April 28, 1959 D. D. MUSGRAVE 2,883,911

MACHINE GUN

Filed March 5, 1956 3 Sheets-Sheet 1

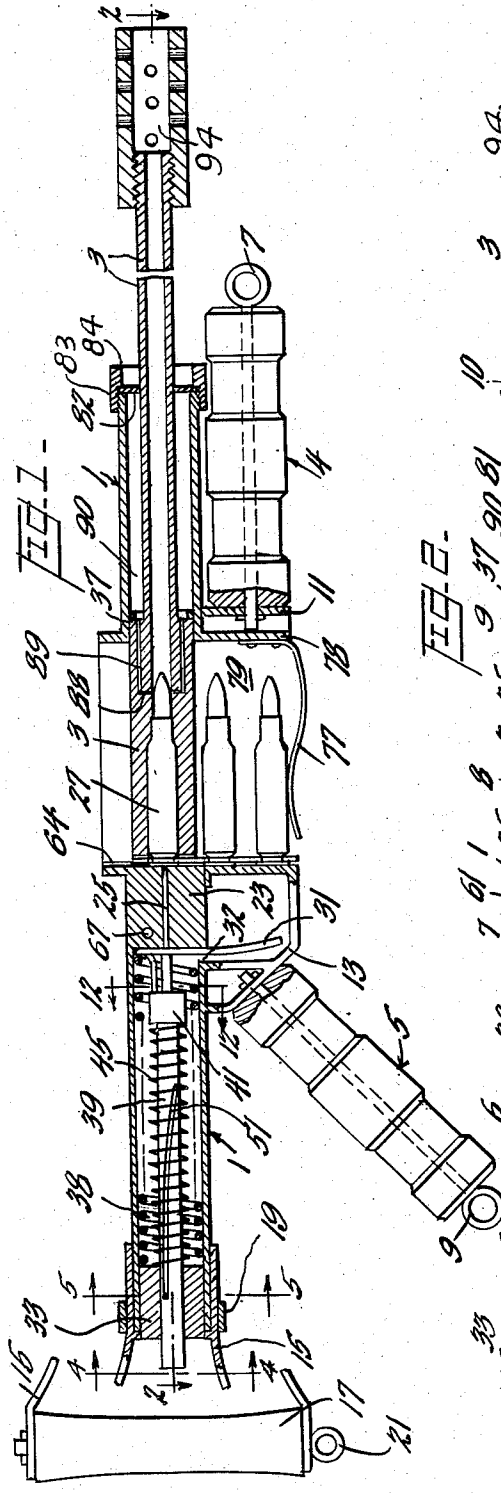

FIG. 1.

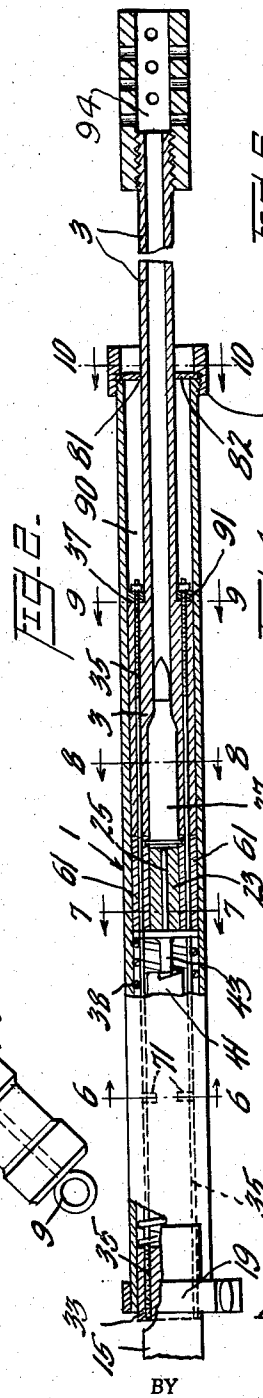

FIG. 2.

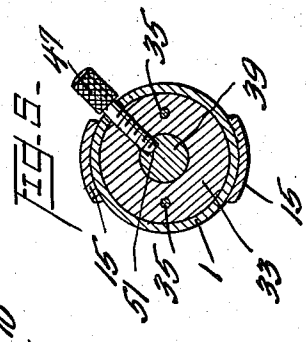

FIG. 5.

