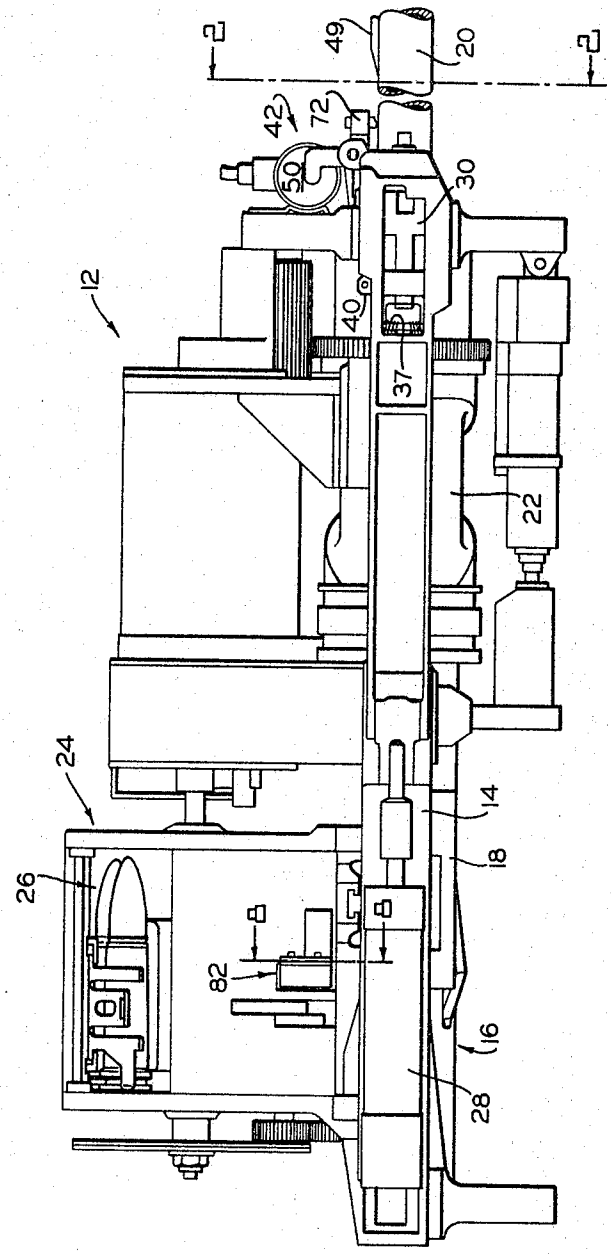
July 18, 1967 B. I. PISKATOR ETAL 3,331,283

SEAR LOCK AND RELEASE MECHANISM FOR DIFFERENTIAL RECOIL GUNS

Filed April 13, 1966 4 Sheets-Sheet 1

Fig. 1



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Filed April 13, 1966 4 Sheets-Sheet 2

Fig. 2.

