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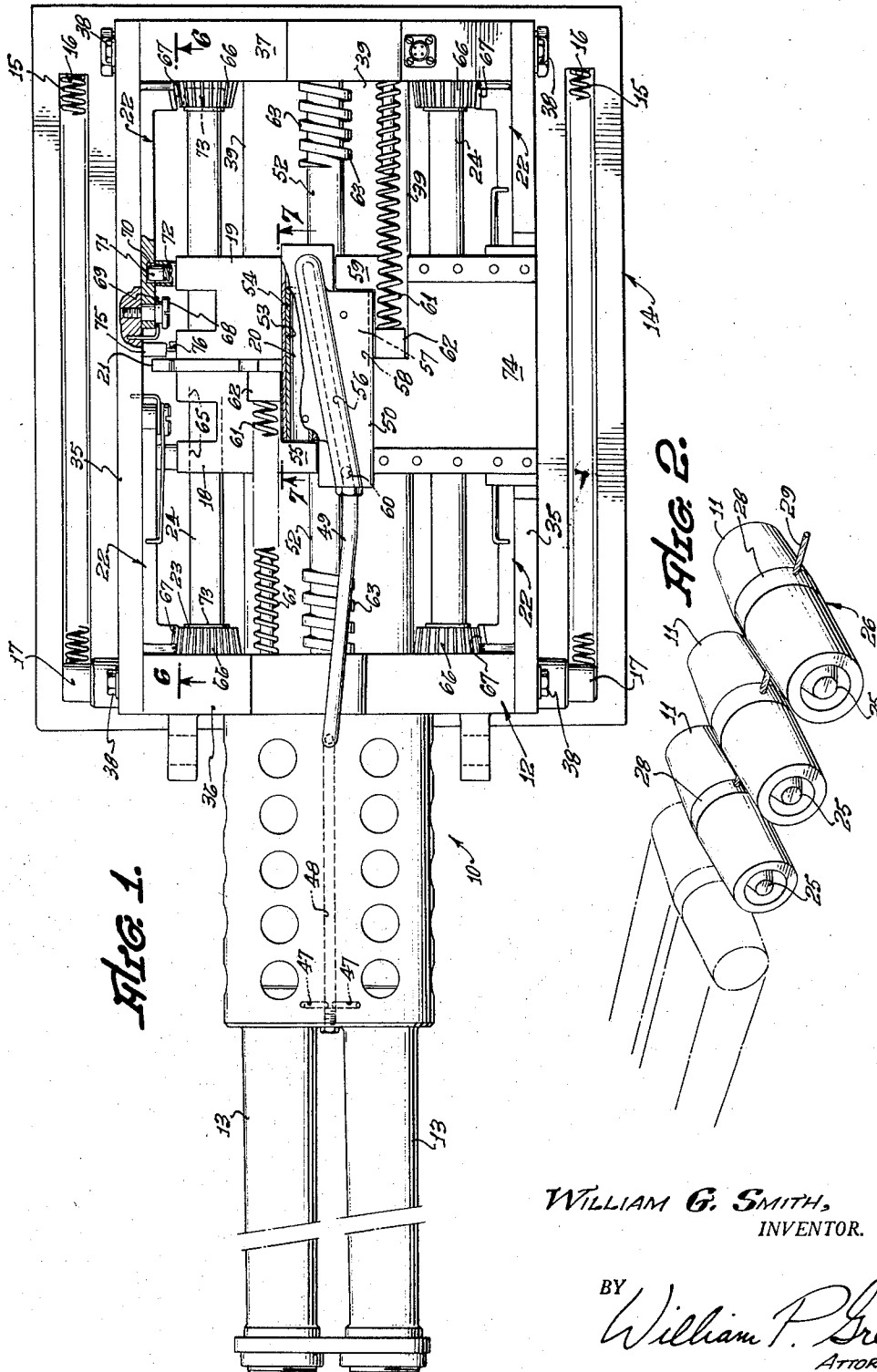
W. G. SMITH

