

Sept. 6, 1960

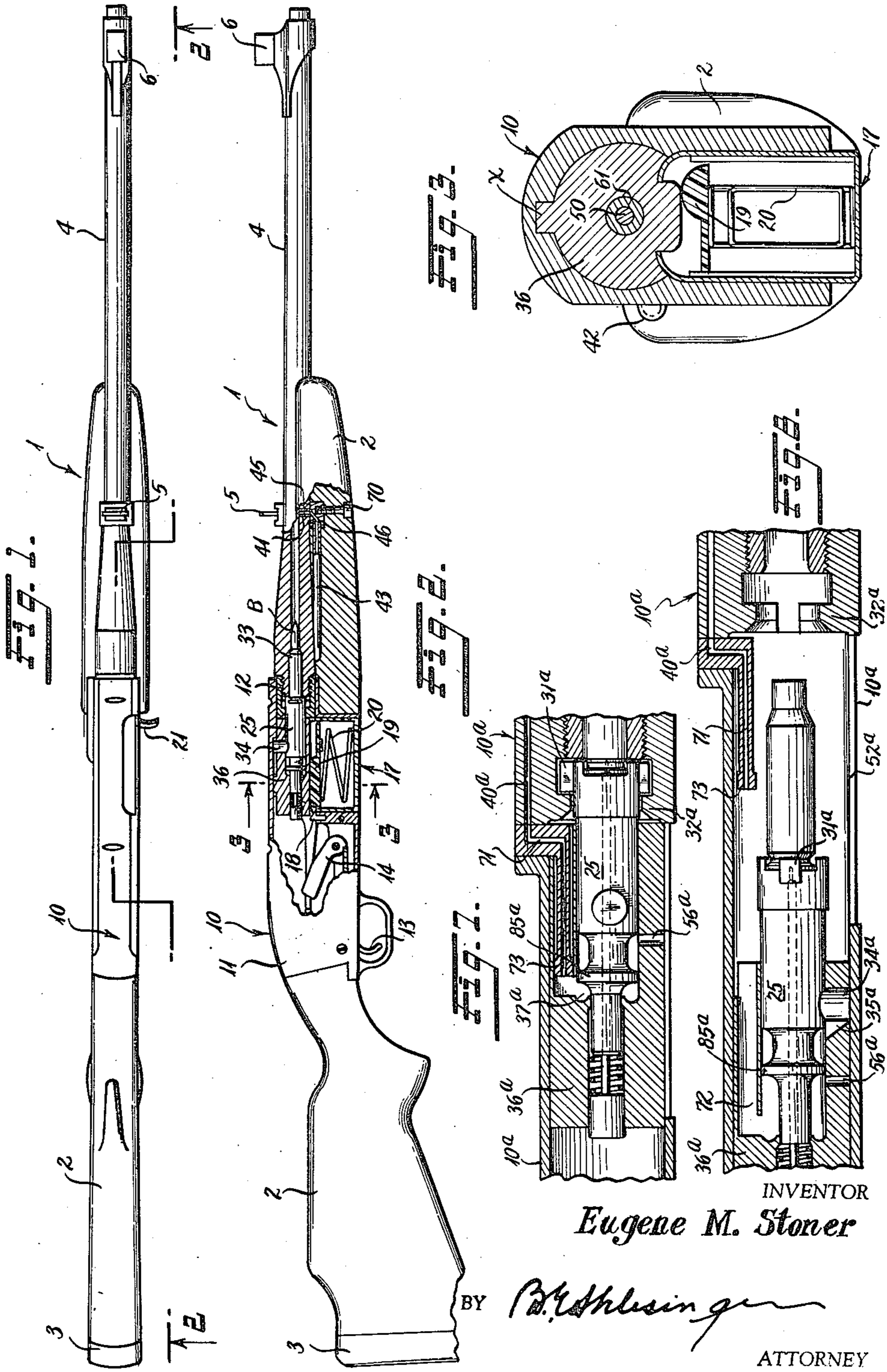
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GAS OPERATED BOLT AND CARRIER SYSTEM

