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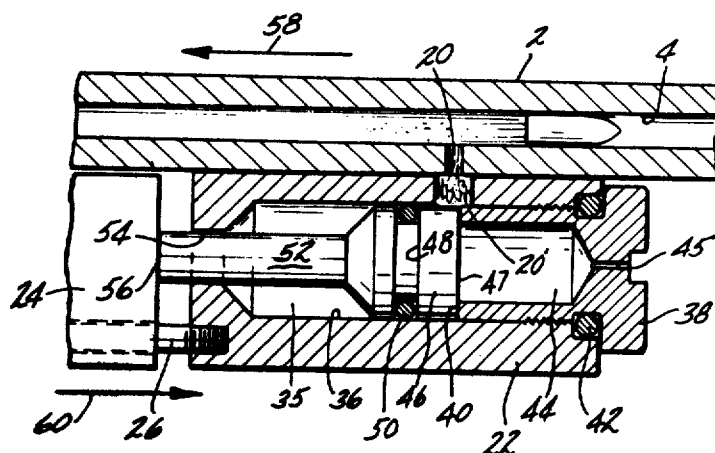
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[54] **GAS SYSTEM FOR AUTOLOADING FIREARM**
7 Claims, 3 Drawing Figs.

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 F41d 5/10
 [50] Field of Search..... 89/191,
 192, 193

ABSTRACT: A gas system for an autoloading firearm wherein the gas piston is operative to seal the gas cylinder against high-pressure combustion gases during early stages of recoil of the firearm after firing thereof. As the force of recoil decreases, the seal is broken and lower pressure gases are bled into the gas cylinder to actuate the gas system.



