Nov. 27, 1956 C. H. MORSE ET AL 2,771,819

GAS-OPERATING FIREARM

Filed Oct. 12, 1953

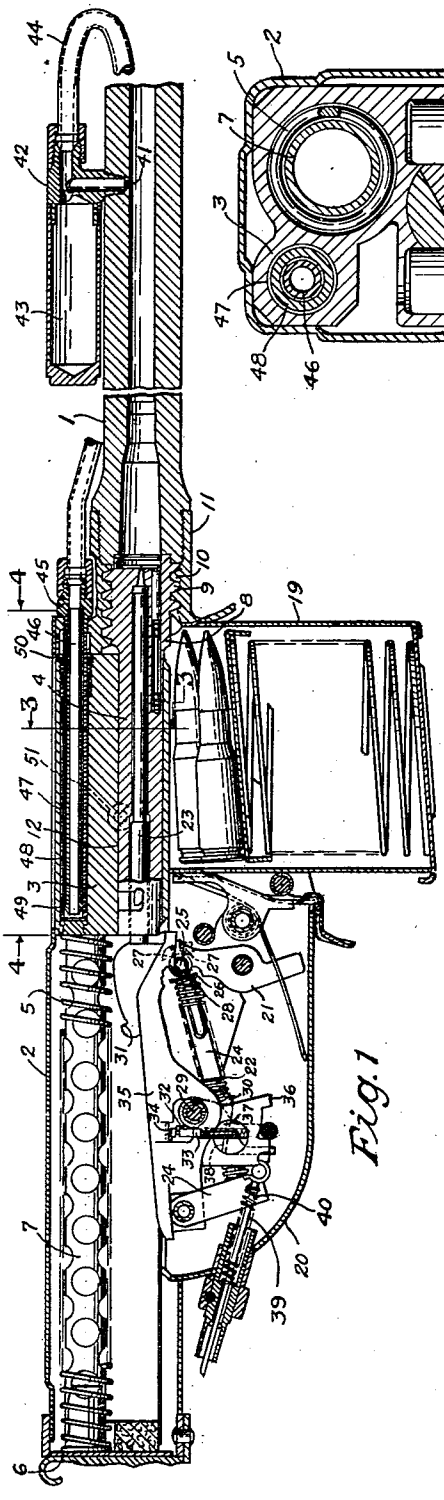


Fig. 1

Fig. 3

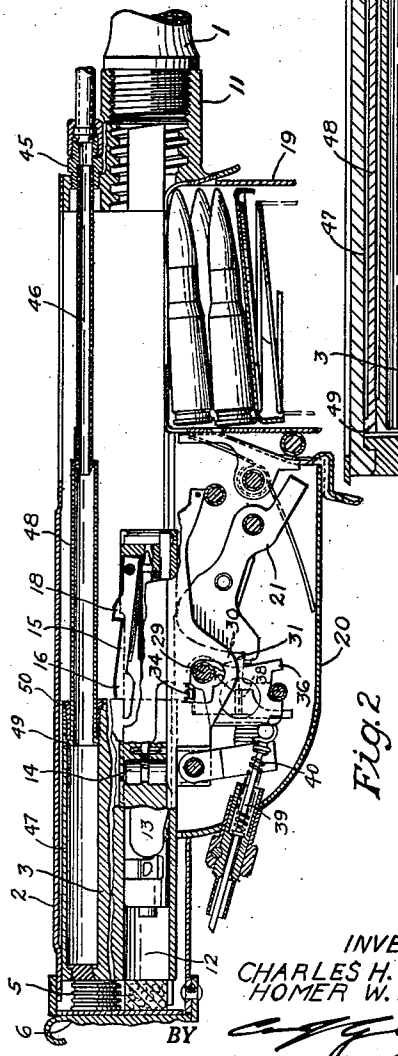


Fig. 2

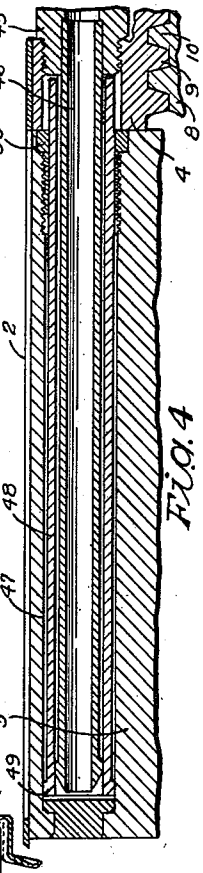


Fig. 4

INVENTORS
CHARLES H. MORSE
HOMER W. YOUNG

BY

John H. Lewis Jr.