Filed Aug. 14, 1956

2 Sheets-Sheet 1



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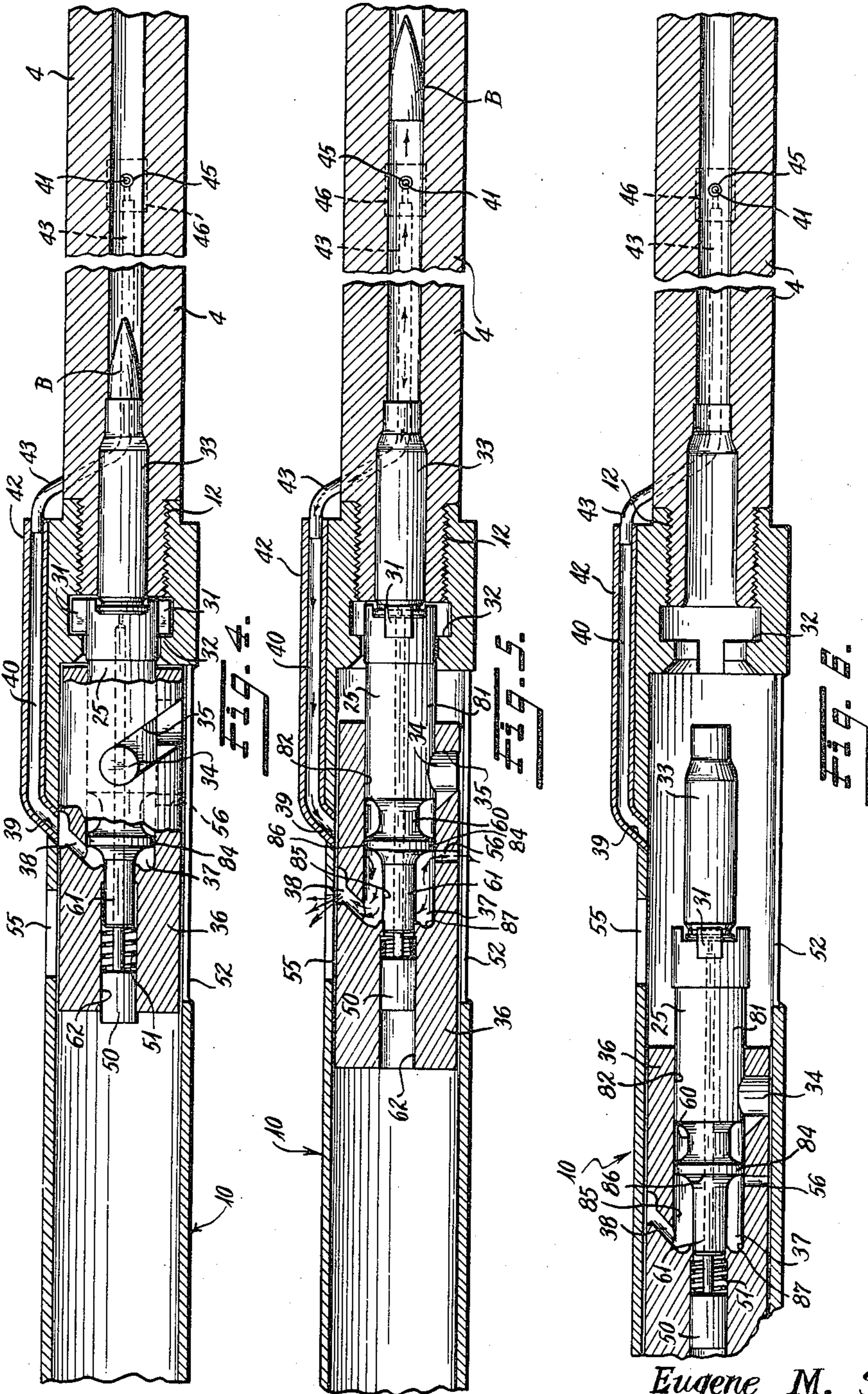
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## GAS OPERATED BOLT AND CARRIER SYSTEM

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Filed Aug. 14, 1956, Ser. No. 603,913

6 Claims. (Cl. 89-191)

This invention pertains to automatic rifle mechanisms and in particular to the gas system employed for operating the bolt and bolt carrier.

