control one or more operating parameters of the electronic projectile accelerator 50, in one form, operating parameters of solenoid 74, as a function of the velocity setting.

[0086] The electronic projectile accelerator 50 further includes a sensor 72 configured to permit determination of a velocity of a projectile exiting the electronic projectile accelerator 50. The electronic circuit board 66 is adapted to adjust one or more operating parameters of the electronic projectile accelerator 50, in one form, operating parameters of solenoid 74, as a function of the velocity determination and the velocity setting.

[0087] Another aspect of the present invention discloses a kit for retrofitting a compressed gas projectile accelerator 50. The kit includes a velocity adjustment mechanism, as disclosed and described above with respect to FIGS. 1-18, that is configured to allow the compressed gas projectile accelerator 50 to expel projectiles between a defined range of velocity settings. A velocity controller is included in the kit for allowing a user to selectively adjust the velocity adjustment mechanism to a respective velocity setting falling in the range of velocity settings. The exact components included in the kit will vary depending on the design of the compressed gas projectile accelerator 50, but will include one or more of the components described and set forth with respect to FIGS. 1-18.

[0088] Referring to FIGS. 19 and 20, a user 10 is illustrated firing projectiles or paintballs at two respective targets 12a, 12b using a compressed gas projectile accelerator or paintball marker 50. User 10 is shooting at target 12a with a marker 50 that is set or configured to expel paintballs at target 12a at an upper velocity setting, which in this form, comprises the maximum allowable velocity setting of 300 FPS. As illustrated, since user 10 is a substantial distance from target 12a, thus requiring the paintball to travel a greater distance (e.g., — 200 feet), the paintball tends to travel along somewhat of an arced path after traveling a predetermined distance due to the force of gravity on the paintball.

[0089] As further illustrated, user 10 is somewhat closer to target 12b (e.g., — 80 feet) who is hiding behind an obstacle 16, which is illustrated as a barrel for representative purposes only. If user 10 fires a paintball at target 12b with marker 50 set at the upper velocity setting, it would be extremely difficult, if not impossible, for user 10 to hit target 12b, due to the fact that obstacle 16 is providing cover for target 12b. This is because the paintball will travel along a relatively straight path toward target 12b thereby causing the paintball to strike obstacle 16 and not target 12b. Despite the effect that gravity has on the paintball, at the maximum allowed velocity setting, paintballs are expelled from the marker 50 along a relatively straight path over short distances, which are the typical distances encountered on the field when shooting at a respective target 12a, 12b.

[0090] If user 10 was able to lower the velocity at which a paintball is expelled from barrel 54 of marker 50 to lets say, for example, 180 FPS, as well as adjust the angle of barrel 54 of marker 50 upward at a predetermined angle relative to ground G, the likelihood of user 10 being able to strike target
12b behind obstacle 16 with a paintball is greatly improved. This is because the paintball will travel along a substantially are shaped path 18 as a function of the speed at which the paintball exits the barrel 54 and the angle of the barrel 54. In other words, user 10 would be lobbing paintballs onto target 12b instead of shooting paintballs directly at target 12b. As illustrated, lowering the velocity at which paintballs are expelled from marker 50 as well as adjusting the angle of barrel 54 affects the flight path of paintballs thereby causing the paintballs to travel along a slightly arched trajectory.

As such, in another form, user 10 is able to expel a plurality of paintballs at a lower velocity setting, and in particular, at a controlled velocity speed spread from barrel 54 of marker 50 to lets say, for example, a 5 shot volley or burst of 160-170-180-190-200 FPS. In this firing mode, user 10 also adjusts the angle of the barrel 54 of marker 50 upward at a predetermined angle relative to the location of target 12b, the likelihood of user 10 being able to strike target 12b behind obstacle 16 with a paintball is greatly improved yet again. This is because the paintballs are traveling along substantially arc shaped paths 18 at a plurality of velocities, instead of the same velocity, thereby providing a greater and more uniform area of coverage when the paintballs land in the target area 1A.

Delivering a controlled spread or volley of paintballs along substantially arc shaped paths 18 onto target 12b reduces the possible inaccuracies or miscalculations of user 10 and/or marker 50. The controlled spread or volley would also reduce the ability of target 12b to react to or avoid the incoming paintballs. Therefore, as illustrated in FIG. 19, user 10 is capable of lobbing a controlled spread or volley of paintballs onto target 12b at various velocity settings, thereby eliminating target 12b.

Referring to FIG. 20, a side view of one illustrative form of marker 50 is illustrated. Marker 50 includes a compressed gas source 100, which may contain compressed air, CO₂, nitrogen, or any other type of suitable compressed gas, which is remotely connected with a tank adapter 102 of marker 50. The compressed gas stored in source 100 is used to selectively expel projectiles from barrel 54 of marker 50. In this illustrative form, a gas line 104 connects an output of tank adapter 102 to a pressure regulator 106. Compressed gas from compressed gas source 100 is in communication with pressure regulator 106. Pressure regulator 106 regulates the pressure of the compressed gas entering marker 50 to a set pressure. It accomplishes this by cutting off source 100 when the pressure in a chamber of the regulator 106 reaches a predetermined pressure. Pressure regulator 106 includes an adjustment knob 108 that provides for adjustment of the set pressure of pressure regulator 106.

Referring collectively to FIGS. 20 and 21, in this form paintball marker 50 includes an on the fly velocity adjustment mechanism 52. Velocity adjustment mechanism 52 is operable or configured to allow user 10 to manually and/or selectively adjust the velocity setting at which paintballs are expelled from barrel 54 of marker 50. Marker 50 is operationally configured to expel projectiles from barrel 54 at a range of velocities ranging from an upper velocity setting to a lower velocity setting. In one form, the upper velocity setting corresponds to the maximum velocity at which a paintball is allowed to be expelled from barrel 54, which may be 300 FPS for example. Further, in one form, the lower velocity setting corresponds to the lowest possible or functional velocity setting at which marker 50 is capable of expelling a paintball from barrel 54. Different user preferred upper and lower velocity limit settings may be utilized in various other forms of the present invention.

In one form, marker 50 includes a housing or frame body 56, a grip frame rail 58, a grip or grip frame 60, a trigger mechanism 62, and a feed tube 64 to which is connected a paintball hopper 63 (see e.g., FIG. 19). As illustrated, body 56 is connected with grip frame rail 58. Alternatively, grip frame rail 58 can be an integral part of body 56 or grip frame 60. Barrel 54 is connected with one respective end of body 56 and, in this illustrative form, velocity adjustment mechanism 52 is connected with the opposite end of body 56. Feed tube 64, which paintball hopper 63 (see FIG. 19) is removably connected with and feeds paintballs to marker 50, is also integrated with or formed as a part of body 56. Trigger mechanism 62 is movably connected with grip frame rail 58 or grip frame 60 and is configured to, with each trigger pull, expel one or more paintballs from barrel 54.

Marker 50 includes an electronic circuit board or controller 66 connected with a power source 68. Although illustrated as being housed in grip frame 60, it should be appreciated that circuit board 66 and power source 68 can be housed in other locations of marker 50. Power source 68 is connected with circuit board 66 and provides power to circuit board 66. As such, an electro-pneumatic marker 50 is disclosed in this representative form. Marker 50 further includes a trigger sensor 70, a velocity or speed sensor 72, and a solenoid valve 74 that are connected with circuit board 66.

Trigger sensor 70 is configured or operable to generate a trigger signal to indicate when trigger mechanism 62 is pulled by user 10. Trigger sensor 70 can comprise an optical eye, a LED sensor, a magnetic sensor, a Hall effect sensor, or any other suitable type of sensor. The trigger signal is sent to circuit board 66. In response to the trigger signal, in one representative form circuit board 66 generates a solenoid firing signal that is sent to solenoid valve 74. Upon receipt of the solenoid firing signal, solenoid valve 74 is operable to release a predetermined amount of compressed gas, as a function of the trigger signal, to expel a paintball from marker 50.

In one form, after a predetermined amount of time, circuit 66 can generate a solenoid deactivate signal sent to solenoid valve 74 thereby stopping the release of compressed gas used to expel the paintball from barrel 54 of marker 50. In another form, circuit board 66 deactivates or ceases generating the trigger signal to stop solenoid valve 74 from releasing compressed gas from source 100. As set forth in greater detail below, depending on the respective firing mode that marker 50 is currently configured to operate in, circuit board 66 is configured to generate one or more solenoid signals to cause marker 50 to expel one or more paintballs from barrel 54. In addition, circuit board 66 is configured to selectively control or adjust the velocity at which paintballs are expelled from marker 50 by controlling the amount of volume of compressed gas used to expel paintballs. In one representative form, this is accomplished by controlling the amount of time compressed gas is allowed to be released by solenoid valve 74 from source 100.

Speed sensor 72 can comprise a laser, an optical eye, a LED speed sensor, a sonic sensor, a radar, or any other suitable type of speed sensor. Speed sensor 72 and solenoid valve 74 can be housed in other locations of marker 50 other than in grip frame rail 58, as illustrated. Speed sensor 72 is configured or operable to generate a speed signal indicative of the velocity at which paintballs are expelled from barrel 54 of
marker 50. The speed signal is directed to or detected by circuit board 66, which is operable to adjust operation of solenoid valve 74 to adjust the velocity at which paintballs are fired according to various firing modes as a function of the speed signal.

A velocity controller 76 is connected with circuit board 66. Velocity controller 76 can comprise a plurality of push buttons, a dial, a slider, or other types of control mechanisms. In one form, velocity controller 76 is configured to allow user 10 to manually adjust the velocity at which paintballs are expelled from barrel 54 of marker 50. Circuit board 66 is configured to monitor the setting or position of velocity controller 76 and adjust the operation of marker 50 according to this setting. Velocity controller 76, in one form, is operable to adjust marker 50 to operate between a maximum and lower velocity setting.

