E. T. MOORE AND S. SINGER.

CENTRIFUGAL MACHINE GUN.

APPLICATION FILED JUNE 20, 1918. RENEWED AUG. 1, 1919

1,332,992.

Patented Mar. 9, 1920.

3 SHEETS—SHEET 1.

Fig. 1.

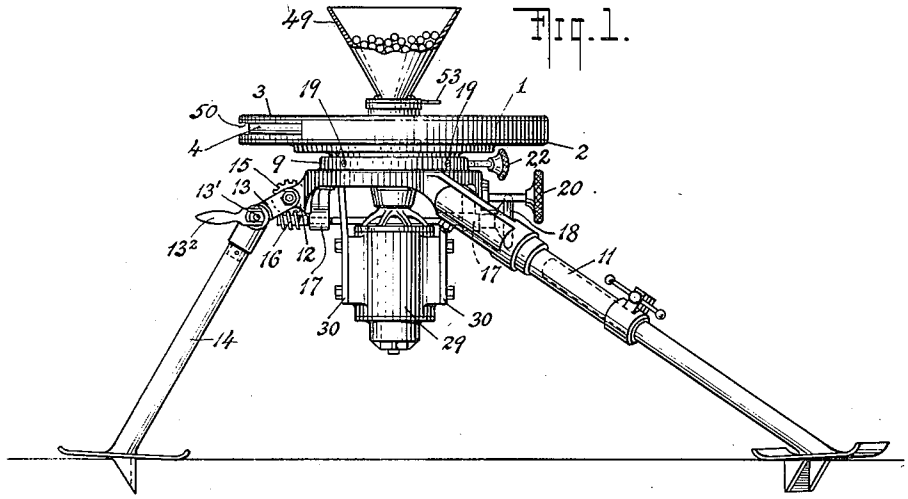

Fig. 2.

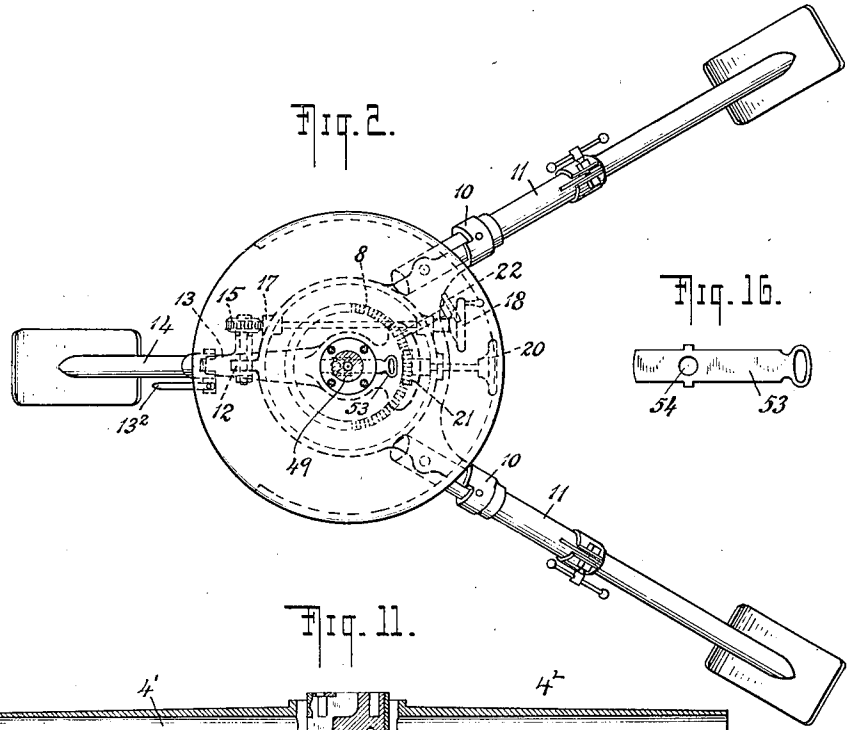

Fig. 16.

Fig. 11.

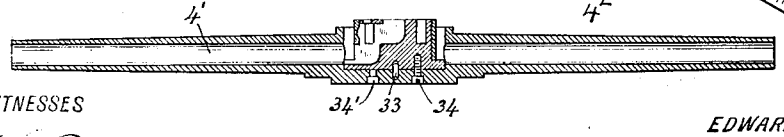

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Fig. 3.