The most widely used method of operation of automatic rifles today is the conventional gas cylinder, piston and actuating rod assembly; the only other system now in production use being the recoil actuating system. The blow-back or inertia block system is usually reserved for weapons using lower powered ammunition, such as pistol and .22 caliber weapons.

It is a principal object of this invention to utilize the basic parts of an automatic rifle mechanism such as the bolt and bolt carrier to perform a double function. This double function consists of the bolt's primary function to lock the breach against the pressure of firing, and secondarily, to act as a stationary piston to actuate the automatic rifle mechanism. The primary function of the bolt carrier is to lock and unlock the bolt by rotating it and to carry it back and forth in the receiver. The secondary function of the bolt carrier is to act as a movable cylinder to actuate the automatic rifle mechanism. By having the bolt carrier act as a movable cylinder and the bolt act as a stationary piston, the need for a conventional gas cylinder, piston and actuating rod assembly is eliminated.

It is an object of this invention to provide a gas system which is lighter and less expensive to produce because of its simplicity than the present gas systems now used in automatic rifle mechanisms.

It is another object of this invention to utilize the energy of the expanding gas developed by the firing of the weapon, for actuating the automatic rifle mechanism directly by use of a metered amount of the gas coming from the barrel. This invention is a true expanding gas system instead of the conventional impinging gas system. By utilization of a metered amount of gas from the barrel, the automatic rifle mechanism is less sensitive to different firing pressures caused by variations in the propelling charge. It is therefore still another object of this invention, to provide a rifle mechanism which is not affected by variations in the propelling charge.

A further object of this invention is to provide smoother operation and longer life of the working parts of the automatic rifle mechanism. Since, in this invention, the actuating force is transmitted directly down the center line of the barrel and the bolt mechanism to the shoulder of the shooter, all of the off center loads found in most other types of gas actuated weapons are eliminated. It will therefore be obvious because of this factor that another object of this invention is to cut down on "climb" which occurs during automatic firing operations.

These and other objects and advantages of this invention will be apparent from the following description and claims. In the accompanying drawings which illustrate by way of example various embodiments of this invention:

Figure 1 is a top plan view of a rifle embodying this invention;

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Figure 2 is a side elevational view of a rifle such as illustrated in Figure 1, having a portion of the rifle broken away in order to show the gas system employed by this invention.

Figure 3 is an enlarged sectional view on the line 3-3 looking in the direction of the arrows of Figure 2.

Figure 4 is an enlarged fragmentary sectional view, a portion being in elevation and the remaining portions being in section, showing the gas system in battery position at the time of firing.

Figures 5 and 6 are enlarged fragmentary sectional views showing the gas system in various operational stages. Figure 5 shows the system just prior to removal of the cartridge casing from the breach; and Figure 6 shows the system at a stage where the cartridge casing has been removed from the breach and is about to be ejected from the rifle.

Figures 7 and 8 show sectional views of a modified bolt and bolt carrier in battery and out-of-battery position respectively.

In Figures 1 and 2 the rifle as indicated by 1 has a stock 2, with a butt plate or cushion 3. The stock is secured to a barrel 4. Gun sights 5 and 6 are secured to the barrel 4.

A receiver 10 is mounted in the stock 2 and has a housing 11. The barrel 4 is adapted to be screwed or otherwise attached to the receiver 10 as indicated at 12.

The receiver 10 carries a trigger 13 which is connected to a hammer 14. The details of the hammer and trigger mechanism are not shown and may be of any convenient construction.

A cartridge magazine is generally indicated at 17. The magazine is held within the receiver by a locking finger 18 or other similar mechanisms. The magazine 17 comprises a follower 19 biased by a magazine spring 20.

A charging lever 21 is shown in Figure 1.

