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(57) **ABSTRACT**

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[illegible]

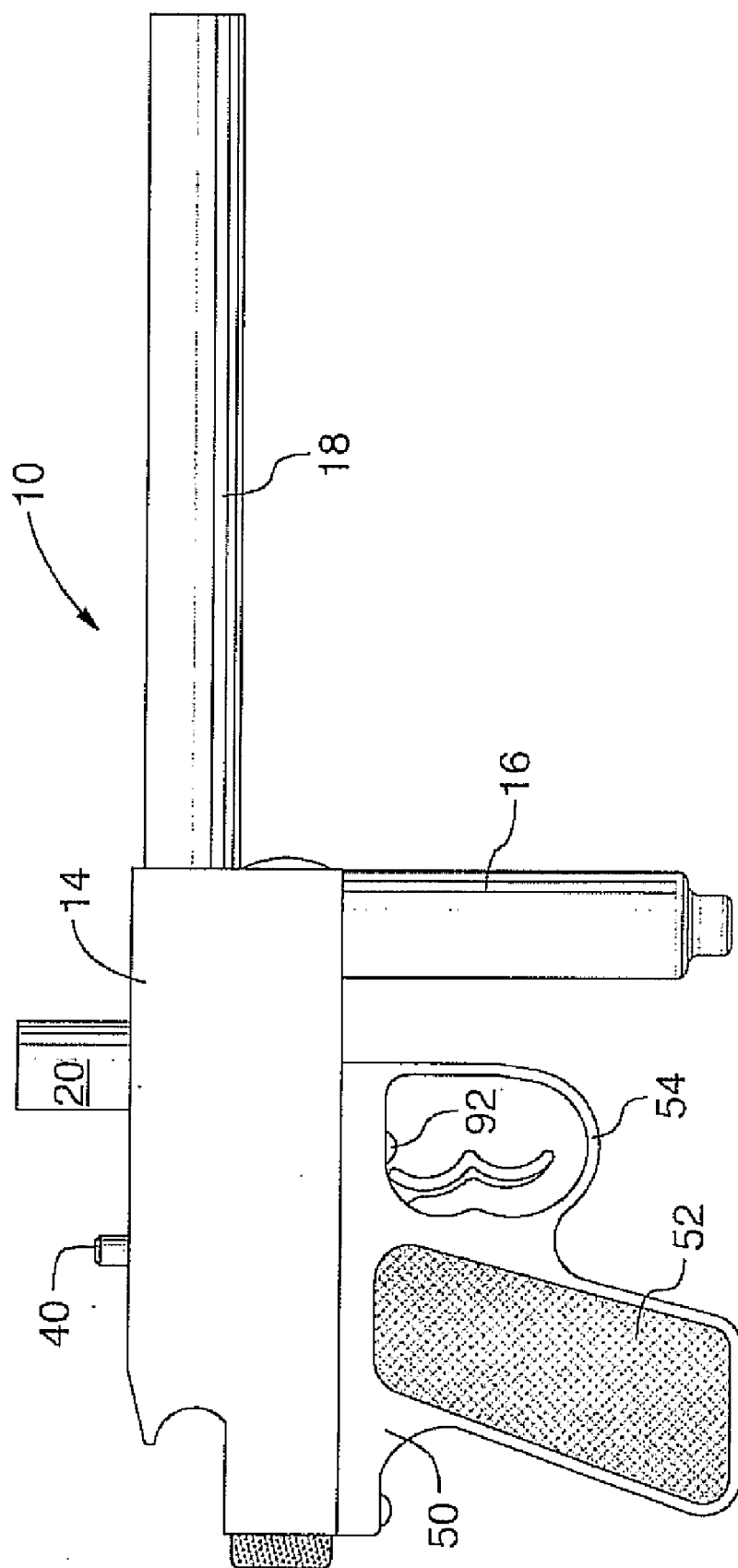


FIG. 1

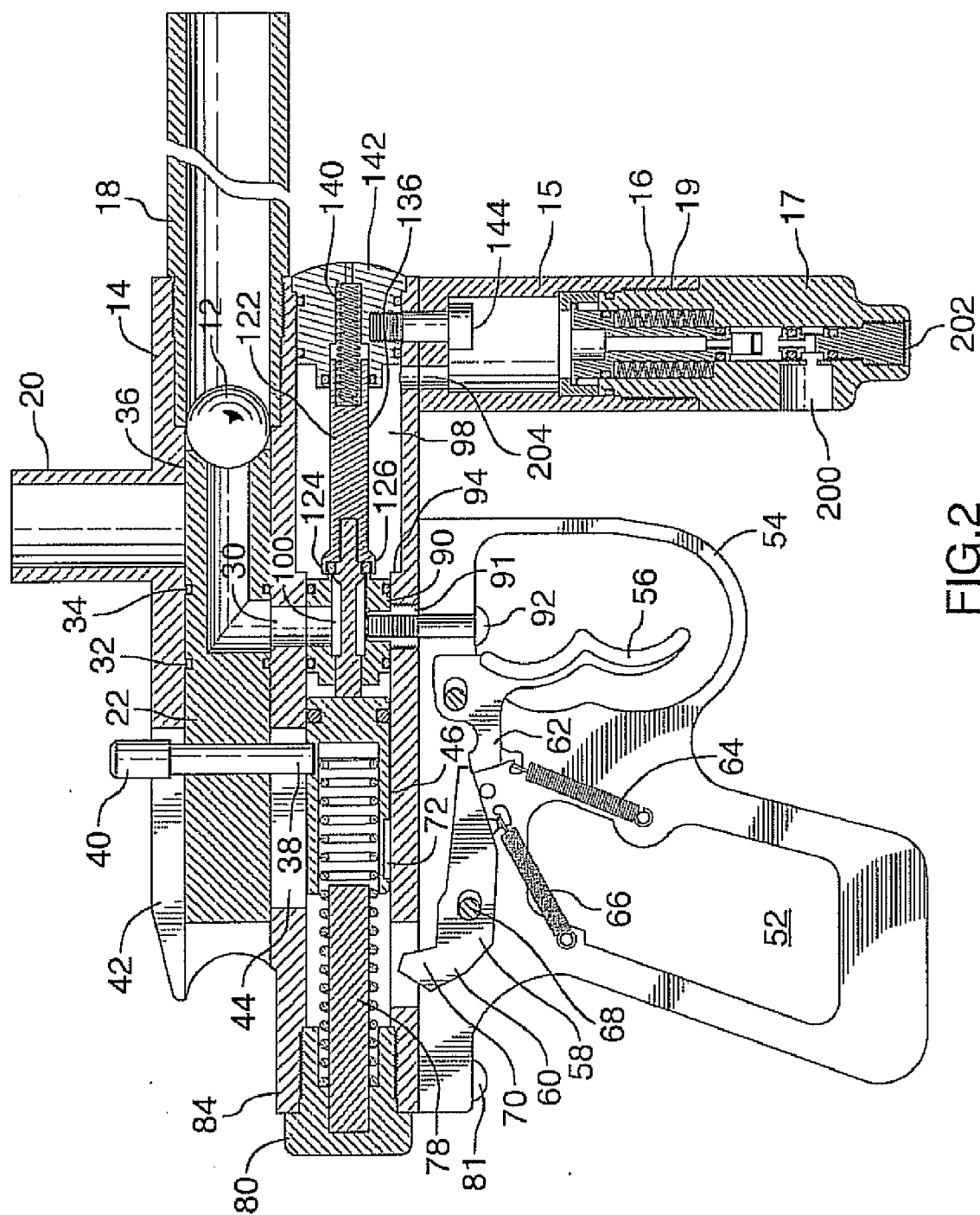


FIG. 2

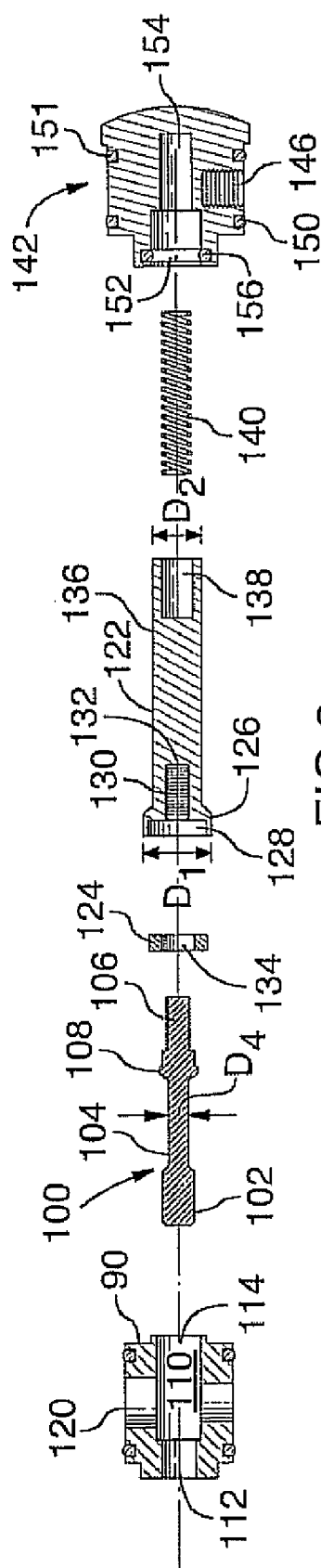


FIG. 3

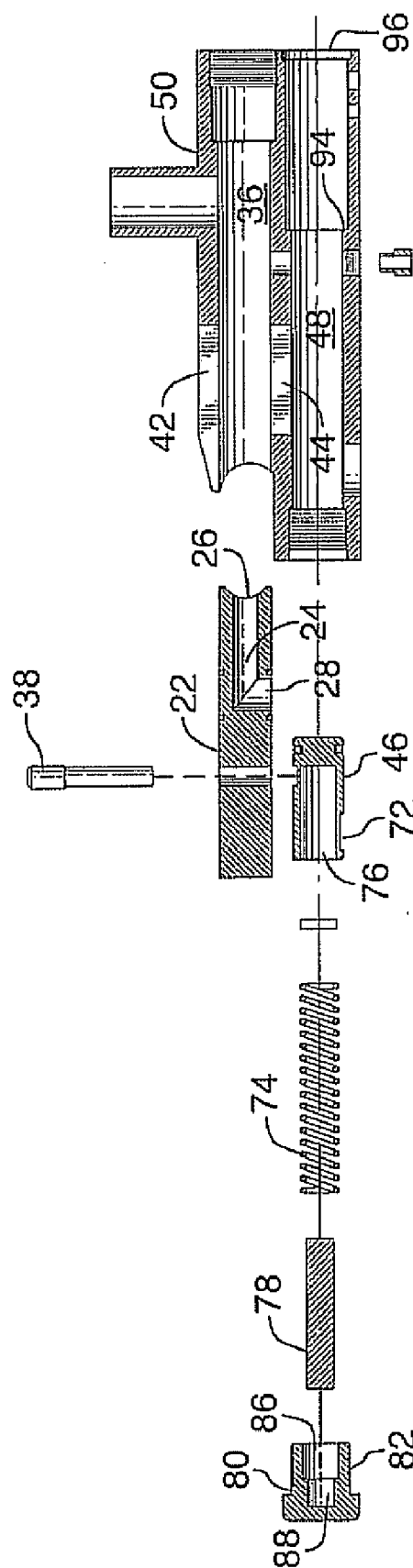


FIG. 4

GUN FOR FIRING BALLS USING LOWER GAS PRESSURE

RELATED APPLICATION

[0001] This application claims priority of U.S. Provisional Patent Application Ser. No. 60/810,146 filed Jun. 2, 2006, which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] This invention relates to gas-powered guns and, in particular, guns suitable for firing balls, such as paintballs, dispensed from a magazine.

[0003] A variety of guns have been developed over many years for firing balls using compressed gas. A number of these guns have been developed for the purpose of shooting paintballs which typically comprise a special, liquid mixture encased in a gelatin layer which will rupture upon impact of the balls with their targets. These guns can each be attached to a pressurized gas source in the form of a metal cylinder containing a gas such as carbon dioxide, nitrogen or air.

