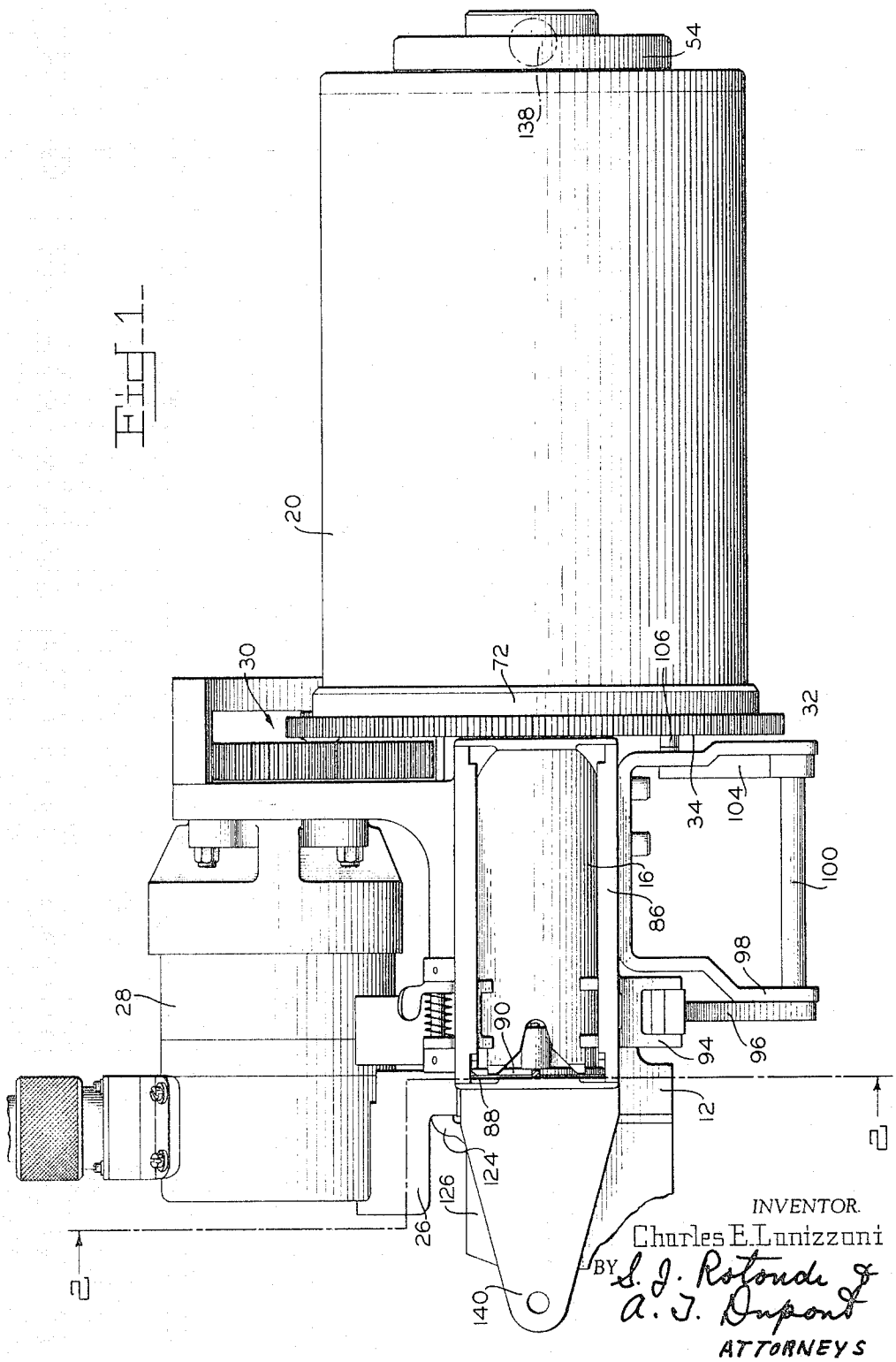
Feb. 14, 1967 C. E. LANIZZANI 3,303,744

BARREL SURROUNDING MOUNT FOR OPERATING DRUM OF EXTERNALLY POWERED AUTOMATIC GUN