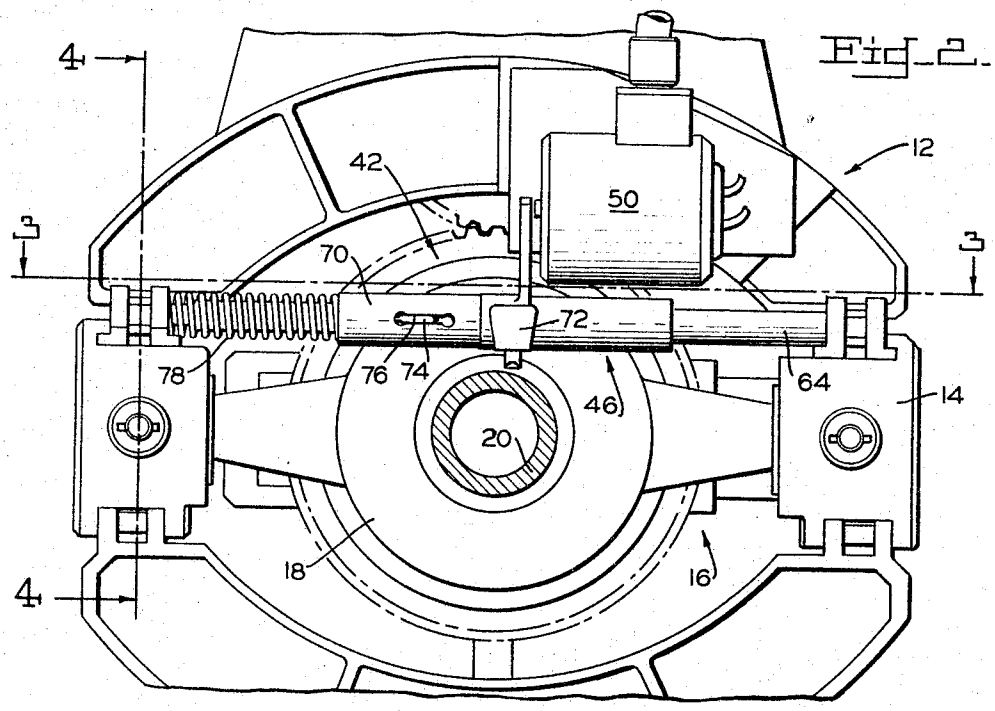
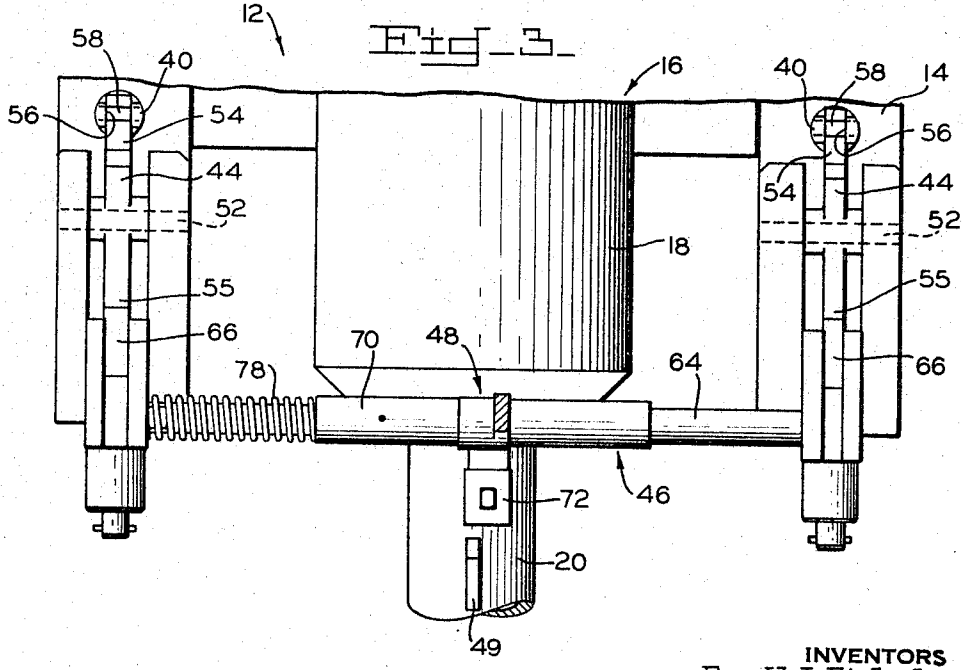


Fig. 3.



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Filed April 13, 1966 4 Sheets-Sheet 3

