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(54) **SPRING ASSIST FOR LAUNCH FROM COMPRESSED GAS GUN**

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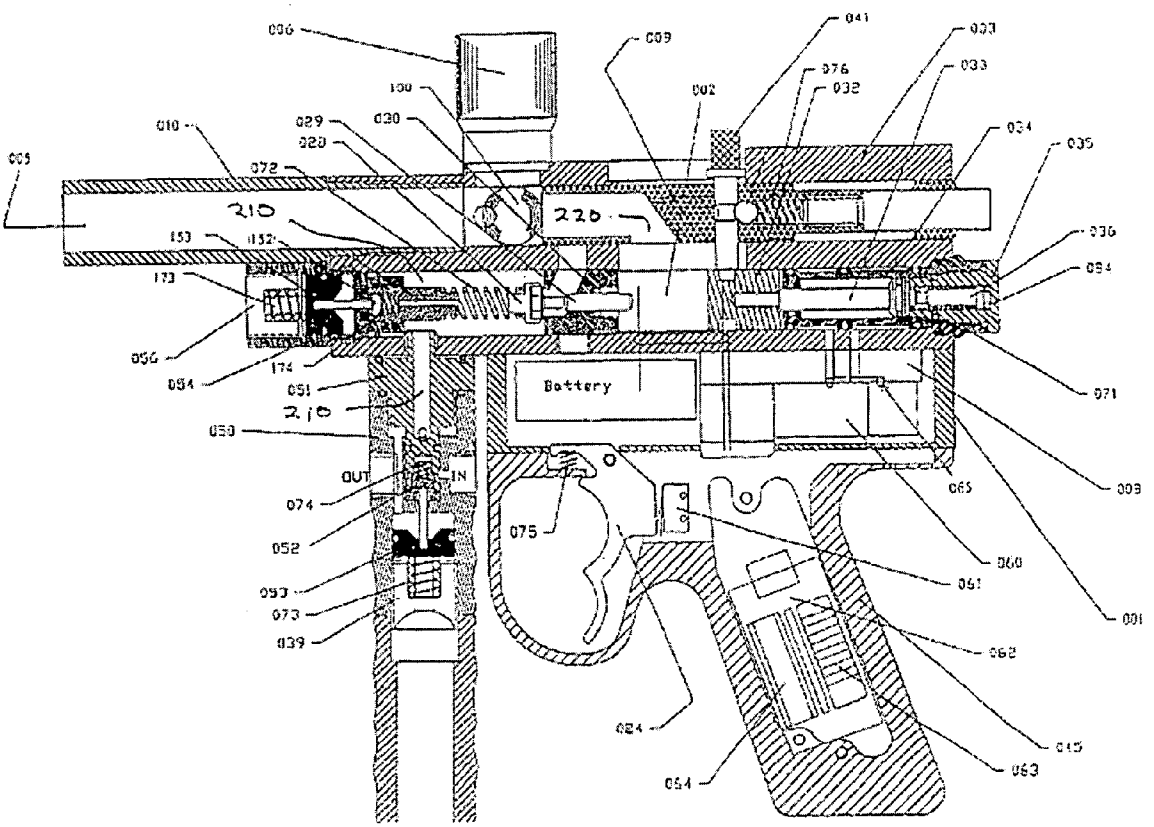
(57) **ABSTRACT**

The present invention is a specially curved discharge port and port within a bolt within the breech for a compressed gas powered gun for the firing of projectiles. The invented gun has many improvements over the prior art including the use of improved gas pressure routing allowing for operation at lower pressures with no decrease in firing rate, efficiency, trajectory, or range. The structure of the present invention provides for embodiments which include the use of specific maximum angles within the gas passage from a compressed gas storage chamber and a portion of the breech through which the gas is routed as it expands to launch a projectile from the gun.