Figure 4 shows a bolt 25 in battery locked position with its lugs 31 engaged in abutment 32 of receiver 10. This supports cartridge 33 during firing. Bolt 25 has a projecting pin or lug 34 which travels in a helical slot 35 cut in bolt carrier 36. The bolt carrier 36 supports the bolt 25 and is keyed against rotation in receiver 10 by key X as shown in Figure 3. Bolt 25 and bolt carrier 36 form an annular chamber 37 with a connecting port 38. A port 39 in receiver 10 mates with port 38. A gas passage 40 is connected to the port 39 which in turn is connected to chamber 37. The other end of gas passage 40 is connected with a port 41 in the barrel 4. The gas passage 40 as shown in the drawings is preferably made up of two tubes 42 and 43 slidably engaged to permit longitudinal expansion during firing and resultant heating conditions. The latter tube 43 is bent so that the port 41 may be located if so desired on the under side of the barrel. This arrangement is not essential and any other type of arrangement may be suitable depending upon the weapon itself. For example, a straight continuous tube may be used instead of two pieces of tubing as illustrated. It will be obvious that various other types of arrangements for the gas passage 40 may be constructed.

It has been found most satisfactory to have a bushing 45 inserted into the port 41 in a vertical fashion. Bushing 45 is connected to a coupling 46 as best shown in Figure 2. Tube 43 enters a side of coupling 46. The coupling 46 for the bushing 45 and the end of tube 43 is not necessary but it has been found that this particular arrangement facilitates manufacturing and avoids the necessity of having to shape tubes 42 and 43 at the time of their connection together and to ports 39 and 41.

The bolt 25 carries a firing pin 50 which is backed up by a firing pin spring 51. The bolt also has an automatic shell ejecting mechanism of conventional construction

(not shown) for kicking the shell out of the gun after it has been extracted from the breech. A window or slot 52 in the receiver 10 is provided for ejecting the shell casing.

Figure 5 shows the gas system and assembly immediately after firing. Bullet B has passed port 41. This permits the explosion gas to flow down the passage 40 through port 39 and into port 38 of Figure 4. As soon as the chamber 37 fills with high pressure gas, the pressure in chamber 37 drives the bolt carrier 36 rearward as in Figure 5. After initial movement of the bolt carrier 36, port 38 is disconnected from port 39, thus cutting off the supply of gas from the barrel. Thus, in effect, the gas is metered from the gun barrel, the bolt carrier moving when the required pressure is reached in chamber 37, regardless of the firing pressure. The gas trapped in chamber 37 continues to expand, driving the bolt carrier rearward. The rearward motion rotates the bolt 25 by action of the projecting pin 34 in the helical slot 35. This rotation disengages the bolt lugs 31 and 32. After the bolt carrier 36 has moved to its most rearward position relative to the bolt 25, the effect of the expanding gas is complete because no further relative motion can continue between the bolt 25 and the bolt carrier 36. This relative motion is stopped when the projecting pin 34 has reached the end of the helical slot 35 in the bolt carrier 36. The bolt carrier 36 and the bolt 25 then move rearward together by inertia. At the end of the power stroke, as best shown in Fig. 5, the bolt carrier 36 has been moved rearwardly by the action of the gas in the chamber 37 to urge the projecting pin or lug 34 on the bolt 25 to the end of the helical slot 35 in the bolt carrier 36.

At this juncture, relative movement between the bolt 25 and the bolt carrier 36 terminates and the bolt 25 and bolt carrier 36 continue moving rearwardly in the receiver 10 as a unit until a rearward position approximating that shown in Fig. 6 is reached. However, when the bolt carrier 36 reaches the end of the power stroke, the port 38 is aligned with the slot 55 in the receiver 10 to exhaust the gas from the chamber 37. Simultaneously, a port 56 in the opposite side of the bolt carrier 36 is exposed because of the relative movement between the bolt carrier 36 and the bolt 25 to permit exhaust of the gas from the chamber 37 through a slot 52 in the side of the receiver 10.

Figure 6 shows the bolt 25 and the bolt carrier 36 in the rear position with the bolt ready to eject the empty cartridge case 33. The gas in chamber 37 has been exhausted through ports 55 and 56. By this time the gas is also exhausted from the barrel. The bolt carrier 36 and the bolt 25 are then driven forward by the action of a driving spring of conventional design (not shown) or the like acting on the bolt carrier 36. This forces and feeds a fresh cartridge from the cartridge magazine 17 into the barrel 4 and locks the bolt 25 to the receiver 10 or barrel 4, thus returning all the parts to the initial position as shown in Figure 4.