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MACHINE GUNS WITH TWO SECTION FIRING CHAMBERS

Filed Jan. 27, 1956

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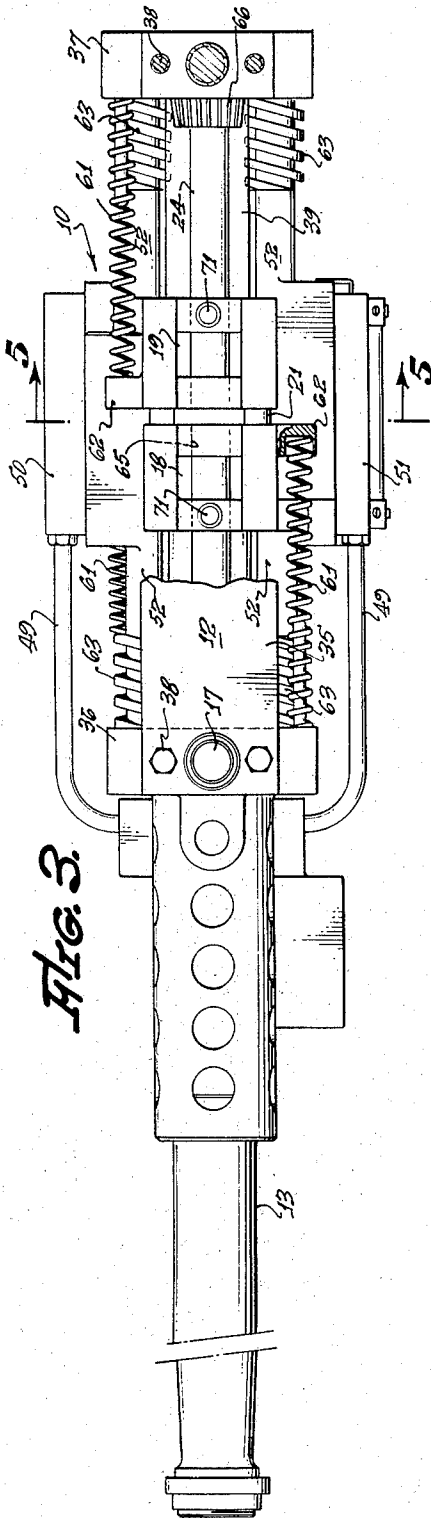
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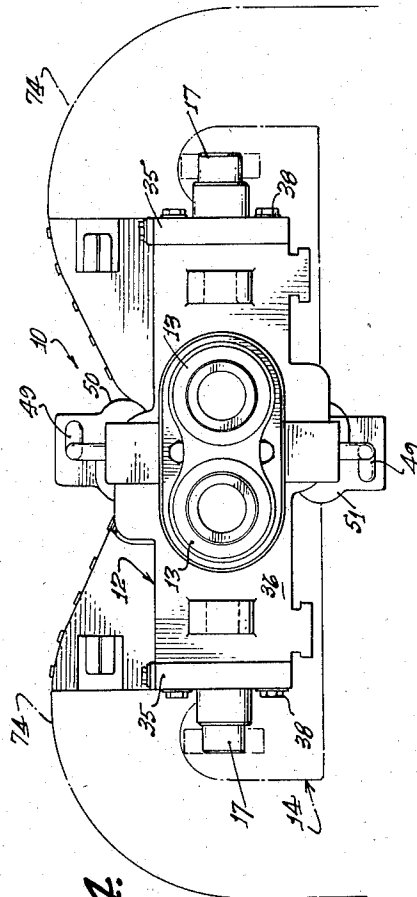