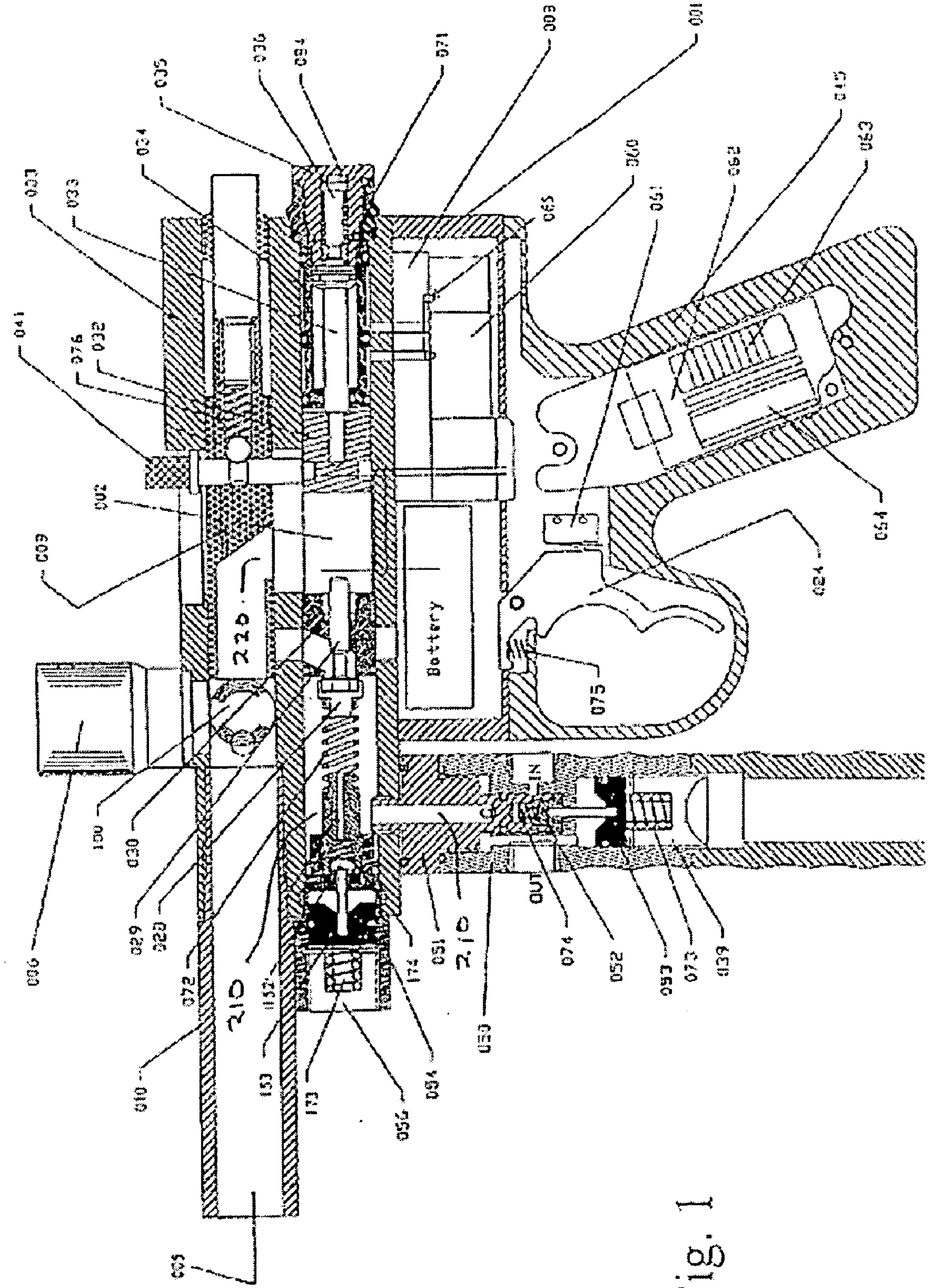


Fig. 1

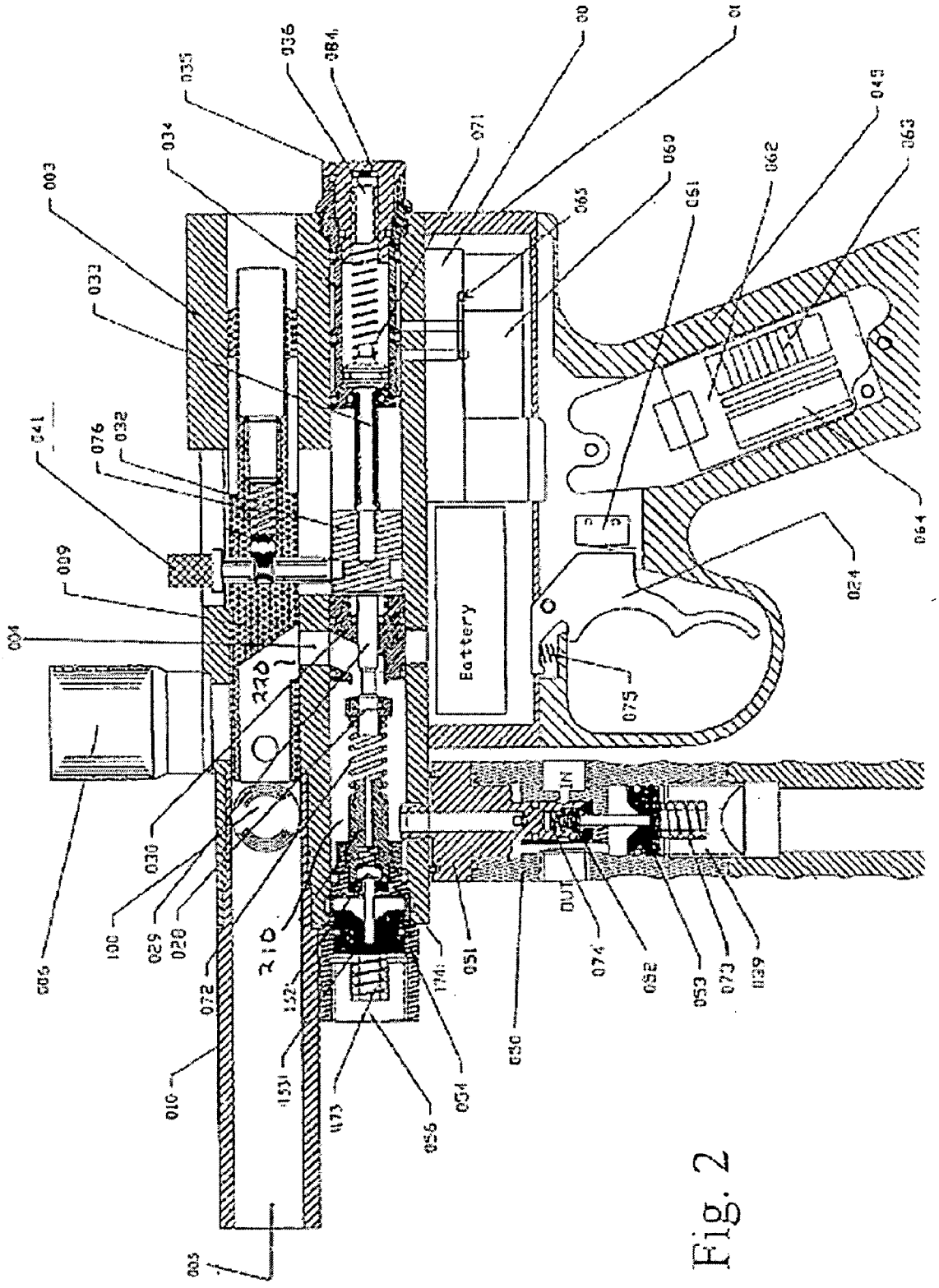


Fig. 2

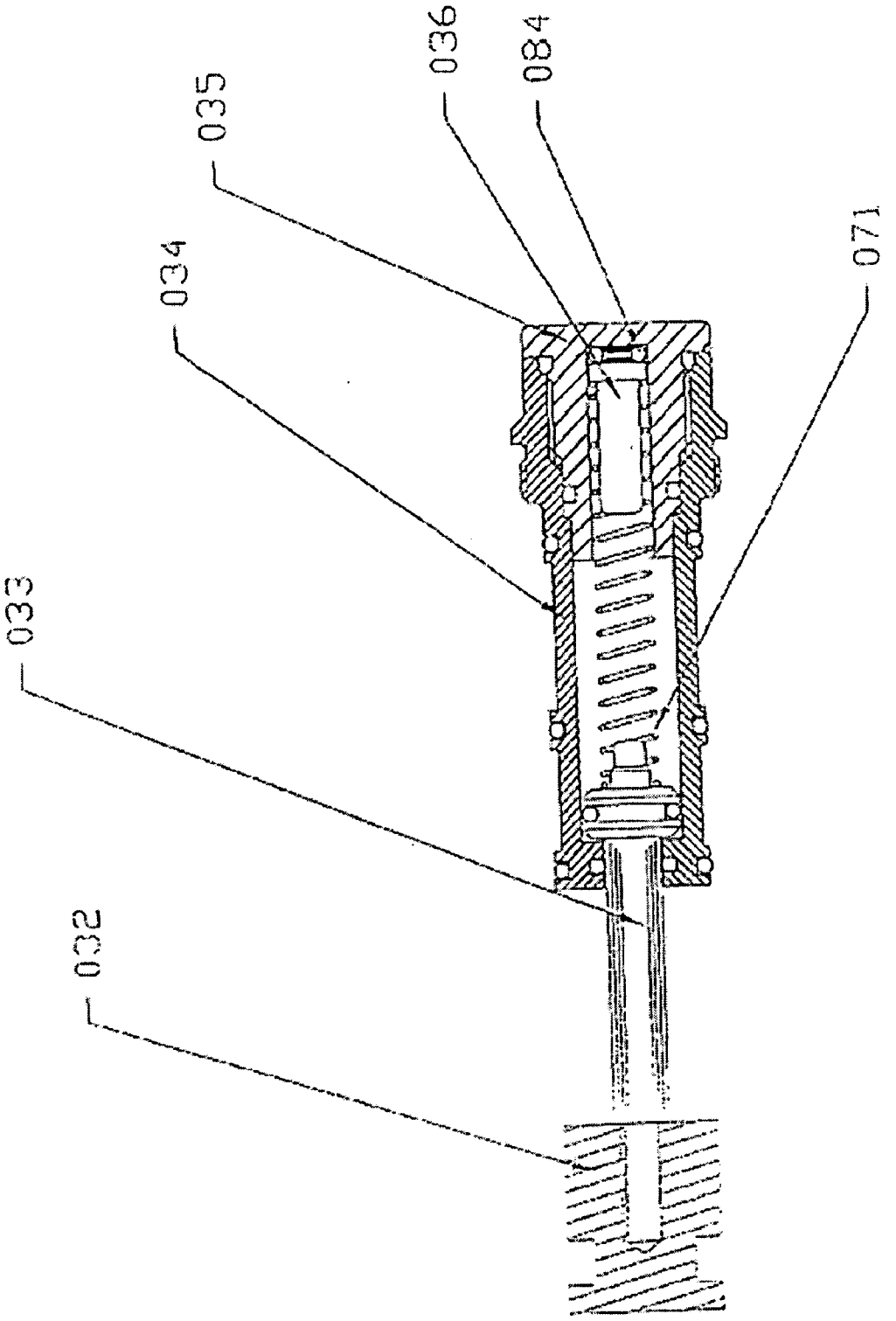


Fig. 3

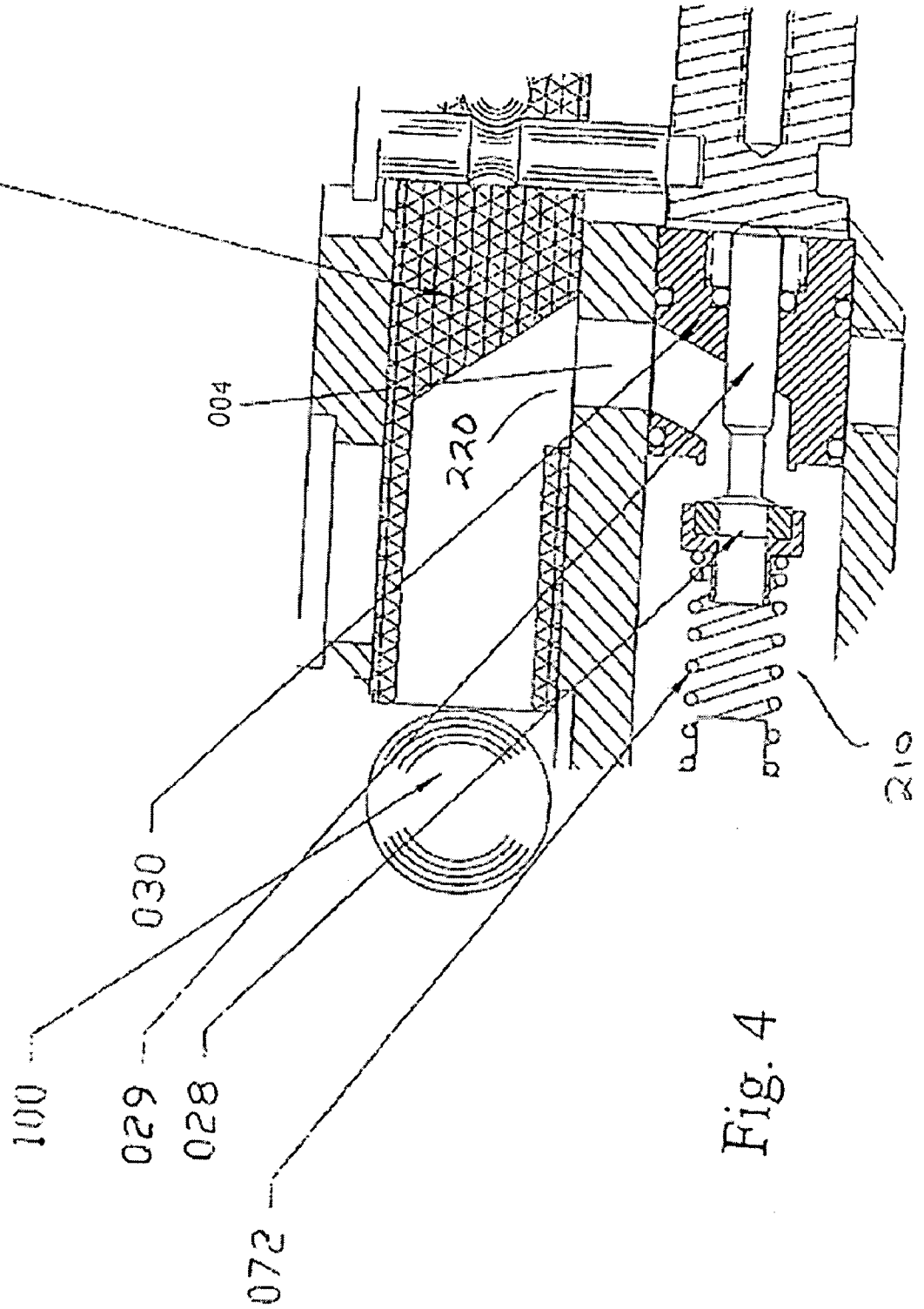


Fig. 4

SPRING ASSIST FOR LAUNCH FROM COMPRESSED GAS GUN

CLAIM OF PRIORITY

[0001] This application is a continuation of, and claims priority of, U.S. conventional patent application, Ser. No. 10/313,465, which is a continuation-in-part of U.S. Ser. No. 10/185,203, filed Jun. 27, 2002, which claims priority of prior U.S. conventional patent application, Ser. No. 09/528,482, filed Mar. 17, 2000, which claims priority of prior provisional applications, U.S. Provisional Patent Application Serial No. 60/125,302, filed Mar. 19, 1999, and U.S. Provisional Patent Application, Serial No. 60/138,323, filed Jun. 9, 1999, the disclosures of all of which are incorporated herein by this reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] This invention generally relates to compressed gas-powered guns and more specifically to guns for firing marker projectiles such as "paint balls." The use of marking guns is well-known. Within a marking gun, there is employed a projectile which is generally in the shape of a sphere. This projectile is constructed of a thin wall which will readily break upon impact against a target. Typical material for the wall of the projectile would be a gelatin. Within the wall of the projectile is contained a quantity of a liquid such as a colored paint. Typical paint colors would be blue, green or yellow.