A breech sensor 78 is connected with circuit board 66 and is positioned along breech 79. Breech sensor 78 can comprise a laser, an optical eye, a LED sensor, an infrared sensor, or any other suitable type of sensor for indicating breech status or condition sensing. Breech sensor 78 can also comprise a plurality or array of suitable sensors. Breech sensor 78 is configured to monitor the status of a breech 79 of marker 50. For example, breech sensor 78 is configured to send a paintball loaded signal to circuit board 66. In yet another form, breech sensor 78 is configured to send a breech obstruction signal to circuit board 66 indicating a problem has occurred. In this example, circuit board 66 is configured to shut marker 50 down or cease operation until the problem has been corrected.

A pressure sensor 46 is connected with circuit board 66. Pressure sensor 46 can comprise an electronic sensor, pneumatic sensor, or any other suitable type of pressure sensor. Pressure sensor 46 is configured to monitor the pressure value associated with marker 50. In particular, in one form, pressure sensor 46 is configured to monitor the pressure value at which compressed gas, supplied from compressed gas source 100, is being supplied to solenoid valve 74. As set forth in greater detail below, a pressure signal is sent to circuit board 66 from pressure sensor 46 which is in turn, configured to control the amount of time solenoid valve 74 is opened during a firing operation at least partially as a function of the value of the pressure signal. For example, as marker 50 is operational and has fired several shots in a row, the pressure value of compressed gas available to solenoid valve 74 to fire the next shot can decrease somewhat, thereby requiring a greater volume of compressed gas to expel a paintball at a desired or controlled FPS value. Circuit board 66 is configured to increase the amount of time that solenoid valve 74 is opened as a function of the desired FPS value (which can vary in different firing modes) and the compressed gas pressure value available to solenoid valve 74.

Circuit board 66 can also be configured to control various additional operating parameters of marker 50 as a function of signals received from pressure sensor 46. In one form, circuit board 66 is configured to place marker 50 in a stand-by mode or shut marker 50 off if, for example, the signal received from pressure sensor 46 indicates compressed gas pressure levels above a predetermined safe threshold or a predetermined operational threshold. While pressure sensor 46 is illustrated in the grip frame rail 58, it should be appreciated that it may be positioned in other locations on marker 50.

One or more conditional indicators 73 are also connected with circuit board 66. Indicators 73 can comprise lights, LED's, indication displays, or any other suitable indicators or display device. Although indicators 73 are illustrated as being on the rear of marker 50, it should be appreciated that they can be positioned in other locations on marker 50. Indicators 73 allow user 10 to monitor the operational status or parameters of marker 50. In addition, indicators 73 can also be used to inform the user of marker 50 of barrel 54 alignment in various firing modes.

In another form, a distance sensor 75 is connected with circuit board 66. Distance sensor 75 can comprise a laser distance sensor, an optical distance sensor, an ultrasonic distance sensor, a range finder, or any other suitable type of distance sensor. In this form, as user 10 aims barrel 54 at potential targets 12a, 12b, distance sensor 75 is configured to generate an electronic distance signal, which can be an analog or digital signal, that is sent to circuit board 66. The distance signal is indicative of the distance from marker 50 to one of the respective targets 12a, 12b.

Circuit board 66 is configured and operable to use the distance signal to calculate the velocity at which paintballs need to be expelled from marker 50 and the angular tilt required for barrel 54 of marker 50 to lob or launch a volley or volley of paintballs down field to strike target 12a, 12b. In the alternative, circuit board 66 can be configured to automatically determine a proper velocity to expel paintballs as a function of the tilt sensor signal received from a tilt sensor 48 and the distance signal. In yet another form, distance sensor 75 can include or be connected with a button 97 that selectively transmits a distance signal to circuit board 66 every time it is pressed by user 10.

Marker 50 can also include a tilt sensor 48 connected with circuit board 66. Tilt sensor 48 is configured to sense or measure, in two axes in one form, the tilting of marker 50. In particular, tilt sensor 48 is used to monitor the angular position of barrel 54 in comparison to a reference plane, which in this case comprises the ground G. In one form, tilt sensor 48 can comprise an electrolytic tilt sensor, an electronic clinometer or inclinometer, an accelerometer, a piezoelectric accelerometer, a gyro sensor, or a full motion sensor, for example. Although tilt sensor 48 is illustrated as being housed in grip frame 60, as are controls 77 and velocity controller 76, it should be appreciated that these elements can be located in other locations of marker 50.

In yet another form, one or more user controls 77 are connected with circuit board 66. Controls 77 can comprise push button controls, dial controls, or any other suitable type of controls. In one form, controls 77 provide manual control to user 10 for adjustment of one or more of the components or operations of marker 50. For example, controls 77 can finely adjust or fine tune the operation of tilt sensor 48, trigger sensor 70, distance sensor 75, velocity controller 76, and/ or breech sensor 78. Further, controls 77 can be configured substitutable and/or alternate with the components or operations, such as, for example, being a manual or overriding controller for tilt sensor 48.

Controls 77 can also be configured to operate as a manual distance controller, wherein controls 77 can be utilized to manually input a distance to a respective target 12a, 12b that is utilized by circuit board 66. In addition, controls 77 can also be used to select different firing modes (e.g.—semi-automatic, automatic, three shot burst, five shot burst, lobbing...
mode, etc.). As such, in this form, controls 77 inform circuit board 66 of the firing mode desired by user 10.

[0110] In one form, marker 50 includes an electronic velocity adjustment mechanism. A velocity controller 76, which may comprise a push button control, a dial control, a sliding control, or any other suitable type of control, is connected with circuit board 66 for allowing a user to selectively set a velocity setting at which projectiles are expelled from barrel 54. For example, if velocity controller 76 comprises two buttons (e.g., a velocity up and a velocity down button), each press of one of the respective buttons causes a signal to be sent to circuit board 66. In response, circuit board 66 will either raise or lower the velocity setting of marker 50 in predetermined increments (e.g.—5 FPS, 10 FPS, and so forth). Controls 77 can be utilized to set the increments in which user 10 desires each button press to raise or lower the velocity setting.

[0111] Velocity controller 76 can be configured as the primary velocity adjustment feature, as a secondary velocity adjustment feature, and/or as an additional velocity adjustment feature on marker 50. In one form, circuit board 66 is configured to control one or more operating parameters of solenoid 74 as a function of the velocity setting. In particular, in one representative form, in response to the user selected velocity setting, circuit board 66 is operable to control the timed release of compressed gas by solenoid 74 as a function of the velocity setting. The higher the velocity setting, the longer circuit board 66 will control solenoid 74 to release compressed gas to expel the paintball from marker 50. As such, circuit board 66 controls the velocity of the paintballs by controlling the volume of compressed gas that is released by solenoid 74 during a firing operation.

[0112] In one form, where the velocity setting is not permitted to go above a predetermined maximum value, circuit board 66 is configured to control one or more operating parameters of solenoid 74 as a function of the velocity setting. In this example, as illustrated in FIG. 22a, user 10 has selected a breech 79 to determine or verify an operational members’ position (e.g.—such as bolt 112 (see FIG. 6) in respect to a paintball’s position and/or any separation from the paintball. Circuit board 66 can then control one or more operating parameters as it relates to breech status and/or the velocity setting. Such as, for example, circuit board 66 can be programmed and operable to disregard an upcoming signal from speed sensor 72 when a paintball, loaded in breech 79, is separated from the bolt 112 above a set threshold value.

[0116] As previously set forth, marker 50 includes tilt sensor 48 connected with circuit board 66. Circuit board 66 can be configured with a safety feature of one or more operating parameters of marker 50 as a function of signals received from tilt sensor 48. For example, when marker 50 is laid down, is pointed straight up or straight down, circuit board 66, which is capable of sensing this angular orientation of marker 50 as a function of the tilt sensor signal, can be configured to automatically place marker 50 in a stand-by mode thereby disabling marker 50 from expelling projectiles. The stand-by mode can also be an energy saving mode.

[0117] Circuit board 66 can also be configured to control other operational parameters of marker 50 as a function of the tilt sensor signal received from tilt sensor 48. For example, when marker 50 is positioned in or exceeds a predetermined angle in relation to ground G, circuit board 66 is configured to switch or change firing modes or change the velocity settings of marker 50. Controls 77 can also be configured to adjust or fine tune the signal (i.e.—the determined angle of marker 50) generated by tilt sensor 48. Also, controls 77 may be configured as a manual mode controller. In other words, user 10 can use controls 77 to set a predetermined angular setting indication thereby overriding the determination made by tilt sensor 48. Controls 77 when configured as a manual mode controller can be configured as a primary, secondary, or additional mode controller.

[0118] Referring collectively to FIGS. 22a-22c, a rear view of one representative form of marker 50 is depicted. In this form, velocity adjustment mechanism 52 includes a primary or main velocity adjustor 80. Main velocity adjustor 80 is configured to adjust a velocity setting of marker 50. In particular, main velocity adjustor 80 is designed to configure marker 50 so that marker 50 cannot expel paintballs above a predetermined upper or maximum velocity setting, which, for illustrative purposes only, is 300 FPS. In this illustrative example, main velocity adjustor 80 comprises an allen head screw configured to adjustably control the upper velocity setting of marker 50 as previously described with respect to other forms disclosed herein. For example, adjustment of main velocity adjustor 80, by tightening or loosening main velocity adjustor 80, increases or decreases the maximum velocity setting of marker 50.

[0119] Velocity adjustment mechanism 52 includes a component adjuster or lever selector 82 that is connected with main velocity adjustor 80. In this form, lever selector 82 is secured to main velocity adjustor 80 with a retention member or set screw 84. Lever selector 82 includes an aperture 85 that fits around an outside diameter of main velocity adjustor 80. Once main velocity adjustor 80 is set to cause marker 50 to function at the user preferred or authorized upper velocity setting, lever selector 82 is positioned about a dial 86 in a user selected position and then set screw 84 is used to tightly secure lever selector 82 to main velocity adjustor 80. In this example, as illustrated in FIG. 22a, user 10 has selected a
twelve o'clock position for lever selector 82 as the setting for the maximum or upper velocity setting.