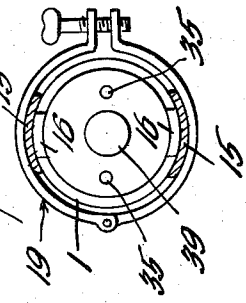

FIG. 4.

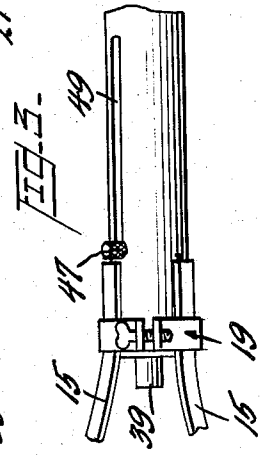

FIG. 3.

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April 28, 1959 D. D. MUSGRAVE 2,883,911

MACHINE GUN

Filed March 5, 1956 3 Sheets-Sheet 2

FIG. 6.

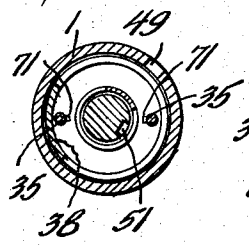


FIG. 7.

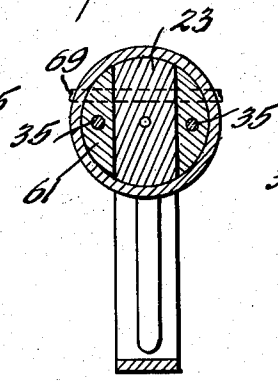


FIG. 8.

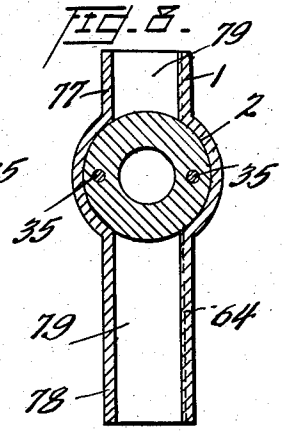


FIG. 9.

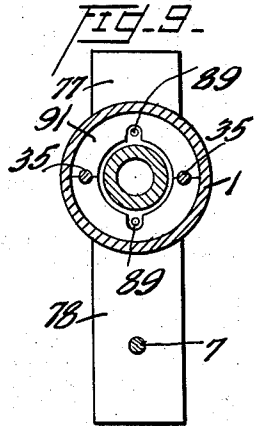


FIG. 10.

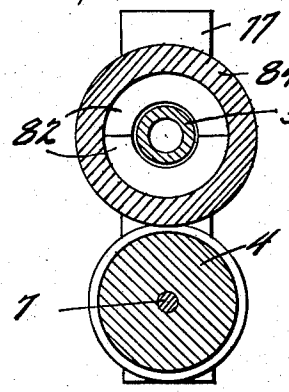


FIG. 11a.

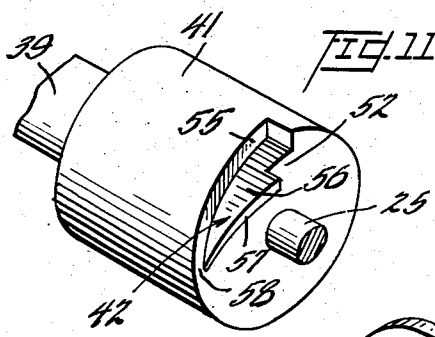


FIG. 11b.

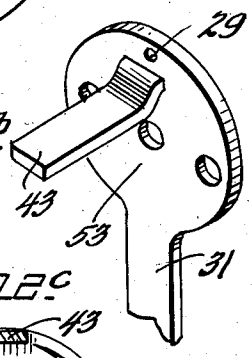


FIG. 12a.

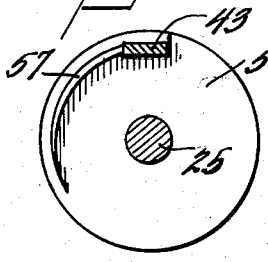


FIG. 12b.