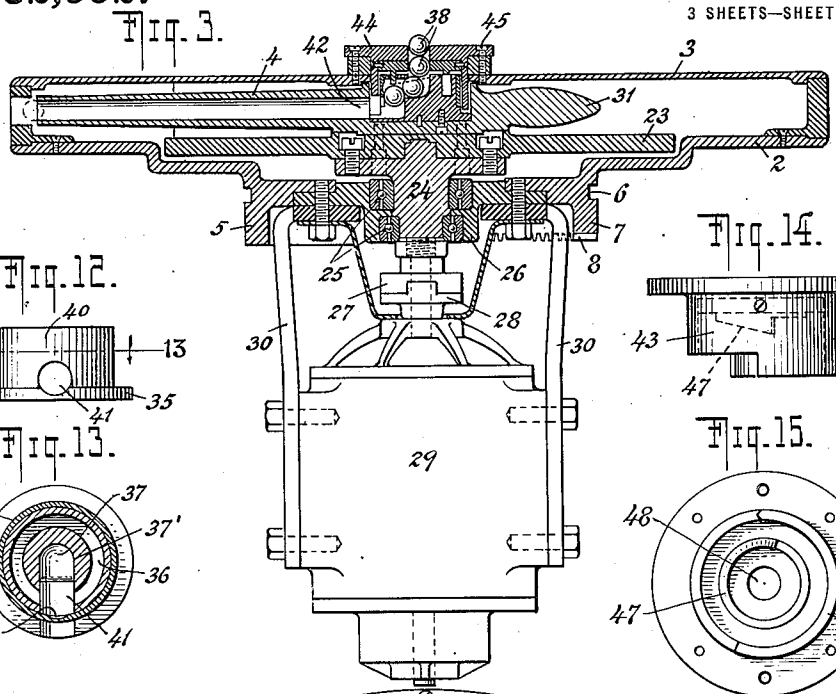


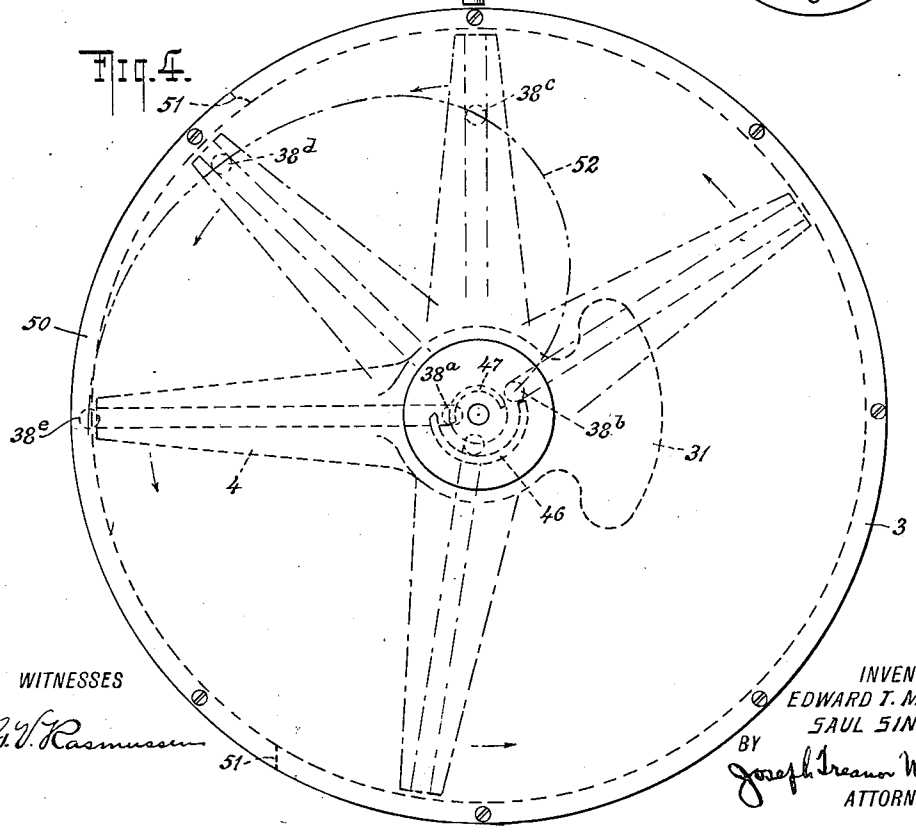
Fig. 12.