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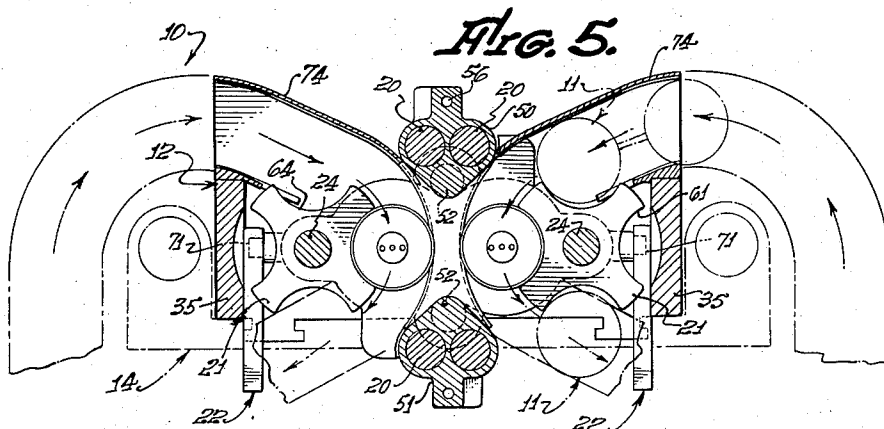
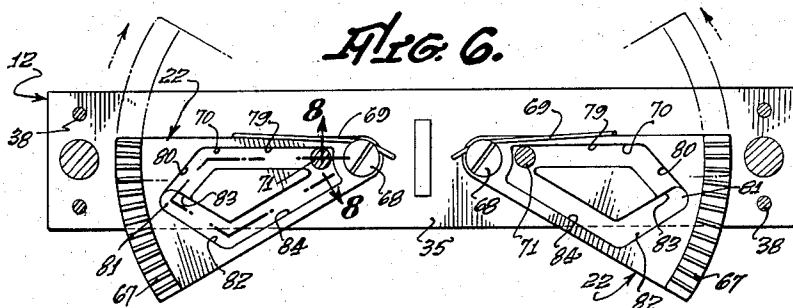
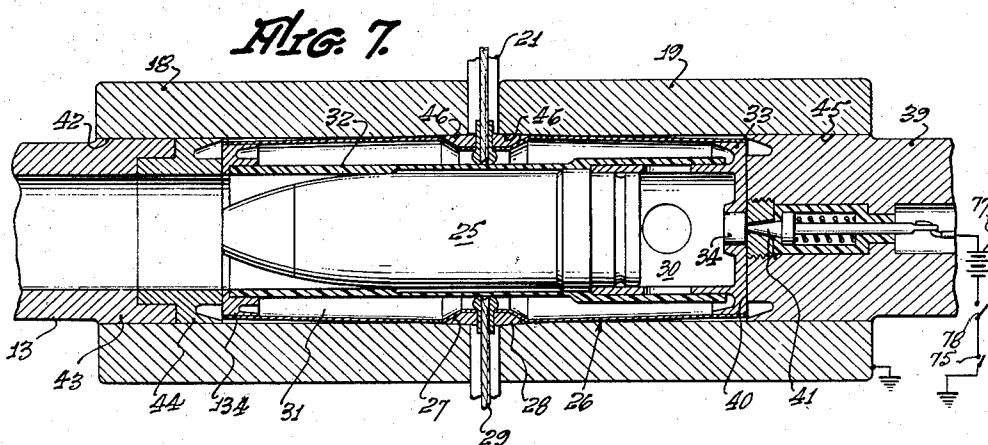
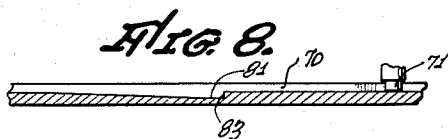
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MACHINE GUNS WITH TWO SECTION FIRING CHAMBERS

