June 12, 1945. A. CORTE 2,378,191

AMMUNITION FEED

Filed Dec. 27, 1941 5 Sheets-Sheet 1

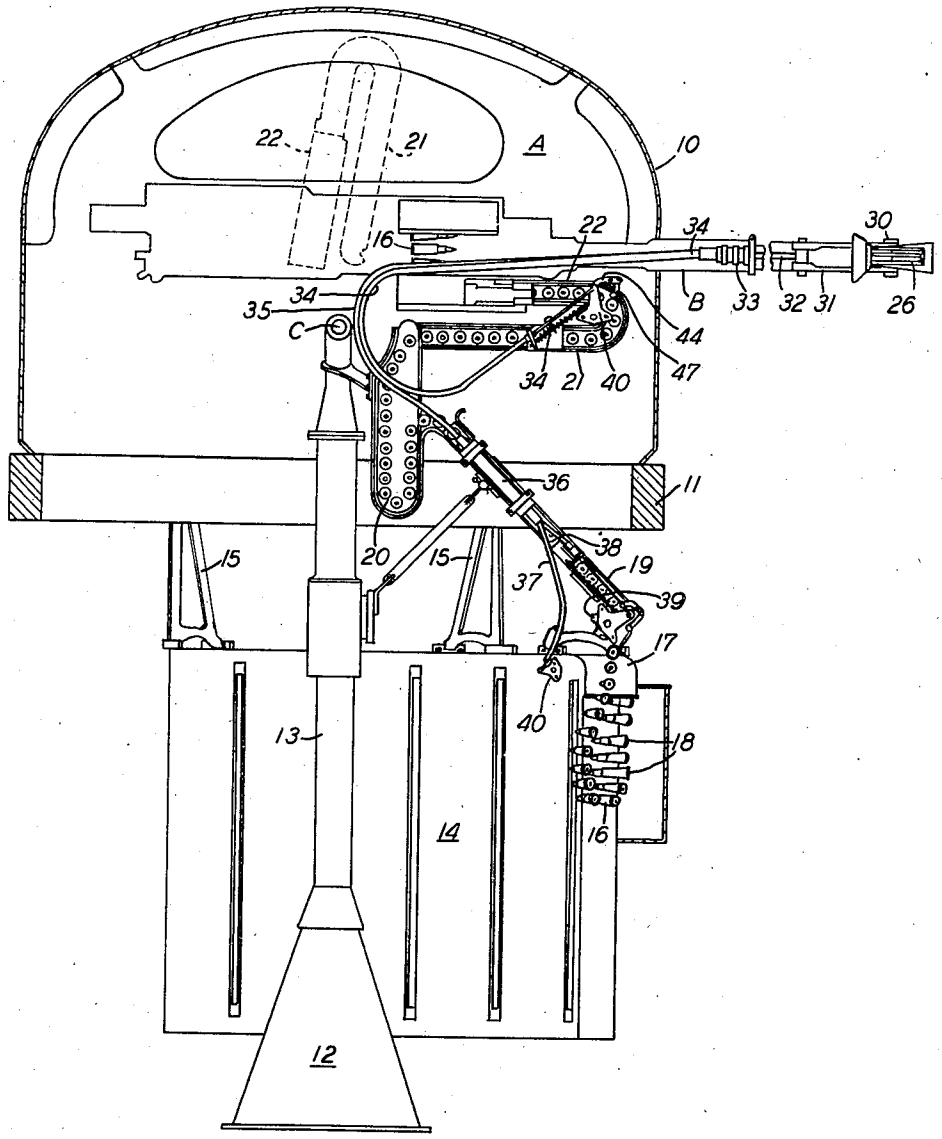

FIG — I

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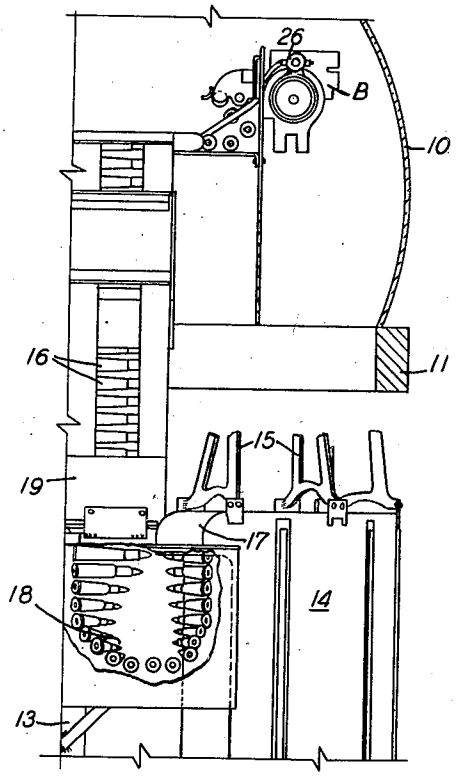