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Fig. 1



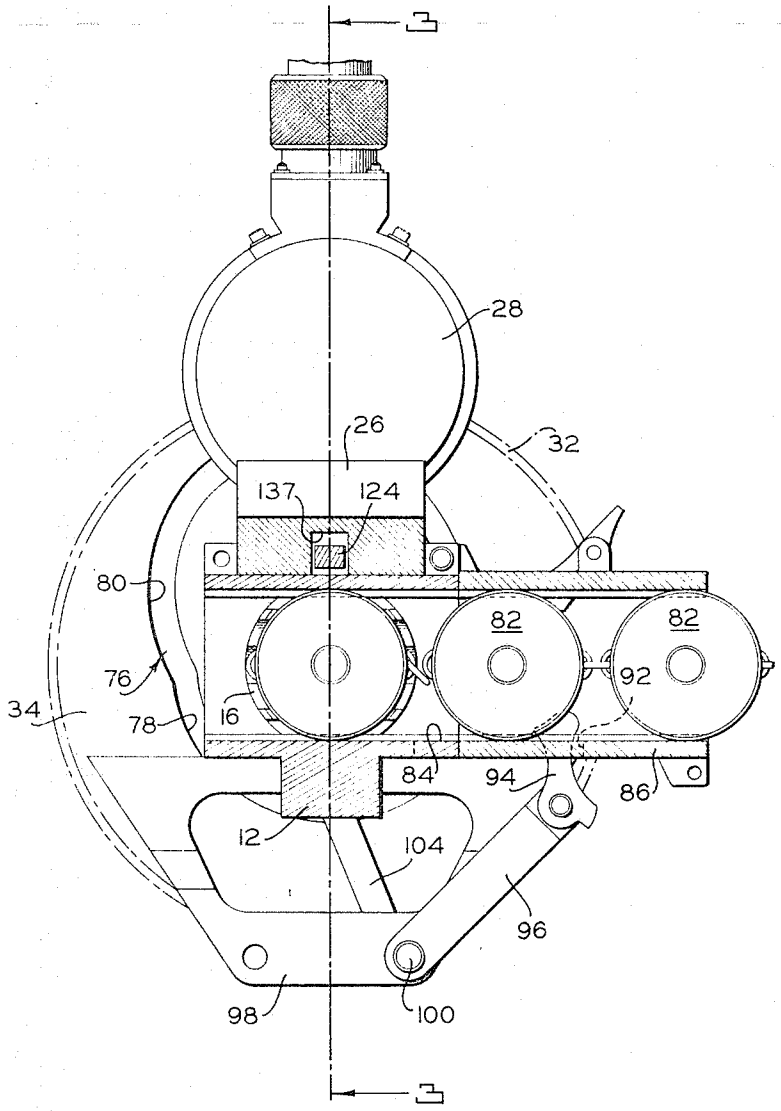
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Fig. 2