Fig. 13.

Fig. 14.

Fig. 15.

Fig. 4.



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3 SHEETS—SHEET 3.

Fig. 5.

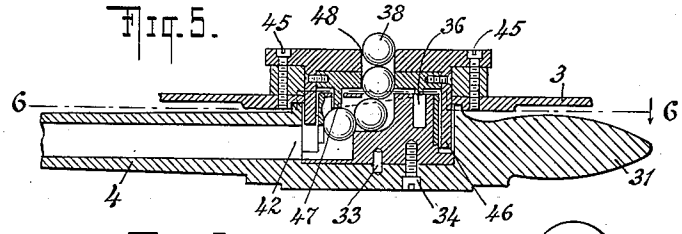


Fig. 6.

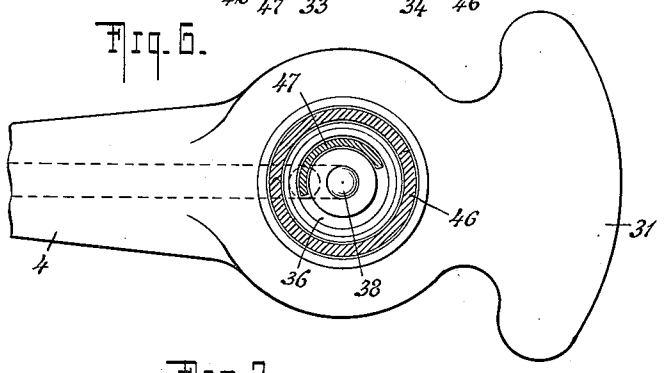


Fig. 7.

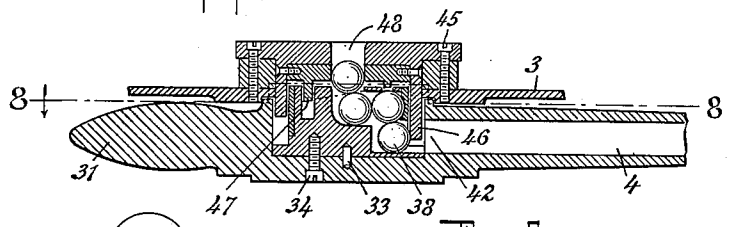


Fig. 8.

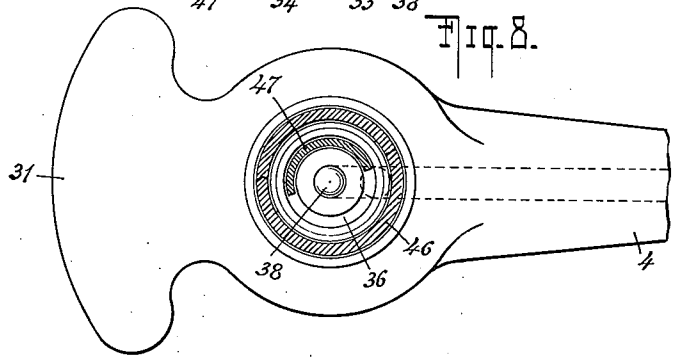


Fig. 9.

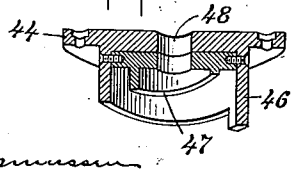
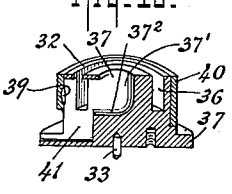


Fig. 10.



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CENTRIFUGAL MACHINE-GUN.

1,332,992. Specification of Letters Patent. Patented Mar. 9, 1920.

Application filed June 20, 1918, Serial No. 240,943. Renewed August 1, 1919. Serial No. 314,728.