[0004] 2. Related Art

[0005] Compressed gas powered guns for the firing of projectiles have long been used. Of more recent use, such guns have been made for the firing of spherical and fragile projectiles containing a colored marking fluid, such projectiles commonly being referred to as "paint balls." Such guns are typified by other inventions of the Inventor, namely U.S. Pat. No. 5,497,758, showing a compressed gas powered gun. Problems associated with such guns include: dangerously high pressure build-up within the gun, potentially damaging the gun and endangering the user; a mechanical limitation on the cycle time of the firing mechanism, limiting the firing rate of the gun; excessive shock and recoil resulting from reciprocal movement of the hammer into the firing and recocked positions.

SUMMARY OF THE INVENTION

[0006] This present invention is a spring in a compressed gas powered gun, which spring simultaneously operates on the actuator for a firing valve in a compressed gas storage chamber and the bolt in a breech in launching a projectile from a compressed gas powered gun. The spring assists the action of low pressure gas on a hammer and slider which actuate the firing valve. Also, because the bolt for launching the projectile is connected by a pin to the hammer and slider, the spring also assists in the acceleration and movement of the bolt. This assistance of the spring on the hammer/slider and the bolt results in increased firing rate, and increased reliability and consistency of shots.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] **FIG. 1** is a side, schematic view of one embodiment of the present invention showing the invented gun in the cocked position.

[0008] **FIG. 2** is a side, schematic view of another embodiment of the present invention showing the invented gun in the firing position.

[0009] **FIG. 3** is a side, schematic view of a pneumatic gas cylinder assembly according to the present invention.

[0010] **FIG. 4** is a side, schematic view of a section of the pressure routing system.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0011] Referring now to the drawings, an embodiment to be preferred of a compressed gas powered gun, made according to the present invention, is disclosed. The gun includes, generally, a grip **45**; a body, including an upper main housing **3** and a lower main housing **1**; a barrel **10**; a bore **5**; a bolt **9** within a breech; a hammer chamber **2**; a pneumatic gas cylinder **34**; a slider **33**; and a trigger **24**. Throughout the Description, the term "forward" indicates being towards the outer, open, free end of the barrel **10** extending from the upper main housing **3** of the gun. "Rearward" indicates the opposite direction of "forward."