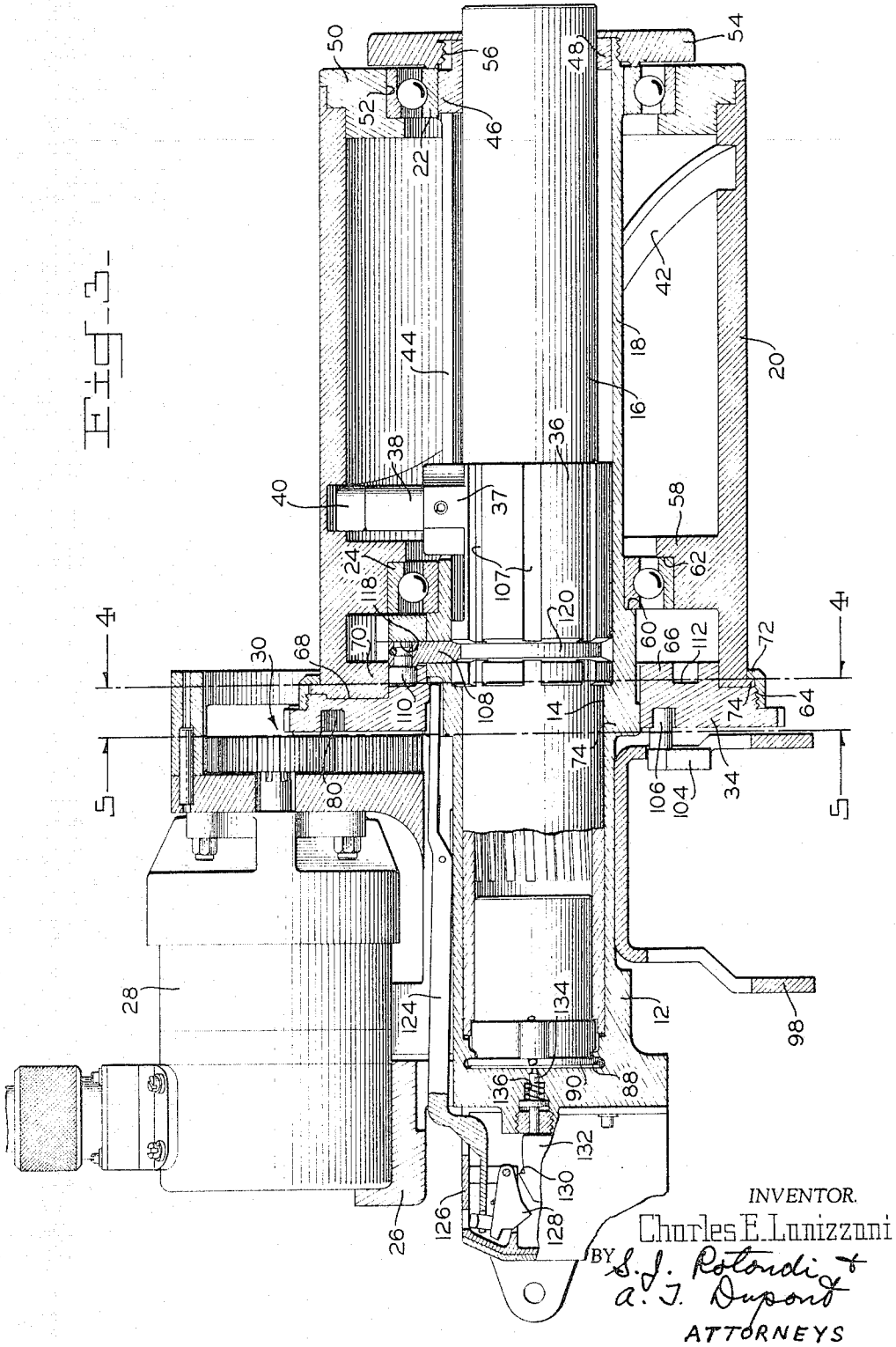


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Fig. 5

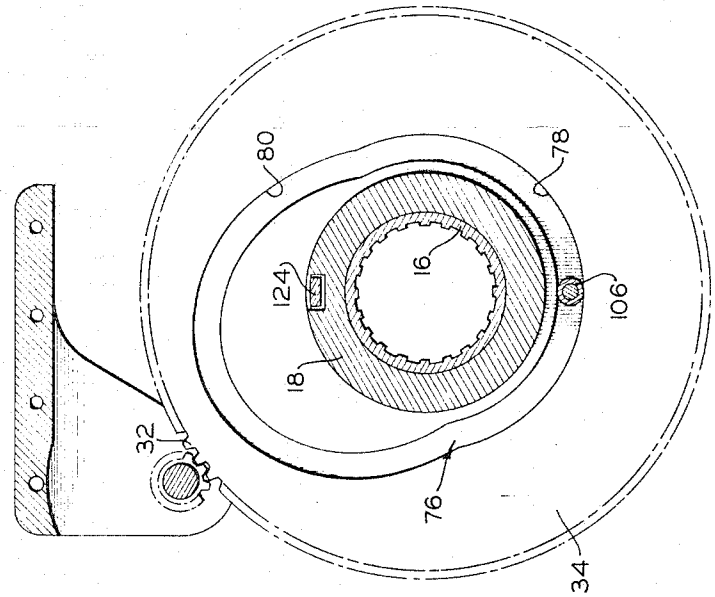
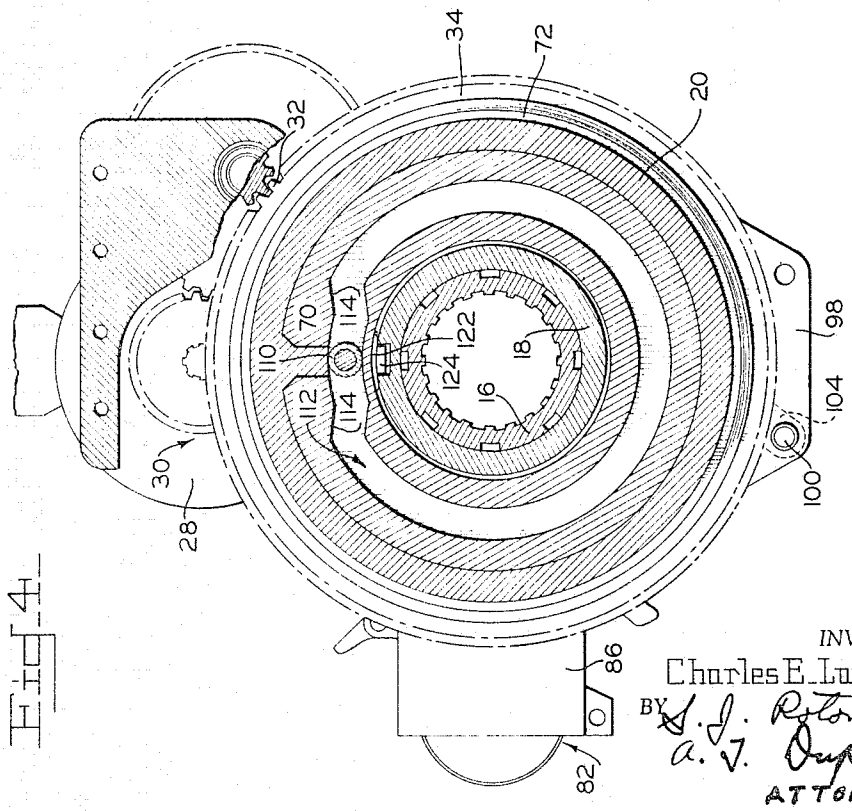


Fig. 4



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3,303,744

BARREL SURROUNDING MOUNT FOR OPERATING DRUM OF EXTERNALLY POWERED AUTOMATIC GUN

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6 Claims. (Cl. 89—161)

The invention described herein may be manufactured and used by or for the Government for governmental purposes without the payment to me of any royalty thereon.

This invention relates to automatic guns which can be operated at different rates of fire and is more particularly directed to a gun of this type in which the operating parts thereof are actuated by a rotating drum powered by an electric motor.

Inasmuch as current military planning contemplates the use of a universal type of machine gun which will be equally effective against such diverse targets as aircraft, ground vehicles, or personnel, it is essential that these guns possess suitable means for increasing or decreasing the rate of fire in a predetermined manner in order to permit a rapid shift in use from one type of target to another. It has been found that the required changes in the rate of fire can best be accomplished if the feeding, locking, and firing cycles of the gun are controlled by separate cams provided in a rotatable drum driven by an external source of power having a variable output.

While this concept has been satisfactorily applied to a gun in which a helical cam on the exterior periphery of the drum is utilized to reciprocate a single barrel between firing and feeding positions, certain problems have arisen due to the erratic rotation of the drum encountered during relatively prolonged bursts of fire.

A careful analysis of this gun design has indicated that the uneven rotation of the drum is largely due to the fact that the location thereof below the axis of the barrel creates a couple which imparts torsional forces to the bearings on which the drum is rotated. Furthermore, another factor which contributes to the undesirable variation in the rotational velocity of the drum is the abrupt change in the forces applied thereto as the followers, which engage the various cam tracks therein, leave the dwell portions thereof and move into positive engagement with the cam portions. Still another factor responsible for the erratic operation of the drum, but to a lesser degree than those previously mentioned, is the excessive transfer of the heat in the barrel to the drum bearings and the consequent binding effect thereon. Of much smaller but still material significance is the exposed location of the various cam tracks formed in the drum which permits the accumulation therein of dirt or other foreign material capable of interfering with the desired smooth transfer of the rotational velocity of the drum to the corresponding operating assemblies in the gun.