[0120] In order to prevent user 10 from being able to turn lever selector 82 clockwise, thereby increasing the velocity at which a projectile may be expelled, lever selector 82 must be restricted. As previously discussed, any velocity setting above the upper or maximum velocity setting would cause marker 50 to be viewed as a "hot marker" as understood by those skilled in the art. In this example, dial 86 includes a plurality of apertures 88 that are positioned around a circumference or perimeter of dial 86. A blocking pin 90 is positioned or placed in a respective aperture 88 immediately next to lever 82 to prevent lever selector 82 from being rotated any further in the clockwise direction. As such, this prevents user 10 from being able to adjust the velocity setting of marker 50 above the upper velocity setting. This is an important feature as user 10 would not be allowed to use marker 50 on the playing field if he/she was capable of adjusting marker 50 to shoot above the maximum allowed velocity setting.

[0121] In this form, as user 10 rotates lever selector 82 counterclockwise, the velocity at which paintballs are expelled from barrel 54 of marker 50 begins to decrease. For example, at the setting illustrated in FIG. 22b, marker 50 is set to expel paintballs at an intermediate or transitional FPS setting. The further lever selector 82 is adjusted counterclockwise, the velocity at which paintballs are expelled from marker 50 decreases until, as illustrated in FIG. 22c, lever selector 82 reaches a lowest functional or lower velocity setting. In FIG. 22c, the lower velocity setting is controlled by placement of blocking pin 92 in a user 10 selected aperture 88 of dial 86.

[0122] During operation, lever selector 82 will hit or bump up against pins 90 and 92, which does not allow lever selector 82 to be adjusted any further beyond the upper and lower velocity settings. Selector 82 can also include a detent mechanism, which is a detent 94 in this example, that is located in alignment with apertures 88 on dial 86 to help temporarily secure lever selector 82 in place once a velocity setting is chosen by user 10. Pins 90, 92 may comprise standard pins, set screws, or any other type of equivalent device that will restrict movement of lever selector 82 beyond the upper and lower velocity settings. Apertures 88 may be threaded and in one form, dial 86 is connected to body 56 of marker 50 and in another form, dial 86 is formed as an integral part of body 56 or other components of marker 50 as disclosed herein.

[0123] In another form, marker 50 includes indicators 73 connected with circuit board 66 (see FIG. 21). Indicators 73 can comprise any suitable indicators, as described above and/or as illustrated FIGS. 21 and 22c. Indicators 73 can also be configured as part of and/or with controls 77. Furthermore, in one form velocity adjustment mechanism 52 includes situational connectors or links 44 and 45, as illustrated in FIG. 22b. Connectors 45 are connected with circuit board 66. Situational connectors or links 44 and 45 can comprise optical eyes, electric contacts, magnetic sensors, or any other suitable type of sensors, contactor, and/or link. Connectors 44 and 45 cooperate to generate an electric output signal that informs circuit board 66 of the velocity setting of marker 50. Those skilled in the art would recognize that the described components or members of marker 50 may be configured, laid out, or connected in a different manner or configuration; and the described components or members may be combined or separated into single members. Also, the described members may be connected directly to power source 68 or have a separate source of power.

[0124] Referring collectively to FIGS. 19, 20, 21 and 22c, in one representative form, marker 50 includes on the fly velocity adjustment feature, which is operable to allow user 10 to manually and/or selectively adjust the velocity at which paintballs are expelled from barrel 54 of marker 50 at a range of velocities ranging from an upper velocity setting to a lower velocity setting. In another form, marker 50 includes a velocity adjustment feature that is automatically configured to adjust the velocity at which paintballs are expelled from barrel 54 of marker 50 at a range of velocities ranging from an upper velocity setting to a lower velocity setting, as well as an RPS setting and/or a firing mode. In yet another form, marker 50 includes a velocity adjustment feature that suggests or advises user 10 of possible velocity settings and/or their value, ranging from an upper velocity setting to a lower velocity setting, as well as possible angles of barrel 54, RPS setting, and/or fire mode for the elimination of a selected target.

[0125] User 10 is illustrated firing projectiles or paintballs at target 12a, using marker 50 set or configured to expel paintballs at an upper velocity setting (see FIG. 19). User 10 is firing the projectiles at target 12a in a semi-automatic firing mode. User 10 then engages target 12b, which is behind obstacle 16, with marker 50 which includes distance sensor 75, indicators 73, and tilt sensor 48 connected with circuit board 66 (see FIG. 21). Circuit board 66 of marker 50 being aware of the distance to target 12b through signals from distance sensor 75 is configured to automatically calculate or determine one or more angles for barrel 54 and then indicate the proper angle(s) of barrel 54 to user 10 through signals received by tilt sensor 48 and indicators 73.

[0126] As an example, as illustrated in FIG. 22a, circuit board 66 is configured to illuminate either the up or down arrows of indicators 73 to inform user 10 which way to move barrel 54 of marker 50 to place marker 50 at the one or more calculated angles. The circular shaped light of indicators 73 is used to inform user 10 that marker 50 has been positioned at a proper angle. Once user 10 positions marker 50 at a respective calculated angle, circuit board 66 is then configured to automatically calculate or determine a proper projectile velocity settings required to lob projectiles or paintballs onto target 12b as a function of the angular position of barrel 54 of marker 50. In one form of the above form, circuit board 66 automatically controls one or more operating parameters of marker 50 to achieve the calculated velocity settings for user 10. User 10 then presses trigger 62 thereby causing marker 50 to expel projectiles from marker 50 at the plurality of calculated velocities. For example, in 5-shot burst mode, marker 50 automatically expels five paintballs at five different velocities at target 12b. In the alternative, marker 50 could be set to expel projectiles in a lobbing manner at the same velocity.

[0127] In another form, user 10 again engages target 12b which is behind obstacle 16 with marker 50. Circuit board 66 of marker 50 knowing the distance to target 12b through distance sensor 75 indicates to user 10 one or more calculated angles of barrel 54 through indicators 73 in order to lob projectiles onto target 12b. In this form, although circuit board 66 has calculated the velocity and preferred angle, user 10 may have set a preference, via controllers 77, for manual adjustment of the velocity using either velocity controller 76 or velocity adjustment mechanism 52. Once user 10 has
adjusted the velocity setting to the calculated setting, circuit board 66 is configured to illuminate an indicator 73 thereby informing user 10 that the calculated velocity setting has been reached. As with the previous form, circuit board 66 can also be configured to illuminate indicators 73 informing user 10 that the velocity setting needs to be increased or decreased in order to reach the calculated velocity setting. For example, the up and down or right and left indicators 73 illustrated in FIG. 22a could be used.

[0128] In another form, user 10 is firing projectiles at target 12a, using marker 50 set or configured to expel paintballs at an upper velocity setting (see FIG. 19). User 10 again is firing projectiles at target 12a in semi-automatic mode. User 10 then engages target 12b, which is behind obstacle 16 with marker 50. In this form, circuit board 66 of marker 50 is configured for burst mode (i.e.—5 shot burst per trigger pull) when marker 50 is lobbing projectiles between an upper velocity setting and a lower velocity setting.

[0129] In one form, circuit board 66 is configured to automatically selectively select between different firing modes of marker 50 as a function of signals received from tilt sensor 48. For example, user 10 is firing at target 12a in semi-automatic mode, and then fires at target 12b in 5 shot lobbing burst mode (see FIG. 19) by positioning marker 50 in a calculated or predetermined angle as before. This pre-programmed self selection of the firing mode is determined by the angle of marker 50 through tilt sensor 48 and circuit board 66. Marker 50 is configured to selectively select or self select the semi-automatic mode when user 10 returns to firing at target 12a as a function of a sensor reading received from tilt sensor 48 by circuit board 66.

[0130] The automatic or self selection of the upper velocity setting in the semi-automatic mode from the lobbing burst mode would also occur when target 12b came around obstacle 16 and was exposed to user 10 thereby giving user 10 a more direct shot at target 12b. This automatic selection of the upper velocity setting in the semi-automatic mode is a function of the sensor reading received by circuit board 66 from tilt sensor 48. As marker 50 is tilted or positioned along latitudinal axis LA-LA (see FIG. 19), such that barrel 54 is positioned at a predetermined angle relative to the ground, circuit board 66 is programmed or configured to automatically switch firing modes. For example, in this mode of operation, if tilt sensor 48 senses that marker 50 is positioned at an angle anything less than 35° relative to ground G, circuit board 66 is configured to set marker 50 in semi-automatic straight fire mode such that marker 50 shoots directly at target 12b. If tilt sensor 48 senses that marker 50 is positioned at an angle greater than 35° relative to ground G, circuit board 66 is configured to automatically set marker 50 in 5 shot lobbing burst mode. Marker 50 could be configured to fire in any one of a number of straight shot firing modes, such as semi-automatic mode, burst mode, ramp mode or fully automatic mode.

[0131] Further, in another form, user 10 is firing projectiles at target 12a, using marker 50 set or configured to expel paintballs at an upper velocity setting (see FIG. 19). User 10 is firing projectiles at target 12a in semi-automatic straight shot mode. User 10 then engages target 12b which is behind obstacle 16 with marker 50. In this form, marker 50 comprises the self selecting lobbing burst mode as a function of tilt sensor 48 and circuit board 66 as described above. Further, marker 50 is configured to include a velocity spreader mode, which may be used in conjunction with different fire modes (i.e. semi-automatic, burst, ramp, full auto, etc.).

[0132] The velocity spreader mode separates projectiles fired into selected or programmed groups or volleys, and then separates the velocity of the projectiles within these volleys such that each projectile is assigned a distinct velocity. For example, in this form, user 10 is engaging targets 12a, 12b as described before (target 12a—upper velocity setting/self selecting semi-automatic mode, 12b—reduced velocity setting/self selecting lobbing burst mode). In the velocity spreader mode, the velocity of the projectiles within the lobbing burst mode's volley are separated or spread out (i.e. 5 shots-160-170-180-190-200 FPS). The spread in velocity of the paintballs in substantially arc shaped paths 18, of the self selecting lobbing burst-velocity spreader mode, allows user 10 to cover a larger target area TA and provides for quicker target acquisition. Thus, the above-configured marker 50 with self selecting lobbing burst mode and velocity spreader mode, allows user 10, on the fly, to engage and eliminate target 12b behind obstacle 16 efficiently, while still engaging target 12a at will in semi-automatic mode.