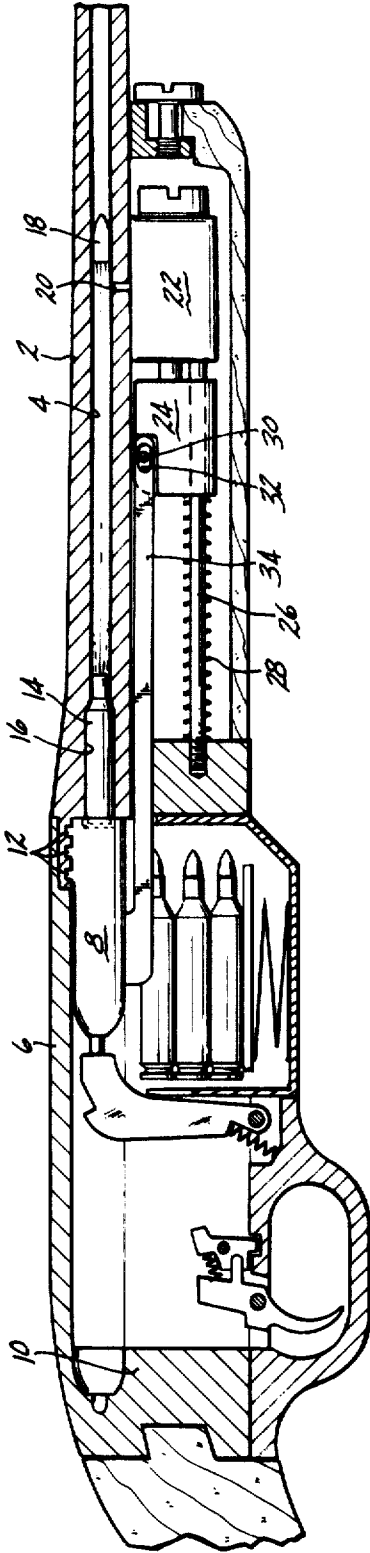


FIG-1

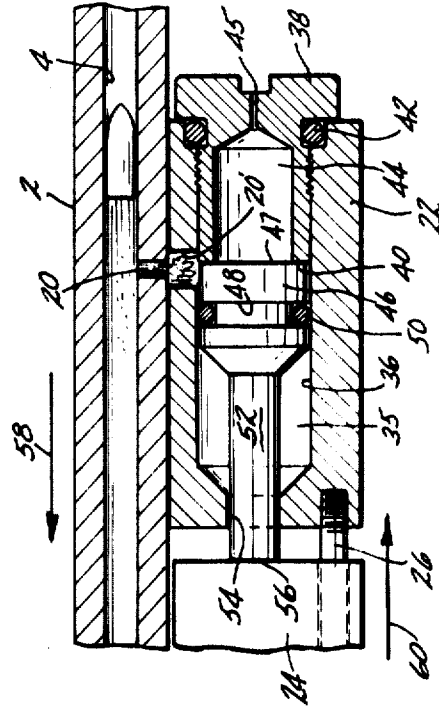


FIG-2

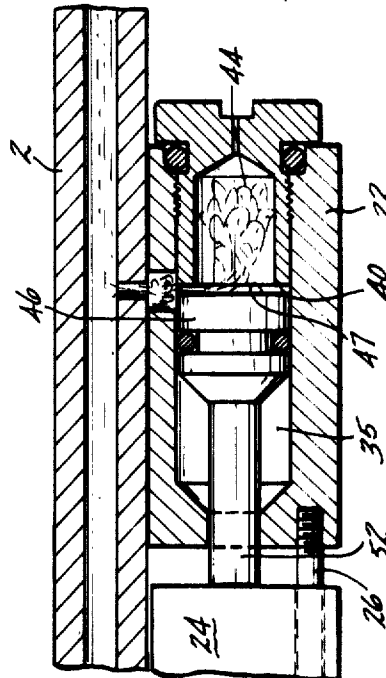


FIG-3

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GAS SYSTEM FOR AUTOLOADING FIREARM

This invention relates to a gas system for an autoloading firearm which utilizes relatively lower gas pressures to operate. The system of this invention may also provide a time lag between the time that pressurized gas is first bled into the gas cylinder and the time at which the gas is able to actuate the system.

In general, gas systems for operating the action of an automatic or semiautomatic, autoloading firearm are old in the art. The combustion gases resulting from firing the cartridge are bled from the gun barrel through a port and into a gas cylinder mounted on the barrel. The pressurized combustion gases are then operative to move a piston through the gas cylinder to thereby cause the action of the gun to move through the rearward portion of its reciprocation cycle. The action is then moved through the forward or return portion of its operating cycle by a spring. When the action reaches the rearwardmost point of its reciprocation cycle, it strikes a recoil block on the receiver of the firearm and begins moving forward under the influence of the spring. The action of the firearm and the recoil block are thus subjected to substantial impact forces during reciprocation, which forces, if not kept at a minimum, can greatly shorten the life of the firearm.

The magnitude of the impact forces to which the action and the receiver are subjected is directly proportional to the pressure of the combustion gases which operate the gas system. When the cartridge is fired, the pressure of the combustion gases reaches a peak value when the bullet is approximately an inch from the cartridge casing, and then the pressure begins to drop off as the bullet moves forward through, and exits from the barrel bore. A bullet of any given caliber may be fired with a variety of powder charges, depending on the bullet weight and the desired muzzle velocity to be attained. The type and amount of powder in a given shell influences the magnitude and duration of the pressure.

One of the prime factors controlling the rate at which gas pressure decreases after the cartridge is fired is the relative diameter of the barrel bore when compared to the chamber diameter. A barrel bore having a given diameter will exhaust a comparatively smaller diameter chamber more quickly than a comparatively larger chamber. It is thus readily apparent that the gas pressure as measured at any given point along the barrel bore at any given time after the cartridge is fired will be higher for a cartridge having a larger powder charge than for a cartridge having a smaller powder charge, due to the fact that the large cartridge generates a higher peak pressure and/or a larger volume of gas which is exhausted at a slower rate.