ATTORNEYS

United States Patent Office 2,771,819
Patented Nov. 27, 1956

2,771,819

GAS-OPERATING FIREARM

Charles H. Morse, Herkimer, and Homer W. Young, Ilion, N. Y., assignors to Remington Arms Company, Inc., Bridgeport, Conn., a corporation of Delaware

Application October 12, 1953, Serial No. 385,428

6 Claims. (Cl. 89—191)

This invention relates to an improved gas-operated autoloading rifle and has particular reference to the gas-operating elements thereof.

In the design of gas-operated rifles it has been realized that there were notable advantages to be gained by the provision of an expansion chamber in which a portion of the gases produced by the cartridge could be trapped and utilized to prolong the effect of the gas upon the working elements of the mechanism. Such systems, however, have usually contained intricate valves, etc., and have suffered from the accumulation of carbonaceous and other deposits from the firing of the weapon.

Attempts have also been made to apply the force of gas operation directly to the breech bolt or breech bolt carrier without the interposition of pistons, operating rods, and the like, but such systems have usually, if not always, been arranged to exhaust to atmosphere after but a short portion of the bolt stroke with the attendant disadvantages of loss of operating power and an intense breech flash.

Important objects of this invention are the provision of a gas expansion system characterized by simplicity, by remaining a closed system throughout its operating cycle, and by the application of power directly to the breech bolt carrier.

These objects and others which will appear from further discussion have been accomplished by the provision of a gas orifice in the barrel forward of the chamber which leads into a fitting on continuous communication with a gas expansion chamber and with a gas tube which leads rearwardly to a fixedly mounted inner piston which, with the bolt locked, is completely housed within a blind hole in the breech bolt carrier. Telescopically mounted in the breech bolt carrier is an outer piston which surrounds the inner piston and when the breech bolt is fully open the outer piston is arranged to bridge the gap which would otherwise exist between the breech bolt carrier and the end of the inner piston.

The exact nature of the invention as well as other objects and advantages thereof will more fully appear upon consideration of the following specification referring to the attached drawings in which:

Fig. 1 is a longitudinal vertical cross-sectional view of a firearm incorporating the invention, the mechanism being shown in breech closed position at the instant of firing.

Fig. 2 is a view similar to Fig. 1, with the mechanism being shown in the position of maximum breech opening after the firing of a cartridge.

Fig. 3 is a partial cross-sectional view on the line 3—3 of Fig. 1.

Fig. 4 is an enlarged view of a portion of Fig. 1.

Referring to the drawings by characters of reference, it may be seen that the arm shown comprises a barrel 1 and receiver 2 within which there are housed a bolt carrier 3 and breech bolt 4. An action spring 5 acts between the bolt carrier 3 and a backplate 6, being guided

on a guide tube 7 over which the bolt carrier may telescope.

The bolt 4 comprises a bolt head 8 provided with interrupted thread locking lugs 9 for engagement with mating lugs 10 in a barrel extension 11 in a known manner. The bolt body is received in a longitudinal bore 12 in the bolt carrier and is machined on its two sides to provide mutually parallel surfaces 13 which define a twisted ribbon cam. A pair of cam pins 14 are vertically disposed in the bolt carrier and intersect the bore therein with a cylindrical surface of each cam pin engaging one of the surfaces 13 defining the ribbon cam. Thus, as the bolt carrier is reciprocated relative to the bolt body, the action of the cam pins and the ribbon cam is to rotate the bolt body while straight portions of the cam at either end provide a dwell which permits limited reciprocation of bolt carrier and bolt without relative rotation.