Fig. 4

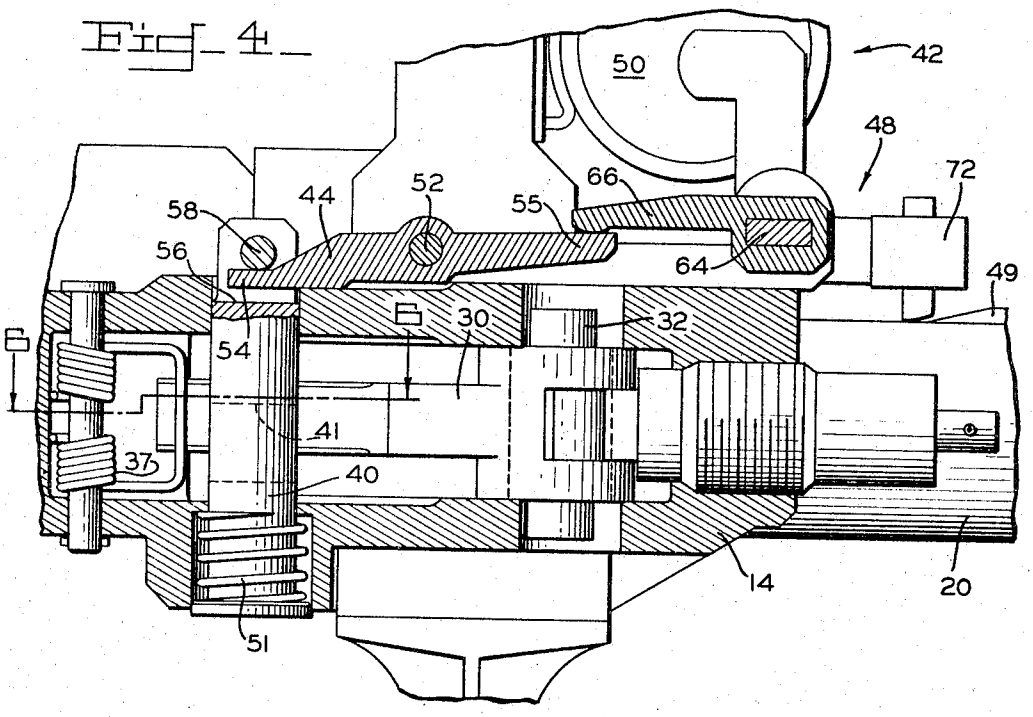
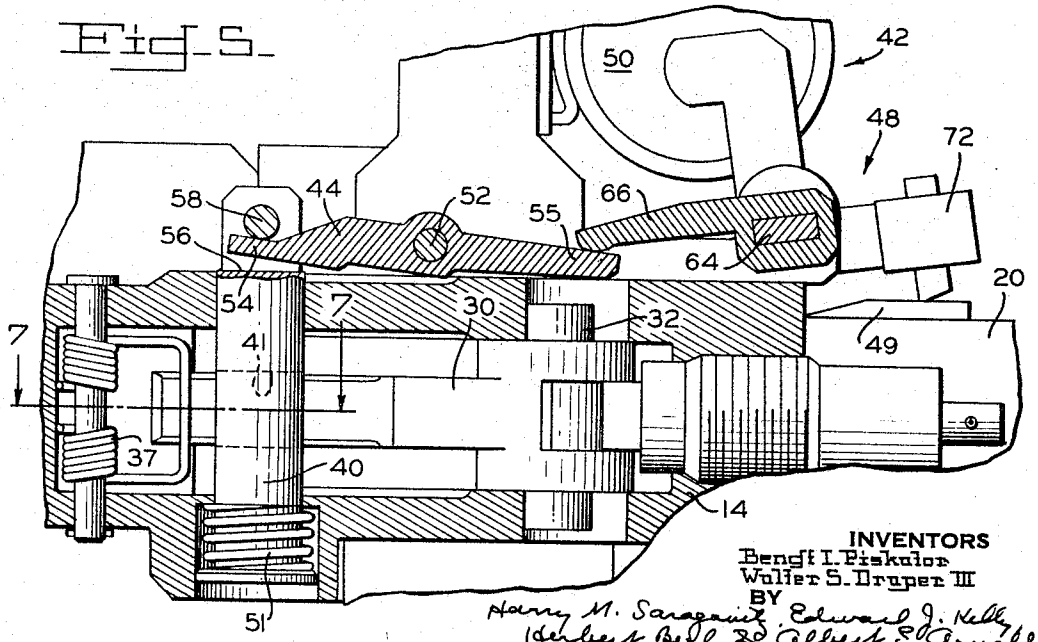


Fig. 5



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Filed April 13, 1966 4 Sheets-Sheet 4