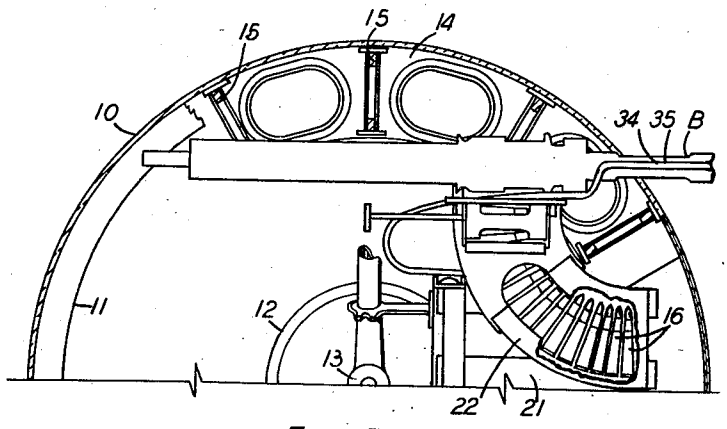


FIG—II



FIG—III

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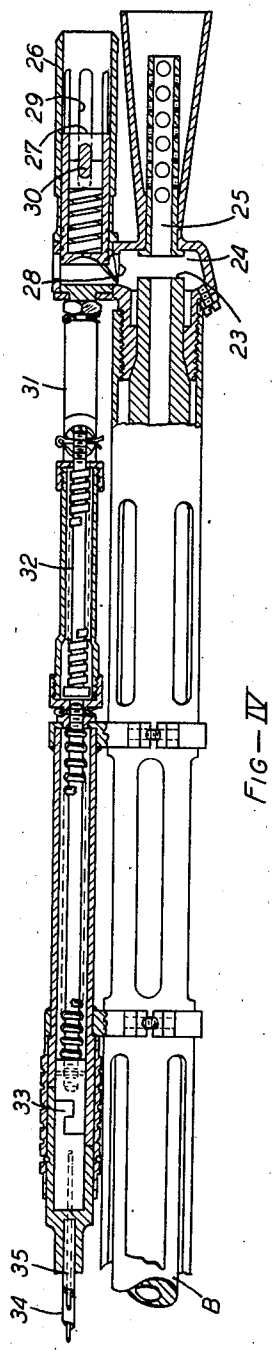
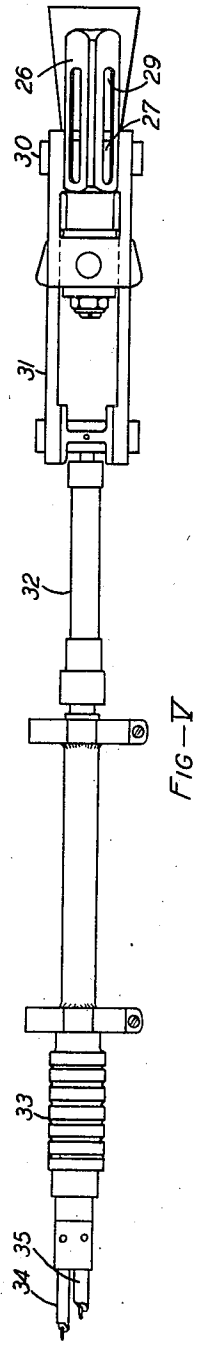
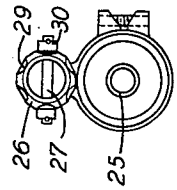