[0012] As shown in **FIGS. 1 and 2**, a projectile feed tube **6** opens into the barrel **10**, said projectile feed tube **6** for supplying the barrel **10** with projectiles **100**, which are preferably spherical in form and contain a marking fluid. A conventional projectile retention lever (not shown) biased by a spring allows only one projectile **100** to enter the barrel **10** at a time.

[0013] Generally rearward and below the barrel **10**, the hammer chamber **2** holds a hammer **32** which is integrally attached to the forward end of the slider **33**. Slider **33** is horizontally and reciprocally moveable within gas cylinder **34** from a cocked position, as shown in **FIG. 1**, to a firing position, as shown in **FIG. 2**, through the use of spring bias and compressed gas. The slider **33** is cocked by means of an electronic solenoid actuated 4-way valve **65** located in the lower main housing **1**. A manifold **8** connects the 4-way valve **65** to the pneumatic gas cylinder **34**. When biased to the firing position, the slider **33** forces the hammer **32** to engage a valve stem **29**. A link pin **41**, circular in cross-section, extends between and connects the bolt **9** to the hammer **32**.

[0014] The bolt **9** is held within the gun through use of the link pin **41**, attached to the hammer **32**. Removal of the link pin **41** allows the bolt **9** to be removed from the gun. This may be done for routine maintenance. The link pin **41** is held in place by means of a bolt retention spring **76**.