To all whom it may concern:

Be it known that we, EDWARD THOMAS MOORE and SAUL SINGER, both citizens of the United States, residing, respectively, in the city and county of Passaic, State of New Jersey, and at Cedarhurst, Queens county, State of New York, have invented certain new and useful Improvements in Centrifugal Machine-Guns, of which the following is a specification.

Our invention relates to centrifugal guns, *i. e.*, to guns which utilize centrifugal force as a propelling means for the discharge of projectiles rather than an explosive, springs or the equivalent, or other means.

In guns of this class the projectile is rotated at a very high velocity about a center by the gun mechanism before it is released therefrom and it is by reason of the kinetic energy of rotation thus acquired by the projectile that the latter is projected through its course.

Our invention relates more particularly to a machine gun of the centrifugal type in which relatively small projectiles are continuously fed to the gun from a hopper or other device to be continuously ejected therefrom at the end of successive very small intervals of time.

Guns of this general class are always ready for use, requiring merely a supply of projectiles and a source of power; if desired, they may be arranged to be driven manually. Being purely mechanical they have but little heating and hence, do not tend to jam in action because of undue expansion of parts as do guns using explosives.

Such guns may therefore, be operated continuously over long periods of time in contradistinction to guns using explosives which must be given time to cool down after a given number of rounds have been fired or else must be provided with elaborate, bulky and heavy cooling devices; and even with attached cooling devices the time of ultimate overheating is merely postponed, and not done away with altogether.

In machine guns of the centrifugal type, fed by a hopper or other device, it is imperative that the several projectiles be delivered to or inserted in the gun or mechanism proper in regular sequence, at a definite time in the cycle of operations, and without mutual interference. In our invention, about to be described, we provide a construction specially adapted to satisfy these requirements with certainty and definiteness while being, at the same time, simple and inexpensive and well suited to quantity manufacture.

It is a principal object of our invention to provide a construction of centrifugal gun feed which will satisfy the requirements of the preceding paragraph. A further object of the invention is to provide a gun feed of the character described which is adjustable so that it may be made to feed any one of several barrels of a multi-barrel centrifugal gun.

Still other objects will appear as the specification proceeds.

Our invention will be better understood by referring to the accompanying drawings, representing a preferred embodiment of machine gun according to the invention, in which Figure 1 shows a side elevation of the assembled gun, ready for action, the hopper being partly in section; Fig. 2 is a plan view of Fig. 1; Fig. 3 is an enlarged view, partly in elevation and partly a central vertical action taken through the axis of the gun barrel; Fig. 4 is a plan view, taken from above, on the same scale as Fig. 3, of the gun casing, showing the rotating balanced gun barrel (dotted) in successive angular positions; Fig. 5 is a section, still further enlarged, taken through the axis of the gun barrel and showing the detailed construction of gun breech and feed (this view is similar to that part of Fig. 3 which deals with the same parts of the gun); Fig. 6 is a section taken along the line 6—6 of Fig. 5; Fig. 7 is a view, similar to Fig. 5, but showing the position of the parts 180° later in the rotational cycle of the gun; Fig. 8 is a section taken along the line 8—8 of Fig. 7; Fig. 9 is a sectional perspective view taken through the fixed member of the feed taken along the same line as Fig. 5; Fig. 10 is a view, similar to Fig. 9, of the movable member of the feed; Fig. 11 is a central vertical section through the axis of the barrels of a gun, similar to the gun of Figs. 1 to 10 except, that the gun has two barrels instead of one; Fig. 12 is a side elevation of the breech block as it would appear if viewed from the left of

Fig. 5; Fig. 13 is a sectional plan view taken along the line 13—13 of Fig. 12; Fig. 14 is a side elevation of the timing and release block as it would appear if viewed from the left of Fig. 5; Fig. 15 is a plan view, taken from below, of Fig. 14; and Fig. 16 is a plan view of the stop slide by means of which the feed from the hopper may be started or stopped thus controlling the firing periods of the gun.

In the drawings (Figs. 1–10), a circular shallow box or casing 1 of cast or pressed steel, bronze or the like, and comprising a body 2 and a cover 3, incloses the gun barrel 4 and its breech mechanism. The body 2 has a central downwardly projecting base portion 5 provided with a peripheral recess 6 and a dependent flange 7; this flange has radial teeth 8 formed therein.