[0133] Circuit board 66 of the above-configured marker 50 with lobbing mode and/or velocity spreader mode is programmable for the "semi-automatic only" rules used by some paintball venues or fields. For example, in this form, user 10 is engaging targets 12a, 12b as described above (see FIG. 19), but in semi-automatic mode only. As before, user 10 switches engagement from target 12a to target 12b such that the lobbing mode is self selected through the cooperation of tilt sensor 48 and circuit board 66. Then, marker 50 with the velocity spreader mode cycles through the programmed number of shots as in the burst mode, but one trigger pull at a time (i.e.—5 trigger pull=160-170-180-190-200 FPS, starting over every 5 trigger pulls). Velocity spreader mode can also work in markers 50 with full auto or ramp modes (i.e. 160-170-180-190-200 FPS, starting over every 5 shots until trigger activation stops) or (i.e. 160-170-180-190-200 FPS for the first 5 shots, then 200-190-180-170-160 FPS for the next 5 shots; replicating until trigger activation stops).

[0134] The number of shots in a spread of the velocity spreader mode is programmable (i.e. 2 shot—burst or spread, 3 shot—burst or spread, 4 shot—group or spread, etc.), and that groups or volleys of the velocity spreader mode can be assembled in clusters and/or configurations (i.e. 3 shot group followed by 5 shot group, replicating). Further, the velocity spread or velocity difference in a group or volley is also programmable (i.e. 5 FPS spread between projectiles, 10 FPS spread between projectiles, etc.). Still further, the position of the calculated velocity is programmable as well. For example, as in an illustrative form above, 180 FPS is the calculated or determined velocity needed for user 10 to lob projectiles on to target 12b which is behind obstacle 16. Also in above illustrated examples, 180 FPS is in the center position of 5 shot group or volley, 2 positions before 180 FPS and 2 positions after, as in 160-170-180-190-200 FPS. This calculated velocity (i.e. 180 FPS) can be programmable set and/or positioned in a group and/or cluster (i.e. 5 shot volley) from: 160-170-180-190-200 FPS, to: 170-180-190-200-210 FPS; or (i.e. 3 shot-5 shot cluster) from: 170-180-190 FPS/160-170-180-190-200 FPS, to: 170-180-190 FPS/170-180-180-180-190 FPS). Further still, it would be recognized that the RPS in a group is programmable and the RPS in a collection of groups is programmable (i.e. {3 shot-5 shot group} 13 RPS for the 5 shot group and 10 RPS for the 5 shot group).
In another form, user 10 is firing projectiles at target 12a, using marker 50 set or configured to expel paintballs at an upper velocity setting (see FIG. 19). User 10 then engages target 12b which is behind obstacle 16 with marker 50. In this form, marker 50 includes the self selecting lobbing mode as a function of the signal from tilt sensor 48 and circuit board 66, and programmable velocity spreader mode, as described above. Also in this form, marker 50 comprises controls 77. While circuit board 66 is the principal controller, controls 77 are an additional or secondary controller. Controls 77 are controls for tuning or adjusting one or more operating parameters of marker 50. For example, as described, user 10 engages target 12b behind obstacle 16 with marker 50, but is shooting into a strong head wind. Controls 77 can be configured to allow user 10 to adjust or tune the reading from distance sensor 75 and/or tilt sensor 48, or their values. Thus, allowing user 10 to properly engage target 12b despite the strong head wind.

Further, in another example, user 10 is currently firing projectiles at target 12b with marker 50 in the lobbing burst-velocity spreader mode, but is unable to eliminate target 12b because of uncontrollable circumstances. However, user 10 is keeping target 12b pinned down and effectively out of play of the game. Control 77 of marker 50 is configured to allow user 10 to adjust the rate of fire or rounds per second (RPS) of the lobbing burst-velocity spreader mode, so that user 10 can pin down target 12b more effectively and/or longer before reloading. In another form of the above form, where controls 77 are programmed to adjust the RPS within the lobbing burst-velocity spreader mode, of marker 50, controls 77 can be further programmed to switch marker 50 to “semi-automatic” only at the end of the controller, and to full auto at the other end of the controller, while controlling the RPS of the lobbing burst-velocity spreader mode with the in-between settings of controls 77.

Yet further, in still another example, user 10 is currently firing projectiles at target 12b with above configured marker 50 in the lobbing burst-velocity spreader mode, but is unable to currently eliminate target 12b because of uncontrollable circumstances, as in the above example. In this example however, user 10 needs to eliminate target 12b. If controls 77 of marker 50 were programmed to adjust the spread of the velocity within the lobbing burst-velocity spreader mode (i.e. from 10 FPS programmed velocity spread like 160-170-180-190-200 FPS to a 5 FPS programmed velocity spread like 170-175-180-185-190 FPS). The more concentrated fire of the now adjusted velocity spreader mode will allow user 10 to better eliminate target 12b behind obstacle 16, while still having some of the area coverage of the velocity spreader mode. Thus, user 10 can re-program the self selecting lobbing fire mode and/or velocity spreader fire mode.

In another form, user 10 is illustrated firing projectiles or paintballs at target 12a, using a marker 50 set or configured to expel paintballs at an upper velocity setting (see FIG. 19). User 10 then engages target 12b which is behind obstacle 16 with marker 50 which includes indicators 73 and tilt sensor 48 connected with circuit board 66 (see FIG. 20). In this form, distance sensor 75 is not connected to circuit board 66 or is not allowed. However, controls 77 can be programmed to set the known or estimated distance to target 12b. Circuit board 66 of marker 50 knowing the distance to target 12b through controls 77 can calculate or determine one or more angles for barrel 54 and then indicate the angle(s) of barrel 54 to user 10 through tilt sensor 48 and indicators 73. Once user 10 positions marker 50 in the one or more calculated angles, circuit board 66 can automatically calculate or determine the projectile velocity settings required to lob projectiles or paintballs on to target 12b.

In another form, user 10 is firing projectiles at target 12a and target 12b with marker 50. Marker 50 includes distance sensor 75, indicators 73, and tilt sensor 48 connected with circuit board 66 (see FIG. 21). In this form, marker 50 includes the self selecting lobbing burst mode as a function of the tilt sensor 48 and circuit board 66, and programmable velocity spreader mode, as described above. Also in this form, distance sensor 75 and/or its determined value are programmable to adjust one or more operating parameters of marker 50. For example, user 10 is firing projectiles at target 12a with marker 50 configured to expel projectiles at an upper velocity setting (see FIG. 19). User 10 then tries to eliminate target 12a using the self selecting lobbing burst mode by positioning marker 50 in a predetermined lobbing angle, as described above. Marker 50 being aware of the distance to target 12a through distance sensor 75, recognizes target 12a is beyond the set or programmed distance limit of the self selecting lobbing burst mode and thus remains in semi-automatic mode.

Further, in another example, user 10 is currently firing projectiles at target 12b behind obstacle 16, with above configured marker 50 in the self selecting lobbing burst-velocity spreader mode (see FIG. 19), but is unable to eliminate target 12b because of uncontrollable circumstances. Target 12b moves to get an advantage and runs by user 10. If user 10 engaged adjacent target 12b, marker 50 would self select the semi-automatic mode, at the upper velocity setting; as a function of the more level angular position of marker 50 as sensed by tilt sensor 48. Marker 50, knowing the distance to target 12b through distance sensor 75, automatically adjusts the velocity setting of marker 50 to a safer and/or lower velocity setting. Many, if not most, paintball fields or venues have a surrender rule for recreational paintball players (i.e.—a player is not allowed to shoot another player at 10 feet or closer, one of the players must surrender). This is for the players’ safety, because the markers are set at one velocity setting, which comprises the upper velocity setting.

The described safer or lower velocity setting for an adjacent opponent or target can be configured as an operational fire mode. This surrender mode, for the sake of brevity, can be configured to be pre-programmable and/or re-programmable. Such as, the distance to a target or the determined value from distance sensor 75 could be set, reset, and/or adjusted. Also the selected velocity setting for the safer lower velocity setting could be set, reset, and/or adjusted. Also the surrender mode can be configured as the default setting for the lobbing mode, such as a low power source situation. Further, the surrender mode can be selected by user 10 through controls 77.

In another form, user 10 is illustrated firing projectiles or paintballs at target 12a, using a compressed gas projectile accelerator 50 set or configured to expel paintballs at an upper velocity setting (see FIG. 19). User 10 is also engaging target 12b which is behind obstacle 16 with marker 50 in the self adjusting and/or selecting lobbing burst-velocity spreader mode. In this form, marker 50 includes distance sensor 75, indicators 73, and tilt sensor 48 connected with circuit board 66 (see FIG. 21), described above. Additionally, marker 50 includes speed sensor 72 connected with circuit
board 66. Speed sensor 72 is configured to permit determination of a velocity of a projectile exiting marker 50. Circuit board 66 is adapted to adjust one or more operating parameters of marker 50 as a function of the velocity determination from speed sensor 72 and the desired velocity setting. Thus, circuit board 66 is configured to adjust the velocity of marker 50 to the calculated or desired velocity setting to allow user 10 to engage target 12b with the lobbing burst-velocity spreader mode more effectively. For example, user 10 tunes in or verifies marker 50 is performing properly before play starts, such as being under the upper velocity limit and is on target while in the lobbing burst-velocity spreader mode. Then, as the ambient temperature and/or the temperature of marker 50 changes the operating gas pressure of marker 50 during play, user 10 can then stay on target in the lobbing burst-velocity spreader mode through speed sensor 72. Also user 10 will not exceed the upper velocity setting when not in lobbing mode when engaging target 12a. Further, user 10 will not exceed the RPS setting, as speed sensor 72 can be configured to verify and adjust marker 50 to a RPS setting.