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3 Sheets-Sheet 3



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MACHINE GUNS WITH TWO SECTION FIRING CHAMBERS

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Application January 27, 1956, Serial No. 561,737

14 Claims. (Cl. 89—33)

This invention relates to improved machine guns of a type particularly designed to attain extremely rapid rates of fire, as are desired especially for aircraft purposes.

In conventional machine guns, the rate of fire is rather definitely limited by the fact that upon the firing of each round, a bolt or other part must move through a somewhat extended range of travel, for feeding the round to firing position, and properly sealing the barrel in firing condition. To reduce the distance through which the bolt or other parts must move, there has recently been proposed a telescoped type of round, in which the projectile is entirely contained within the cartridge case, so that the rounds may be much shorter than heretofore. The general object of the present invention is to further this advantageous result by so designing the gun mechanism itself as to reduce even more the distance through which the parts must move.

In order to achieve this object, I employ a unique firing chamber structure which is formed of two relatively axially movable sleeves adapted to extend about and enclose opposite ends of a round, with both of the sleeves extending to approximately the center of the axial extent of a contained round. This sectionally formed firing chamber can then be opened to receive a round by simultaneously actuating the two sleeves in opposite axial directions relative to the round and barrel, so that a round may be inserted transversely or laterally into the chamber, following which the chamber can be closed by returning the sleeves axially toward one another. Since each of the sleeves must only move through one half the length of the round, the range of movement of the parts is just one half as great as where a single conventional bolt or other part must move the entire length of the round.

The two sleeves may be actuated automatically, upon the firing of each round, by the gases produced by the round. When the sleeves are apart, an automatic feeding mechanism acts to remove a fired round from the firing location and advance a second round to that location. Preferably, this feeding mechanism is actuated by the movement of the firing chamber sleeves, typically through a suitable cam arrangement.

The rounds fired by the gun may have seal ring portions at a longitudinally central or intermediate location, for engagement in sealing relation with the two sleeves to seal the firing chamber. This seal ring may also serve as a portion of a link for interconnecting successive rounds in an ammunition belt. Desirably, the round tapers externally in opposite directions away from the ring, to facilitate movement of the sleeves into firing position about the round.

The above and other features and objects of the present invention will be better understood from the following detailed description of the typical embodiment illustrated in the accompanying drawings in which:

Fig. 1 is a plan view of a machine gun constructed in accordance with the invention;

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Fig. 2 is a fragmentary representation of a belt of ammunition for the Fig. 1 gun;

Fig. 3 is a side view of the gun, not including the main mounting cradle;

Fig. 4 is a front view of the Fig. 1 gun;

Fig. 5 is a transverse section taken on line 5—5 of Fig. 3;

Fig. 6 is a longitudinal vertical section taken essentially on line 6—6 of Fig. 1, but showing only the camming mechanism for actuating one of the ammunition feeding sprockets;

Fig. 7 is an enlarged fragmentary axial section through one of the firing chambers, taken on line 7—7 of Fig. 1, and

Fig. 8 is a developed sectional view showing the configuration of the cam groove in one of the sprocket actuating sectors, and taken on the line represented at 8—8 in Fig. 6.

In the drawings, there is shown at 10 a double barrel machine gun adapted to fire a series of rounds of ammunition such as are shown at 11 in Fig. 2. The gun includes a main rigid body structure 12 which rigidly carries the two forwardly projecting barrels 13, and which is mounted for recoiling movement within the usual cradle typically represented at 14. The recoiling movement is yieldingly resisted by recoil springs 15, each of which bears at its opposite ends against a shoulder 16 formed on the cradle, and a lug 17 which projects laterally from body structure 12. The two firing chambers for the barrels are formed by and within a pair of front and rear firing chamber sections 18 and 19, which are actuable relatively axially apart for movement of the ammunition rounds 11 into and out of the sectionally formed firing chambers. Such actuation of the firing chamber sections is produced by a number of pistons 20 which are operated by gases bled off from the barrels 13 on firing. The ammunition is fed to the firing chambers by a pair of sprocket wheels 21, which are actuated by and in timed relation with the axial movement of firing chamber sections 18 and 19, by means of a number of swinging gear segments 22 which engage bevel gears 23 attached to shafts 24 which carry the sprocket wheels.