Starting with the mechanism in the Fig. 1 position, the cam pins are engaging a straight portion of the cam and the bolt carrier can move rearwardly about one and one-fourth inches before the twist of the cam starts to rotate the bolt. Preferably, the initial portion of the cam will accelerate gradually and merge into a uniform cam which completes the rotation of the bolt to unlocked position after slightly more than 2½ inches displacement of the bolt carrier. At the end of a further dwell on the cam of about ½ inch, the bolt carrier picks up the bolt and except for some rebound of the bolt during automatic firing, the bolt and carrier progress together.

A bolt lock 15 is swingably mounted in the bolt body and spring-urged outwardly. Whenever the cam pins are riding on the rearmost dwell on the bolt cam, the lug 16 on the bolt lock is positioned to engage the front face of the bolt carrier and prevent the return of the bolt into the bolt carrier until the bolt lock has been depressed by engagement of the shoulder 18 with the barrel extension 11. This bolt lock also has the effect of limiting rebound of the bolt due to the impact of the cam pins at the rear terminal end of the ribbon cam.

During the forward stroke of the bolt and carrier, the bolt head pushes a fresh cartridge out of the lips of the box magazine 19 and feeds it to the chamber in the barrel. If it were not for the bolt lock the thrust against the cartridge would be taken by the cam pins, tending to rotate the bolt, and would require the provision of a guide track in the receiver to insure that the bolt locking lugs were correctly lined up to enter the receiver.

Fire control means

Fire control means is supported from the bottom of the receiver in a housing 20. A hammer 21 is provided and is urged by a mainspring 22 to strike a firing pin 23 in the bolt. A mainspring guide 24 is pivotally mounted in the housing 20 and a bifurcated end thereof passes on either side of a hammer thrust pin 25 while a mainspring retainer 26 which is of washer-like form applies the thrust of the mainspring to the pin. For convenience in disassembly of the arm, out-turned hooks 27 are provided on the mainspring guide which engage the retainer and prevent the escape of the spring. An angled tab 28 on the retainer partially spans the hole therein and passes between the legs of the bifurcated mainspring guide to prevent moving the legs together to disengage the hooks 27 from the retainer unless the retainer is biased sidewise to throw the tab 28 parallel to, but out of the plane of, the guide, in which position the legs can be sprung together to pass the hooks 27 thereon through the hole in the retainer.

A pivot pin 29 provides a mounting for a sear 30 which engages a notch 31 in the hammer. There are wide vertical slots in each face of the sear which receive in vertically slidable relation a sear stirrup 32. The sear

stirrup is urged upwardly by a spring-urged plunger 33 in the sear and is held down by a tab 34 turned out of the plane of the disconnector 35. The disconnector 35 is pivotally supported from the same pin as the mainspring guide and it will be seen by comparison of Figs. 1 and 2 that the disconnector is displaced downwardly every time the bolt carrier moves rearwardly, thus also lowering the sear stirrup on the sear.

A connector 36 is pivotally supported on the sear pivot and is a U-shaped member provided with legs which engage the outer surfaces of the sear stirrup. The hook 37 on the back leg of the connector is shown in dotted lines in the drawings and with the disconnector and sear stirrup up, as in Fig. 1, the hook 37 engages an out-turned tab 38 on the back leg of the sear stirrup, also shown in dotted lines, so that swinging movement of the connector swings the sear to disengage from the hammer. In the position shown in Fig. 2, the disconnector and sear stirrup are depressed and the tab 38 is below the level of the hook 37 and the sear is urged forward by the reaction against the sear stirrup plunger 33 to engage the hammer. In this position, the connector may be moved independently of the sear and if the connector had been held back after firing, the sear would have been disengaged therefrom to reengage the hammer and the firing of a second round would not be possible until the connector had been released to reengage the sear stirrup. For a remotely controlled application, the connector is engaged by a cable 39 and return spring 40. This fire control, it will be seen, provides for remotely controlled semi-automatic operation and requires a separate operation of the cable for each shot fired.

Gas operating means

The breech bolt carrier 3 and breech bolt 4 are driven backward after firing each shot by means of powder gas tapped from the barrel 1 and are returned by the force of the action spring 5.