[0145] In yet another form, user 10 is firing projectiles or paintballs at target 12a, using a marker 50 set or configured to expel paintballs at an upper velocity setting (see FIG. 19). User 10 is also engaging target 12b which is behind obstacle 16 in the lobbing burst-velocity spreader mode with marker 50, which includes distance sensor 75, indicators 73, controls 77, tilt sensor 46 and speed sensor 72 connected with circuit board 66 (see FIG. 21). Marker 50 also includes pressure sensor 46 connected with circuit board 66. Pressure sensor 46 is configured to permit determination of the operational pressure of compressed gas and/or its value. Circuit board 66 is configured to adjust one or more operating parameters of marker 50 as a function of the sensed pressure value by pressure sensor 46, and the desired velocity setting, and/or the fire mode. For example, as in previous illustrated form, user 10 is engaging target 12a and target 12b with marker 50 configured as described above. As the ambient temperature and/or the temperature of marker 50 changes the operating gas pressure of marker 50 during play, user 10 can then stay on target in the lobbing burst-velocity spreader mode through speed sensor 72 and/or pressure sensor 46. Also, during play, marker 50 determines that the desired pressure determination and/or the value of pressure sensor 46 cannot be maintained in the lobbing burst-velocity spreader mode at its current RPS setting. Pressure sensor 46 adjusts or reduces the RPS setting to allow user 10 to stay properly engaged with target 12b.

[0144] In still another form, user 10 is illustrated firing projectiles or paintballs at target 12a, using a compressed gas projectile accumulator 50 set or configured to expel paintballs at an upper velocity setting (see FIG. 19). User 10 is also engaging target 12b which is behind obstacle 16 in the lobbing burst-velocity spreader mode with marker 50, which includes distance sensor 75, indicators 73, controls 77, tilt sensor 48 and speed sensor 72 connected with circuit board 66 (see FIG. 21). Marker 50 also includes breech sensor 78 connected with circuit board 66. Breech sensor 78 is configured to permit determination of the status of breech 79. For example, since the breech sensor 78 is an array of sensors, breech sensor 78 can determine or verify an operational members' position (i.e. such as the bolt) in respect to a paintball's position and/or their separation, as a function of the velocity setting and firing modes and/or their values.

[0145] Additionally, in the above form, breech sensor 78 is configured to determine the breech's status and/or condition, such as whether or not breech 79 is fouled with broken paintballs. A fouled breech 79 can affect history of fired paintballs and/or affect the readings from speed sensor 72. For example, user 10 is engaging target 12a with above configured marker 50 at the upper velocity setting. User 10 is also engaging target 12b behind obstacle 16 with marker 50 in the lobbing burst-velocity spreader mode. Breech 79 of marker 50 becomes fouled in the engagement, breech sensor 78 then indicates the fouled breech to user 10 through indicators 73. Also, the fouled breech status from breech sensor 78 in marker 50 allows circuit board 66 to compensate for and/or change the lobbing burst-velocity spreader mode; or allows user 10 to compensate for the broken paintballs in breech 79 of marker 50 with controls 77.

[0146] In still another form, projectile accelerometer 50 is configured with manually selected velocity adjustment mechanism 52, which includes a main velocity adjustor 80, selector 82, set screw 84, aperture 85, dial 86, apertures 88, blocking pin 90, blocking pin 92, and detent 94, disclosed above (see FIGS. 22a-22c). Also velocity adjustment mechanism 52 comprises distance sensor 75, indicators 73, and tilt sensor 48 connected with circuit board 66 (see FIG. 21). In this illustrated form, user 10 sets the upper velocity setting through main velocity adjustor 80 of velocity adjustment mechanism 52 prior to the start of play. User 10 is then able to lob projectiles at a range of velocities ranging from an upper velocity setting to a lower velocity setting once play begins. In one form of the above form, user 10 is able to lob projectiles at a range of velocities ranging from an upper velocity setting to a lower velocity setting, as calculated and/or indicated by circuit board 66 of marker 50 through indicators 73. For example, user 10 is firing projectiles at target 12a in semi-automatic mode with configured and set marker 50. User 10 then engages target 12b which is behind obstacle 16 with marker 50. Circuit board 66 of marker 50 being aware of the distance to target 12b through distance sensor 75 can calculate or determine one or more angles for barrel 54 and indicate the angle(s) of barrel 54 to user 10 through tilt sensor 48 and indicators 73. Once user 10 positions marker 50 in a calculated angle, circuit board 66 can automatically calculate or determine the projectile velocity setting needed to lob projectiles or paintballs on to target 12b. Circuit board 66 can then indicate the calculated velocity setting for velocity adjustment mechanism 52 of marker 50 to user 10 through indicators 73.

[0147] In another form, marker 50 is configured with velocity adjustment mechanism 52 (see FIGS. 22a-22c). Marker 50 includes distance sensor 75, indicators 73, and tilt sensor 48 connected with circuit board 66 (see FIG. 21); as detailed in the above form. In this form though, velocity adjustment mechanism 52 includes speed sensor 72, breech sensor 78, controls 77, and situational connectors or links 44 and 45 connected with circuit board 66. Situational connectors or links 45 are a plurality of connectors positioned on dial 86 to match up with connector 44 of selector 82 of velocity adjustment mechanism 52 (see FIG. 22b). Circuit board 66 being status aware and/or situational aware of marker 50 can further advise user 10 through indicators 73. For example, circuit board 66 of marker 50 can indicate corrections, recalculations, determination changes and/or status changes, and/or their value to user 10 through indicators 73.

[0148] As an example, user 10 is illustrated firing projectiles at target 12a, using above configured marker 50 set to expel paintballs at an upper velocity setting (see FIG. 19).
User 10 is also lobbing projectiles, along one or more substantially arc shaped paths 18 onto target 12b behind obstacle 16. As user 10 switches between target 12a and target 12b, circuit board 66 can indicate the appropriate barrel 54 angle (s) of marker 50 as related to the user 10 selected position of selector 82, or circuit board 66 can indicate a new calculated setting for selector 82 of velocity adjustment mechanism 52 for a current angle of barrel 54. In another example, circuit board 66 of marker 50 can also indicate, through indicators 73, changes in barrel 54 angle(s) or position of selector 82 of velocity adjustment mechanism 52 as it relates to a determined value of speed sensor 72 and/or breech sensor 78. Also, the determined value of speed sensor 72 and/or breech sensor 78 could be adjusted by controls 77, as described above.

[0149] In another form, marker 50 is configured with velocity adjustment mechanism 52 (see FIGS. 22a-22c). Again marker 50 also includes distance sensor 75, indicators 73, speed sensor 72, breech sensor 78, a trigger sensor 70, controls 77, connectors 45, connector 44, and tilt sensor 48 connected with circuit board 66 (see FIGS. 21, 22b). While those skilled in the art would recognize that above configured marker 50 could lob projectiles onto a target, such as target 12b (see FIG. 19), in a lobbing burst mode (as disclosed above) as a function of velocity adjustment mechanism 52 and tilt sensor 48 connected with circuit board 66. Those skilled in the art would also recognize that configured marker 50 could also lob projectiles onto a target, such as target 12b (see FIG. 19), in a velocity spreader mode (also disclosed above) as a manual function of selector 82 of velocity adjustment mechanism 52 connected with circuit board 66 through connectors 45 and connector 44; and indicators 73 and tilt sensor 48 also connected with circuit board 66.

[0150] In yet another form, marker 50 is configured with velocity adjustment mechanism 52 (see FIGS. 22a-22c). Marker 50 also includes distance sensor 75, indicators 73, speed sensor 72, breech sensor 78, trigger sensor 70, controls 77, connectors 45, connector 44, solenoid valve 74, and tilt sensor 48 connected with circuit board 66 (see FIG. 21). Since circuit board 66 of marker 50 can comprise the self selecting lobbing burst mode and/or the velocity spreader mode, with manual assistance. Circuit board 66 of marker 50 can be configured for the combination fire mode, the self selecting lobbing burst-velocity spreader mode (as described above), but with manual assistance. For brevity, the self selecting lobbing burst-velocity spreader mode. For example, user 10 is firing projectiles at target 12a, at an upper velocity setting with marker 50 (see FIG. 19). User 10 is also engaging target 12b in the self selecting lobbing burst-velocity spreader mode with said marker 50.

[0151] Marker 50 includes velocity adjustment mechanism 52 (see FIGS. 22a-22c) connected with circuit board 66, through connector 44 and connectors 45. Circuit board 66 being aware of the distance to target 12b through distance sensor 75 and status aware through speed sensor 72 and breech sensor 78. User 10 simply positions marker 50 in the predetermined angle for barrel 54 with the assistance of indicators 73, moves selector 82 of velocity adjustment mechanism 52 from the upper velocity setting (i.e. FIG. 22a) to the lower velocity setting (i.e. FIG. 22c), while activating trigger sensor 70. Thus, circuit board 66 would release a fire sequence to solenoid valve 74 every time connector 44 of selector 82 linked with and/or connected with a connector 45 that had value, that is, value to the programmed and/or calculated fire commands to lob projectiles in one or more substantially arc shaped paths 18 of a self selecting lobbing burst-velocity spreader mode.

[0152] The release of fire commands and/or sequences from circuit board 66 to solenoid valve 74, as related to moving selector 82 of velocity adjustment mechanism 52 and velocity spreader mode, could be increasing and/or decreasing in nature (i.e. upper velocity setting or lower velocity setting or upper velocity setting). Thus, user 10 could lob projectiles onto target 12b, back to front then front to back as a function of the movement of selector 82 from the upper velocity setting to the lower velocity setting, and then from the lower velocity setting to the upper velocity setting, while activating trigger sensor 70. Additionally, the release of fire commands and/or operational commands from circuit board 66 to solenoid valve 74, as related to moving or rotating selector 82 of velocity adjustment mechanism 52 and velocity spreader mode while activating trigger sensor 70, can be further controlled through circuit board 66 and/or controls 77.