It is, therefore, a general object of this invention to provide an automatic machine gun adapted to be cycled by an operating drum which will not be subject to undesirable variations in the rotational velocity thereof during sustained fire.

It is an important object of this invention to produce a gun of the aforesaid type wherein the operating drum is specifically located to virtually eliminate the transmission of torsional forces thereto.

A further object of the present invention lies in the provision of an automatic machine gun, as aforesaid, wherein the bearings on which the operating drum is mounted are substantially isolated from the heat generated in the barrel by sustained automatic fire.

Still another object of this invention is to provide an automatic machine gun, as aforesaid, wherein the connection between the drive motor and the operating drum is geared in a manner which actually enhances the ability of the latter to overcome the inertial resistances of the feeding, locking, and firing functions encountered in each cycle of operation.

A secondary object of this invention is to provide an automatic gun, as aforesaid, wherein the functions of feeding, locking, and firing are sequentially and independently controlled by suitable cam tracks which are disposed on or in the operating drum in such a manner as to prevent the accumulation of dirt or other deleterious foreign matter.

In accordance with the teachings of the present invention, the torsional forces heretofore encountered during the automatic fire of those guns in which the functions of feeding, locking, and firing are controlled by a motor driven operating drum can be virtually eliminated by locating the latter so that the central axis thereof coincides with the longitudinal axis of the barrel. This desirable relationship is best achieved by forming the drum as a hollow cylinder and mounting such cylinder for symmetrical rotation about a tubular member which extends forwardly from the receiver to surround the barrel. In this arrangement, the helical cam track utilized to reciprocate the barrel is formed about the interior periphery of the hollow drum and the cams responsible for feeding, locking, and firing are provided on a ring gear member which closes the rear end of the drum and also operates as a flywheel capable of overcoming the inertia forces encountered in the starting and stopping of the feeding, locking, and firing mechanisms of the gun. In addition, the forward end of the operating drum is also closed to completely seal the interior thereof against the entry of dirt or other foreign matter.

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 a side view of the gun of this invention with the cartridges normally disposed in the feed tray being removed to show the barrel in battery position;

FIG. 2 is a sectional view taken along line 2—2 of FIG. 1 to show the manner in which a linked cartridge belt is fed into the gun to position the leading cartridge in firing position;

FIG. 3 is a longitudinal section of the gun with the housing for the firing mechanism partially broken away to show the hammer in the fired position and the barrel partially broken away to show the fired cartridge case;

FIG. 4 is a cross-sectional view taken along line 4—4 in FIG. 3 to show the firing and locking cams in the drum; and

FIG. 5 is a cross-sectional view taken along line 5—5 in FIG. 3 to show the feeding cam in the drum.

As illustrated in the drawings, the gun of the present invention includes a substantially rectangular receiver 12 provided with a forwardly opening central bore 14 for slidably receiving a reciprocal barrel 16. Receiver 12 is forwardly extended in coaxial alignment with bore 14 to form a tubular housing 18 concentric with barrel 16. A hollow cylinder 20 is rotatably mounted on housing 18 by means of front and rear roller bearings 22 and 24, respectively, to serve as an operating drum for controlling the feeding, locking, and firing functions of the gun as will be hereinafter shown. A bracket 26 projects upwardly from receiver 12 and serves to mount an electric drive motor 28 capable of a variable output which is transmitted to drum 20 by a gear assembly 30 engageable with a ring gear 32 forming a portion of a flywheel 34

secured to the rear end of drum **20** for rotation therewith.

A central portion of barrel **16** is diametrically increased, as shown at **36**, to provide a bearing surface therefor in housing **18**. Forwardly of increased diameter portion **36** is a base **37** for an upwardly projecting post **38** terminating in a roller **40** engageable in helical cam track **42** formed about the interior periphery of drum **20**. The top of housing **18** is longitudinally slotted, as indicated at **44**, to provide a passage for the longitudinal travel of base **37** during the reciprocal movement imparted to barrel **16** by the rotation of drum **20**. The forward end of slot **44** is enlarged to receive an arcuate spacer **46** in contact with the upper surface of barrel **16** and of sufficient height to provide contact with both roller bearing **22** and barrel housing **18**. A ring **48** depends from spacer **46** and is positioned within the interior of housing **18** to encircle barrel **16** and provide support thereto during the longitudinal reciprocation thereof.