FIG—IV



FIG—V



FIG—VI

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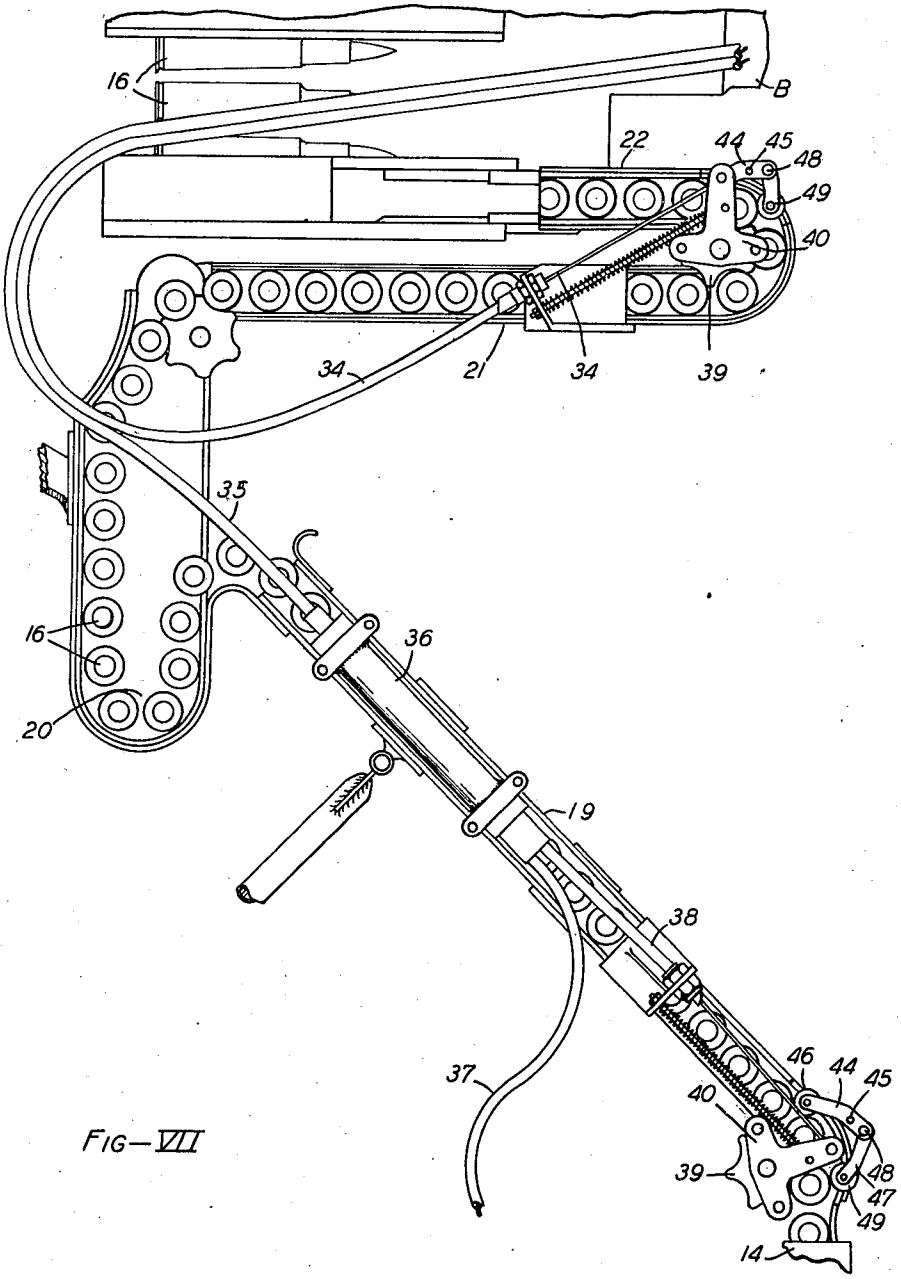