[0004] A common mechanism for firing a gun, including a paintball gun, involves the use of a sear mechanism and a sliding hammer which can be held in a cocked position by a sear member. The sear mechanism can be operated by means of a trigger and, when the trigger is pulled, the sear member becomes disengaged from the hammer, allowing the hammer to be driven to its firing position. It is known to use a coil spring which biases the hammer to the firing position. In the firing position, the hammer strikes a valve member causing it to move and release a quantity of pressurized air to propel a paintball from a loaded position through the gun barrel. In addition, many gas-powered guns employ gas blowback, i.e. a smaller quantity of pressurized air which is released when the hammer strikes the valve, to push the hammer back in order to reload the gun. In many of these known gas-powered guns, the force required to open the gas valve is proportional to the area of the valve stem exposed to the source of pressurized gas. The hammer and the spring which drives the hammer forwardly must overcome the force of the pressurized gas on this area in order to open the valve sufficiently to release the desired quantity of pressurized gas or air.

[0005] If one can reduce the area of the valve stem which is exposed to the source of pressurized gas, the result will be that less force will be required to open the valve. However, there must be a good seal between the valve seat and the valve body to prevent leakage or passage of pressurized gas through the valve body when the valve is closed. Because of this necessity, there is a limit on the smallest diameter of the valve seat that can be used in practice if the valve seal and valve body are to seal the pressurized air properly while at the same time allowing a sufficient flow of pressurized air through the valve when the valve is opened. Because of these known gun requirements, prior art pressurized gas guns generally require a pressure of 500 to 600 psi in order to operate as desired and to provide a paintball velocity of 300 fps.

[0006] There remains a need for an improved gas-powered gun which can operate at reduced gas pressures while still having the capability of propelling a paintball from the barrel at a velocity of at least 300 fps. By providing a

pressurized gas gun that is able to operate at a lower operating pressure, and in particular at an operating pressure not exceeding 300 psi (in one exemplary embodiment at a pressure not exceeding 250 psi), the gun of the present disclosure has a pressurized gas valve that can be opened with less force. Also, a gun constructed according to the present disclosure can be constructed with a hammer having a reduced weight as compared to prior art guns operating at much higher pressures of 500-600 psi. By using a hammer of lighter weight, the kickback of the gun can be reduced, making the gun more comfortable for the user.

SUMMARY OF THE PRESENT DISCLOSURE

[0007] According to an exemplary embodiment of the present disclosure, a gas-powered gun for firing balls dispensed from a magazine into the gun is adapted to be connected to a source of pressurized gas and includes a gun body having a gun handle and a breech section capable of receiving one ball at a time from the magazine. A barrel is connected to a front end of the breech and a bolt is slidable within the breech section to advance a ball to a firing position and close off a ball feed port in the breech section. A hammer is slidable in a first chamber formed in the gun body. Means are provided to bias the hammer to a forward position for firing the gun. A trigger is movably mounted on the gun body and a sear mechanism including a sear member is movably mounted in the gun body and adapted to hold the hammer in a rear, cocked position thereof until the trigger is pulled. When the trigger is pulled, the sear member is disengaged from the hammer and permits the hammer to move to the forward position. A pressurized gas circuit is provided for delivering pressurized gas from the source to the barrel of the gun for propelling one ball at a time therefrom. The gas circuit includes a gas pressure regulator capable of providing gas to the gas circuit at a pressure not exceeding 300 psi, a second chamber for pressurized gas formed in the gun body and having a gas inlet operatively connected to a gas outlet of the regulator, and a pressurized gas valve including a valve body fixably mounted in the gun body in front of the first chamber and at a rear end of the second chamber. A valve stem is mounted for sliding movement in a central passage of the valve body. A movable elongate valve guide is connected to the valve stem and has a valve seal mounted on a seat section formed on a rear end of the valve guide. This seat section with the seal has an external first diameter greater than a second diameter, the latter being the diameter of a substantial, elongate section of the guide member. There are also a guide arrangement for holding the valve guide and guiding movement thereof in a lengthwise direction and means for biasing the valve guide and valve seal towards a rearward, valve closing position. The valve guide and valve seal are located in the second chamber. During use of the gun, the hammer when it moves to its forward position, strikes the valve stem and opens the valve, thereby releasing the pressurized gas with a pressure not exceeding 300 psi into the breech to propel the ball in the firing position through the barrel. The release of the pressurized gas also causes the hammer to be driven rearwardly to a cocked position.