With particular reference now to Figs. 2 and 7, the ammunition rounds handled by the present gun are of the telescoped type, in which the projectile 25 is initially entirely contained within the tubular preferably metal cartridge case 26. This cartridge case has an annular groove at its longitudinal center, and a rigid metal gas sealing ring 28 is contained within that groove. As seen in Fig. 7, the outer surface of this ring 28 preferably has a slight axial taper toward the opposite ends of the shell, and also the cartridge case itself 26 is tapered toward its opposite ends. Successive rounds 11 of the ammunition are interconnected in belt form by suitable links, preferably comprising a number of short flexible high strength cables 29, whose ends may extend into the cartridge case through ring 28 and carry enlargements within the case for firmly attaching cables 29 to the various rounds. The powder charge is contained within a chamber 30 at the rear of projectile 25, and also within an annular chamber 31 about the projectile formed between cartridge case 26 and an inner preferably combustible tubular partition 32. The rear end of each round is closed by a rear wall 33, within the center of which there is mounted the usual electrically ignited primer 34. The forward end of space 31 is closed by a ring 134.

The recoiling body 12 of the gun includes a pair of spaced parallel rigid side plates 35 forming opposite sides of the body, and interconnected in fixed relation by a pair of transverse forward and rear members 36 and 37. Parts 35, 36 and 37 may be attached together in any

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suitable manner as by screws 38. The two parallel firing barrels 13 extend rearwardly through and beyond openings in the forward transverse body member 36, and are rigidly attached to member 36. Spaced rearwardly from and in axial alignment with barrels 13, the rear transverse member 37 of body 12 carries a pair of breech blocks 39 (see Figs. 1 and 7), which are fixed relative to the body 12, and have forward transverse faces 40 for engaging the rear ends of the rounds 11 upon firing. Each breech block 39 contains a central electrical contact 41, which engages primer 34 to fire a round when the firing circuit is closed.

The forward firing chamber section 18 contains two spaced parallel bores 42, which receive the forward end portions 43 of the two gun barrels 13 respectively (see Fig. 7). If desired, each of the barrels may include a rear replaceable ring 44 which is frictionally held in fixed relation to the main portion of the barrel. By virtue of its reception about the rear ends of the barrels, section 18 is axially slidable relative to the barrels, but at the same time is a close enough fit about the barrels to form essentially a gas tight seal between these parts.

The rear firing chamber section 19 is similar to forward section 18, and contains two spaced parallel bores 45 aligned with bores 42 of the forward section and receiving the externally cylindrical forward ends of the two breech blocks 39. As will be apparent, section 19 is slidable rearwardly relative to breech blocks 39, and is a close enough fit about the breech blocks to form a gas tight seal between these parts. The bores 42 and 45 within firing chamber sections 18 and 19 are cylindrical along almost their entire extent, and of a diameter slightly less than the external diameter of ring 28 on each of the ammunition rounds. At the adjacent ends of sections 18 and 19, bores 45 flare slightly outwardly at 46, essentially in correspondence with the taper of the outer surface of ring 28, to tightly engage the tapered ring surface and thus form a very effective gas tight seal between ring 28 and the inner ends of sections 18 and 19. In their firing position of Fig. 7, sections 18 and 19 are spaced a short distance axially apart, so that sprocket wheels 21 may remain in engagement with the rounds being fired. After simultaneous firing of two of the rounds in the two firing chambers, sections 18 and 19 are actuated relatively axially apart, so that sprocket wheels 21 may displace the empty cartridge cases from the firing chambers and feed new rounds laterally into firing positions within the chambers. The sections 18 and 19 may then close for firing of the two new rounds.

The sections 18 and 19 are intermittently actuated relatively axially apart by the force of some of the gases which are produced by the rounds upon firing. For this purpose, the two barrels 13 have in their side walls the usual bleed passages 47, through which some of the gases flow into a passage 48 communicating with a pair of upper and lower lines 49, which connect into a pair of upper and lower cylinder blocks 50 and 51. Each of these two blocks 50 is mounted in fixed relation to body structure 12, as by forming the blocks to have integral shaft-like projections 52 extending in opposite axial directions and connecting rigidly to the transverse body members 36 and 37.

Each cylinder block 50 contains a first cylindrical bore 53 which opens forwardly, and contains a piston 54 adapted to be actuated forwardly against a laterally projecting lug 55 on section 18, to actuate section 18 forwardly.

