BUFFER ASSEMBLY HAVING A PLURALITY OF INERTIAL MASSES ACTING IN DELAYED SEQUENCE TO OPPOSE BOLT REBOUND

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An automatic firearm having a bolt assembly and a coaxial recoil assembly mounted for rectilinear movement between battery and recoil positions at a high rate of reciprocation wherein the recoil assembly is provided a longitudinal cavity housing an elongated mass segmented into a plurality of coaxial weights spaced apart by washers having a low coefficient of restitution, the weights having a lost motion connection with each other and with the recoil assembly to apply their respective inertias in a delayed sequence to oppose rebound of the bolt assembly from battery position.

The present invention relates to an automatic firearm and more particularly to a new and improved recoil or buffer assembly therefor.

It is an object of this invention to provide means for insuring that the bolt assembly of an automatic firearm is properly maintained in full battery position during automatic firing despite variations in the explosive power of the ammunition used. Included in this object is the provision of means for minimizing the shock waves and vibrations transmitted through the recoil mechanism and bolt carrier assembly upon the firing of the firearm.

Another object of the present invention is to provide an improved buffer assembly which repetitively assures uniform and adequate firing pin protrusion when the bolt assembly is in battery position.

Another object of this invention is to provide means for overcoming any adverse effects of bolt carrier bounce or rebound from battery position at the return thereof after recoil. Included in this object is the provision of a buffer having a low coefficient of restitution to minimize the secondary rebound thereof.

A further object of the present invention is to provide an improved buffer assembly which exhibits not only the functional characteristics mentioned hereinbefore but is of simple and compact design so that it is adapted to be applied on a retrofit basis.

Other objects will be in part obvious and in part pointed out more in detail hereinafter.

The invention accordingly consists in the features of construction, combination of elements and arrangement of parts which is exemplified in the construction hereinafter set forth, and the scope of the invention is indicated in the appended claims.

In the drawings:

FIG. 1 is a fragmentary side elevational view partially broken away and partially in section of a firearm containing the improved buffer assembly of this invention;
FIG. 2 is an enlarged sectional view showing the improved buffer assembly and bolt carrier as it approaches battery position after recoil;
FIG. 3 is an external view of intermediate size showing the improved buffer assembly;
FIG. 4 is an end view of FIG. 3;
FIG. 5 is an enlarged cross-sectional view of the buffer of FIG. 3 taken along lines 5—5 of FIG. 3; and
FIG. 6 is a fragmentary enlarged section view showing a second embodiment of the buffer assembly of the present invention.

Referring now to the drawings in detail wherein like reference numerals indicate like parts throughout the several figures, FIG. 1 shows an automatic firearm 10 of the gas operated type. The firearm 10 comprises a receiver 12 defining in the upper portion thereof a chamber 14 for receiving a bolt assembly. The rear of the chamber 14 communicates with a receiver extension 16 located in stock 18. Operatively connected forwardly of the chamber 14 is a barrel 20 having a cartridge chamber 22 in which may be positioned a cartridge 24.

The trigger mechanism 30 is generally similar to design and operation to the mechanism described in my prior Patent No. 3,236,155, issued Feb. 22, 1966, and is not described in detail herein. Suffice it to say for the purposes of this invention, that upon pulling the trigger 34, the spring-biased hammer 36 is released to rotate clockwise through slot 43 of bolt carrier 42 to strike firing pin 46 to fire the cartridge 24 whereupon a portion of the expanding gas developed on firing the gun passes through a passage 40 in the bolt carrier 42 to actuate the automatic recoil of the bolt and bolt carrier, causing ejection of the spent cartridge shell and subsequent successive chambers of cartridges 24 located in cartridge chamber or magazine 26 as the bolt carrier returns to battery position after recoil.

The details of the means for providing the gas operated automatic recoil are more fully set forth in E. M. Stoner's Patent No. 2,951,424 issued September 6, 1960. As more fully set forth in that patent, the chamber 44 defined by the bolt 46 and the bolt carrier 42 fills with high pressure exhaust gas on the firing of a cartridge 24 driving the bolt carrier 42 rearwardly within the chamber 14 against the bias of recoil spring 64 and initially causing the annular shoulder 48 of the carrier 42 to contact the flange 50 of firing pin 38 while at the same time by virtue of the lost motion connection between the carrier 42 and the bolt 46 causing the bolt cam pin 52 to travel in the helical slot 54 cut in the bolt carrier 42 (FIG. 1). The movement of the cam pin 52 within the helical slot 54 causes relative rotation of the bolt 46 and the bolt carrier 42, the latter being held against rotation by the cooperation of carrier key 56 with the longitudinal groove 58 of the receiver 12.