The bolt 25 incorporates an annular groove 60 intermediate its extremities and incorporates a stem 61 which is of smaller diameter than the forward extremity 81 of said bolt. The stem 61 projects into a bore 62 which is of smaller diameter than the bore 82 in the forward portion of the carrier 36. The firing pin spring 51 engages the extremity of the stem 61 and the stem 61 is of such a length as to have a portion thereof located at all times in the bore 62 during relative movement of the carrier 36 and the bolt 25. The transverse dimension of the stem 61 is slightly less than that of the bore 62 in order to prevent rapid loss of pressure from the chamber 37 when gases enter said chamber from the barrel 4.

The annular groove 60 formed in the forward extremity 81 of the bolt 25 serves both to reduce the weight of the bolt and to provide an area for the collection of carbon deposited out of the actuating gas. Moreover, the

groove 60, in conjunction with the stem 61, defines a piston 84 whose perimeter engages the cylindrical wall 85 of the chamber 27. The perimeter of the piston 84 is thus disposed in sealing and gas-tight engagement with the adjacent portion of the wall 85 of the chamber 37 and the left-hand side 86 thereof constitutes the right-hand end wall of the chamber, as viewed in Figs. 4-6 of the drawings, while the left-hand end wall 87 of the chamber is located at the juncture between the chamber 37 and the reduced bore 62.

It is to be noted that coupling 46 is preferably bolted by means of a bolt 70 to the stock 2. This coupling serves as a projection whereby the stock 2 may be adequately connected to the barrel 4 without the necessity of having to drill a threaded opening into the barrel thereby weakening the same.

An alternative embodiment of the invention is shown in Figs. 7 and 8 of the drawings as including a bolt carrier 36a which incorporates an elongated cylindrical bore 72 communicating at its left-hand extremity, as viewed in Figs. 7 and 8 of the drawings, with the chamber 37a and at its right-hand extremity with the forward extremity of the carrier 36a. The actuating gas is led from the barrel 4 through a gas passage 40a into an elongated tubular gas outlet fitting or nozzle 71 having an expanded end 73 adapted to engage within the bore 72 to cause actuating gas to flow into the chamber 37. The expanded extremity 73 of the tubular fitting 71 provides a sliding fit with the bore 72 of the bolt carrier 36a in order that leakage of gas therepast will be minimized.

In the embodiment of the invention shown in Figs. 7 and 8, only one exhaust port 56a is provided which, as best shown in Fig. 7 of the drawings, is disposed to the right of the piston 85a when the lugs 31a on the bolt 25 are locked upon the abutment 32a in the forward extremity of the receiver 10a. It should be understood that the abutment 32a can be incorporated in a barrel extension and need not necessarily be incorporated in the receiver itself when the receiver is fabricated from a light material such as aluminum or the like. Thus, the exhaust port 56a does not communicate with the interior of the chamber 37a while actuating gas is being fed thereinto through the bore 72 in the receiver 36a.

However, when the gun is fired, the piston 85a will remain stationary until the actuating gas has caused the carrier 36a to move relative to the piston 85a until the lug 34a reaches the end of the helical slot 35a. The relative movement between the carrier 36a and the piston 85a on the bolt 25 locates the exhaust port 56a to the left of the piston 85a and in communication with the chamber 37a to permit gas to be exhausted into the interior of the receiver 10 and ultimately to atmosphere through the slot 52a.

While the invention has been described in connection with different embodiments thereof, it will be understood that it is capable of further modification, and this application is intended to cover any variations, used, or adaptations of the invention following, in general, the principles of the invention and including such departures from the present disclosure as come within known or customary practice in the art to which the invention pertains, and as may be applied to the essential features hereinbefore set forth and as fall within the scope of the invention of the limits of the appended claims.