Fig. 6

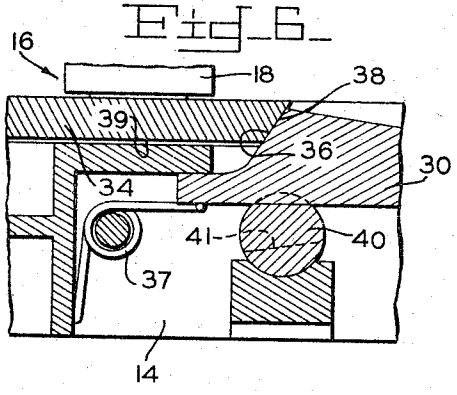


Fig. 7

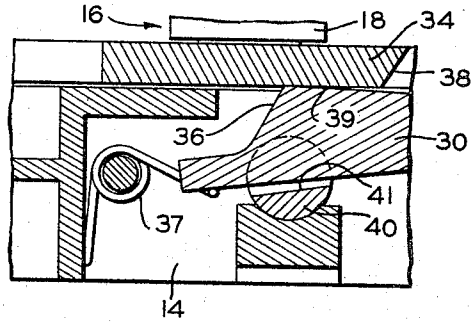


Fig. 8

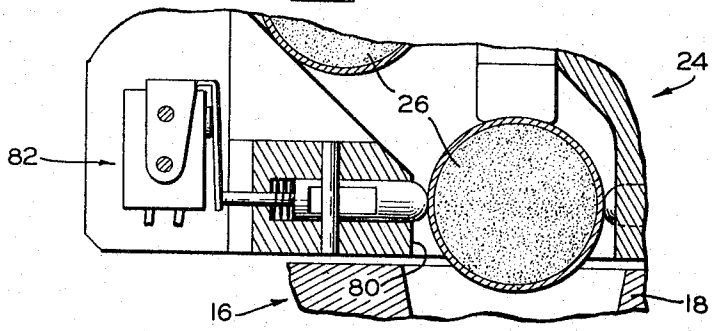
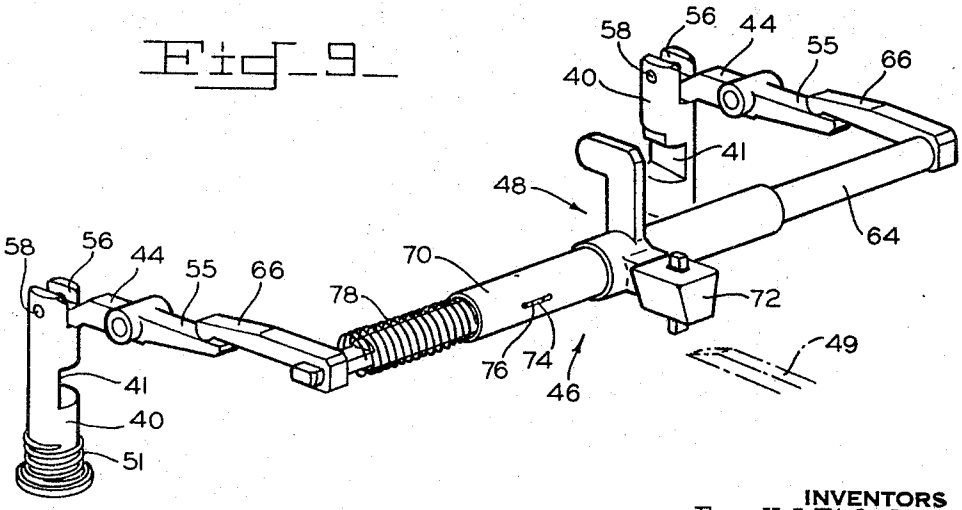


Fig. 9



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SEAR LOCK AND RELEASE MECHANISM FOR DIFFERENTIAL RECOIL GUNS

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Filed Apr. 13, 1966, Ser. No. 542,712
4 Claims. (Cl. 89—42)

This invention relates to machine guns of the XM140 type in which the recoiling mass of the weapon is seared each firing cycle to a non-recoiling mount against the force of loaded buffer springs with means provided for releasing the sears at the appropriate time before the chambered cartridge is fired so that the force of the buffer springs can be applied against the recoil force produced by the firing of the cartridge to reduce the recoil force transferred to the mount trunnions. The invention pertains more particularly to the device for releasing at the proper time in the firing cycle the sears which hold the recoil mass in its recoil position against the force of the buffer springs.