Rotation of bolt 46 results in the registry of bolt lugs 60 and the slots between the inwardly protruding lugs 62 on the breech end of the barrel thereby permitting rearward movement of the bolt and bolt carrier upon continuing recoil of the carrier. The rearward movement of the recoil bolt assembly is absorbed by the compression of recoil spring 64 which, upon dissipation of the rearward momentum of the carrier, acts upon the bolt assembly to return it to locked battery position. During the recoiling operation, the expended cartridge 24 is, of course, ejected and a new cartridge 24 is fed from the magazine 26 into the firing chamber 22.

As will be appreciated it is essential that the bolt 46 be fully closed and locked and that the bolt carrier 42 be in its full forward position in order to fire the gun. If the bolt carrier 42 is moved up too far or the bolt rebounds or "bounces" momentarily at battery impact, it is possible for the annular shoulder 48 of the bolt carrier to engage the flange 50 of the firing pin 38 so that the rearward movement of the firing pin is limited despite the fact that the bolt lugs 60 and the depressend lugs 62 on the breech end of the barrel are in locked battery position if the hammer 36 should strike the firing pin under automatic firing operation during the short interval measured in milliseconds, before the recoil spring 64 returns the bolt carrier 42 to its full forward position.

The limited movement of the firing pin 38 after it is struck by the hammer 36 under such circumstances may result in a malfunction or a failure to fire of the cartridge.

It is, therefore, essential that such difficulties be prevented, and the gun will not fail to fire under any conditions.
The present invention provides means for avoiding this condition by controlling the bounce or rebound of the bolt carrier at battery impact and absorbing the bounce energy thereof.

According to the present invention, the recoil assembly includes a generally tubular buffer body 66 having a closed forward end engaging the rearward end of bolt carrier 42 and mounted for reciprocation in receiver extension 16. The buffer is preferably formed of a lightweight aluminum alloy to provide a low coefficient of restitution to minimize buffer rebound or separation of the buffer from the carrier at battery impact and is provided with generally annular guide flanges 68 and 70 to mount the same in the tube extension 16 with the flange 70 further providing a seal for the end of recoil spring 64 which concentrically surrounds the rearward end of the buffer member 66. The flanges 68 and 70 are provided with flats 67 on the periphery thereof to minimize the pressurization of the air within the tube 16 during the recoil operation.

Disposed within the open end of the buffer tube 66 is a plug 72 which is secured therein by transverse pin 74, and the plug 72 mounts on the rearward end thereof a bumper 76 preferably formed of polyurethane of high durometer hardness to minimize the shock waves and vibrations otherwise imposed by a sharp blow as the buffer bottoms in receiver extension 16 at recoil position. The plug 72, which is shown as being formed of aluminum, is provided with an annular groove 79 into which is crimped portions 81 of a wall of the aluminum buffer 66 and is sealed thereto by any suitable means to prevent the entry of liquids or contaminants into the buffer 66. If desired and as shown in FIG. 6, a plug 72a and bumper 76a may be integrally molded from polyurethane and assembled in the buffer as illustrated. Due to the limited resiliency of polyurethane, the body of the plug 72a may be slightly larger in relaxed condition, than the bore of buffer 66 to seal the same against leakage.

Disposed within the buffer 66 is a plurality of weights 80 (shown as being five in number), interposed between each adjacent pair of weights 80 and between the forward weight 80 and the buffer end 68 is a washer 82 formed of a material having a very low coefficient of restitution, or resiliency, such as buna N rubber or polyurethane. As shown in the drawings, the combined length of the weights 80 and the washers 82 is less than the length of the bore between the end wall 84 of the plug 72 and the closed end wall at the other end of the buffer. It is desirable that the weights 80 be as heavy as possible with respect to the buffer 66 in order to provide the maximum amount of effective force resisting carrier bounce at battery position as hereinafter more fully described.

The operation of the gun under automatic operation is as follows. The trigger 34 is pulled to release the hammer 36 which moves upwardly through the vertical slot 43 in the bolt carrier 42 to strike the firing pin 38 to fire the cartridge 24 chambered in the gun barrel. The expanding gas, due to the discharge of the cartridge, forces the bolt carrier 42 and after a time delay as hereinafter described, the bolt 46, rearwardly against the bias of spring 64 which absorbs the recoil. As the bolt carrier 42 reaches the end of the recoil stroke, the bumper 76, which is formed of a material having a low coefficient of restitution, bottoms against the end wall of the tube extension 16 with the bumper 76 reducing the sharpness of the shock waves which the buffer might otherwise transmit through the recoil mechanism and the bolt carrier mechanism. The weights 80, being loosely disposed in the buffer 66, move to the rear of the buffer and are bottomed in its rearward position at the moment of impact due to the reducing velocity of the buffer as it moves toward recoil position against the bias of spring 64.