As previously noted, it is desirable to operate the action of the firearm with a minimum gas pressure in order that the action and receiver not be subjected to violent shocks during reciprocation. The gas pressure as measured along the barrel bore at any given time after the cartridge is fired, lessens as the distance between the point of measurement and the chamber increases. Furthermore the gas pressure at any given point in the barrel bore decreases with increase of the time interval between measurement and firing of the cartridge. Thus one can decrease the gas-operating pressure for a given cartridge by moving the gas bleed port further away from the chamber, or by delaying the entry of combustion gases into the gas chamber. The former solution does not accommodate itself to the mass production of firearms, since the bleed port location, slide arms, forearm, and other components of the gas system would necessarily be customized for the same caliber gun chambered to fire different powder charges. Accomplishment of the latter solution is a primary object of this invention.

Another problem which is found to occur with different cartridges having the same caliber bullet relates to extraction of the cartridge casing from the chamber. When the cartridge is fired, the gas pressure generated causes the casing to expand against the chamber wall to seal the chamber from the bolt face. When the gas pressure decreases the casing contracts so

that it is extractable from the chamber. The lower the chamber pressure, the easier the extraction, thus it is desirable that the cartridge be extracted after a time delay which is sufficient to permit the chamber pressure to drop to a reasonably low level.

The gas system of this invention operates to seal the gas cylinder against admittance of combustion gases during the period in which gas pressure within the chamber and bore is above a predetermined level. The system provides that the gas cylinder remain sealed even after the bullet has passed the gas port and exited through the muzzle. The gas system of this invention may also provide for a time lag between the time that combustion gases first enter the gas cylinder and the time that the gases can force the gas piston to move rearwardly in the cylinder, thereby further delaying reciprocation of the action to permit further dropping of the chamber pressure. The system includes a gas cylinder which is mounted on the firearm barrel at a predetermined distance forward of the chamber. The cylinder houses a gas piston which reciprocates therein and which includes a stem portion projecting from one end of the cylinder and toward the receiver. The other end of the cylinder is sealed with a plug. The piston is movable from one extreme position where its working face seats against an inner shoulder on the plug, to another extreme position wherein its stem projects to its fullest extent toward the receiver. For purposes of this disclosure, the face of the piston against which pressurized gas acts to drive the piston is termed the "working face" of the piston. A gas bleed port interconnects the barrel bore and the interior of the gas cylinder, the port opening into the cylinder interior in the area of the inner shoulder of the plug, preferably with the inner portion of the plug partially covering the port. The opening defined by the intersection of the port with the cylinder interior is completely contained within the sidewall of the cylinder interior so that gases within the port cannot act directly upon the piston work face. In order to act upon the work face, the gases must first enter the cylinder interior. An inertia body is movably mounted on a rod below the barrel and between the gas cylinder and the receiver, and a spring engages the inertia body to bias the latter against the protruding stem of the piston. Thus the spring and inertia body serve to bias the piston against the inner shoulder of the plug to close off the port. The inertia body is loosely connected to the bolt in such a way so as to permit the inertia body a limited extent of forward longitudinal movement with respect to the bolt. The connection also serves to transmit extensive rearward and forward longitudinal movement of the inertia body to the bolt so that the latter is reciprocated when the inertia body is driven rearwardly and forwardly over its rod by the piston and spring respectively.

When the gun is fired, the receiver, barrel and stock recoil rearwardly. Since the bolt is locked to the receiver, and since the gas cylinder and plug are rigidly secured to the barrel, the bolt and the gas cylinder and plug also recoil to the rear. The piston, however, is movably mounted in the cylinder, and the inertia body is mounted on its rod for limited forward movement with respect to the bolt, therefore the inertia body and piston "move" forward relative to the rest of the gun during recoil. The inertia body thus forces the piston against the inner shoulder of the plug to substantially seal the port against entry of combustion gas. Of course, the total sealing force exerted on the piston can be varied by varying the mass of the inertia body. As the recoil decelerates, the opposite sealing force of the inertia body and piston also decreases, until a point is reached where the seal is ineffective to keep combustion gases from entering the cylinder interior. When this point is reached, the pressure of the gases in the barrel bore and port has declined to a comparatively low value. When the comparatively low pressure gases enter the cylinder interior, they are free to act upon the work face of the piston to drive the latter rearwardly through the cylinder, and the piston in turn drives the inertia body rearwardly over its rod. This rearward movement of the inertia body is operative, through the con-