[0153] For example, in the above form, user 10 is engaging target 12b, which is behind obstacle 16, with the above described configured marker 50. User 10 is moving or rotating selector 82 of velocity adjustment mechanism 52 as a function of the assisted velocity spreader mode, while activating trigger sensor 70. User 10 moves selector 82 to fast and marker 50 is in jeopardy of exceeding the programmed RPS limit, as such one or more values of the fire commands are ignored by circuit board 66. Thus, the release of fire commands and/or operational commands from circuit board 66 of the assisted velocity spreader mode are programmable and/or re programmable.

[0154] Another aspect of the present invention discloses a kit for retrofitting a compressed gas projectile accelerator 50. The kit includes a velocity control method, as disclosed and described above with respect to FIGS. 1-22c, that is configured to allow marker 50 to expel a plurality of projectiles between a defined range of velocity settings, within a range of operational modes. A component controller or circuit board is included in the kit for allowing a user to selectively configure, program, and/or re-program the velocity control method or operational modes. The exact components included in the kit will vary depending on the design of marker 50, but will include one or more of the methods described and set forth with respect to FIGS. 1-22c.

[0155] Referring to FIG. 23, as previously set forth, marker 50 includes electronic circuit board 66 that is configured to monitor and control various functional aspects of marker 50. In one representative form, circuit board 66 includes a processor 101 that is programmable to execute one or more software routines. Processor 101 can comprise a microprocessor including on-board memory for storing executable program code or memory may be connected with processor 101. In some prior art electronic markers, it is envisioned that the markers can be retrofit with a new circuit board, as well as other components, to incorporate one or more features of the present invention.

[0156] In one form, circuit board 66 includes a firing mode module or routine 600 that allows user 10 to select a desired firing mode for marker 50. User 10 can configure marker 50 to fire in a straight fire mode, a lobbing mode, or an auto-select mode. In one form, controls 77 are used by user 10 to select a respective firing mode within the firing mode module 600. Selection of the straight fire mode causes marker 50 to execute a straight fire mode module 602. In straight fire mode,
marker 50 is configured to fire projectiles as a conventional marker 50. In other words, marker 50 is configured to fire projectiles at the upper velocity setting and can fire projectiles in either semi-automatic mode (e.g. —1 projectile per trigger pull), fully automatic mode (e.g. — continuous projectile fire as long as trigger is depressed), burst mode (e.g. —5 projectiles per trigger pull) or ramp mode (e.g. —12 projectiles per 6 trigger pulls). As such, in one form, straight fire mode module 602 is configured to selectively execute a semi-automatic mode module 604, a fully automatic mode module 606, a burst mode module 608, or a ramp mode module 605. Each of the above-referenced modules 604-608 configure marker 50 to operate according to each respective firing mode.

Firing mode module 600 also allows user 10 to configure marker 50 to fire in a lobbing mode by execution of a lobbing mode module 610. As previously set forth, the lobbing mode allows user 10 to lower the velocity at which projectiles are expelled from barrel 54 of marker 50 such that the projectiles travel along arc shaped paths. Together with angling barrel 54 at predetermined angles, the lobbing mode allows user 10 to strike targets 12b behind obstacles 16 that would otherwise be able to avoid being struck if marker 50 was firing in straight fire mode. This is because at lower velocity settings, projectiles leaving barrel 54 of marker 50 travel along various arc shaped paths as a function of the velocity setting of marker 50. As previously set forth, in one form, circuit board 66 is configured to control operation of solenoid valve 74 to allow marker 50 to expel projectiles at varying velocity settings.

Firing mode module 600 also allows user 10 to select an auto-select mode module 612 that configures marker 50 to operate in an auto-select fire mode. As used herein, the phrase auto-select fire mode should be construed to mean that marker 50 is configured to automatically select either a straight fire mode or lobbing mode as a function of a sensor signal from tilt sensor 48. As previously set forth, if tilt sensor 48 indicates that barrel 54 of marker 50 is angled above a predetermined threshold value (e.g. —any angle above 35° relative to ground G), which would indicate that marker 50 is positioned to lob projectiles on target 12b, auto-select mode module 612 is configured to switch marker 50 to lobbing mode. If marker 50 is positioned below the predetermined threshold value, which would indicate that marker 50 is positioned to fire substantially directly at a target 12a, auto-select mode module 612 is configured to switch marker 50 to straight fire mode.

Referring to FIG. 24, lobbing mode module 610 is configured to allow user 10 to set marker 50 to fire in a semi-automatic firing mode 616, a full-automatic firing mode 617, a burst firing mode 614, or a ramp firing mode 615. If burst firing mode 614 or ramp firing mode 615 is selected by user 10, a configuration module 618 allows user 10 to configure a projectile per trigger pull (e.g. —burst firing mode — 3 projectiles per trigger pull, 5 projectiles per trigger pull, and so forth) or (e.g. —ramp firing mode — 12 projectiles per second for 6 trigger pulls per second)). A spreader mode module 620 allows user 10 to determine whether or not marker 50 is configured to expel projectiles in a spread of velocity settings in which each projectile is assigned a distinct velocity within a range of velocities. If user 10 selects velocity spreader mode, a velocity spread setting module 622 allows user 10 to set the FPS difference between respective rounds. For example, user 10 can configure marker 50 to expel projectiles in increments of 5 FPS, 10 FPS, and so forth.

Also, velocity spread setting module 622 allows user 10 to set the FPS setting, assign placement in the volley to the determined velocity, and combine volleys or groups into collections, as previously set forth.

Once user 10 configures marker 50 to function in lobbing mode and selects the velocity spreader mode, a progressive mode module 624 provides user 10 with the option to select a progressive mode. Progressive mode module 624 allows marker 50 to expel projectiles in a progressive up, a progressive down, or a progressive up and down manner. For example, marker 50 is configured to expel projectiles in a progressive mode such that the velocity settings progresses up and down in the spreader mode (e.g. — first 5 shot burst at velocities of 160 FPS, 170 FPS, 180 FPS, 190 FPS, and 200 FPS; second 5 shot burst at velocities of 200 FPS, 190 FPS, 180 FPS, 170 FPS, 160 FPS). As such, progressive mode module 624 configures marker 50 to function in a velocity progressive mode as represented at 626. As previously set forth, user 10 can use controls 77 to configure the operation of marker 50 amongst the various operating modes.

Referring to FIGS. 21 and 25, in one form marker 50 is configured in the lobbing mode to automatically calculate velocity settings and angles of barrel 54 as a function of readings obtained from distance sensor 75 and tilt sensor 48. For the sake of brevity, marker 50 has already been configured by user 10 to either operate in the lobbing mode or the auto-select mode. During play, user 10 encounters target 12b, which is hidden behind a respective obstacle 16. Using distance sensor 75, a distance reading module 700 allows user 10 to obtain a distance reading to target 12b. In the alternative, user 10 can manually enter a distance to target 12b using controls 77.

Marker 50 includes a lobbing algorithm module 702 that is configured to calculate a plurality of angles for barrel 54 to be positioned at and a plurality of velocity settings needed for marker 50 to be able to lob projectiles onto target 12b. In one form, the velocity settings are calculated as a function of the calculated angles. As such, one respective calculated angle setting will have a first set of velocity settings used to lob projectiles onto target 12b and another calculated angle setting will have a second set of velocity settings, and so forth. Multiple angles and sets of velocity settings may be required to lob projectiles onto target 12b depending on various factors, such as the height of the obstacle, the distance to target 12b, and so forth. As such, lobbing algorithm module 702 is configured to calculate a plurality of angles and sets of velocity settings corresponding to each respective calculated angle in order to lob projectiles onto target 12b.

In another form, marker 50 also includes an indicator control module 704 configured to control operation of indicators 73 to guide user 10 to position barrel 54 of marker 50 at the one or more calculated angles. Indicator control module 704 uses signals from tilt sensor 48 to determine whether barrel 54 of marker 50 is positioned at one in more of the calculated angles. As previously set forth, up and down arrows (see FIG. 22(a) of indicators 73 can be used to guide user 10 to place marker 50 in the proper angular position. Once marker 50 is placed at one or more of the calculated angles, a respective indicator 73 is illuminated to indicate marker 50 is positioned at one or more of the calculated angles.

A firing module 706 monitors the status of trigger 62 and in response to a pull of trigger 62, marker 50 expels a plurality of projectiles in a spreader mode at target 12b. In this
form, marker 50 expels the projectiles at the set of velocity settings corresponding to the calculated angle. As should be appreciated, varying the angle of barrel 54 will vary the arc shaped path that projectiles that are expelled from marker 50 travel to reach target 128. As the angle of barrel 54 is changed, the set of calculated velocities that projectiles need to be expelled to reach target 128 adjusts as a function of the distance to target 128 and the angular position of barrel 54 of marker 50.

[0165] Another aspect of the present invention discloses a method, comprising the steps of a) configuring a compressed gas projectile accelerator to expel multiple projectiles from multiple selected velocity settings falling between a first velocity setting and a second velocity setting; and b) providing a controller configured to allow a user to selectively choose, program, and/or reprogram a plurality of velocity settings falling between the first and second velocity settings.

[0166] Yet another aspect of the present invention discloses a method, comprising the steps of a) configuring a compressed gas projectile accelerator to expel multiple projectiles from multiple selected velocity settings falling between a first velocity setting and a second velocity setting; and b) providing a programmable controller configured for selectively choosing a plurality of velocity settings falling between the first and second velocity settings.

[0167] A further aspect of the present invention discloses a method, comprising the steps of a) configuring a compressed gas projectile accelerator to expel multiple projectiles from multiple selected velocity settings falling between a first velocity setting and a second velocity setting; and b) providing a programmable controller configured for selectively choosing an operational mode from a plurality of operational modes with velocity settings falling between the first and second velocity settings.