An annular plate **50** is securely fitted into the forward end of drum **20** and is centrally provided with a circular recess **52** for seating roller bearing **22** therein which is, in turn, retained in place by an annular cap **54** secured to the forward end of barrel housing **18** by threads **56**. At the rear end of drum **20**, the interior diameter thereof is reduced, as shown at **58**, to seat roller bearing **24** in coaxial relation with roller bearing **22** for engagement with the exterior periphery of housing **18**. Longitudinal displacement of roller bearing **24** is prevented by opposite annular shoulders **60** and **62** respectively provided in housing **18** and drum **20**.

Flywheel **34** is formed with an exteriorly threaded portion **64** of reduced diameter disposed forwardly of and immediately adjacent to ring gear **32** and is further provided with a forwardly projecting circular portion **66** which serves as the closure for the rear end of drum **20**. Circular portion **66** is radially slotted, as shown at **68**, to engage a correspondingly shaped lug **70** formed in the interior of drum **20** for insuring the proper radial orientation of flywheel **34** relative thereto. Flywheel **34** is releasably secured to drum **20** by an interiorly threaded collar **72** simultaneously engageable with threaded portion **64** on flywheel **34** and an outwardly projecting flange **74** at the rear end of drum **20**.

As best shown in FIG. 5, the rear face of flywheel **34** is formed with a cam track **76** having a circular dwell portion **78** and an eccentric cam portion **80** for controlling the feeding of a linked belt of cartridges **82** into a transverse feedway **84** in the rear of receiver **12**. A feed tray **86** (FIG. 2) is fixedly secured to the side of receiver **12** in coaxial alignment with feedway **84** to complete the passageway for the linked cartridge belt. The floor of feedway **84** is grooved along the junction with the rear end wall thereof, as shown at **88**, to engage the annular rim **90** of each cartridge **82** and guide such cartridge into the proper firing position thereof. The bottom of feed tray **46** is suitably slotted, as indicated at **92**, to accommodate a reciprocal feed pawl **94** pivotally secured to the upper end of a feed lever **96**. A bifurcated bracket **98** is secured to the underside of receiver **12** for rotatably supporting a rod **100** whose rear end is fixed to the lower end of feed lever **96**. The forward end of rod **100** is similarly fixed to the lower end of a follower arm **104** on the upper end of which is provided a roller **106** for engagement in feed cam track **76** in flywheel **34**.

Thus, as drum **20** is rotated by drive motor **28**, each cartridge **82** in the linked cartridge belt is successively advanced into firing position in feedway **84** to eject the previously fired cartridge case therein. Flywheel **34** is, of course, so oriented in drum **20** that the dwell portions of cam tracks **76** and **42** prevent movement of barrel **18** during the feeding advance of the cartridge belt and also prevent the feeding movement of the cartridge belt during the reciprocation of barrel **18**. Chambering of the leading cartridge **82** in the belt is accomplished as barrel **18** is moved rearwardly into battery position and is halted therein upon contact with the annular rim **90** of such cartridge. Since the contact between the increased diameter portion **36** of barrel **16** and the interior periphery of housing **18** provides a piston and cylinder relationship, the circumference of barrel **16** is longitudinally slotted, as shown at **107**, at a plurality of areas to minimize the compressive effect thereof on the air within barrel housing **18**.

Locking of barrel **18** in battery position is accomplished by a locking block **108** provided with a rearwardly projecting roller **110** at the upper end thereof slidably seated in a substantially circular cam track **112** formed into the front face of flywheel **34** as best shown in FIG. 4. The upper portion of cam track **112** is formed with oppositely disposed cam slopes **114** which are spaced apart to insure that barrel **18** is properly locked during the entire firing operation. Locking block **108** is slidably mounted in a suitable slot **118** passing through the top of barrel housing **18** and is arranged to be cammed into and out of a correspondingly located annular locking groove **120** in barrel **16** by cam slopes **114** which are located in flywheel **34** so that contact thereof with follower roller **110** occurs while both the cartridge belt and barrel **18** are stationary.