Gases from line 49 are communicated through a passage 56 in block 50 to the rear end of bore 53, to thus actuate piston 54 and section 18 forwardly. Similarly, each of the cylinder blocks 50 contains a second piston 57, which is slidable within a rearwardly opening bore 58, and which is adapted to be actuated rearwardly against lug 59 of section 19, to move section 19 rearwardly. Gases from line 49 are of course suitably introduced into

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the forward end of cylinder bore 58, forwardly of piston 57, by a port 60 leading into bore 58 from passage 56.

Such gas pressure induced relative axial separation of sections 18 and 19 is yieldingly resisted by a number of coil springs 61 bearing at first ends against body members 36 and 37, and bearing at second ends against integral lugs 62 formed on sections 18 and 19. At the end of the relative separating movement of the sections 18 and 19, an increased resistance to the separating movement is offered by four relatively strong buffer springs 63 which are disposed about the shaft-like portions 52 of cylinder block parts 50, and which engage elements 36 and 37 at first ends of the springs, and the sections 18 and 19 at the opposite ends of the springs. The yielding resistance offered by springs 61 is of course sufficient to maintain sections 18 and 19 in their Fig. 7 firing positions until the force of the gases has effectively propelled projectile 25 forwardly through and from the barrel, to thus avoid loss of any of the effective force of the gases. After the sections 18 and 19 have been urged part by the gas force, the pressure of the gases of course reduces immediately, and springs 61 are then effective to return sections 18 and 19 relatively together for the next firing operation.

While sections 18 and 19 are in their axially separated positions, sprocket wheels 21 act to advance the fired cartridge cases out of firing positions, and to feed the next successive rounds to those positions. These sprocket wheels 21 may be shaped substantially as shown in Fig. 5, each typically having four circumferentially spaced arcuate recesses 64, adapted to receive and control the positioning of successive rounds 11. Sprocket wheels 21 are rigidly carried by parallel shafts 24 which extend parallel to the gun barrels. As previously mentioned, sprocket wheels 21 are received axially between sections 18 and 19. The latter two sections contain bores 65 through which shafts 24 extend, so that the shafts are journaled for rotary movement by sections 18 and 19, and yet sections 18 and 19 are free for axial movement relative to shafts 24. At its opposite ends, each of the two shafts 24 carries a pair of bevel gears 66, each of which meshes with an arcuate series of teeth 67 (see Figs. 1 and 6) on one of the gear segments 22. The gears 66 are operatively connected to shafts 24 by one-way clutches 73 of any conventional construction. These clutches 73 are effective to transmit rotation from each of the gears 66 to the corresponding shaft 24 in a direction for moving the associated sprocket wheel 21 in an ammunition advancing direction, but the clutches will not transmit reverse rotation. These gear segments 22 have the shape illustrated in Fig. 6, and are mounted by screws 68 to swing vertically along the inner sides of the two vertical side plates 35 of body 12. A pair of springs 69 yieldingly urge gear segments 22 downwardly to their Fig. 6 full line positions, and yieldingly resist upward swinging movement of those segments to their broken line positions of Fig. 6. In the inner face of each of the gear segments 22 there is provided an endless cam groove 70 having the configuration shown in Fig. 6, and into which there projects laterally a pin 71 which is carried by either section 18 or section 19, and is spring pressed laterally by a spring 72 into groove 70. As will be apparent from Figs. 1 and 6, the pins 71 carried by the rear firing chamber section 19 are received within the cam grooves 70 in the two rear gear sectors 22, while the pins 71 carried by section 18 are received within the cam grooves 70 in the forward gear sectors. It will also be noted from Fig. 6 that the forward and rear cam sectors on each side of the gun are shaped and swing reversely with respect to each other.

The shape of endless cam grooves 70 in sectors 22 is such that the relative axial movement of sections 18 and 19 together and apart serves to intermittently swing sectors 22 upwardly, and then allow their downward returning movement, so that gears 66 engaged by gear

teeth 67 of sectors 22 are correspondingly first rotated in one direction and then in the other direction. The one-way clutches 73 cause the rotation of gears 66 in one direction to turn shafts 24 and sprocket wheels 21 in a direction for advancing the ammunition toward the firing chambers, while the reverse rotation of gears 66 does not turn shafts 24 and sprocket wheels 21 in a reverse direction.