nection, to drive the bolt through the rearward portion of its reciprocation cycle. The bolt then impacts the recoil block on the receiver to terminate rearward movement and permit the spring to move the inertia body and bolt forward to their respective initial positions. In order to further delay reciprocation of the action, the plug or piston, or both, can be hollowed out to form a void in the interior of the cylinder, which void must be filled before the piston will be driven by the combustion gas. The size of the void can be varied to alter the duration of the delay in initiation of reciprocation.

The time period during which the gas cylinder is sealed after firing the gun will increase as the size of the charge in the cartridge increases for the reason that, other things being equal, the larger the powder charge, the greater the recoil force; and the greater the recoil force, the greater the sealing force exerted by the piston and inertia body. Of course, the converse of the above is also true, so that a small powder charge will cause a lesser recoil, a lesser sealing force, and the seal will break sooner so as to ensure that sufficient gas pressure is available to operate the action.

It is, therefore, an object of this invention to provide a gas system for autoloading firearms which operates at a lower gas pressure despite variations in the size of the powder charge utilized by cartridges in the firearms.

It is a further object of this invention to provide a gas system of the character described which seals the gas cylinder against entry of combustion gases until after the bullet has exited through the muzzle and combustion gas pressure has dropped.

It is yet another object of this invention to provide a gas system of the character described wherein the duration during which the gas cylinder is sealed is proportional to the gas pressure developed by firing the cartridge.

It is still another object of this invention to provide a gas system of the character described wherein a time lapse may be provided between the time combustion gases first enter the cylinder and the time the combustion gases are able to act upon the piston to drive the latter.

These and other objects and advantages of this invention will become more readily apparent from the following detailed description and accompanying drawings, in which:

FIG. 1 is a vertical sectional view of a portion of a firearm utilizing the gas system of this invention and showing the firearm after a cartridge has been fired and the bullet has passed the gas port;

FIG. 2 is an enlarged vertical sectional view of the gas cylinder area of the firearm of FIG. 1 showing the manner in which the gas port is sealed from the interior of the gas cylinder during a portion of recoil of the firearm; and

FIG. 3 is a vertical sectional view similar to FIG. 2 but showing the seal being broken as the force of recoil declines after the bullet has passed from the muzzle of the firearm.

Referring now to FIG. 1, a semiautomatic firearm is shown having a barrel 2 with a bore 4, a receiver 6 connected to the barrel 2, and a bolt assembly 8 reciprocally mounted in the receiver 6. The rear portion of the receiver forms a recoil block 10 which the bolt 8 impacts at the rearward end of its reciprocation cycle. The bolt 8 is shown locked by conventional lugs 12 in its battery position, and a cartridge casing 14 is seated in the chamber 16. The cartridge has just been fired as shown in FIG. 1, and the bullet 18 has traveled down the barrel bore 4 to point beyond a gas bleed port 20 opening into the barrel bore 4. Thus, as shown in FIG. 1, the gas port 20 is exposed to high-pressure combustion gases trapped between the cartridge casing 14 and the bullet 18. A gas cylinder 22 is rigidly mounted on the barrel 2. An inertia body 24 of predetermined mass is slidably mounted on a rod 26 extending between the receiver 6 and the gas cylinder 22, and a spring member 28 is sandwiched between the receiver 6 and the inertia body 24 to bias the latter toward the gas cylinder 22. The inertia body 24 includes a pin 30 which extends into an elongated slot 32 in a slide arm 34, the latter of which is connected to the bolt assembly 8. Thus the inertia body 24 is free to move longitudinally forward over a limited distance even though the

bolt 8 is locked to the receiver 6. The forward movement of the inertia body 24 is accomplished by means of the pin 30 and slot 32; however, this movement may be provided by any of a number of ways without departing from the spirit of this invention. For example, the inertia body could be rigidly secured to the slide arm which in turn could be slidably secured to the bolt, as, for example, by means of a sliding bolt carriage.