The inner periphery of flywheel **34** is provided with a protruding cam segment **122** located immediately below cam slopes **114** and in concentric alignment with the portion of cam track **112** therebetween. As best shown in FIG. 4, the arcuate extent of cam segment **122** is such that the ends thereof thereof are disposed inwardly of cam slopes **114** to insure that the camming action thereof is limited to the period in which barrel **16** is fully locked. Firing of the chambered cartridge **82** is accomplished by an elonagated lever **124** pivotally mounted in receiver **12** to lie immediately above barrel housing **18**. The forward end of lever **124** is engageable with cam segment **122** during rotation of drum **20** while the rear end of lever **124** is extended into the hollow interior of a housing **126** suitably secured to the rear end of receiver **12**. A sear **128** is pivotally mounted within housing **126** to engage a cocking notch **130** formed in a hammer **132** pivotally mounted to the floor of housing **126**. As the forward end of lever **124** is depressed by firing cam **122**, the corresponding movement imparted to the rear end thereof lifts sear **128** to release hammer **132** for impact with a firing pin **134** slidably seated in a central counterbore **136** through the rear end wall of receiver **12**. The underside of motor bracket **26** is suitably undercut, as indicated at **137**, to provide for this pivotal movement of firing lever **124**.

Thus, the entire operation of the gun is completely dependent upon the continuous rotation of drum **20** which is, in turn, driven by motor **28** whose speed can be quickly and easily varied in accordance with the type of target at which the gun is to be aimed. Since the major gun assemblies are specifically located to position the center of gravity in substantially close relation to the axis of barrel **16**, and since drum **20** is rotated about an axis which coincides with the barrel axis, little or no torque is transmitted to the front and rear trunnions **138** and **140** by means of which the gun is adapted to be mounted in a vehicle or aircraft. The resulting freedom from vibration during relatively long bursts of fire is particularly valuable in securing increased hit probability. In addition, the reduced torque permits the utilization of lighter and less complex mounts which is especially desirable when the gun is mounted in aircraft.

Furthermore, the concept of mounting drum **20** for rotation about an axis coincident with the barrel axis became a practical possibility as a result of providing the interior of drum **20** with front and rear roller bearings designed to ride about the exterior periphery of the barrel housing **18** which is spaced from barrel **16** except for limited support areas in the vicinity of the roller bearings. Such design minimizes the flow of heat thereto from barrel **16** and, consequently, eliminates any binding thereof even under the extremely high temperatures encountered upon prolonged firing.

Since the rotation of drum **20** does not result in any substantial torque on the gun or mount therefor, the flywheel **34** utilized to transmit the driving forces of motor **28** to drum **20** may be of substantial weight. This factor virutally eliminates any variations in the rotational velocity of drum **20** at the particular instances at which barrel roller **40**, feed roller **106**, locking rollers **110**, and firing lever **124** engage with their respective operating cams.

Another desirable feature provided by the utilization of cam tracks within the interior of a closed hollow drum **20** is the prevention of dirt accumulation therein which could interfere with the smooth operation of the major assemblies in the gun. Although the feed cam track **76** at the rear end of drum **20** is partially exposed, the location thereof beneath receiver **12** aids in preventing any appreciable accumulation of foreign matter therein.

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.

I claim:

1. In an automatic gun having a receiver with a forwardly opening bore in rearward communication with a transverse feedway for the passage of a linked belt of cartridges, the combination of a barrel slidably disposed in the receiver bore for reciprocal movement into and out of battery position, a tubular housing extending forwardly from the receiver to surround said barrel in spaced relation thereto, a hollow cylindrical drum rotatably mounted on said housing in axial coincidence with said barrel therein, a follower projecting outwardly from said barrel, cam means in the interior of said drum engageable with said follower on said barrel, and means for continuously rotating said drum to reciprocate said barrel for successively chambering each cartridge in the belt during rearward movement of said barrel into battery position.