FIG—VII

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AMMUNITION FEED

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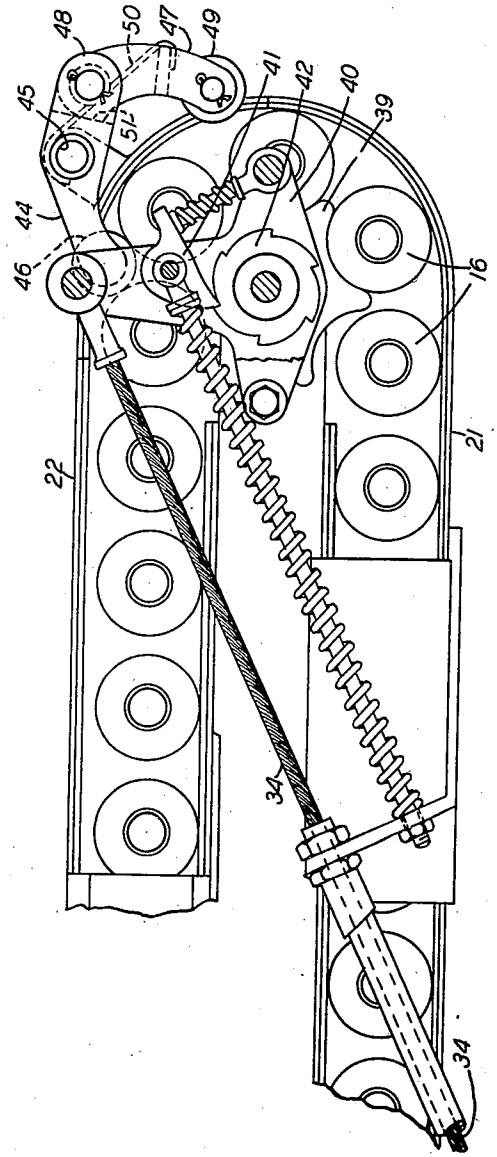

FIG — VIII

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Patented June 12, 1945

2,378,191

UNITED STATES PATENT OFFICE

2,378,191

AMMUNITION FEED

Alfred Corte, Glendale, Calif., assignor, by mesne assignments, to Lockheed Aircraft Corporation, a corporation of California

Application December 27, 1941, Serial No. 424,636

7 Claims. (Cl. 89—33)

This invention relates to an improved ammunition feed especially adapted for use with machine guns and the like which must be freely movable about one or more axes, as when mounted in airplane, boat or tank turrets, providing both traversing and elevating movements for the gun or guns carried therein.

The ammunition supply for the machine guns of a movable turret is ordinarily made integral with the gun mount, in which case the feeding is little different from that of a stationary gun, or, it is placed on some more or less stationary part of the turret. With the latter type of installation, it is usual to provide a long loop of ammunition between the supply box and the gun to compensate for the varying distance between the gun and the box as the gun is moved in traverse. In addition, the cartridge belt must be twisted through some 110° to allow the belt to follow the angular movement of the gun as it is elevated and lowered.

The integral mounting arrangement is, of course, the simplest and the most reliable. However, it means placing the ammunition box close to the gun and hence taking up space inside the turret. If the ammunition supply requirements exceed a certain number of cartridges, the size of the necessary supply box rather than the size of the gunner will determine the size of the turret.