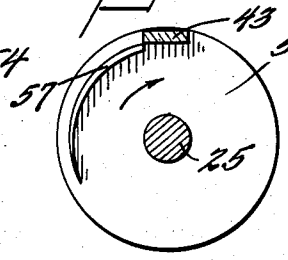
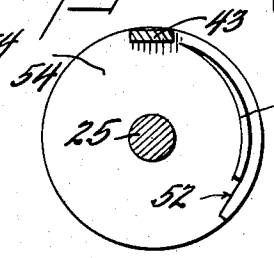


FIG. 12c.



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April 28, 1959 D. D. MUSGRAVE 2,883,911

MACHINE GUN

Filed March 5, 1956 3 Sheets-Sheet 3

FIG. 13.

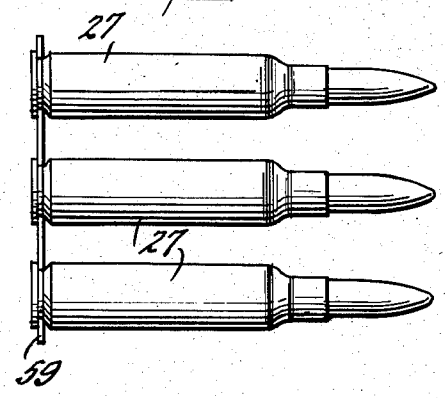


FIG. 14.

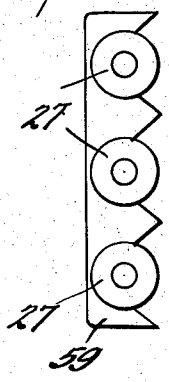


FIG. 15.

FIG. 16.

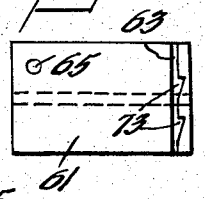


FIG. 17a.

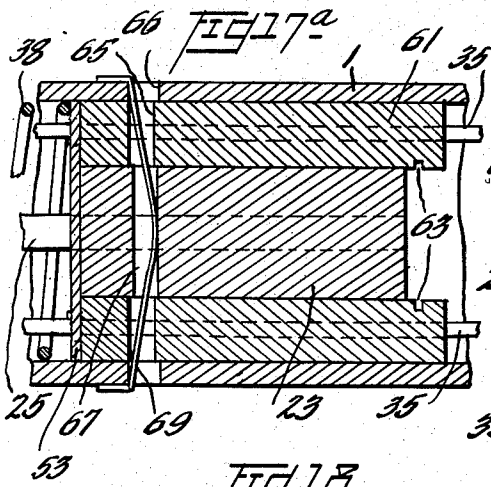


FIG. 17b.

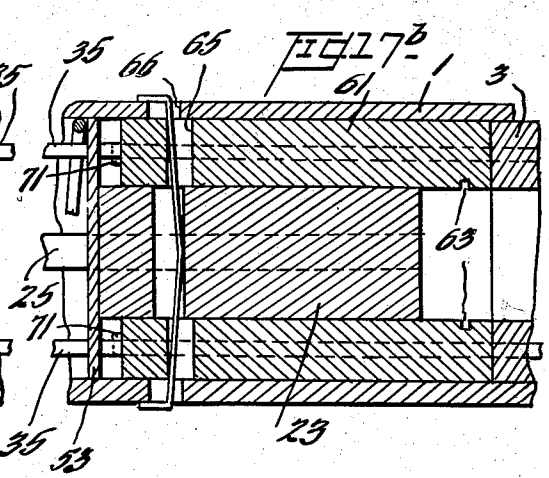


FIG. 18.

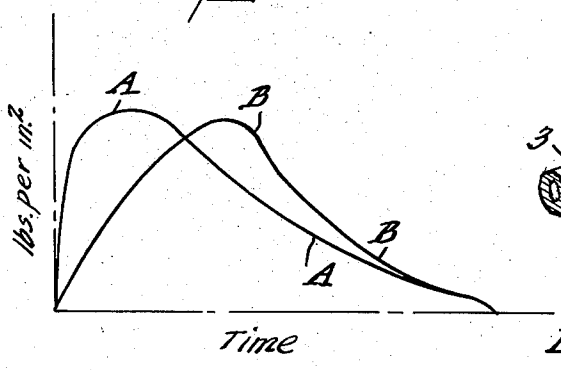
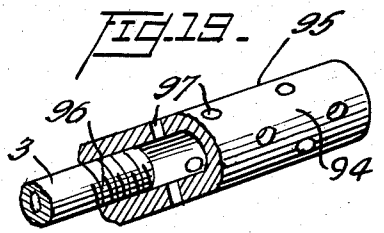


FIG. 19.