The relationship of the recoiling mass and the mount assembly of the XM140 machine gun, including its sear device, is fully described in patent application for Machine Gun With Mount for Reducing the Recoil Forces Applied to the Trunnions by Frederick P. Reed, Ser. No. 470,942, filed July 9, 1965, now Patent No. 3,318,191. As described therein, the pair of sears for holding the recoiling mass to the mount are released by an electric solenoid which slidingly displaces the locks that block the sears in their holding positions and the actuation of the solenoid is timed by a microswitch which is actuated by a cam on the reciprocating barrel. This means for releasing the sears has been found unsatisfactory as the timing of the release can not be controlled as exactly as is necessary, due to insufficient force produced by the solenoid to actuate the sear locks at a constant rate of displacement regardless of the degree of frictional drag placed upon the sear locks by changing atmospheric conditions and the temperature of the gun, and it is important that the recoiling mass be released from the mount exactly at the proper time in the operating cycle of the weapon to apply the energy in the buffer springs against the recoil force in the recoiling mass.

It is therefore the principal object of this invention to provide for machine guns of the XM140 type a sear release mechanism which is accurately timed in the firing cycle by being mechanically actuated by the reciprocating barrel.

It has also been discovered in the operation of the XM140 machine gun that whenever the ammunition belt feeding cartridges to the weapon runs out the recoiling mass ends up in its forward position and consequently it has to be pulled back against the powerful buffer springs before firing can be resumed.

It is therefore another object of this invention to provide for guns of the XM140 type a sensing device which will prevent actuation of the sear release means when the ammunition fed to the weapon is depleted and thereby firing may be resumed without retraction of the recoiling mass when a fresh supply of ammunition is provided.

The specific nature of the invention as well as other objects and advantages thereof will clearly appear from a description of a preferred embodiment as shown in the accompanying drawings in which:

FIG. 1 is an elevational view of the machine gun showing the barrel positioned forwardly in the loading position by the cam drum;

FIG. 2 is a view taken along line 2—2 of FIG. 1;

FIG. 3 is a view taken along line 3—3 of FIG. 2;

FIG. 4 is a view taken along line 4—4 of FIG. 3;

FIG. 5 is a view similar to FIG. 4 but showing the sear release device actuated to lift the locks to their unblocking position;

FIG. 6 is a view taken along line 6—6 of FIG. 4;

FIG. 7 is a view taken along line 7—7 of FIG. 5;

FIG. 8 is a view taken along line 8—8 of FIG. 1; and

FIG. 9 is a perspective view of the sear release device.

Shown in the figures is a machine gun **12** having a non-recoiling mount **14** and a recoiling mass **16** which is mounted thereon for sliding, longitudinal reciprocation. Recoiling mass **16** includes a receiver **18**, and a barrel **20** mounted thereon for longitudinal displacement between a forward loading position and a rearward firing position responsive to rotation of a cam drum **22**. A feeder **24** fixed on mount **14** is arranged to deliver cartridges **26** succesively to a battery position in receiver **18** ready for engulfment by barrel **20** during displacement by cam drum **22** to the firing position.

A pair of energy storing buffers **28** are operationally disposed between receiver **18** and mount **14** for biasing recoiling mass **16** forwardly thereon. Buffers **28** are loaded by recoiling mass **16** when actuated rearwardly to its recoil position and the recoiling mass is held in its recoil position by a pair of sears **30** which are mounted on opposite sides of mount **14** by means of vertically disposed pins **32** so as to be pivotal between inward holding positions and outward release positions. When in their holding positions, sears **30** are engageable with cooperating lugs **34** on receiver **18** to hold recoiling mass **16** rearwardly in its recoil position against the bias of buffers **28**. Each of the sears **30** is provided with a cam surface **36** which is contactable with a mating angular surface **38** on the front of the cooperating ones of the lugs **34** when the sears are in their holding positions and recoiling mass **16** is in its recoil position. Cam surfaces **36** and surfaces **38** are arranged, when held in contact, to block forward displacement of recoiling mass **16** and to cam sears **30** to their release positions when receiver **18** moves forwardly respective to mount **14**.

Sears **30** are held in their release positions by sliding contact of edges **39** of lugs **34** therewith as receiver **18**, when released from mount **14**, moves forwardly respective thereto. When lugs **34** are free of sears **30**, during rearward displacement of receiver **18** relative to mount **14**, the sears are free to be pivoted to their holding positions by springs **37**.