Rather than increase the size of the turret, the practice has been to move the ammunition supply box to the lower part of the turret and to use the twisted loop. This again is subject to the criticism that under certain conditions of acceleration, and unless the ammunition belt has been loaded just right, the shells will not enter the gun properly and the gun will jam.

Another consequence of moving the ammunition supply down into the fuselage of the plane is the need for a separate device to assist in the lifting of the belt up to the gun, since the gun is limited in the weight of belt which it can lift and still operate reliably. The most successful of these prior devices has been an arrangement in which there is provided a small reservoir of cartridges near the gun and with the main supply below. The cartridge belt runs from the main supply box up to the reservoir, which may consist of one or several loops located near the gun. The lift from the main supply box is accomplished by an electric motor drive which is connected to a limit switch in such a manner that it will maintain the number of cartridges in the reservoir within certain limits. The gun itself will draw the cartridges from the reservoir. Although simple in principle, the extra equipment needed for this device is sufficiently complicated that occasional failures may be expected, particularly under the diversity of conditions such as extremes of acceleration and temperature which are encountered in service.

It is accordingly an object of this invention to develop an ammunition feed which operates directly from the gun and hence is at least as reliable as the gun and requires no separate power system. In principle, each time the gun fires a round, the power feed advances one cartridge. The power available is sufficient to lift the ammunition under the most severe conditions of adverse acceleration. Yet, since the feed is intermittently operated by the gun, one and only one cartridge will be advanced for each cartridge fired even for accelerations considerably less than one "g".

Other and further important objects of this invention will be apparent from the disclosures in the specification and the accompanying drawings.

This invention in its preferred form is illustrated in the drawings and hereinafter more fully described.

A preferred form of this invention is shown diagrammatically in the drawings, wherein:

Figure I is a central vertical section through a twin gun airplane turret showing the cartridge feeding chutes and mechanism for elevating the cartridges from an ammunition container to the gun breech, the dotted lines showing the position of the upper chute when the gun has been elevated for vertical fire.

Figure II is a half of a vertical cross-section of the turret with one gun and its feed mechanism shown in elevation from the muzzle end of the gun.

Figure III is a top plan view of Figure II with the turret shell omitted.

Figure IV is a fragmentary detail in plan view, partly in section to show the spent gas operating mechanism associated with the gun barrel.

Figure V is an elevation view of the spent gas operating mechanism of Figure IV, with the gun barrel omitted.

Figure VI is a muzzle end view of Fig. IV.

Figure VII is an enlarged detail view of the cartridge chutes and cartridge feeding mechanism.

Figure VIII is a further enlarged detail of the upper or final cartridge feeding mechanism which delivers the cartridges through a right

angle turn, in the plane of the belt, to the conventional gun feeding mechanism.

As shown on the drawings—

I have chosen to illustrate the power ammunition feed in connection with an airplane turret A such as has been disclosed in my previous application, Serial No. 362,067, filed October 21, 1940. However, I have simplified the turret enclosure by the ommission of that part thereof which rotates in elevation about a horizontal axis. For present purposes it will be convenient to consider the gun B as elevating about the axis C, the gun mounting and elevating mechanism being omitted. As shown and described in my above mentioned copending application, a turret shell 10 rotates about its vertical axis in a horizontal ring bearing 11 forming part of an airplane structure, a central pedestal 12 and column 13 being connected thereto at the axis C of the elevating portions of the turret. The gun B, one of a pair disposed on either side of the gunner, is mounted on, and moves as a unit with the elevating portions of the turret. The pedestal 12 and column 13 preferably do not carry the weight of the turret, which weight is supported by the ring bearing 11, but serve as a power and communications conduit, and support the ammunition feed chutes of this invention.