As the ammunition is fed to the two firing chambers of the gun, the two belts of ammunition advance laterally into engagement with sprocket wheels 21 through a pair of ammunition guide chutes 74 (see Fig. 5). These guide chutes may of course be attached to body structure 12 in any suitable manner.

To now describe the operation of the gun, assume that the gun is in a condition in which two belts of ammunition such as that shown in Fig. 2 are threaded into the two feed chutes 74 from opposite sides of the gun, and a leading round of each belt is in the Fig. 7 firing position within the corresponding firing chamber. With the parts in this condition, an operator may close the firing circuit, to feed current to the primers 34 of the two rounds which are in firing position. This of course fires those two rounds, causing the powder charges and element 32 to burn, forcing projectiles 25 from the two rounds forwardly through the barrels and out of their forward ends. The engagement of the tapered surfaces 46 on sections 18 and 19 with the correspondingly tapered surfaces on rings 28 effectively seals the two firing chambers against the leakage of any of the gases from those chambers.

After the projectiles pass the location of bleed ports 47 in the barrels, some of the gases are allowed to vent through those ports and passage 48 into line 49, to actuate pistons 54 and 57. This gas pressure causes pistons 54 and 57 to actuate section 18 forwardly and section 19 rearwardly (the relative separation of these sections commencing after the projectiles have left barrels 13). When the sections 18 have moved sufficiently far apart to allow the cartridge cases 26 of the two fired rounds to be removed from the firing chambers, sectors 22 become effective to cause rotation of sprocket wheels 21 for moving the fired cases out of the chambers and advancing other rounds into the firing chambers. The sprocket motion then stops, while sections 18 and 19 again move relatively together toward their Fig. 7 firing positions, so that the second pair of rounds may be fired. If desired, there may be provided in the firing circuit an automatically operated switch for closing the firing circuit as sections 18 and 19 reach their firing positions. This control switch is represented typically at 75 in Fig. 1, and may be considered as including a movable actuating element adapted to be engaged and actuated by a lug 76 on section 19. The firing circuit may include a suitable power source 77 (see Fig. 7), a trigger operated switch 78, and the automatically operated control switch 75.

To now describe somewhat more particularly the manner in which the movement of pins 71 with sections 18 and 19 functions to actuate gear sectors 22 and sprocket wheels 21, assume first that pins 71 are in their Fig. 6 positions, with sections 18 and 19 in their Fig. 7 firing positions. As sections 18 and 19 and pins 71 commence to move relatively apart, the pins first advance within the straight horizontal portions 79 of grooves 70 in sectors 22, and because these portions are at that time horizontal, this initial pin movement does not cause any actuation of gear sectors 22. Thus, during that portion of the separating movement of sections 18 and 19, sprocket wheels 21 and the controlled ammunition belts remain stationary. When pins 71 reach the location of inclined portions 80 of grooves 70, the inclination of those grooved portions causes pins 71 to commence camming segments 22 upwardly. Such upward movement of segments 22 causes the engaged gears 66 to turn shafts 24 and sprocket wheels 21 in a direction for advancing the sprocket wheels and engaged ammunition. This advancement of course occurs

only after sections 18 and 19 have moved relatively apart far enough to allow such advancement of the rounds. When each pin 71 reaches the outer end portion 81 of its groove 70, the pins commence to move relatively together along inwardly inclined parts of groove 70, and the angularity of these portions 82 of the grooves is such as to continue the upward deflecting movement of sectors 22. At the specified portion 81 of each groove, the corresponding pin 71 advances past a step or shoulder 83 formed in the groove to move into a deepened portion of the groove under the influence of spring 72, to thus require the pin in its returning movement to follow branch 82 of the groove rather than branch 80.