As the recoil spring 64 moves the buffer 66 and the bolt carrier 42 forwardly toward battery position, the bolt 46 engages another cartridge 24 and chambers it. If the trigger continues to be pulled for automatic firing, the forward movement of the bolt carrier 42 also releases the hammer for firing the newly chambered cartridge and allows a very few milliseconds for the bolt and bolt carrier to be positioned in the proper location for firing. Because of the desired firing rate of the firearm, the spring 64 must have a sufficient spring rate to thrust the bolt carrier forward rapidly and the result is that the bolt carrier strikes the end of the gun barrel with considerable impact at battery position, and due to the resiliency of the steel which forms these parts, the buffer bottoms against the spring 64 and the bolt carrier 42 away from full forward position. While the bias of spring 64 is sufficient to overcome the bounce and return the bolt carrier 42 to battery position, the firing pin, if struck by the hammer during the transient interval before this occurs, may have insufficient penetration of the primer cap to fire the chambered cartridge.

Referring specifically to FIG. 2, which illustrates the buffer and bolt carrier as they approach battery position, it will be observed that the weights 80 are spaced from the forward end 68 of the buffer 66. With this construction, when rebound of the bolt carrier 42 occurs, it tends to the buffer end 68, as the left as viewed in FIG. 2, against the bias of spring 64. However, the inertia of the weights 80 will cause them to continue to move to the right as the result of the lost motion connection produced by the clearance between the weights 80 and the end of the buffer 66 to produce a slightly delayed force or to oppose the rearward movement of the buffer as viewed in FIG. 2. Since this snubbing action occurs just after the bounce of the bolt carrier 42 from battery position is initiated, the amplitude of the bounce of the bolt carrier 42 at battery position is reduced to the point where it does not interfere with the firing of the cartridge 24 which has been chambered.

The plurality of weights 80 are spaced apart by washers 82 to provide, in effect, lost motion connections between each of the several weights 80. In this manner, the weights 80 do not act entirely in unison but act sequentially with respect to each other in overcoming the bounce of the bolt carrier in battery position to produce a series of forces which are out-of-phase with any further oscillation of the bolt carrier 42 while at the same time providing the full amount of inertia required to overcome the primary bounce of the bolt carrier 42 at battery position. The use of washers 82 having a low coefficient of restitution minimizes the bounce of the weights 80 within the buffer 66 despite the elasticity of the steel weights which further assist the buffer in providing an effective and simple application of the inertia force of the individual weights.

As can be appreciated from the foregoing description, the present invention assures that the bounce of the bolt carrier 42 at battery position under the severe shock and impact conditions encountered under automatic firing of high speed, high performance firearms is minimized in a simple and foolproof design requiring no field adjustment during a long service life.

As will be apparent to persons skilled in the art, various modifications and adaptations of the structure above-described will become readily apparent without departure from the spirit and scope of the invention, the scope of which is defined in the appended claims.

I claim:

1. In an automatic firearm, a receiver having a longitudinal cylindrical, a bolt assembly mounted in said cavity for reciprocal movement between recoil and battery positions, a recoil assembly mounted in said cavity for recollinear movement with said bolt assembly between recoil and battery positions, said recoil assembly comprising means to bias the bolt assembly toward battery position and a buffer mounting an elongated mass segmented into a plurality of coaxial weights, said weights having a lost motion connection with said buffer and with each other for transmitting to the bolt assembly the force resulting from their inertia in moving toward bat-
2. A device as recited in claim 1 wherein said buffer is provided with a bumper having a low coefficient of restitution engageable with the end of said longitudinal cavity in recoil position to minimize the shock of recoil movement.

3. A device as recited in claim 1 wherein a plurality of washers having a low coefficient of restitution are interposed between each adjacent pair of said weights.

4. A device as recited in claim 3 wherein said plurality of weights are disposed within a longitudinal cavity provided by said buffer.

5. A device as recited in claim 4 wherein said longitudinal cavity provided by said buffer is sealed against the entry of contaminants.

6. A device as recited in claim 4 wherein said bolt assembly comprises a bolt carrier and a bolt having limited relative reciprocal movement therebetween.

7. In an automatic firearm, a bolt assembly mounted for reciprocal movement between recoil and battery positions, said assembly comprising a bolt carrier and a bolt having a limited lost motion connection therewith, a recoil spring for biasing the bolt carrier assembly into battery position and means comprising an elongated mass segmented into a plurality of coaxial weights, said plurality of weights being movable with said bolt assembly and having a lost motion connection therewith and with each other whereby the weights produce a plurality of sequentially effective inertia forces after the bolt carrier reaches battery position.

8. The device of claim 7 wherein a plurality of washers having a low coefficient of restitution are interposed between each adjacent pair of said weights.

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