Sears **30** are releasably blocked in their holding positions by a pair of cooperating cylindrical locks **40** which are mounted in mount **14** for sliding vertical displacement in back of the respective sears when in their holding positions to block displacement therefrom. A recess **41** is formed in each of the locks **40** so that when the lock is in its unblocking position the recess is positioned to receive the corresponding sear **30** which is thereby free for displacement to its release position. Actuation of locks **40** to unblock sears **30** is provided by a sear release device **42** which includes a pair of lifters **44**, a connector **46**, an actuator **48**, a cam projection **49** on barrel **20** and a solenoid **50**. Locks **40** are blocked in their release positions by sears **30** which, when in their release positions, are located within recesses **41** as shown in FIG. 5. When sears **30** are pivoted inwardly to their holding positions by springs **37**, locks **40** are free to be depressed to their blocking positions by springs **51** as shown in FIG. 4.

Each of the lifters **44** is pivotally mounted in mount **14** on a laterally disposed pin **52** so as to be in association with a corresponding one of the locks **40**. Pins **52** mount lifters **44** between the ends thereof to form on each of the lifters a rear end **54** and a front end **55**. Each of the rear ends **54** is received by a slot **56** in the top end of the receptive lock **40** and a pin **58** pivotally connects the rear end to the respective lock so that pivotal displacement

of lifters 44 to raise rear ends 54 is converted to upward vertical displacement of the locks to an unblocking position from a depressed blocking position respective to sears 30.

Connector 46 includes a cross-shaft 64, which extends transversely across mount 14 and is journaled for rotation thereon, and a pair of arms 66 extending rearwardly from opposite ends of the cross-shaft over front ends 55 of the corresponding one of the lifters 44 so that rotation of cross-shaft 64 in a direction to rotate arms 66 downwardly against the front ends pivots the lifters to raise locks 40 to their unblocking positions. Connector 46 is so rotated by actuator 48 through the cooperation of cam projection 49 on barrel 20, as hereinafter described.

Actuator 48 includes a sleeve 70 slidingly mounted on cross-shaft 64 and an integral follower 72 which extends radially from the sleeve so as to be contactable with cam projection 49 on barrel 20, when positioned in alignment therewith, so that rearward displacement of the barrel is converted to rotational displacement of actuator 48. Rotation of actuator 48 is transferred to connector 46 by means of a key 74 which extends from cross-shaft 64 into slot 76 in sleeve 70. Slot 76 is elongated so that actuator 48 has limited lateral displacement on cross-shaft 64 and is designed so that when one end is in contact with key 74 follower 72 is positioned for contact by cam projection 49 and when the other end is in contact with the key the follower is located out of alignment with the cam projection and so is free of contact thereby.

A spring 78 is mounted on cross-shaft 64 so as to press aaginst sleeve 70 for biasing actuator 48 to the retracted position out of alignment with cam projection 49. Solenoid 50 is arranged, when energized, to displace actuator 48 to the aligned position respective to cam projection 49.

Referring to FIG. 8, there is shown mounted in throat 80, which is located between feeder 24 and receiver 18, a sensor device 82 which is actuated by cartridge 26 when moved to the battery position in the receiver to close the electrical circuit to solenoid 50. Located in the electrical circuit between sensor device 82 and solenoid 50 is a time delay device of conventional design (not shown) which holds the electrical circuit closed to the solenoid long enough for cam projection 49 on barrel 20 to contact bar 72 and so actuate locks 40 for release of sears 30. It is obvious that if there are no cartridges 26 available for transfer to battery position, recoiling mass 16 remains seared to mount 14 until machine gun 12 is reloaded and a cartridge is moved to battery position.

Operation

During operation of machine gun 12, a cartridge 26 is fed by feeder 24 to battery position in receiver 18 when barrel 20 cycles through its forward loading position. Displacement of cartridge 26 through throat 80 to battery position actuates sensor device 82 to energize solenoid 50 which slides actuator 48 to its aligned position respective to cam projection 49 on barrel 20. Thus, as barrel 20 travels rearwardly to its firing position, cam projection 49 contacts follower 72 at the proper time to rotate connector 46 and raise locks 40 to their release positions. Thereby, recoiling mass 16 is free to be disposed forwardly by buffers 28 on mount 14 and is moving forwardly when the cartridge 26 is fired to apply the force of the buffers against the recoil force produced by the firing of the cartridge.