The base portion 5 is shaped to seat in an azimuth ring 9 having a pair of sockets 10 in which are set telescopically adjustable tripod legs 11, and an arm 12 carrying a pivotally attached link 13 which, in turn, at its outer end 13′ carries a third pivotally attached tripod leg 14. The inner end of link 13 carries a worm gear 15 engaged with a worm 16 whose shaft is carried by brackets 17 depending from ring 9. The outer end of the worm shaft is provided with a wheel 18 by which the worm may be operated thus rotating the link 13 about the axis of the worm gear and also about the pivotal point 13′ so that this side of ring 9 is raised or lowered, as the case may be, the tripod as a whole with all attached parts, already described or to be described, swinging about an axis joining the feet of legs 11. A clamp operated by handle 13^2 locks the joint at pivotal point 13′ when the correct adjustment has been secured.

Screws 19, fixed in ring 9, have their inner ends loosely engaged with recess 6 so that casing 1 may be rotated in the ring but not withdrawn therefrom. To thus rotate the casing, a wheel 20 carrying a gear 21 is mounted upon ring 9, the gear being engaged with the radial teeth 8 of flange 7. A clamp block (not shown) operated by clamp wheel 22 is also attached to ring 9 and adapted to be seated tightly in recess thus holding the casing 1 and preventing its further rotation when it has been correctly set by the operation of wheel 20.

The gun barrel 4 is of the usual tubular design and, with part of its breech mechanism, is mounted upon a plate 23 sunk in a depression of base portion 5 and itself attached to an axis or shaft 24 which is rotatably mounted in roller bearings 25 held by a bearing plate 26 forming the bottom central part of body 2. The lower end of axis 24 carries a clutch member 27 which engages a similar clutch member 28 fixed to the upper end of a shaft of an electric motor 29. This motor 29 is carried by straps or hangers 30 whose upper ends are clamped against bearing plate 26.

The plate 23 serves as a flywheel to insure smoothness and steadiness of motion.

The gun barrel is balanced with respect to the axis of rotation by having its rear end, beyond the axis, formed as a fan shaped mass 31.

The breech mechanism.—The top of the gun barrel 4, with its integral balancing mass 31, is bored out centrally to a level preferably just a little below the lowest point of the inner surface of the barrel and in the recess thus formed is seated a receiving chamber or breech block 32. This block is fastened in place by a center pin 33 and screw 34 and comprises, essentially, a cylindrical plug having a bottom flange 35. The top of the plug has a concentric tubular recess 36 sunk therein, the depth of the recess being about half that of the plug. There is also formed, in a radial plane of this plug, an L shaped cylindrical bore or passage 37 which extends from the top of the plug to the periphery thereof and is sufficiently large, at all points, to permit the passage of the projectiles 38 which the gun is designed to throw. The vertical leg 37′ of this passage is coaxial and is joined to the horizontal or radial leg 37^2 by a gentle curve. This radial leg ends, short of the outer surface of the plug, in a depression or retaining recess 39. For purposes of convenient construction this recess is formed in the inner wall of a separately formed sleeve 40 with which the inner part of the plug is jacketed.

The outer end of leg 37^2 is joined at its bottom, by another L shaped passage or chamber 41 lying in the plane of passage 37. The outer end of this passage 41 is in registry with the inner end 42 of the gun barrel and the passage, like passage 37, is sufficiently large at all points to permit the passage of the projectiles 38.

The top of casing cover 3 is cut out at the center to receive the fixedly attached timing and release block 43. This block, like breech block 32, is made of several united but independent pieces for purposes of easier manufacture. As regards its functions however, it may be considered as integral and will be so described. This block comprises essentially, a head 44 by means of which screws 45 attach the block to the cover; dependent from this head is an outer tubular apron 46 and an inner tubular cam 47 the surfaces of both being concentric. The center of the head is perforated at 48 to register with the top opening of passage 37.

Apron 46 and cam 47 are so dimensioned that the apron will occupy the space between the outer periphery of breech block 32 and the inner periphery of the recess which was formed in the top of the gun barrel and its

balancing mass to receive the breech block and this without touching either the breech block or the gun barrel and its balancing mass; while the cam will, similarly, without touching, occupy the tubular recess 36 formed in the top of the breech block.