[0008] These and other aspects of the disclosed gas-powered gun will become more readily apparent to those having ordinary skill in the art from the following detailed description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] So that those having ordinary skill in the art to which the present disclosure pertains will more readily understand how to make and use the subject invention, exemplary embodiments thereof will be described in detail herein below, with reference to the drawings wherein:

[0010] FIG. 1 is a right side view of paintball gun or marker constructed in accordance with the disclosure herein, the gun being shown without a standard compressed gas cylinder connected thereto and with only a portion of the barrel being shown;

[0011] FIG. 2 is a detailed vertical cross-section of the breech portion, the regulator, the gun handle and the trigger section of the gun of FIG. 1, the cross-section taken in a vertical plane extending through the central longitudinal axis of the breech and gun barrel;

[0012] FIG. 3 is a parts diagram illustrating a number of components of the gun in FIGS. 1 and 2 separately and the manner in which they are arranged, these components including the valve body, a valve stem and an elongate valve guide and a cap; and

[0013] FIG. 4 is a further parts diagram illustrating additional components of the gun of FIG. 1 and the gun body, the components including a bolt, a hammer connected to the bolt, a hammer spring, and the gun body.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0014] Advantageous gas-powered guns for firing balls, and in particular paintballs, are disclosed herein. These paintball guns permit the use of relatively low operating gas pressure in the gun, and in particular, in the pressurized gas circuit. An exemplary embodiment of such a gun has a gas regulator capable of providing gas to the gas circuit at a pressure not exceeding 300 psi and, in a particular exemplary embodiment at a pressure of about 250 psi. In the detailed description that follows, these exemplary embodiments are described. However, the disclosed embodiments are only illustrative of gas powered guns and markers that can be constructed in accordance with the present disclosure.

[0015] With reference now to FIGS. 1 and 2, there is illustrated a gas-powered gun 10 that is capable of firing balls and in particular paintballs, which can be of standard construction. One of these balls 12 is shown in a breech section 14 of the gun in FIG. 2. It will be understood that this gun 10 is adapted to be connected to a source of pressurized gas (not shown) and typically this source is a hollow metal cylinder in which the gas can be stored under pressure. The pressurized gas from the cylinder is fed to an adjustable gas pressure regulator 16 which can be of standard construction except that the regulator is set to provide pressurized gas at a pressure not exceeding 300 psi. The regulator can be constructed of first and second body parts 15 and 17 which are threaded together at 19. In one exemplary embodiment of the present gun, the regulator provides pressurized gas at a pressure of about 250 psi, a pressure substantially below that used in many prior art guns to propel individual paintballs from the gun breech and through the barrel 18. To attach the regulator the first part 15 is first connected to the gun body by means of screw 144 which also attaches the valve cap. The second part 17 can then be threaded onto the

first part 15. The second part has a pressurized gas inlet at 200 and an adjustment screw 202 at its bottom end by which the operating pressure can be adjusted. The regulator has a pressurized gas outlet 204 at its top end. The paintballs are typically dispensed from a standard paintball magazine or bulk loader (not shown) into the breech of the gun through a feed tube 20. It will be understood that paintballs are able to drop one at a time into the breech under the force of gravity when a gun bolt 22 is in a pulled back or rearward position. The gun bolt 22 is shown in a forward position in FIG. 2, and the ball 12 in the breech can be advanced by the bolt to a forwardmost position ready for firing of the gun. As illustrated in FIG. 4, the bolt is formed with a L-shaped gas passageway 24 including a longitudinally extending section having an open end 26 at the front of the bolt and a short downward section having an open end 28 that is aligned with a short gas passage 30 formed in the gun body when the bolt is in its forwardmost position. Located on opposite sides of the downward extension of passageway 24 are two annular grooves which accommodate o-rings 32 and 34 which effectively seal a portion of the elongate chamber 36 in which the bolt is slidably mounted. Thus, when the bolt is in the forward position, pressurized gas entering the passageway 24 from passage 30 cannot escape through any gap between the hammer and the chamber 36. Connected to the bolt and extending through the bolt is a pin member 38 which can be formed with an enlarged upper end or head 40 to make it easier to grasp for the gun user. The pin can be used to pull the bolt to its rearward position manually, if required. The pin extends through an upper slot 42 formed above a rear portion of chamber 36 and a lower slot 44 formed in the gun body below a rearward section of the chamber 36. The bottom end of the pin is connected to a hammer 46 and in this way, the bolt 38 always moves forwardly or rearwardly with the hammer 46 which is slidable in a lower chamber 48, sometimes referred to herein as a first chamber. This lower chamber is also formed in the gun body indicated generally by reference 50. This gun body can include a gun handle 52 and the breech section 14. Preferably formed on the gun body or attached thereto is a trigger guard 54 which extends around an exposed portion of a trigger 56. In a manner known per se, the trigger is mounted on the gun body and it can be used to operate a sear mechanism 58 shown in FIG. 2. The gun handle portion can be detachably connected to the upper portion of gun body 50 by two screws 81 and 92.