At an appropriate point on the barrel 1, a radial gas port 41 penetrates to the bore of the barrel and this port is internally threaded or otherwise fitted to receive and retain a gas orifice coupling 42. The gas orifice coupling provides a T connection and divides the gas flowing from the barrel between a gas expansion chamber 43 and a gas tube 44. For convenience in assembly, the gas tube extends from the forward end of the gas orifice coupling and makes a 180° bend extending rearwardly to the front face of the barrel extension 11, where it is secured to a coupling 45. Also secured to or integral with the coupling 45 is an inner piston 46 which extends rearwardly into the receiver for almost the full length of the bolt carrier 3. When the breech bolt carrier is in its foremost or breech locked position, a longitudinal bore 47 in the carrier receives the inner piston. The bore 47 also receives in slidable relation an outer piston 48 which has a relatively close telescoping fit over the inner piston 46 and is provided at its rear end with a flange 49 closely fitting the bore 47 and arranged to engage an outer piston retainer 50 which is threaded into the breech bolt carrier.

As the fired bullet passes the gas port 41, gas passes through the orifice coupling and is admitted simultaneously to the expansion chamber 43 and to the gas tube 44. Within the expansion chamber a quantity of gas is stored and, as pressure in the barrel is lowered, this stored gas acts to hold up pressure in the gas tube for a longer period. Gas passing through the gas tube probably provides some initial impulse action against the closed end of the bore 47 in the bolt carrier and it thereafter expands between this closed end and the flange 49 on the outer piston 48 which then abuts the coupling 45. After the bolt carrier has been driven rearwardly enough to bring the flange 49 into engagement with the outer piston retainer 50, the outer piston will be picked up and will thereafter be drawn rearwardly over the inner piston 46. At the rearmost extremity of carrier movement, as shown in Fig. 2, the two pistons are still in engagement and there is no substantial leakage of gas and, hence, no substantial breech flash. Pressure in the system and the fast return of the breech bolt carrier prevents any substantial separation of the pistons due to the tendency of inertia forces to continue rearward movement of the outer piston.

As the breech bolt and carrier return to their breech locked position, the inner and outer pistons again telescope over each other completely and any gas remaining in the system is forced back through the gas tube and into the barrel.

When the breech bolt carrier is manually retracted by means of a handle 51, the outer piston will usually remain within the bolt carrier and be retracted with it, leaving a substantial gap between the ends of the inner and outer pistons and permitting ready inspection and cleaning, if found necessary. If the outer piston should for any reason fail to be fully retracted with the manually operated carrier, it may be readily retracted with the fingers to open up a gap between the pistons. In practice it has been found that there is little tendency for carbonaceous deposits or other forms of fouling to build up in or upon the gas tube, pistons, or breech bolt carrier bore and cleaning is seldom necessary. This experience agrees generally with that of others with closed gas systems and, in addition, it may be theorized that a major part of the cooling and condensation which might tend to deposit fouling takes place in the expansion chamber and gas tube where substantial deposits must be made before there is any appreciable effect upon functioning.

In an experimental rifle using a shortened version of the caliber .50 machine gun cartridge, a gas port of .129 inch diameter has been found suitable and the volume in the gas system with breech closed (volume of expansion chamber, gas tube, and inner piston) is 2.55 cubic inches. The gas port is located 6.82 inches forward of the unfired position of the base of the bullet and the volume of the bore and cartridge chamber to the rear of the gas port is 2.13 cubic inches. With the breech bolt carrier in its rearmost position, the volume of the gas system has been expanded by 1.7 cubic inches. It has been found possible to tolerate fairly large piston clearances and in one test .007 to .008 inch clearance was allowed between the pistons and the gun functioned well with a slightly larger gas port (.147 inch diameter).

With this system it is possible to move the gas port far enough forward from the chamber that pressures in the bore when the port is uncovered by the bullet are not much, if any, more than ⅔ peak chamber pressure and yet derive sufficient power to reliably operate the rifle action. Pressure time curves recording pressure in the expansion chamber show peak pressures less than one-tenth as high as peak chamber pressures, but this lower pressure is maintained at usable values for four milliseconds and more after the bullet has left the muzzle of the barrel and bore pressure has dropped to very low values.