Having thus described my invention, what I claim is:

1. In a gas operated system for a firearm, the combination of: a receiver; a bolt carrier slidable in said receiver; a bolt movably mounted in said carrier, said bolt having a piston thereupon and locking lug means thereupon engageable with corresponding lug means on said receiver to prevent relative movement between said bolt and said receiver when the lug and lug means are engaged, said bolt piston and bolt carrier defining between them an expandable chamber; and means for carrying the explosive gases resulting from the firing of said firearm to said

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expandable chamber whereby the gases operate within said chamber directly on said bolt and said bolt carrier to retract said bolt carrier relative to said bolt.

2. In a firearm construction, the combination of: a receiver having an abutment thereupon; a bolt carrier having an axial bore therein terminating intermediate the extremities of said carrier, said carrier being movable in said receiver; a bolt mounted for movement in said bore and having a piston thereupon engageable with the side wall of said bore to define an expandable chamber in said carrier, said bolt and said carrier being movable relative to each other and said bolt having locking lugs thereupon engageable with said abutment on said receiver; and means for carrying explosive gases directly from the barrel of said firearm to said expandable chamber whereby, when said firearm is fired, the gases expand said chamber by sliding said bolt carrier relative to said bolt while simultaneously causing rotation of said bolt to release said lugs from said abutment until said chamber is fully expanded whereupon said bolt is retracted.

3. In a gas operated system for a firearm, the combination of: a receiver having an abutment therein; a barrel mounted in said receiver; a bolt carrier movable in said receiver, said bolt carrier having an axial bore formed therein provided with an end wall terminating intermediate the extremities thereof and said carrier having an intake port and an exhaust port communicating with said bore adjacent said end wall; a bolt slidable in said carrier bore having a portion thereupon defining an expandable chamber in conjunction with said end wall; and a conduit for carrying gases from the bore of the barrel of said firearm to said intake port having sliding engagement with said intake port whereby said intake port communicates with said conduit when said bolt and bolt carrier are in battery position and whereby, upon firing said firearm and ingress of gases into said expandable chamber, communication between said intake port and said conduit is terminated.

4. In a gas operated system for a firearm, the combination of: a bolt carrier having a longitudinal bore therein provided with an end wall intermediate the extremities of said carrier, said carrier having an exhaust port communicating with said bore; a bolt slidable in said bore having a piston portion thereupon engageable with the wall of said bore and defining an expandable chamber in conjunction with said end wall of said bore; and means for carrying the gases resulting from firing of said firearm to said expandable chamber, said piston portion of said bolt being adapted to isolate said exhaust port from communication with said expandable chamber when said bolt is in battery position and to permit said exhaust port to

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communicate with said chamber when said carrier is slidably reciprocated with reference to said bolt to expand said chamber.

5. In a gas operated system for a firearm, the combination of: a receiver having a barrel and a bolt abutment thereupon; a bolt carrier slidably mounted in said receiver having a first bore extending inwardly from one end thereof and a second bore of lesser diameter than said first bore communicating with said first bore, said carrier having an operating groove therein; a bolt having abutment engaging lugs thereupon and a first portion slidable in said first bore and a second portion slidable in said second bore, said bolt having an operating lug engageable in said operating groove in said carrier and having a piston portion defined at the juncture between said first and second portions thereof and defining an expandable chamber in said carrier in conjunction with the opposed end of said first bore; and means for introducing actuating gas into said expandable chamber whereby said chamber will be expanded to cause relative sliding movement between said bolt and said carrier to cause said lug to move from one extremity of said groove to the other and rotate said bolt relatively to said receiver to release said lugs from said abutment.

6. In a gas operated system for a firearm, the combination of: a receiver having a barrel and a bolt abutment thereupon; a bolt carrier slidably mounted in said receiver having an axially oriented bore with one end located intermediate the extremities of said carrier and the opposite end open to the forward extremity of said carrier, said carrier having intake and exhaust ports adjacent said one end; a bolt slidably mounted in said carrier having abutment engaging lugs thereupon projecting from the open end of said bore and having a piston thereupon located within said bore and defining an expandable chamber in conjunction with said one end thereof; and means for transmitting firing gases from said barrel to said intake port including an elongated tubular member terminating in a gas outlet opening in said receiver engageable with said intake port in said carrier.

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