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United States Patent Office 2,883,911 Patented Apr. 28, 1959

2,883,911

MACHINE GUN

Daniel D. Musgrave, Cabin John Park, Md.

Application March 5, 1956, Serial No. 569,510

1 Claim. (Cl. 89—161)

This invention relates to firearms and more particularly to firearms of the automatic or semi-automatic type. While the invention is disclosed as applied to a shoulder, automatic rifle, it will be apparent that the invention is not so limited and that it may be applied to weapons supported on mechanical mounts, such as automatic guns.

In one of the conventional types of machine guns, a series of cartridges are fed into the gun on a belt or clip, where a breech plug mechanism opens and closes the rear end of a stationary barrel. In another type of machine gun, such as shown in U.S. Patent 1,334,052, issued to Putnam on March 16, 1920, the barrel moves to the rear to successively encompass the cartridges being fired and, upon the firing of the cartridges, the barrel moves forward under apparent recoil, which movement permits the empty cartridge cases to be ejected. The present invention relates particularly to this latter type of gun.

The principal object of the invention is to provide a gun in the operation of which the energy released at the time of firing is applied to parts of the gun so as to reduce the apparent recoil of the gun and thereby permit of the use of lighter parts in the gun.

Another object of the invention is to provide a gun having a pressure cylinder subjected to the gases of explosion upon the firing of the gun, whereby the energy released upon firing will be applied to a piston-like part of the gun barrel sliding in the cylinder to reduce the apparent recoil of the gun.

Another object of the invention is to provide a gun having a plurality of pressure cylinders subjected to time-controlled pressures of the gases of explosion, whereby part of the energy in the said gases are dissipated in different directions, and in timed opposition to each other, to retard or to accelerate the recoil of the barrel of the gun.

Another object of the invention is to provide a gun having a barrel slidable as a piston in a single or a plurality of cylindrical chambers that include parts of the receiver of the gun, that is, parts of the gun that support and house the stationary and moving parts of the gun.

Another object of the invention is to provide a gun adapted to easy packing, storage and shipment.

Another object of the invention is to provide a gun most of the parts of which are of such conventional commercial shapes, such as cylinders or rods, as are generally available commercially, so as not to require extensive specialized machine tools in the manufacturing of some of the parts of the gun.

Other advantages and objects of the invention will be apparent from the following detailed description hereinafter set forth and from the drawings made a part thereof in which:

Figure 1 is a vertical section view of a gun employing the present invention;

Figure 2 is a horizontal section view taken on line 2—2, Figure 1;

Figure 3 is a side elevation view of the rear end of the receiver of the gun of the present invention;

Figures 4 and 5 are sectional views taken on lines 4—4 and 5—5, respectively, of Figure 1;

Figures 6, 7, 8, 9 and 10 are sectional views taken on lines 6—6, 7—7, 8—8, 9—9 and 10—10, respectively, of Figure 2;

Figure 11*a* is an enlarged view in perspective of the head of the rod that carries the firing pin;

Figure 11*b* is a view in perspective of the trigger assembly;

Figures 12*a*, 12*b* and 12*c* are enlarged, vertical, end views taken on line 12—12 of Figure 1, at different rotational positions of the firing pin carrier of the gun;

Figure 13 is an enlarged side elevation view of three cartridges engaged in a clip;

Figure 14 is a rear view of the cartridges and clip of Figure 13;

Figure 15 is a view similar to that of Figure 14, but with the cartridges removed;

Figure 16 is an enlarged partial side elevation view of a detent, showing a cartridge clip guide groove and escapement notches;

Figures 17*a* and 17*b* are vertical sectional views of the breech block and the detents of the gun shown in their rearward and their forward positions, respectively;

Figure 18 consists of three curves showing the relation of the pressures in the cylinders of the present invention in relation to the elapsed time after the firing of a cartridge; and

Figure 19 is a perspective view, partly in cross section, of a conventional muzzle-brake for a rifle barrel.