2. In an automatic gun having a receiver with a forwardly opening bore in rearward communication with a transverse feedway for the passage of a linked belt of cartridges, the combination of a barrel slidably disposed in the receiver bore for reciprocal movement into and out of battery position in which the leading cartridge in the feedway is completely chambered thereby for firing, a tubular housing extending forwardly from the receiver to surround said barrel in spaced relation thereto, a hollow cylindrical drum having front and rear roller bearings therein for rotatably mounting said drum on said housing in axial coincidence with said barrel therein, a follower projecting upwardly from said barrel through said housing, helical cam means in the interior of said drum engageable with said follower on said barrel, means for continuously rotating said drum to reciprocate said barrel for successively chambering each cartridge in the belt, and cam means in said drum for locking said barrel to the receiver during the battery position thereof.

3. The combination defined in claim **2** wherein said means for continuously rotating said drum comprises a ring gear secured to the rear face of said drum, a drive motor mounted to the receiver, and gear means for connecting said drive motor to said ring gear.

4. In an automatic gun having a receiver with a forwardly opening bore in rearward communication with a transverse feedway for the passage of a linked belt of cartridges, the combination of a barrel slidably disposed in the receiver bore for reciprocal movement into and out of the feedway for chambering the leading cartridge therein, a tubular housing extending forwardly from the receiver to surround said barrel in spaced relation thereto, a hollow cylindrical drum having an annular front cover with a forwardly opening circular recess therein, said drum also having a rearwardly disposed internal reduced diameter portion in coaxial alignment with said circular recess, first and second roller bearings respectively seated in said circular drum recess and in said reduced diameter portion for rotational engagement with the exterior periphery of said barrel housing whereby said drum is positioned in axial coincidence with said barrel, a ring gear secured to the rear end of said drum in bearing relation with the exterior periphery of said barrel housing, a follower projecting upwardly from said barrel, said housing having a longitudinal slot along the top thereof for passage of said barrel follower, a helical cam track about the inner periphery of said drum engageable with said barrel follower, drive means engageable with said ring gear for continuously rotating said drum to impart reciprocal movement to said barrel whereby each cartridge in the linked belt is successively chambered thereby, means for locking said barrel to the receiver during the period in which each cartridge is fully chambered, and a cam track in the rear face of said ring gear for actuating said barrel locking means.

5. The combination defined in claim **4** wherein said barrel is formed with an annular locking groove and said barrel locking means comprises a vertical lock slidably disposed in said barrel housing for movement into and out of engagement in said barrel locking groove, and a roller extending rearwardly from said lock to engage in said cam track in the rear face of said ring gear.

6. In an automatic gun having a receiver with a forwardly opening bore in rearward communication with a transverse feedway for the passage of a linked belt of cartridges, the combination of a barrel slidably disposed in the receiver bore for reciprocal movement into and out the feed for chambering the leading cartridge therein, a tubular housing extending forwardly from the receiver to surround said barrel in spaced relation thereto, said barrel having an enlarged diameter portion in slidable bearing relation with the interior periphery of said housing, a hollow cylindrical drum having an annular plate secured to the forward end thereof and a forwardly opening circular recess centrally formed in said plate, a first annular roller bearing seated in said circular recess, said drum having an internal reduced diameter portion adjacent the rear end thereof, a second annular roller bearing seated in said reduced diameter portion in axial alignment with said first roller bearing, said roller bearings being thereby positioned to mount said drum on said barrel housing for rotation about an axis coincident with the axis of said barrel therein, a ring gear secured to the rear end of said drum in bearing relation with the exterior periphery of said barrel housing, a follower projecting upwardly from said barrel immediately forward said enlarged diameter portion thereof, said barrel housing having a longitudinal slot along the top thereof for passage of said follower during the reciprocal movement of said barrel, a helical cam track formed in the interior periphery of said drum for engagement with said barrel follower, drive means engageable with said ring gear for continuously rotating said drum to impart reciprocal movement to said barrel whereby each cartridge in the linked belt is successively chambered thereby, and individual cam means in said ring gear for successively actuating the cartridge feeding, barrel locking, and firing operations of the gun, said ring gear being of sufficient weight to act as a flywheel for minimizing the forces encountered in the initiation and cessation of each operating function of the gun.

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