The apron through a little more than 180° of its circumference, is of uniform depth sufficient to substantially cover the inner end of the bore of the gun barrel while its remaining portion lies above the bore.

The cam, 47, has but a single step; its surface is of uniform depth for 180° and then tapers continuously to a maximum through the remaining 180°. At the maximum the cam surface will lie at approximately the level of the center of recess 39. The depth of the cam increases counter clockwise (viewed from above) and its maximum is attained, measuring in this direction, just after (say 10° to 15°) the deeper part of the apron begins. And the cam begins to taper at about the same number of degrees before the deeper part of the apron ends.

Bolted fast to the head 44 is a feed hopper 49 having a bottom opening (not shown) in registry with the opening 48 in head 44 and hence with passages 37 and 41. In this hopper the projectiles 38 may be placed in bulk.

The peripheral wall of casing 1 is cut away at 50 between the points 51, 51, over an arc of, preferably, a little over 120°. The center of this cut away portion is substantially opposite to the beginning of the deeper part of the apron 46 (measuring counter clockwise). This center point may be regarded as the front of the gun as will appear from the description of the gun's operation, which is as follows:

The gun being suitably leveled up by adjusting telescopic legs 11 and leg 14, the latter by the aid of worm wheel 18 and clamp handle 13^2, and the front of the gun being in the plane of leg 14; and the hopper 49 being filled with projectiles 38; the circuit of motor 29 is closed. This will cause the motor to revolve counter clockwise (viewed from above) and, through clutch members 27, 28, will similarly revolve the axis 24 and hence the gun barrel 4 with its balancing mass 31 and attached breech block 32. The casing 2 with the fixedly attached timing and release block 43 will of course, remain stationary. The projectiles will naturally pass through the opening in the bottom of the hopper, and through the opening 48 in head 44, into the passage 37; they will proceed along this passage partly because of gravity, partly because of the air suction or aspirating effect created in the barrel of the gun resulting from its rotation about the axis 24, partly because of the pressure of the projectiles behind them and partly because of the centrifugal force engendered by their rotation about the vertical axis of the gun and acting upon them. At a point in the rotation of the gun where the recess 39 reaches the shallow portion of cam 47 the cam surface will lie so far above the recess that the projectile will be pressed into the recess where it will be held by centrifugal force as well as by the pressure exerted upon it by the projectiles behind it. As the gun barrel and breech block continue to revolve the recess will reach the beginning of the tapered part of the cam and will carry the projectile under the continuously deepening cam surface which will descend, relatively to the recess, more and more. The effect of this will be to gradually push the projectile out of the recess so that it will drop to the bottom of passage 41. By this time, however, the outer end of passage 41 will have passed behind the deeper part of the apron 46 (38^a Fig. 4); the projectile will therefore, be carried along in the passage 41, the centrifugal force holding it against the inner side of the apron all the while, until this deeper part of the apron ends (at 38^b Fig. 4). The inner end of gun barrel 4 is thereby uncovered and the projectile immediately slips therein and moves toward the muzzle at a very high rate of speed.

As the projectile moves out through the gun barrel, the gun barrel itself is continuing its rotatory movement. The path of the projectile through space is, hence, a resultant of these two motions and is shown, for the assumed rate of speed, by the dotted line 52 (Fig. 4). When the muzzle of the gun barrel has just reached the front of the gun the projectile 38^e will be just about to leave the muzzle; its path thenceforward will lie in a plane somewhere between a radial plane though the axis of the gun barrel and a plane tangent to the muzzle of the barrel, the position of these limiting planes being considered as at the instant the projectile leaves the barrel.

As soon as the gun barrel has revolved sufficiently to again cause the recess 39 to be uncovered by the cam 47, a second projectile will be forced into the recess and held there, as previously described, to be in its turn thrust out by the cam and thence to enter and be ejected from the gun barrel.

It will be seen from the above that for each revolution of the gun barrel, a single projectile is automatically fed into the breech block at a definite point of the rotational movement and that the projectile is released from the breech block and permitted to enter the barrel at another equally definite point of the rotational movement. And that, furthermore, if the speed of rotation be kept constant, the paths of the successive projectiles should remain identical.