Referring to the drawings, 1 designates generally the receiver of the gun of the present invention, that is, the parts of the gun that house and support the various stationary and moving parts of the gun. The rear section and the forward section of receiver 1 are cylindrical. The mid-section of receiver 1 is open at the rear part thereof, in the top and bottom to provide a feedway for the insertion of cartridges into the gun and the ejection of empty cartridge cases from the gun. The side walls of the forward part of said mid-section, are cylindrical in shape, as shown at 2, Figure 8, and fit accurately the rear and enlarged end of barrel 3, as barrel 3 slides in the mid and forward sections of receiver 1.

The receiver 1 is supported from below by hand grips 4 and 5, which are secured by bolts 7 and 9, respectively, and brackets 11 and 13 respectively, which brackets are welded or otherwise secured to the receiver 1. The receiver 1 is supported against the shoulder of the user by spring struts 15 and shoulder rest 17. Struts 15 with their lugs or offsets 16 are fastened to the rear end of receiver 1 by, for example, a conventional spring clamp, shown generally at 19, Figures 3 and 4. The shoulder rest 17 is secured at the rear end of the spring struts 15 by a bolt 21.

Secured, by welding or otherwise, in the forward end of the rear section of receiver 1 is a solid block 23 through which the firing pin 25 passes to explode a cap in the rear of cartridge 27 as it fits into the rear end of barrel 3. Block 23 also forms the support of trigger lever 31, after lever 31 has been passed through hole 32 in receiver 1. A guard is provided for trigger lever 31 by the bracket 13, which is positioned on receiver 1 under the trigger lever 31.

Sliding in the rear end of the rear section of receiver 1 is thrust block 33, which is rigidly connected to the rear ends of tension rods 35, which rods also are rigidly connected at their forward ends to the barrel 3, contiguous the flat surface of barrel 3 designated as 37. Between blocks 33 and 23 is positioned the main recoil spring 38 that forces barrel 3 to the rear and absorbs mechanically part of the recoil of the barrel 3 following the explosion of a cartridge. There is thus provided a mechanical

retardation of the forward movement or recoil of the barrel upon the firing of the gun.

In the rear section of receiver 1, and concentric to block 33, is firing pin carrier rod 39 at the forward end of which is an enlarged head 41. On the forward face of head 41 is formed a cocking cam shown generally at 42 (see Figure 11*a*) which cam cooperates with the trigger sear 43 to release the firing pin or hammer 25, which pin extends into and is fastened to head 41. Between block 33 and head 41 is hammer spring 45, which exerts a force to move rod 39 forward. The positions of head 41 are determined by the part of cam 42 on head 41 that is engaged by trigger sear 43 as the trigger assembly operates to fire the gun and the gun barrel recoils and returns back to its firing position, as will be explained hereinafter. Carrier rod 39 is rotated about its axis by pin 47, which passes through slot 49 (Figure 3) of receiver 1, is screwed or otherwise fastened into block 33, and slides in groove 51 in rod 39. It will thus be seen that when pin 47 is moved forward, rod 39 is rotated substantially one-fourth of a turn clockwise (looking rearward as in Figure 12*b*) and when pin 47 is moved to the rear, rod 39 is rotated the same amount counterclockwise to the position shown in Figure 12*c*. The rearward movement of block 33 is limited by the pin 47 engaging the rear end of groove 49.

The trigger assembly is made of a resilient material and consists of a trigger lever 31, a flat section 53 and a sear 43. This assembly is held flat against the rear side of block 23 by the main spring 38. In this position of the flat section 53, the sear 43 engages the forward face 54 of head 41 just below the cutaway cam surface 42 in the forward end of head 41, as at 52. (See Figures 11*a* and 12*a*, the latter figure showing the pin in its cocked condition, with sear 43 against the face 54 at area 52 of head 41.) The trigger assembly is supported vertically by the firing pin 25 which passes through a hole in the flat section 53 with enough clearance so as to permit the trigger assembly to pivot sufficiently upon the pin for sear 48 to clear area 52 in the front face of head 41.

Cam 42 consists of a radial surface 55 and a cylindrical surface 56, tapering off from a maximum and merging into and with the forward face 54 of head 41, as at 58. Extending forward and part way along the forward peripheral edge of the cylindrical surface 56 is a ledge 57, which ledge is tapered from one of its ends near the point of merger 58 to its maximum radial thickness at its other end where it clears the trigger sear 43 when the gun is in its cocked condition. This ledge 57 insures that sear 43 cannot rise upward as the head 41 is rotated counterclockwise as the carrier rod is moved to the rear under the force of springs 38 and 45.