Referring now to FIG. 2, the gas cylinder 22 is hollowed out to form a chamber 35 having a cylindrical sidewall 36. The gas bleed port 20 is extended at 20' through the cylinder 22 to open into the chamber 35 through the sidewall 36. It is noted that the gas port 20, 20' opening is completely contained in the sidewall 36. A plug 38 is threaded into the forward end of the cylinder 22 with the inner face of the plug 38 terminating in the area of the gas port 20, 20' to define a shoulder 40. As shown in FIG. 2, a portion of the plug 38 preferably overlies a portion of the gas port 20, 20', however, the inner plug face shoulder 40 can be disposed closely adjacent to the gas port 20, 20' without departing from the spirit of the invention. A sealing ring 42 is preferably sandwiched between the gas cylinder 22 and the plug 38 to seal the forward end of the cylinder chamber 36. The plug 38 is hollowed out to form a void 44 which provides a delay in reciprocation of the action, as will be more clearly pointed out hereinafter. A pressure reduction passage 45 is drilled through the forward end wall of the plug 38 so that the void 44 is vented to the exterior. The passage 45 provides for controlled reduction of gas pressure and resultant energy input in the void 44 and gas chamber 35, and permits the gas bleed port 20 and 20' to be greater in diameter than would otherwise be possible with high-pressure cartridges. Thus the diameter of the gas bleed port 20, 20' is rendered substantially noncritical and the bleed port 20, 20' can be of a standard diameter. It is noted that, while the plug 38 is hollowed out in the preferred embodiment of the gas system, the void 44 may be omitted from the plug 38 without departing from the spirit of the invention. A piston 46 is slidably mounted in the gas chamber 35, the piston having a groove 48 in which is seated a gas-sealing ring 50 operative to form a gastight seal with the chamber wall 35. The piston 46 also includes a stem portion 52 which protrudes rearwardly from the cylinder 22 through an opening 54. The rear face 56 of the piston stem 52 is thus disposed for contact with the inertia body 24.

As shown in FIG. 2, when the firearm is fired, the receiver, the barrel, the gas cylinder 22, and all parts of the firearm rigidly connected to the receiver, accelerate in the direction of the arrow 58 during recoil caused by the pressurized combustion gases. Since the inertia body 24 and piston 46 are not rigidly connected to the receiver, the inertia body 24 and piston 46 move (relative to the rest of the firearm) in the direction of the arrow 60. The working face 47 of the piston 46 is thus forced against the plug shoulder 40 so that the piston face 47 and plug shoulder 40 combine to seal off the gas port 20, 20' from the cylinder chamber 35. In order to be effective, the seal thus formed need not be perfect, rather it must merely prevent more than just a trickle of pressurized gas from entering the cylinder chamber 35. It is noted that the pressurized gas in the gas port 20, 20' can only exert a force upon the piston 46 which is normal to the axis of the piston, thus the pressurized gas, while confined to the gas port, cannot force the piston 46 to move rearwardly through the chamber 35.

As the recoil force declines, the seal between the piston face 47 and the plug shoulder 40 becomes less effective to exclude the pressurized gas from the chamber 35, but at the same time the pressure of the combustion gas is lowering. Finally a condition shown in FIG. 3 is reached where the seal is broken and the combustion gas is free to pass between the piston working face 47 and the plug shoulder 40 and into the cylinder chamber 35, the gap between the face 47 and shoulder 40 being greatly exaggerated in FIG. 3. After the gas passes the shoulder 40, the void 44 must fill up before the gas will be able

to drive the piston 46 rearwardly through the chamber 35. Thus the presence of the void 44 provides a delay in reciprocation of the action. When the void 44 is filled with combustion gas, the latter will drive the piston 46 rearwardly through the chamber 35 and the piston stem 52 will in turn drive the inertia body 24 rearwardly over the rod 26. The momentum imparted to the inertia body 24 by the piston 46 will carry the inertia body 24 and the bolt 8 through the entire rearward portion of their reciprocation cycle.