Sufficient recoil force is retained in recoiling mass 16 so that it continues with reduced force to its recoil position, reloading buffers 28. When lugs 34 are moved free of sears 30, the sears are pivoted inwardly to their holding positions by springs 37. With sears 30 in their holding positions, locks 40 are free to be depressed to their blocking positions, and sear release device 42 returned to its normal position by springs 51 and thereby recoiling mass 16 is seared to mount 14 until sear release device 42 is triggered by passage of cartridge 26 to battery position during the next operating cycle. Actuator 48 is biased by

spring 78 to its retracted position so that when solenoid 50 is deenergized follower 72 is located free of cam projection 49 as barrel 20 moves forwardly to the loading position.

From the foregoing it is evident that sear release device 42 of this invention provides exact timing of sear release in the operating cycle as sear locks 40 are actuated by positive mechanical means and thereby recoiling mass 16 is released respective to mount 14 at the proper time in the operating cycle to oppose the recoil force produced by cartridge discharge.

Although a particular embodiment of the invention has been described in detail herein, it is evident that many variations may be devised within the spirit and scope thereof and the following claims are intended to include such variations.

We claim:

1. A machine gun including a mount, a recoiling mass including a barrel and a receiver slidingly mounted on said mount for rearward displacement to a recoil position responsive to a recoil force produced by discharge of a cartridge in said barrel, said barrel being reciprocal relative to said receiver between a forward loading position and a rearward firing position, energy storing buffer means operationally disposed between said mount and said recoiling mass so as to be energized by the recoil force during displacement of said recoiling mass to the recoil position for biasing said recoiling mass forwardly on said mount, sear means for releasably engaging said recoiling mass when in the recoil position to said mount against the forward bias of said buffer means, mechanical means for actuating said sears to release said recoiling mass from said mount, a cam on said barrel arranged for engageable cooperation with said mechanical means to release said recoiling mass for forward displacement by said buffer means at the proper time to apply the energy stored therein against the recoil force for reduction thereof, and an actuator element of said mechanical means displaceable to a position for engagement by said cam during a portion of the reciprocating cycle of said barrel.

2. The machine gun as defined in claim 1 and including a feeder mounted on said mount and arranged for delivering the cartridge to a battery position in said receiver when said barrel is in the loading position, a throat located between said feeder and said receiver for passage of the cartridge from said feeder to the battery position, an electrical solenoid arranged when energized to actuate said actuator to the position for engagement by said cam, and a sensor device located in said throat for actuation by the cartridge during passage therethrough and electrically connected to said solenoid so that actuation of said sensor by the cartridges causes said solenoid to be energized.

3. The machine gun as defined in claim 1 wherein said sear means includes a pair of sears pivotally mounted on opposite sides of said mount for releasable engagement with cooperating lugs on said receiver when said recoiling mass is in the recoil position, cooperating cam surfaces on said sears and said lugs for converting forward displacement of said receiver to pivotal displacement of said sears to positions releasing said recoiling mass for forward displacement, and wherein said mechanical means include a pair of locks respectively mounted in back of each of said sears for blocking displacement thereof to prevent release of said recoiling mass, and means for transferring displacement of said actuator by said cam on said barrel to said locks for displacement thereof to positions unblocking said sears.

4. The machine gun as defined in claim 3 wherein said means for transferring displacement of said actuator to said locks includes a connector provided with a cross-shaft journaled for rotation on said mount and a pair of arms respectively extending from opposite ends of said cross-shaft towards corresponding ones of said locks, a lifter

operationally disposed between each of said arms and the corresponding one of said locks for transferring displacement of said connector to said locks for displacement thereof to the positions unblocking said sears, and wherein said actuator is slidingly mounted on said cross-shaft for displacement by said solenoid to a position contactable by said cam on said barrel and for displacement by a cooperating spring out of alignment with said cam when said solenoid is deenergized.

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