When the sear 43 is lifted by the trigger lever 31 being moved to the rear, sear 43 slides on the cylindrical surface 42 of head 41 and head 41 moves forward under the force of spring 45. The forward movement of head 41 moves pin 25 into contact with the firing cap in the base of cartridge 27. Upon the firing of the gun, block 33 moves forward and pin 47, by engaging groove 51, rotates head 41 to the position shown in Figure 12*c*.

The cartridges 27 are fed into the gun in clips 59. Three cartridges are shown attached to the clips 59 in Figures 13 and 14, but it is apparent that other numbers of cartridges could be assembled in clips by making the clips longer. The clips 59 are made of some resilient material and are flat so as to slide in groove 63 in detents 61 and slide in groove 64 in receiver 1.

The inner surfaces of detents 61 are flat to fit the sides of block 23 and the outer surfaces are curved to fit the inside of receiver 1 of the gun. The detents have longitudinal holes for the passage therethrough of tension rods 35 and transverse holes 65 to cooperate with hole 66 in receiver 1 and hole 67 in block 23 to form a passageway for a spring 69 that engages the walls of the several holes to keep the detents under a spring bias in a rearward direction (see Figure 17*a*). Detents 61 are of such length that when they are in their rearward position, their forward ends are just clear of the rear end of barrel 3. When block 33 is at its most forward position and spring 38 is completely compressed against the trigger flat section 53 and block 23, pins 71 on tension rods 35 engage the rear end of detents 61 and force the detents 61 to their most forward position, as shown in Figure 17*b*. The grooves 63 in detent 61 are generally straight, but with cutaway escapement notches 73 spaced along the grooves equal to the distances between teeth 75 on clips 59. These teeth 75 are midway between the centers of cartridges 27 and engage notches 73 when the axes of cartridges 27 are in the axis of the firing pin 25. The notches, therefore, center the cartridges 27 in the axis of the barrel 3 so that the barrel 3 will encompass a cartridge when it is moved to the rear position under the force of spring 38.

It is thus apparent that when a cartridge has been fired and the barrel 3 has reached its most forward position, barrel 3 has cleared the fired cartridge case as pins 71 on the tension rods 35 sharply strike the detents 61, forcing detents 61 forward and thereby releasing teeth 75 from escapement notches 73, thus permitting spring 77, fastened to the wall 78 of feedway 79, to force clip 59 upward. The rebound rearward of thrust block 33 is so quick that detent 61 is moved to the rear in sufficient time for notches 73 to intercept the next lower teeth 75 of clip 79 and thus prevent the clip 59 from moving upward more than the space between two successive teeth on clip 59.

The barrel 3 is machined to slide forward and rearward in receiver 1, the rear portion of the barrel engaging the cylindrical wall of the middle portion of the receiver 1 and a portion of the barrel 3, as at 81, loosely passes through split ring 82. Ring 82 is held in position by welding or otherwise fastened to receiver 1 as by collars 83 and 84 and has a hole therein for the barrel 3 to slide therethrough. Ring 82 forms the forward face of receiver 1.

The gases of explosion from the cartridges 27 pass through holes 88 and 89 into chamber 90, which is in the form of a cylinder in which slides the piston-like section of barrel 3. A flexible or split washer 91 provides a gas tight seal between the enlarged portion of barrel 3 and receiver 1. Gases from cylinder 90 pass between the walls of the hole in the split ring 82 and the barrel 3 into the atmosphere.

In operation: With the gun unloaded, spring 38 is forcing the barrel 3 to the rear with the rear end of barrel 3 resting against detents 61. Rods 35 are under tension, they being screwed at one end into block 33 and secured at the other end to the barrel 3 contiguous the flat surface 37. Pin 47 is in contact with the rear end of groove 49. Sear 43 is engaging the front face 54 of head 41 at area 52.