[0016] The sear mechanism includes a sear member 60 which is movably mounted in the gun body 50 and, in a known manner, is adapted to hold the hammer 46 in a rear, cocked position thereof until the trigger 56 is pulled. When the trigger is pulled, the sear member is disengaged from the hammer and permits the hammer to move to the forward position shown in FIG. 2. A variety of sear mechanisms capable of firing a gun are known in the gun art and accordingly a detailed description of the sear mechanism used to release the hammer 46 is deemed unnecessary. However, a typical sear mechanism and trigger are illustrated in FIG. 2 and a brief description of this particular mechanism is now provided. The illustrated trigger 56 has a rearward extension 62 which is biased downwardly by means of a coil spring 64 mounted in the gun handle and connected at its bottom end to the gun handle. The rearward extension 62 engages a forward end of the sear member 60, this end being biased downwardly by means of coil spring

66. Again, the spring 66 is mounted in the gun handle and has its lower or rear end connected to the handle. The sear member is able to pivot about a pivot pin 68 and, when the trigger is pulled so as to overcome the bias of spring 64, the front end of the sear member is pushed upwardly which causes an upward projection 70 on the sear member to move downwardly out of engagement with the hammer, which is formed with a downwardly facing recess 72. It will be understood that when the trigger is released and the hammer is driven by gas to its rearward position, the upward projection 70 of the sear member goes into the recess 72, thereby holding the hammer in the rearward, cocked position until the trigger is pulled again.

[0017] The hammer, and therefore the bolt as well, is biased to a forward position by means of a hammer spring 74 which can be a coil spring as shown. The forward section of this spring fits snugly into a longitudinally extending hammer cavity 76 which is closed at its front end. The spring 74 is also guided and held in position by means of a guide pin 78 which is secured at its rear end in an externally threaded cap 80. External threads on a forward portion 82 of the cap engage a threaded section 84 formed in the gun body at the rear end of the first chamber 48. Section 82 of the cap is formed with a cylindrical cavity 86 which forms a seat for a rear end section of the hammer spring as shown in FIG. 2. A further, smaller cavity at 88 receives a rear end portion of the pin 78. The rear end portion of the pin 78 can be threaded into the cavity 88 if threads are formed on the pin or the rear end of the pin can be held in the cavity 88 by friction fit.

[0018] With reference now to the parts diagram of FIG. 3, there are shown components of a pressurized gas valve that includes a valve body 90 fixedly mounted in the gun body 50 at the front of the first or lower chamber 48. The valve body can be held in position by means of a hollow threaded connector 91 that extends through a hole formed in the gun body in front of the trigger. The screw 92 used to attach the gun handle portion can extend through the threaded passage in connector 91. If desired, a shoulder 94 can be formed at the front end of the lower chamber 48. It will also be noted that the valve body is located rearwardly of a second chamber 98 which extends between the front opening 96 and the shoulder 94. The gas valve includes a valve stem 100 which has a cylindrical rear end section 102, a narrower central section 104 and a threaded front end section 106. An annular shoulder 108 can be provided between the narrower section 104 and the front end section 106. When the gun is assembled as shown in FIG. 2, the valve stem 100 is movable in a central passageway 110 formed in the valve body. This passageway has a rear portion 112 of smaller diameter than a longer, front portion 114. The rear end section 102 of the valve stem fits snugly within the rear portion 112 but is slidable therein. It will be understood that when the gas valve is in the open position, some pressurized gas can escape past or through the rear end section 102 in order to drive the hammer 46 to its rearward or cocked position. For example, pressurized gas can pass through a suitably small gap between the periphery of section 102 and portion 112 of the passageway. In the alternative, a central passageway can be provided in the section 102 to allow pressurized gas to pass from the annular space around the central section 104 and through the passageway in section 102 to the front of the hammer. An upwardly extending passageway or opening 120 extends from a top side of the valve body 90 to the passageway 110 and when the gas valve