[0015] Within the pneumatic gas cylinder **34**, a main compression spring **71** extends between the slider **33** and an end-cap **35** which is attached at the rearward end of the gas cylinder **34**. A solid main spring guide **36** rests within the cylinder **34** between the slider **33** and the end-cap **35**, said guide **36** for receiving the coiled main compression spring **71**. Slider **33** is biased forward to a firing position by the main compression spring **71** and compressed gas (not shown). The shock of the hammer **32** is dampened both as the hammer **32** moves forward into the firing position and as it returns to a recocked position. The forward motion of the hammer **32** is dampened by both the valve spring **72** and the compressed gas surrounding the valve spring **72**. The rear-

ward motion of the hammer **32** is dampened by an o-ring **84** located in gas cylinder **34**, between the guide **36** and the end-cap **35**.

[**0016**] Releasably holding the slider **33** in a cocked position is an electronic solenoid activated 4-way valve **65**. The electronic solenoid **60** is actuated through a micro-switch **61** located rearward of the trigger **24**. Pulling on the trigger **24** sends an electronic signal to a CPU (microprocessor) **64** located in the grip **45**. This CPU **64** by means of software determines which of a number of dual in-line package (hereinafter "dip") switches **63** have been switched on or off, thereby determining the firing rate and mode selected by the user. The CPU **64** then, based on firing rate and mode, actuates the solenoid **60**, causing the 4-way valve **65** to shift, causing the slider **33** to be propelled forward under the bias of spring pressure and compressed gas. The CPU **64** then deactuates the solenoid **60** causing the 4-way valve **65** to shift, and compressed gas forces the main compression spring **71** to compress thereby recocking the gun. A trigger spring **75** forces the trigger **24** back to its original position.

[**0017**] Compressed gas for propelling projectile **100** and for moving the slider **33** to a firing position is provided from a canister or cylinder (not shown), which may be attached directly to the gun or may be attached to the person operating the gun. The gas is fed through a high pressure (hereinafter "HP") regulator **50**, and then through a passageway through a high pressure adaptor **51** to a cavity, the high pressure storage chamber **210** defined by upper main housing of body **3**. The high pressure regulator **50** reduces the gas pressure from over 500 pounds per square inch (hereinafter "p.s.i.") to around (hereinafter "about") 250 p.s.i. The HP regulator comprises an HP adjustment screw **39**, an HP regulator spring **73**, an HP regulator piston **53**, an HP regulator cup **52**, and an HP regulator cup spring **74**. This high pressure regulator **50** further comprises a safety feature forcibly closing the high pressure regulator cup **52** when over 800 or so p.s.i. is applied. This closure protects the inner workings of the gun and protects the gun's operator.

[**0018**] Contained within the gun are two valve means. The first valve means is for operating a low pressure (hereinafter "LP") circuit, including for propelling the slider **33**. The second valve means is for operating an HP circuit, including for supplying gas to propel the projectile **100**. The first valve means further comprises a LP regulator **54** for reducing pneumatic gas pressure from the about 250 p.s.i. supplied to about 85 p.s.i. This pressurized gas is then channeled to the gas cylinder **34** for the propulsion of the slider **33** upon actuation of the trigger **24**. The LP regulator comprises an LP adjustment screw **56**, an LP regulator spring **173**, an LP regulator piston **153**, an LP regulator cup **152**, and an LP regulator cup spring **174**. This low pressure regulator **54** further comprises a safety feature forcibly closing the low pressure regulator cup **152** when over 300 or so p.s.i. is applied. This closure protects the inner workings of the gun and protects the gun's operator.

[**0019**] The second valve means includes a horizontally oriented valve stem **29** which is horizontally and reciprocally moveable within the valve stem guide **30**. Valve stem **29** is provided with a valve cup **28** engaged by a valve spring **72**, biasing the value cup **28** to a seated position on the valve stem guide **30** to prevent flow of compressed gas from the high pressure storage chamber **210** into the barrel **10**.

[**0020**] It has also been found that projectile **100** velocity can be maximized through the use of specifically angled surfaces within the gas passage **4**, through which the gas expands as it enters the barrel **10**. The gas passage **4** is defined by the continuous conduit extending from the valve cup **28**, through the valve stem guide **30** and the forward portion of the bolt **9**. When the valve cup **28** is actuated to an open/firing position, the gas is allowed to expand through the conduit extending through the valve stem guide **30** and the bolt **9**. Bolt **9** has an angled port **220** drilled through its forward portion. Valve stem guide **30** is the discharge port. Bolt **9** with its port **220** is in the breech of the gun. The breech is connected to the rearward port of barrel **10**. The inner surfaces of the valve stem guide **30** and the bolt **9** are machined to form a conduit having a specific maximum angle through which the gas expands. It has been found by the inventor that 23 degrees±5 degrees is the optimal angle for these surfaces. Use of such angular surfaces allows the present invention to fire a projectile **100** using less than one half the p.s.i. of traditional guns at the same firing rate as those guns, without jeopardizing the efficiency, trajectory or range of the projectile **100**. By funneling the gas as it expands through the use of such angular surfaces, resistance is reduced, thereby allowing firing at a high firing rate to be done with lower p.s.i.