To load the gun, pin 47 is moved forward in groove 49, thereby compressing spring 38 and also moving barrel 3 forward by rods 35 to a position clear of the feedway 79 (Figure 8). The inner end of pin 47, engaging the groove 51 in the surface of rod 59 rotates carrier rod 39 about its axis and ledge 57 on face 54 of head 41 rides over the rear end of sear 43 which prevents trigger lever 31 from releasing head 41 that is under the force of spring 45. Firing pin 25 is thus prevented from moving forward.

Clip 59 and cartridges 27 are then passed down through the feedway 79, one side of clip 59 passing down through the groove 64 in receiver 1 and groove 63 in detents 61. The other side of clip 59 passes down through the groove of the other of the detents 61. The clip is forced downward against the force of spring 77. Upon the moving of pin 47 to the rear, pins 71 on tension rods 35 are withdrawn from contact with detents 61, which detents move rearward so that notches 73 on detents 61 engage teeth 75 on clips 59. In this position of clip 59, the uppermost cartridge 27 is alined axially with barrel 3 as barrel 3 moves rearward, barrel 3 encompasses the uppermost

cartridge. In the meantime, head **41** is rotated approximately 90° counterclockwise as seen looking to the rear and the rear end of sear **43** is now out from under ledge **57** and is free to be raised by trigger lever **31** so that spring **45** may force firing pin **25** into contact with the cartridge cap and thus fire the cartridge.

Upon the firing of cartridge **27**, the barrel **3** recoils in a forward direction. As soon as the bullet has left the cartridge cases the pressure in the cartridge chamber rises (see curve A, Figure 18) and the gases of explosion pass through holes **88** and **89** into cylinder **90**. The rise in pressure in cylinder **90**, as plotted against time, is shown in curve B, Figure 18. The shape of the curve will depend upon the diameter of the holes **88** and **89**. As the pressure in cylinder **90** rises, a force is exerted on the flat surface **37** of barrel **3** which tends to force the barrel **3** rearward, thus providing a pneumatic retardation force for the retardation of barrel **3** and assisting main spring **38** in stopping the forward recoil of the barrel.

After the gases escape to the atmosphere from the barrel cartridge chamber, by the barrel having moved forward, after the gases in cylinder **90** escape from cylinder **90** into the atmosphere through the space between ring **82** and barrel **3**, the main spring **38** moves the barrel **3** to the rear to encompass the next cartridge **27** as the cartridge clip is stopped by notches **73** in groove **63** of detents **61**, with the next live cartridge in clip **59** in a position axial to barrel **3**.

The muzzle-brake **94** consists of a cylinder **95**, with holes **97** therethrough, and secured to barrel **3** by screw threads **96**. The gases of explosion impinge on the walls of holes **97** and thus exert a force to move the barrel **3** in a forward direction and accelerate the recoil of the barrel **3**.

With the combination of a retardation chamber and a muzzle-brake, the barrel would first be retarded by the gases of explosion and later, after a delayed time, would be accelerated by the gases of explosion passing through the holes in the muzzle-brake.

While the preferred embodiments of the invention have been illustrated and described by way of example, it will be obvious that changes may be made therein within the spirit and scope of the invention and, therefore, the invention is not to be limited to the precise form herein disclosed.

The diameter of holes **88** and **89** and the clearance between barrel **3** and the edges of the hole in split ring **82** will depend upon the type of ammunition being fired and the pressures in the breech chamber of the gun upon the amount of retardation and acceleration desired during the barrel recoil.

The average pressure in the breech chamber of a 30 caliber machine gun is approximately 46,000 p.s.i. when a short cartridge is fired and is approximately 50,000 p.s.i. when a long cartridge is fired. For these pressures, the diameters of holes **88** and **89** should be approximately between 0.025 and 0.015 inch, and the clearance between barrel **3** and the edges of the hole in split ring **82** should be approximately 0.003 inch.

What I claim is:

In a machine gun, a receiver having a forwardly extending cylindrical portion, a barrel, means slidably mounting said barrel in said receiver, said barrel having substantially at its breech end a forwardly facing, laterally extending portion mounted in said cylindrical portion, a forward end member on said cylindrical portion engaging said barrel and forming with said laterally extending barrel portion a cylindrical space to the rear of said end member, means for conducting gases of explosion in said barrel to said space, said explosive gases acting against said laterally extending barrel portion to retard the forward recoil of said barrel, and means comprising a muzzle-brake on said barrel for causing forward recoil of said barrel.

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