is open, pressurized gas can pass through passageway 110, the opening 120 and the passage 30 in the gun body to enter the breech of the gun for firing a paintball 12. The valve stem can also be made without the central section 104 being narrower provided there is sufficient clearance around the central section for the gas to pass into the opening 120.

[0019] Located forwardly of the valve stem is a movable, elongate valve guide 122 having a valve seal 124 mounted on a seat section 126 formed on a rear end of the valve guide. The seat section forms a shallow recess 128 capable of receiving and holding the valve seal 124. Extending longitudinally forwardly from the recess 128 is a threaded passage 130 having a closed inner end at 132. The valve seal 124 is annular and has a central opening 134 through which the front end section 106 of the valve stem can extend and be threaded into the passage 130. Thus the valve guide 122 is firmly connected to the valve stem and moves with it. It will be appreciated that the valve guide 122 holds the rear portion of the valve stem in position. The valve stem is moved a short distance by the hammer when the gun is fired in order to open the gas valve. The valve guide has a substantial, elongate section 136 that extends from the seat section 126 to the front end of the guide, this elongate section having a diameter D_2 . Located in a forward section of the valve guide is another elongate passage 138 which is sized to receive at least a portion of a coil spring 140. Also shown in FIG. 3 and mounted in the front section of the second chamber 98 is a valve cap 142 which provides a guide arrangement for holding the valve guide 122 and guiding movement thereof in a lengthwise direction. The spring 140 provides means for biasing the valve guide and valve seal towards a rearward, valve closing position and, as can be seen in FIG. 2, the valve guide and valve seal are located in the second chamber 98.

[0020] The valve cap 142 can be held in the front portion of the chamber 98 by means of a bolt or screw 144 which is also used to mount the regulator 16 as shown in FIG. 2. The threaded end of the bolt extends into a threaded side hole 146 formed in the cap. In order to seal the front portion of the chamber 98, the cap is formed with a first annular groove to receive an O-ring seal 150. There is also a second annular groove forwardly of the hole 146 to receive an O-ring seal 151. The cap is formed with a central passage that includes larger diameter section 152 in which a front section of the valve guide 122 is slidably received and a smaller diameter section 154 which receives a portion of the spring 140. Extending around the section 152 is an annular groove that receives an O-ring seal 156. This seal effectively closes the gap between the valve guide and the cylindrical wall of section 152 and prevents pressurized gas from passing between the chamber holding spring 140 and the second chamber 98.

[0021] It will be appreciated by those skilled in the construction of guns operated by pressurized gas and employing a standard type of gas valve and valve stem that the force required to open the valve is proportional to the area of the valve stem exposed to the source of pressurized gas. Thus, if this affected area can be reduced, the force required to open the valve will be less. In the gas powered gun of the present disclosure, the operating pressure required to operate the gun and propel paintballs through the barrel is reduced by providing the valve seat section 126 on an elongate or extended valve guide 122. In fact, in the exemplary embodi-

ment illustrated, the valve guide **122** extends into the valve cap **142** with an O-ring extending around the forward section of the valve guide. This reduces the force applied by the pressurized air or gas and allows the valve stem **100** to open with less force. Instead of the force being based on the area $A1 = \Pi(D_1 + 2)^2$ the required force is proportional to area $A2 = \Pi(D_1 + 2)^2 - \Pi(D_2 + 2)^2$. Thus, in a gun constructed in accordance with the present disclosure, less force from the hammer spring is required to open the valve, which valve is opened when the hammer strikes the rear end of the valve stem. Also, with the valve and valve guide configuration of the present disclosure, it is possible to reduce the weight of the hammer **46** and, by having a lighter hammer, the kickback of the gun can be reduced, making it more comfortable for the user. Also the reduced gas pressures and lighter hammer in the present gun allow the use of a lighter spring **74** for the hammer and this puts less force on the paintball when pushing it forward. This reduces the chance of breaking the ball and allows the use of more fragile paintballs that break easier on the target. Use of a lighter spring and hammer result in less stress on the sear and handle frame. A gun constructed according to the present disclosure using a regulator **16**, which can be an adjustable regulator, can be constructed so as to propel a paintball at a speed of at least 300 fps using an operating gas pressure provided by the regulator of about 250 psi.