It is thus readily apparent that the gas system of this invention permits lower pressure gases to operate the piston by sealing the bleed port during a portion of the recoil movement after the weapon is fired. Since the force of recoil is the same force that initiates and maintains the seal, the seal will be greater for a higher pressure cartridge and will block combustion gases from entering the gas chamber for a longer period of time when a higher pressure cartridge is fired. Still further, the provision of a void in the system adjacent the working face of the piston causes a further delay in actuation to occur after the gas first enters the gas chamber. Inclusion of a pressure reduction passage to vent the gas chamber permits control of the energy input in the gas chamber without unduly restricting the size of the gas bleed port.

What I claim is:

1. In an autoloading firearm having a receiver and a barrel with a bore rigidly connected to the receiver, a gas system for operating the action of the firearm, said gas system comprising:

- a. a gas cylinder rigidly secured to the barrel, said gas cylinder including a gas chamber having a cylindrical sidewall;
- b. port means interconnecting said gas chamber and the barrel bore, said port means opening into said gas chamber in an area completely contained within said gas chamber sidewall, said port means being operative to bleed pressurized combustion gases from the barrel bore to said gas chamber;
- c. shoulder means in said gas chamber and overlying a portion of said port means opening;
- d. piston means having a working face and slidably mounted in said gas chamber, said piston means being movable into abutting contact with said shoulder means; and
- e. inertia body means operative to force said piston means against said shoulder means during recoil to substantially seal said port means from said gas chamber.

2. The gas system of claim 2, further comprising passage means operative to continuously provide venting of said gas chamber to control energy input in said gas chamber.

3. The gas system of claim 1, wherein said gas cylinder further includes a void adjacent said port means opening, and bounded on one end by a transverse end wall of said gas

chamber, and bounded on the other end by said working face of said piston.

4. In an autoloading firearm having a receiver and a barrel with a bore rigidly connected to the receiver, a gas system for operating the action of the firearm, said gas system comprising:

- a. a gas cylinder rigidly secured to the barrel, said gas cylinder having a gas chamber with a cylindrical sidewall;
- b. port means opening into said cylindrical sidewall and interconnecting said gas chamber with the barrel bore;
- c. plug means rigidly secured to one end of said gas cylinder and extending into said gas chamber, said plug means including an inner portion overlying a part of said port means opening and defining a shoulder;
- d. piston means slidably mounted in said gas chamber in sealing engagement with said cylindrical sidewall, said piston means being movable into abutting contact with said shoulder; and
- e. inertia body means movably mounted on said firearm and operative to force said piston means against said shoulder during recoil to substantially seal said port means from said gas chamber.

5. The gas system of claim 4, wherein said plug means is hollowed out to form a void adjacent said port means opening and bounded on one end by said piston means.

6. The gas system of claim 4, further comprising passage means through said plug means operative to continuously vent said gas chamber to control energy input in said gas chamber.

7. In a system for operating the action of an autoloading firearm having a receiver, said system comprising:

- a. a barrel having a bore rigidly secured to said receiver;
- b. bolt means slidably mounted in said receiver for movement between a battery position and a retired position;
- c. means operative to lock said bolt means to the receiver when said bolt means is in its battery position;
- d. slide arm means connected to said bolt means;
- e. gas cylinder means rigidly connected to said barrel, said gas cylinder means having a gas chamber with a cylindrical sidewall;
- f. port means opening into said cylindrical sidewall and interconnecting said barrel bore with said gas chamber;
- g. shoulder means in said gas chamber and overlying a portion of said port means opening;
- h. piston means slidably mounted in said gas chamber, said piston means being movable into abutting contact with said shoulder means; and
- i. inertia block means slidably connected to said slide arm means, said inertia block means being operative to force said piston means against said shoulder means during recoil to substantially seal said port means from said gas chamber.

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