After passing through branch 82 of the groove, the pin reaches a final portion 84 of the groove, which portion is at that time extending parallel to the direction of movement of the pin, so that the pin is able to move along portion 84 of the groove without further actuation of segments 22. Thus, the final inward movement of pins 71 occurs without advancement of the ammunition. It will of course be understood that the juncture of breeches 82 and 84 of groove 70 is so located as to stop the advancement of the ammunition by the time sections 18 and 19 reach locations at which they commence to enclose the rounds which are then located at the firing positions. As pins 71 reach the innermost ends of portions 84 of the cam grooves, springs 69 are able to return segments 22 downwardly to the full line positions of Fig. 6, so that the rounds in firing position may be fired to commence another cycle of operation. Such downward movement of segments 22 is effective to turn engaged gears 66, but does not turn shafts 24 and sprocket wheels 21, since one-way clutches 73 will not transmit rotation in this reverse direction.

I claim:

1. A machine gun comprising a barrel, a breech assembly at the rear of said barrel forming a firing chamber for holding a round of ammunition at a firing location, said assembly including two sections having tubular sleeve portions adapted to extend about and contain opposite ends of a round and mounted for axial movement relatively toward and away from each other and relative to the barrel between a first position in which they form said chamber and second relatively separated positions in which a round may move transversely to and from said firing location, means for alternately actuating said sections relatively toward and away from each other and relative to the barrel to fire successive rounds of ammunition, means for firing said rounds while the sections are in said first positions, and means for advancing successive rounds of ammunition to said firing location while the sections are in said second positions.

2. A machine gun as recited in claim 1, in which said means for actuating the sections comprise means actuable by the force of the gases produced by said rounds to separate the sections on each firing.

3. A machine gun as recited in claim 1, in which said means for actuating the sections include gas operated piston and cylinder means for actuating the sections relatively axially apart and relative to the barrel, means for conducting some of the gases produced on firing from said barrel to said piston and cylinder means to actuate the sections apart, and spring means for returning the sections relatively axially toward one another.

4. A machine gun as recited in claim 1, in which said sleeve portions of the sections both extend about a round to approximately the center of its axial extent.

5. A machine gun as recited in claim 1, in which there is a short space between said sections in said first positions through which there extends a connecting link between a round at the firing location and a next successive round.

6. A machine gun as recited in claim 1, in which a forward one of said sections in said second position slides forwardly about a rear portion of the barrel.

7. A machine gun as recited in claim 1, in which said breech assembly includes a breech block at the rear of said firing location for backing up the rear of a round upon firing.

8. A machine gun as recited in claim 1, in which said breech assembly includes a breech block at the rear of said firing location for backing up the rear of a round upon firing, a rear one of said sections in said second position being slidable rearwardly to a position about said breech block.

9. A machine gun as recited in claim 1, in which said breech assembly includes a breech block at the rear of said firing location for backing up the rear of a round upon firing, a rear one of said sections in said second position being slidable rearwardly to a position about said breech block, the forward section in said second position being slidable forwardly about a rear portion of the barrel, there being a space axially between said sections in said first positions through which links interconnecting successive rounds extend.

10. A machine gun as recited in claim 9, in which said sections extend to approximately the center of the axial extent of a contained round and have end portions annularly engageable in gas tight sealing relation with an annular seal ring on the round.

11. A machine gun as recited in claim 10, in which said means for actuating the sections comprise means actuable by the force of the gases produced by said

rounds to separate the sections on each firing, said round advancing means including a round feeding sprocket, and means actuable by said movement of the sections to turn the sprocket for feeding the rounds successively to said firing location.

12. A machine gun as recited in claim 1, including means operable by said movement of the sections for actuating said round advancing means.

13. A machine gun as recited in claim 1, in which said round advancing means include a round feeding sprocket, and cam means actuable by the axial movement of said sections for rotating said sprocket.

14. A machine gun as recited in claim 13, in which said cam means include a gear for driving the sprocket, a swinging gear sector for actuating said gear, and a pin projecting from one of said sections into a cam groove in said sector to actuate it in accordance with axial movement of the sections.

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