[0168] A further aspect of the present invention discloses a projectile accelerator. The projectile accelerator includes a compressed gas source; a gas releasing mechanism in communication with the compressed gas source; a trigger mechanism for selectively controlling the gas releasing mechanism; and a controller associated with said gas releasing mechanism for allowing said projectile accelerator to be selectively controlled in a manner in which projectiles are expelled from said projectile accelerator between an upper velocity setting and a lower velocity setting, where said projectiles are expelled from said projectile accelerator in a lobbed manner with differing lower velocities and in a non-lobbed manner with an upper velocity setting.

[0169] Another aspect of the present invention discloses a compressed gas projectile accelerator, comprising: a compressed gas source; a compressed gas control mechanism in communication with said compressed gas source for selectively controlling compressed gas to expel a multiple of projectiles; and a projectile velocity controller configured to selectively expel projectiles at a multitude of selected velocity settings falling within a range of velocity settings.

[0170] Yet another aspect of the present invention discloses an electronic projectile accelerator, comprising: an electronic circuit board; a velocity control in communication with the electronic circuit board for allowing the velocity selection from a variety of velocity settings at which projectiles are expelled from a barrel, where a velocity selection is not permitted to go above a predetermined maximum value; and a fire mode within the electronic circuit board, where the fire mode is configured to control one or more operating parameters of the electronic circuit board as a function of the velocity selection.

[0171] Another aspect of the present invention discloses an electronic projectile accelerator, comprising: an electronic circuit board; a controller connected with said electronic circuit board to allow the selection of velocity settings from a range of velocity settings at which projectiles are expelled from a barrel, while not permitting said velocity setting to go above a predetermined maximum value; and an operational mode in association with said electronic circuit board, where said electronic circuit board is configured to control one or more operating parameters of said electronic projectile accelerator as a function of said velocity settings, while not permitting a determined value to go above a predetermined maximum value in said operational mode.

[0172] A further aspect of the present invention discloses a circuit board for a compressed gas projectile accelerator. The circuit board includes software routines or modules that include a firing module configured to operate the compressed gas projectile accelerator in a straight fire mode and a lobbing mode. The straight fire mode is operable to configure the marker to operate in a semi-automatic mode, a fully-automatic mode, and a burst mode. The lobbing mode is configured to expel a group of projectiles at varying velocities within a range of velocities falling between an upper velocity limit and a lower velocity limit. Each projectile in the group of projectiles is assigned a distinct velocity setting.

[0173] While the invention has been illustrated and described in detail in the drawings and foregoing description, the same is to be considered as illustrative and not restrictive in character, it being understood that only the preferred embodiments have been shown and described and that all changes and modifications that come within the spirit of the inventions are desired to be protected. It should be understood that while the use of words such as preferable, preferably, preferred or more preferred utilized in the description above indicate that the feature so described may be more desirable, it nonetheless may not be necessary and embodiments lacking the same may be contemplated as within the scope of the invention, the scope being defined by the claims that follow. In reading the claims, it is intended that when words such as "a," "an," "at least one," or "at least one portion" are used there is no intention to limit the claim to only one item unless specifically stated to the contrary in the claim. When the language "at least a portion" and/or "a portion" is used the item can include a portion and/or the entire item unless specifically stated to the contrary.

What is claimed is:

1. A compressed gas projectile accelerator, comprising: a controller configured to dynamically expel projectiles within a range of velocity settings falling between an upper velocity setting and a lower velocity setting.

2. The compressed gas projectile accelerator of claim 1, where said controller is further configured to expel a plurality of projectiles at a plurality of velocities falling within said range of velocity settings.

3. The compressed gas projectile accelerator of claim 2, where said controller is configured to expel a plurality of projectiles at a plurality of velocities in a controlled manner falling within said range of velocity settings.

4. The compressed gas projectile accelerator of claim 3, where said controller is configured to expel a plurality of
projectiles at a plurality of velocities assembled in one or more groups in a controlled manner falling within said range of velocity settings.

5. The compressed gas projectile accelerator of claim 1, further comprising a tilt sensor connected with said controller, said controller being configured to control one or more operational parameters of said compressed gas projectile accelerator as a function of signals received from said tilt sensor.

6. The compressed gas projectile accelerator of claim 1, further comprising a breech sensor connected with said controller, where said controller is configured to control one or more operational parameters of said compressed gas projectile accelerator as a function of signals received from said breech sensor.

7. The compressed gas projectile accelerator of claim 1, further comprising a velocity sensor connected with said controller, where said controller is configured to control one or more operational parameters of said compressed gas projectile accelerator as a function of signals received from said velocity sensor.

8. The compressed gas projectile accelerator of claim 1, further comprising a distance sensor connected with said controller, where said controller is configured to control one or more operational parameters of said compressed gas projectile accelerator as a function of signals received from said distance sensor.

9. The compressed gas projectile accelerator of claim 1, where said controller is connected with a solenoid valve and is configured to control one or more operational parameters of said solenoid valve as a function of one or more velocity settings.

10. The compressed gas projectile accelerator of claim 1, further comprising a secondary velocity controller configured to control one or more operational parameters of said compressed gas projectile accelerator.

11. The compressed gas projectile accelerator of claim 1, further comprising a pressure sensor connected with said controller, where said controller is configured to control one or more operational parameters of said compressed gas projectile accelerator as a function of signals received from said pressure sensor.

12. The compressed gas projectile accelerator of claim 1, further comprising a selector configured to control one or more operational parameters of said compressed gas projectile accelerator.

13. The compressed gas projectile accelerator of claim 1, where said controller comprises a microprocessor-based programmable controller.

14. The compressed gas projectile accelerator of claim 1, where said controller comprises an electronic circuit board.

15. The compressed gas projectile accelerator of claim 1, where said controller comprises an electronic circuit board configured to control one or more operational parameters to expel projectiles within said range of velocity settings.

16. The compressed gas projectile accelerator of claim 1, where said controller is configured to expel projectiles in a plurality of firing modes within said range of velocity settings.

17. The compressed gas projectile accelerator of claim 16, where said firing modes are either pre-programmed or re-programmable.

18. The compressed gas projectile accelerator of claim 1, where said controller is automatically configured to enter a surrender fire mode where projectiles are expelled at a low velocity setting if a target is below a predetermined distance threshold.

19. The compressed gas projectile accelerator of claim 1, where said controller is configured to place said compressed gas projectile accelerator in an energy saving mode if a tilt sensor senses said compressed gas projectile accelerator is positioned in a predetermined angular alignment relative to a reference point.

20. The compressed gas projectile accelerator of claim 1, where said controller is configured to vary a number of projectiles expelled in a group of projectiles.

21. The compressed gas projectile accelerator of claim 1, where said controller is configured to automatically expel projectiles in a plurality of groups of projectiles and vary the velocity setting at which one or more of said groups of projectiles are expelled from said compressed gas projectile accelerator.

22. The compressed gas projectile accelerator of claim 1, where said controller is configured to vary velocity settings of one or more projectiles in a group of projectiles being expelled from said compressed gas projectile accelerator.

23. The compressed gas projectile accelerator of claim 1, where said controller is connected with a tilt sensor and a distance sensor, where said controller is configured to automatically calculate one or more velocity settings within said range of velocity settings to expel projectiles at a target as a function of signals received from said distance sensor and said tilt sensor.

24. The compressed gas projectile accelerator of claim 23, where said controller is further configured to automatically calculate an angular alignment of said compressed gas projectile accelerator relative to a reference point as a function of said velocity settings.

25. The compressed gas projectile accelerator of claim 24, further comprising one or more indicators connected with said controller, where said controller is configured to guide a user to said angular alignment using said indicators.

26. The compressed gas projectile accelerator of claim 1, where said controller controls said velocity settings as a function of readings determined from an array of sensors.

27. The compressed gas projectile accelerator of claim 1, where said controller is configured to self select an operational firing mode.

28. The compressed gas projectile accelerator of claim 1, where said controller is configured to combine different operational firing modes.

29. The compressed gas projectile accelerator of claim 1, where said controller is configured to self select a velocity setting from said range of said velocity settings.

30. The compressed gas projectile accelerator of claim 1, where said controller is configured to determine a proper velocity setting from said range of velocity settings as a function of a distance to target value.

31. The compressed gas projectile accelerator of claim 30, where the distance to target value is input by a user.

32. The compressed gas projectile accelerator of claim 30, where the distance to target value is obtained from a distance sensor connected with said controller.

33. The compressed gas projectile accelerator of claim 30, where said controller is further configured to determine a proper angular position for a barrel of said compressed gas projectile accelerator as a function of the distance to target value.
34. The compressed gas projectile accelerator of claim 1, where said controller is configured to expel a plurality of projectiles in arc shaped paths within said range of velocity settings.

35. The compressed gas projectile accelerator of claim 1, where said compressed gas projectile accelerator is configured to expel a plurality of projectiles at diverse velocity settings chosen from within said range of velocity settings.

36. A method, comprising:
   configuring a compressed gas projectile accelerator to dynamically expel projectiles at a variety of selected velocity settings falling between an upper velocity setting and a lower velocity setting.

37. The method of claim 36, further comprising prohibiting the selection of a velocity setting above said upper velocity setting.

38. The method of claim 36, further comprising controlling operation of a solenoid to control projectile velocity between said upper and lower velocity settings.

39. The method of claim 36, further comprising setting a velocity setting as a function of a signal from a tilt sensor.

40. The method of claim 36, further comprising setting a velocity setting as a function of a signal from a breech sensor.

41. The method of claim 36, further comprising setting a velocity setting as a function of a signal from a distance sensor.

42. The method of claim 36, further comprising setting a velocity setting as a function of a signal from a pressure sensor.

43. The method of claim 36, further comprising setting a velocity setting with a selector.

44. The method of claim 36, further comprising setting a velocity setting as a function of a reading from a pressure sensor.

45. The method of claim 36, further comprising providing a firing sequence configured to control projectile velocity such that projectiles are expelled having multiple velocity settings within said upper and lower velocity settings.