[0022] Another improvement in the disclosed gas powered gun is the construction of the valve stem itself. In particular, in the exemplary illustrated valve stem, the narrow central section **104** has a reduced diameter $D4$. This creates an additional area equal to the transverse area of rear end section **102** minus the transverse area of section **104** upon which the pressurized air can act to close the valve faster. Construction of the valve in this manner does not result in more force being required to open the valve since this area will be exposed to the pressurized air only when the valve is opened.

[0023] It will be appreciated that the improved valve and valve guide arrangement disclosed herein can also be employed in known guns where the hammer is not biased to the firing position by means of a hammer spring but rather is controlled by a gas operated piston. In this type of gas-powered gun, no blowback is required to recock the gun. An example of a paintball gun of this type is described and illustrated in U.S. Pat. No. 6,973,748 issued Dec. 13, 2005 to NPF Limited. The specification and drawings of this patent are incorporated herein by reference. By employing a valve and valve guide arrangement with a reduced pressure regulator as disclosed in the present disclosure, the piston which controls the hammer can be operated at a lower pressure and this in turn substantially improves the efficiency of this type of gun.

[0024] While the present invention has been illustrated and described as embodied in various exemplary embodiments, it is to be understood that the present invention is not limited to the details shown herein, since it will be understood that various omissions, modifications, substitutions and changes in the forms and details of the disclosed gas powered guns and their operation may be made by those skilled in the art without departing in any way from the spirit and scope of the present invention. For example, those of ordinary skill in the gas powered gun art will readily adapt

the present disclosure for various other applications without departing from the spirit and scope of the present invention.

1. A gas-powered gun for firing balls dispensed from a magazine into such gun, said gun being adapted to be connected to a source of pressurized gas, and said gun comprising:

- a gun body including a gun handle and a breech section capable of receiving one ball at a time from said magazine;

- a barrel connected to a front end of said breech section;

- a bolt slidable within said breech section to advance a ball to a firing position and close off a ball feed port in said breech section;

- a hammer slidable in a first chamber formed in said gun body;

- means for biasing said hammer to a forward position for firing said gun;

- a trigger movably mounted on said gun body;

- a sear mechanism including a sear member movably mounted in said gun body and adapted to hold said hammer in a rear, cocked position thereof until said trigger is pulled, whereby when said trigger is pulled, said sear member is disengaged from said hammer and permits said hammer to move to said forward position; and

- a pressurized gas circuit for delivering pressurized gas from said source to said barrel of said gun for propelling one ball at a time therefrom, said gas circuit including a gas pressure regulator capable of providing gas to said gas circuit at a pressure not exceeding 300 psi, a second chamber for pressurized gas formed in said gun body and having a gas inlet operatively connected to a gas outlet of said regulator, a pressurized gas valve including a valve body fixedly mounted in said gun body at a front of said first chamber and at a rear end of said second chamber, a valve stem mounted for sliding movement in a central passage of said valve body, a movable, elongate valve guide connected to a front section of the valve stem and having a valve seal mounted on a seat section formed on a rear end of the valve guide, said seat section with the seal having an external first diameter greater than a second diameter, the latter being the diameter of an elongate section of said guide, a guide arrangement for holding said valve guide and guiding movement thereof in a lengthwise direction, and means for biasing said valve guide and valve seal towards a rearward, valve-closing position, said valve guide and valve seal being located in said second chamber.

wherein, during use of said gun, said hammer when it moves to its forward position, strikes said valve stem and opens said valve, thereby releasing said pressurized gas at a pressure not exceeding 300 psi into said breech to propel said ball in the firing position through said barrel, said release of said pressurized gas also causing said hammer to be driven rearwardly to a cocked position.