[**0021**] The gun further comprises an electronic system comprising a circuit board **62** containing a microprocessor (CPU) **64**, and a series of dip switches **63** which can be set to control the firing rate and mode of the gun. The gun is further programmable so as to allow firing rate and mode limits to be forcibly set.

[**0022**] Sequential action of the gun may be seen to advantage. A projectile **100** is in place within the barrel **10**. A second projectile (not shown) is held in place above the barrel **10** and within feed tube **6** by the projectile retention lever (not shown). Slider **33** is in the cocked position via the solenoid **60**. It is assumed that the high pressure regulator **50** is in fluid communication with an external compressed gas source (not shown) to fill the high pressure storage chamber **210** with compressed gas.

[**0023**] The trigger **24** is then pulled, a microswitch **61** is activated sending a signal to the CPU **64** that the user wishes to fire the gun. The CPU **64** then determines which dip switches **63** have been preset by the user, thereby determining the firing rate and mode of the gun. Upon determining the firing rate and mode, the CPU **64** then directs the solenoid **60** to act accordingly. The firing rate and mode of the gun are detailed as follows:

[**0024**] DIP Switch Settings—Modes—Rate of Fire

[**0025**] (Note: the following settings are not shown in attached Figures.)

[**0026**] Rate of fire is dependent on the mode and switch settings of the dip switches. Modes are:

[**0027**] 1. semi-auto (one single shot per trigger pull),

[**0028**] 2. 3 shot (3 shots if the trigger is pulled and not released, with single shot capabilities),

[**0029**] 3. 6 shot burst (6 shots if the trigger is pulled and not released, with single shot or any amount between capabilities),

[0030] 4. Full auto (as long as the trigger is pulled it will cycle).

[0031] Mode selection is done via switches #1 and #2. Mode settings using the switches are as follows:

[0032] Mode selection is done via switches #1 and #2. Mode settings using the switches are as follows:

#1	#2	
off	off	Semi automatic mode
on	off	3 shot mode
off	on	6 shot burst mode
on	on	Full auto mode

[0033] Rate of fire and timing is as follows:

[0034] Dip switch #3 and #4 (registers Solenoid on; times in milliseconds)

#3	#4	
off	off	06 ms
on	off	08 ms
off	on	10 ms
on	on	12 ms

[0035] Dip switch #5, #6, and #7 (registers Solenoid off (delay before re-cycle); times in milliseconds)

#5	#6	#7	
off	Off	off	70 ms
on	Off	off	80 ms
off	On	off	90 ms
on	On	off	100 ms
off	Off	on	110 ms
on	Off	on	120 ms
off	On	on	130 ms
on	On	on	140 ms

[0036] Dip switch #8: display cycle rate, mode and shot count.

On	display yes
Off	display no

[0037] As the solenoid **60** is deactuated, the gun is cocked. As the solenoid **60** is actuated, compressed gas and the main compression spring **71** move the hammer **32** and slider **33** to the firing position, by moving the slider **33** forward with hammer **32** slidably engaging the valve stem **29**. The hammer **32** engages valve stem **29**, thereby unseating the valve cup **28**, causing the release of compressed gas into the gas passage **4**, thereby propelling the projectile **100** through the barrel **10**.

[0038] The slider **33** has moved forward into the firing position forcing the hammer **32** to engage the tip of valve stem **29**. Simultaneously, valve stem **29** is forced inwardly against the bias of valve spring **72** to unseat the valve cup **28** from its seat, thus allowing the compressed gas to enter the barrel **10**. Gas entering the barrel **10** progresses through the conduit formed by angular surfaces of the valve stem guide **30** and the port **220** in the forward portion of the bolt **9**, forcing projectile **100**, which has a diameter approximating that of the bore **5** of the barrel **10**, out of the barrel **10** at a velocity dependent upon the gas pressure within the barrel **10** which is controlled by high pressure regulator **50**. The solenoid-**60** is then deactuated to force the slider **33** and hence hammer **32** back to the recocked position. Valve stem **29** is again biased into its seated position by valve spring **72** to prevent further flow of compressed gas into the barrel **10**. Upon deactuation of solenoid **60**, the slider **33** and hence the link pin **41** and bolt **9** are forced back to the recocked position. As the bolt **9** moves to the recocked position, the projectile retention lever (not shown) allows a new projectile **100** to enter barrel **10** and again holds a next projectile (not shown) in place under bias of a spring.