46. The method of claim 36, further comprising configuring said compressed gas projectile accelerator to include a plurality of firing modes.

47. The method of claim 36, further comprising allowing a predetermined number of projectiles to be expelled relative to trigger activations.

48. The method of claim 36, further comprising configuring said compressed gas projectile accelerator to fire projectiles in a group in response to a trigger pull.

49. The method of claim 48, further comprising automatically selecting a distinct velocity setting for each projectile in said group.

50. The method of claim 36, further comprising calculating an expelling angle of a barrel for selected velocity settings falling between said upper and lower velocity settings.

51. The method of claim 36, further comprising configuring said compressed gas projectile accelerator to dynamically select a firing mode as a function of one or more sensed values.

52. The method of claim 51, where said sensed value comprises a distance sensor signal.

53. The method of claim 51, where said sensed value comprises a tilt sensor signal.

54. The method of claim 36, further comprising automatically entering a safety mode as a function of a sensed value.

55. The method of claim 54, where said sensed value comprises a distance sensor signal, where said safety mode comprises automatically setting a velocity setting to a low velocity setting as a function of said distance sensor signal.

56. The method of claim 54, where said sensed value comprises a sensed angular position of a barrel of said compressed gas projectile accelerator.

57. The method of claim 54, where said safety mode comprises restricting said compressed gas projectile accelerator from expelling projectiles.

58. The method of claim 36, further comprising configuring said compressed gas projectile accelerator to include a projectile lobbing mode.

59. The method of claim 58, where said projectile lobbing mode is configured to automatically expel at least one group of projectiles at varying velocity settings within said upper and lower velocity settings.

60. The method of claim 58, where said projectile lobbing mode comprises expelling projectiles in a collection of groups at velocity settings falling within said upper and lower velocity settings.

61. The method of claim 58, where said projectile lobbing mode comprises expelling projectiles with selected positions within a group at varying velocity settings.

62. The method of claim 36, further comprising obtaining a distance to target signal from a distance sensor.

63. The method of claim 62, further comprising calculating one or more angles for a barrel position as a function of said distance to target signal.

64. The method of claim 63, further comprising calculating one or more sets of velocity settings corresponding to each said one or more angles.

65. The method of claim 64, further comprising monitoring an angular position of said barrel and generating an indication to a user when said barrel reaches said one or more calculated angles.

66. The method of claim 65, further comprising expelling projectiles at said calculated set of velocity settings corresponding to said one or more calculated angles.

67. A compressed gas projectile accelerator, comprising:
   a compressed gas source;
   a compressed gas releasing mechanism in communication with said compressed gas source for selectively releasing compressed gas to expel projectiles; and
   a controller connected with said compressed gas releasing mechanism configured to selectively expel projectiles at a plurality of velocity settings falling within a range of velocity settings.

68. The compressed gas projectile accelerator of claim 67, further comprising a selector for adjustably selecting a velocity setting in said range of velocity settings.

69. The compressed gas projectile accelerator of claim 67, further comprising a spreader mode module stored in said controller configured to expel a plurality of projectiles, where said plurality of projectiles are each assigned a distinct velocity setting.

70. The compressed gas projectile accelerator of claim 67, further comprising an auto-select mode module configured to automatically change firing modes as a function of a sensed value.

71. The compressed gas projectile accelerator of claim 70, where said sensed value comprises a tilt sensor signal.
72. The compressed gas projectile accelerator of claim 67, where said controller is configured to expel projectiles in a projectile grouping mode.

73. The compressed gas projectile accelerator of claim 67, where said controller is configured to determine one or more velocity settings for projectiles as a function of a distance determination.

74. The compressed gas projectile accelerator of claim 67, where said controller is configured to determine one or more velocity settings for projectiles as a function of a distance determination.

75. The compressed gas projectile accelerator of claim 67, where said controller is configured to determine one or more angles of a barrel as a function of a velocity setting falling within said range of velocity settings.

76. The compressed gas projectile accelerator of claim 67, where said controller is configured to determine one or more velocity settings for projectiles from a velocity determination.

77. The compressed gas projectile accelerator of claim 67, where said controller is configured to determine one or more velocity settings for projectiles from a pressure determination.

78. The compressed gas projectile accelerator of claim 67, where said controller is configured to control and verify a number of projectiles expelled in a time setting.

79. The compressed gas projectile accelerator of claim 67, where said controller is configured to control and verify a number of projectiles expelled in a group of projectiles, where each projectile in said group of projectiles is assigned a distinct velocity setting.

80. The compressed gas projectile accelerator of claim 67, where said controller is configured to expel projectiles separated into groups falling within said range of velocity settings.

81. The compressed gas projectile accelerator of claim 67, where said controller is configured to advise a user of calculated angular positions of a barrel such that projectiles are expelled from said barrel at a target in a lobbed manner.

82. A kit for retrofitting a compressed gas projectile accelerator, comprising:
   - a controller configured to allow the selection of a straight firing mode and a lobbing firing mode, where said controller is further configured to expel projectiles in a range of velocity settings.
   - The kit for retrofitting a compressed gas projectile accelerator of claim 82, where said controller comprises an electronic circuit board.
   - The kit for retrofitting a compressed gas projectile accelerator of claim 82, where said controller is configured to expel a group of projectiles.
   - The kit for retrofitting a compressed gas projectile accelerator of claim 84, where each projectile in said group of projectiles is assigned a distinct velocity.
   - The kit for retrofitting a compressed gas projectile accelerator of claim 82, further comprising a distance sensor connected with said controller.
   - The kit for retrofitting a compressed gas projectile accelerator of claim 82, where said controller is configured to expel projectiles at distinct velocity settings as a function of a distance signal generated by said distance sensor.
   - The kit for retrofitting a compressed gas projectile accelerator of claim 82, further comprising a user control connected with said controller.

83. The kit for retrofitting a compressed gas projectile accelerator of claim 88, where said controller is configured to expel projectiles in said range of velocity settings as a function of a distance to target value input with said user control.

84. The kit for retrofitting a compressed gas projectile accelerator of claim 82, further comprising a tilt sensor connected with said controller.

85. The kit for retrofitting a compressed gas projectile accelerator of claim 90, where said controller is configured to expel a group of projectiles as a function of a signal from said tilt sensor.

86. The kit for retrofitting a compressed gas projectile accelerator of claim 82, where said controller is configured to automatically select a respective firing mode from a group of firing modes.

87. A projectile accelerator, comprising:
   - an electronic circuit board; and
   - a controller connected with said electronic circuit board configured to allow the selection of velocity settings from a range of velocity settings at which projectiles are expelled from a barrel.

88. The projectile accelerator of claim 94, further comprising a sensor configured to permit determination of a velocity of a projectile exiting said projectile accelerator.

89. The projectile accelerator of claim 94, where said electronic circuit board is adapted to adjust one or more operating parameters of said projectile accelerator as a function of said velocity.

90. The projectile accelerator of claim 93, further comprising a sensor configured to permit determination of an angular position of said projectile accelerator.

91. The projectile accelerator of claim 98, where said electronic circuit board is configured to adjust one or more operating parameters of said projectile accelerator as a function of said velocity.

92. The projectile accelerator of claim 93, further comprising a sensor configured to permit determination of a distance to a target.

93. The projectile accelerator of claim 93, further comprising a sensor configured to permit determination of an angular position of said projectile accelerator.

94. The projectile accelerator of claim 96, where said electronic circuit board is adapted to adjust one or more operating parameters of said projectile accelerator as a function of said angle.

95. The projectile accelerator of claim 93, further comprising a sensor configured to permit determination of a distance to a target.
operating parameters of said projectile accelerator as a function of said number of projectiles expelled in said time setting.

106. The projectile accelerator of claim 93, further comprising a user control configured alternatively to a sensor.

107. A compressed gas projectile accelerator, comprising:
- a compressed gas source;
- a compressed gas control mechanism in communication with said compressed gas source for selectively controlling compressed gas to expel a plurality of projectiles; and
- a projectile velocity controller configured to selectively expel projectiles at a plurality of selected velocity settings falling within a range of velocity settings.

108. A projectile accelerator, comprising:
- a compressed gas source;
- a gas releasing mechanism in communication with said compressed gas source;
- a trigger mechanism for selectively controlling said gas releasing mechanism; and
- a controller associated with said gas releasing mechanism for allowing said projectile accelerator to be selectively controlled in a manner in which projectiles are expelled from said projectile accelerator between an upper velocity setting and a lower velocity setting, where said projectiles are capable of being expelled from said projectile accelerator in a straight fire mode and a lobbing fire mode.

109. The projectile accelerator of claim 108, where said lobbing fire mode expels projectiles at controlled lower velocity settings such that projectiles travel along an arced shaped path.

110. A circuit board for a compressed gas projectile accelerator, comprising:
- a firing module configured to operate said compressed gas projectile accelerator in a straight fire mode and a lobbing mode.

111. The circuit board of claim 110, where said straight fire mode is configured to operate said compressed gas projectile accelerator in a semi-automatic mode, a fully-automatic mode, a ramp mode and a burst mode.

112. The circuit board of claim 110, where said lobbing mode is configured to expel a group of projectiles at varying velocities within a range of velocities falling between an upper velocity limit and a lower velocity limit.

113. The circuit board of claim 112, where each projectile in said group of projectiles is assigned a distinct velocity setting.

114. The circuit board of claim 110, where said lobbing mode includes a progressive mode configured to expel a group of projectiles at varying velocities that increase and decrease in velocity within a range of velocities.

115. The circuit board of claim 110, where said lobbing mode is configured to operate said compressed gas projectile accelerator in a semi-automatic mode, a fully-automatic mode, a ramp mode and a burst mode.

116. A compressed gas projectile accelerator, comprising:
- a compressed gas source;
- a compressed gas control mechanism in communication with said compressed gas source for selectively controlling compressed gas to expel projectiles; and
- a tilt sensor configured to sense the angular position of said compressed gas projectile accelerator.

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