The direction taken by the projectiles, *i. e.*, the azimuth of the trajectory, may be

varied to the one side or the other, by rotating the casing 1 in ring 9 through the aid of wheel 20. The effect of this will be to rotate the timing and release block 43 and hence to cause the projectiles to be released from the recess 39 and to enter and leave the gun barrel at an earlier or later point in the rotation of the barrel, as the case may be.

Or, the direction taken by the projectiles may be varied by varying the R. P. M. of the motor and gun barrel. This will not appreciably alter the point at which the projectile is released from the retaining recess or the point at which it will enter the gun barrel but it will alter the rate at which it speeds through the gun barrel and hence the point in its rotation at which it will leave its muzzle. If the speed of the motor be lessened the plane of the trajectory will be swung to the left or counter clockwise; if it be quickened the plane of the trajectory will be swung to the right or clockwise.

The passage of the projectiles through the breech mechanism and particularly through the gun barrel is substantially assisted by air suction applied to the muzzle of the gun barrel. This result from the rapid movement of the muzzle through the air surrounding it being the well known aspirator effect utilized in many arts.

Besides the added propulsive effect due to the above aspirating action we obtain the additional advantage thereby that any heat generated in the operation of the gun is rapidly carried off so that the gun can be used continuously through long periods of time without becoming overheated.

Instead of using the fan shaped mass 31 as a balance for the gun barrel proper we may, if we prefer, use a plurality of barrels which, if disposed at equal angles, will obviously constitute a symmetrical structure which will not require other balancing. Thus in Fig. 11 we show our invention applied to a two barreled gun. As drawn the barrel 4′ will be served with projectiles. To serve the barrel 4^2 instead, it will merely be necessary to loosen the screw 34 and rotate the breech block 32 through 180° and replace screw 34 in screw hole 34^1. Should a barrel heat through too long use it is, therefore a simple matter to change over to another barrel.

Furthermore, if desired, a distinct individual barrel or barrels need not be employed at all and, instead a disk having a suitable bore or bores may be used. But this makes an unnecessarily heavy construction and is not to be preferred.

Stopping the motor will of course, stop the fire of the gun. But it will also waste ammunition since projectiles will continue to be discharged as long as the motor rotates but at a range decreasing with the speed of rotation. For this and other reasons we prefer, where short intermissions of fire are desired, to shut off the feed from the hopper. For this purpose we use a slide 53 having an opening 54. This slide is mounted in the base of the hopper and can be slid in or out so as to either bring opening 54 into registery with the feed passage 37 or to close said passage.

While we have described our invention as embodied in a machine gun, it may also be embodied in guns for firing single individually aimed projectiles or groups of projectiles.

The invention may also be embodied in devices other than guns as, *e. g.*, in amusement devices for throwing base balls and the like.

The azimuth of the projectiles, *i. e.*, the angle of fire, may be varied by varying the speed of the motor, as previously pointed out, (although this also changes the distance through which the projectile will be propelled); or by rotating the casing 1 in the azimuth ring; or by rotating the timing and release block 43 with respect to the casing. This block, in the drawings, is shown as non-adjustable, but may easily be arranged adjustable if desired.

Various changes in detail may, of course, be made within the spirit of the invention and the scope of the claims.

Having described our invention, we claim:

1. In a centrifugal gun, a rotatable barrel having a projectile feeding passage which terminates eccentrically and to one side of the barrel's plane of rotation so that a bullet entering therein will be normally held by centrifugal force against the end of the passage, and means controlled by the rotation of the barrel for engaging the bullet and positively pushing it out of the passage and feeding it into the breech.

2. In a centrifugal gun, a rotatable barrel having a projectile feeding passage part of which is coincident with the axis of rotation while another part extends radially outward, a transverse wall at the end of this latter part against which a projectile will be normally held by the centrifugal force due to the rotation of the barrel, a chamber adjacent said passage and adapted to be connected with the gun barrel at its breech, and releasing means controlled by the rotation of the barrel and arranged to intermittently engage a projectile held against said wall and push it therefrom and into said chamber.