By utilizing the combination of the expansion chamber to maintain pressure and the telescoping pistons to apply that pressure over the full stroke, it has been found possible to produce a rifle which functions reliably and with very low shock loadings upon its reciprocating mechanism. It has also been found that a rifle constructed in this way will function dependably with ammunition having widely different pressure-time characteristics. In one series of tests a heavier than normal action spring was used so that in no case did the breech bolt carrier reach the back plate and bolt carrier travel was recorded with cartridges of five lots each having widely different muzzle velocity and peak chamber pressure. The peak chamber pressure in one lot was as high as 44,300 p. s. i. and in another lot as low as 27,400 p. s. i., but throughout the series of tests the shortest bolt carrier travel recorded was 6¾ inches and the longest about 7½ inches. The fact that some of the longest bolt carrier

travels recorded in this test were produced with the lower pressure ammunition at least suggests that within these limits there is not a statistically significant variation in bolt carrier travel as related to chamber pressure. Attempts to make the gun function with the same variation in ammunition but with a known jet type of gas system in which gas was conducted directly from a port in the bore to a nozzle extending into a blind hole in the bolt carrier were not successful. With this jet system it was necessary to relocate the gas orifice in the barrel whenever there was any appreciable change in the pressure-time characteristic of the ammunition. In fact, one of the loads which functions with completely satisfactory results in the system to which this application is directed lacked power to operate the rifle even when the gas orifice of a jet system was moved back practically to the mouth of the cartridge case and increased in diameter to .200 inch.

Although a preferred embodiment is here described and shown in some detail, it should be understood that it is not considered that the invention is limited particularly to that embodiment. For an exact definition of the limits upon the invention, reference may be made to the appended claims.

We claim:

1. In a gas-operated firearm having a barrel, a receiver and a reciprocating breech bolt carrier housed therein, the combination comprising an orifice in the barrel, tubular means for conveying gas rearwardly from said orifice into said receiver, and a system of telescoping pistons within said receiver comprising a longitudinal bore with a closed rear end formed in said bolt carrier, an inner tubular piston affixed to said receiver in communication with said tubular means and extending rearwardly in axial alignment with said bore, said bore being telescoped over said inner tubular piston when the bolt carrier is in forward position, and an outer tubular piston mounted in said bore in the bolt carrier with capacity for limited forward extension relative to said bolt carrier, said outer tubular piston surrounding and being in telescoping relation to said inner tubular piston.

2. The combination described in claim 1, including a flange formed on the rear end of said outer tubular

piston substantially engaging the wall of said bore, and an outer piston retainer secured in the forward end of said bore and engageable with said flange to limit forward extension of said outer tubular piston relative to said carrier.

3. The combination described in claim 2, said tubular pistons being each shorter than the length of the reciprocating stroke of said breech bolt carrier but of sufficient length to remain in telescoping engagement when said breech bolt carrier is in said rearmost position and said outer tubular piston is urged by gas pressure acting on the rear surface of said flange to project forwardly from said bolt carrier to the limit permitted by said piston retainer.

4. In the combination described in claim 2, a gas orifice coupling connecting the orifice in the barrel to said tubular means, and a member defining a gas expansion chamber mounted on said coupling in continuous communication with said orifice and said tubular means.

5. The combination described in claim 4, said expansion chamber and said tubular means being connected together through a bore in said orifice coupling having a diameter larger than said orifice in the barrel.

6. The combination described in claim 5, said orifice coupling being formed in T configuration to divide the initial flow of gas from the orifice in the barrel between said tubular means and said expansion chamber.

References Cited in the file of this patent

UNITED STATES PATENTS

2,052,368	Sutter et al.	Aug. 25, 1936
2,088,268	Lauf	July 27, 1937
2,149,512	Eiane	Mar. 7, 1939
2,409,225	Schaich	Oct. 15, 1946

FOREIGN PATENTS

9,579	Great Britain	1914
312,613	Italy	Nov. 21, 1933
560,866	Great Britain	Apr. 25, 1944
935,613	France	Feb. 2, 1948
440,214	Italy	Oct. 7, 1948