[0039] Having thus described in detail a preferred embodiment of the present invention, it is to be appreciated and will be apparent to those skilled in the art that many physical changes could be made in the apparatus without altering the inventive concepts and principles embodied therein. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the forgoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore to be embraced therein.

I claim:

1. A spring assisted launching mechanism for a compressed gas powered gun comprising:

(a) a breech having a forward end and a rear end;

(b) a bolt having an aperture therethrough contained within the breech, the bolt moveable within the breech between a rearward position to a forward position;

(c) a chamber adjacent to the breech having a forward end and a rear end, the chamber containing a slider moveable between a rearward and a forward position, the slider connected to the bolt;

(d) a firing valve positioned forward of the slider;

(e) a spring within the chamber positioned rearward of the slider and biasing the slider toward the forward position; and,

(f) a trigger adapted to send an electronic signal for firing the gun when the trigger is pulled.

2. The spring assisted launching mechanism for a compressed gas powered gun of claim 1, wherein the valve has a valve stem, further comprising a hammer disposed on the forward end of the slider, the hammer contacting the valve stem when the slider is in the forward position.

3. The spring assisted launching mechanism for a compressed gas powered gun of claim 1, further comprising an electronic firing system, the electronic firing system adapted to receive the electronic signal from the trigger, the electronic firing system being connected to the slider for controlling actuation of the slider.

4. The spring assisted launching mechanism for a compressed gas powered gun of claim 1, further comprising means for dampening the rearward motion of the slider.

5. The spring assisted launching mechanism for a compressed gas powered gun of claim 1, further comprising a low pressure circuit extending between an input port for receiving compressed gas and the chamber at a location rearward of the slider.

6. The spring assisted launching mechanism for a compressed gas powered gun of claim 5, further comprising a high pressure circuit extending between the input port and the breech, wherein the firing valve controls passage of compressed gas through the high pressure circuit.

7. A spring assisted launching mechanism for a compressed gas powered gun comprising:

(a) a breech having a forward end and a rear end;

(b) a bolt having an aperture therethrough contained within the breech, the bolt moveable within the breech between a rearward position to a forward position;

(c) a chamber parallel to the breech having a forward end and a rear end, the chamber containing a slider moveable between a rearward and a forward position, the slider connected to the bolt, the chamber adapted to receive compressed gas from a source of compressed gas;

(d) a firing valve positioned adjacent the slider, the hammer contacting the firing valve when the slider is in the forward position;

(e) a low pressure circuit for conveying compressed gas between the source of compressed gas and the chamber rearward of the slider; and,

(f) a spring within the chamber positioned rearward of the slider and biasing the slider toward the forward position, the spring assisting the compressed gas in moving the slider toward a forward position.

8. The spring assisted launching mechanism for a compressed gas powered gun of claim 7, further comprising a trigger adapted to send an electronic signal for firing the gun when the trigger is pulled.

9. The spring assisted launching mechanism for a compressed gas powered gun of claim 7, further comprising an electronic firing system, the electronic firing system adapted to receive the electronic signal from the trigger, the electronic firing system being connected to the slider for controlling actuation of the slider.

10. The spring assisted launching mechanism for a compressed gas powered gun of claim 7, wherein the valve has a valve stem, further comprising a hammer disposed on the forward end of the slider, the hammer contacting the valve stem when the slider is in the forward position.

11. The spring assisted launching mechanism for a compressed gas powered gun of claim 7, further comprising a high pressure circuit extending between the source of pressurized gas and the breech, wherein the firing valve controls passage of compressed gas through the high pressure circuit.

12. A spring assisted launching mechanism for a compressed gas powered gun comprising:

(a) a breech having a forward end and a rear end;

(b) a bolt having an aperture therethrough contained within the breech, the bolt moveable within the breech between a rearward position to a forward position;

(c) a chamber adjacent to the breech having a forward end and a rear end, the chamber containing a slider moveable between a rearward and a forward position, the slider connected to the bolt;

(d) a high pressure circuit extending between an input port for receiving a source of pressurized gas and the breech;

(e) a firing valve positioned forward of the slider, the firing valve controlling passage of compressed gas through the high pressure circuit;

(f) a spring within the chamber positioned rearward of the slider and biasing the slider toward the forward position and into engagement with the firing valve;

(g) an electronic firing system located within the gun, the electronic firing system including an solenoid connected to the slider for controlling actuation of the slider; and

(h) a trigger adapted to send an electronic signal to the electronic firing system when depressed, the electronic firing system actuating the slider in response to the signal.

13. The spring assisted launching mechanism for a compressed gas powered gun of claim 12, wherein the solenoid is adapted to retract the slider after firing to reload the gun.

14. The spring assisted launching mechanism for a compressed gas powered gun of claim 12, wherein the electronic control system includes a user selectable switch to permit the solenoid to automatically re-actuate the slider after firing and reloading when the switch is set into a first mode.

* * * * *