3. In a centrifugal gun, a rotatable barrel having a projectile feeding passage part of which is coincident with the axis of rotation while another part extends radially outward, a transverse wall at the end of this latter part having a concave retaining recess in which a projectile will be normally held by the centrifugal force due to

the rotation of the barrel, a chamber below said recess adapted to be connected with the gun barrel at its breech, and releasing means controlled by the rotation of the barrel and arranged to intermittently engage a projectile held in said recess and force it therefrom so as to pass into the said chamber.

4. In a centrifugal gun, a rotatable barrel having a projectile feeding passage provided with a radially disposed branch adjacent to the breech and terminating in a concave retaining recess in which the projectile will be normally held by centrifugal force there being a chamber to the rear of the breech connected with said branch, and adapted to be connected with the barrel, and means for positively but intermittently pushing the projectile out of said recess into the chamber, said means being actuated and controlled by the rotation of the barrel.

5. In a centrifugal gun, a rotatable barrel having a projectile feeding passage provided with a radially disposed branch adjacent to the breech and terminating in a concave retaining recess in which the projectile will be normally held by centrifugal force, there being a chamber to the rear of the breech connected with said branch but normally separated from the breech, means for positively pushing the projectile out of said recess into the chamber and means for then admitting the projectile into the breech.

6. In a centrifugal gun, a barrel, a breech block for said barrel, the barrel and block being arranged to rotate about an axis through said block and the block having a projectile feeding passage concentric with said axis and having a radial portion ending adjacent to the inner end of the barrel in a concave recess in which the projectile will normally be held by centrifugal force, said block also having a chamber to the rear of the barrel connected with said radial portion, means intermittently reciprocating in front of said recess and adapted to push the projectile into the chamber, and means for intermittently opening and closing the chamber with respect to the barrel, both of said means being actuated and controlled by the rotation of the barrel and operating synchronously therewith.

7. In a centrifugal gun, a barrel adapted to be rotated about a transverse axis through the breech, a pair of tubular slots concentric with said axis, a projectile feeding passage having a portion which opens radially into the inner slot, the outer wall surface of said slot at the end of said radial portion having a retaining recess formed therein in which a projectile is held by centrifugal force, a chamber at the rear end of the barrel connected with the projectile feeding passage, a tapered tubular cam for the inner slot and a stepped apron for the outer slot both cam and apron being fixed with respect to the barrel and disposed so that, as the barrel revolves, the cam will first push a projectile out of the retaining recess into the chamber and the apron will then open the chamber and admit the projectile into the barrel.

8. In a centrifugal gun, a barrel adapted to be rotated about a transverse axis through the breech, a tubular slot concentric with said axis, a projectile feeding passage which opens into the tubular slot and terminates eccentrically and to one side of the barrel's plane of rotation said passage being periodically put into communication with the breech by the rotation of the barrel, and a tapered tubular cam, fixed with respect to the rotatable barrel in said slot so that as the barrel revolves the bullets successively in said passage will be positively and periodically pushed therefrom thence to pass into the breech.

9. In a centrifugal gun, a barrel adapted to be rotated about a transverse axis through the breech, a tubular slot concentric with said axis, a projectile feeding passage which opens into the tubular slot and terminates eccentrically and to one side of the barrel's plane of rotation, said passage being periodically put into communication with the breech by the rotation of the barrel, and a tapered tubular cam normally fixed with respect to the rotatable barrel in said slot so that as the barrel revolves, the bullets successively in said passage will be positively and periodically pushed therefrom thence to pass into the breech, said cam being, however, adjustable in azimuth so as to correspondingly change the azimuth of fire.

10. In a centrifugal gun, a rotatable barrel having a projectile feeding passage which terminates eccentrically and to one side of the barrel's plane of rotation so that a bullet entering therein will be normally held by centrifugal force against the end of the passage, and a timing and release block comprising a cam adapted to engage the bullet as the barrel rotates and to positively push said bullet out of the passage and feed it into the breech, said block being normally fixed with respect to the rotatable barrel but adjustable in azimuth so as to correspondingly change the azimuth of fire.

In testimony whereof we have affixed our hands.

EDWARD THOMAS MOORE. [L. S.]
SAUL SINGER. [L. S.]