It is not feasible to carry an adequate supply of ammunition in a container attached to and elevating with the gun, so I provide a generally arcuate container 14 suspended by brackets 15 below and approximately aligned with the ring gear 11, in order to provide clearance within the turret for the gunner's seat and foot rest, as well as entrance to such space. Accordingly, the container 14 rotates with the turret as the latter is traversed in azimuth. Because of the arcuate shape of the container its capacity is increased if the cartridges are placed therein point inwards. Thus the cartridges 16, linked together by a belt or disintegrating links, are drawn out of the container at one corner 17 and are twisted through an angle of approximately 135° while hanging in a loop 18, prior to entering a lower chute 19 wherein the cartridges point away from the longitudinal center line of the turret.

From the lower chute 19 the cartridges hang in a second loop 20 prior to entering an upper chute 21 which is attached to and elevates with the gun B. As the cartridges leave the upper chute they feed around a curved chute 22 into a position parallel to and adjacent the gun breech but slightly therebelow, the regular gun feeding mechanism being relied upon to lift the few cartridges suspended between the gun breech and the surface of the curved chute 22. The second hanging loop 20 provides sufficient slack in the cartridge feed belt to provide for the elevating motion of the gun, since the gun and the upper chute 21 pivot about the turret axis C and the chute therefore takes up the slack of the loop 20 when moved to the dotted line position of Figure I.

The power for the ammunition feed is derived from the residual pressure of the gas in the gun barrel just after the bullet has left the muzzle 23 as shown in detail in Figures IV and V.

This gas is allowed to escape from the muzzle into an expansion chamber 24 which has a tube 25 slightly larger than the bore of the gun for the bullet to pass through, and through which the gases eventually escape. The purpose of this expansion chamber 24 is two-fold. First, it creates a back pressure on the gases for a short time so the combustion can continue. Although this continued combustion time adds nothing to the velocity of the bullet, it does allow at least part of the burning of the gases to be completed within the chamber, so that when the gases finally emerge from the gun, a large fraction has ceased glowing and hence the flash is considerably reduced. Also, the after-burning tends to prolong the pressure interval and thus provide continued power behind the piston. Secondly, by means of this expansion chamber, at least a part of the energy represented by the residual pressure is made available to operate the ammunition feed. A cylinder 26 and piston 27 are located adjacent to the expansion chamber with an opening 28 leading from the expansion chamber into the cylinder. At the end of the piston stroke, the cylinder chamber is vented to the atmosphere by means of ports 29 in the cylinder wall located so that during the stroke, they are closed off by the piston but at the end of the stroke, the head of the piston has moved past the ports so that the gas is allowed to escape from the cylinder.

Immediately after the bullet has left the gun muzzle, the gases in the gun barrel escape from the muzzle into the expansion chamber 24, and the pressure in the chamber rapidly builds up. The gases escape partly into the head space of the cylinder and partly directly to the atmosphere through the exit port. In a short time, the gases in the chamber will have escaped through the exit port and the pressure will have dropped to atmospheric. The gas in the cylinder can expand in two ways: first, by moving the piston and second, back through the connecting port to the chamber and thence to the atmosphere. During the first part of the cycle, the pressure in the expansion chamber is high and the gas in the cylinder has no alternative but to move the piston. Later in the cycle, the movement of the piston is dependent upon the relationship between the size of the piston and the size of the port leading into the expansion chamber. In any case, the high initial force of the piston serves to start the load moving and the remaining pressure keeps it moving, until by the end of the piston stroke, the load has been allowed to gradually come to a stop.

The piston 27 is connected by means of a wrist pin 30 and outside connecting rods 31 to a spring shock absorber 32 and thence to a coupling 33 to two cable drives 34 and 35 which transmit the piston movement in tension to shell advancing ratchet mechanisms, one of which is shown in detail in Figure VIII. One cable 35 is led into a coupling 36 which divides into two cables 37 and 38 each leading to a similar ratchet mechanism. The three ratchet mechanisms are located respectively inside the ammunition container 14, at the bottom of the lower chute 19, and at the turn of the upper chute 21. Since the three ratchet mechanisms are identical, it will be convenient to describe the last mentioned, which is detailed in Figure VIII.

Each of these shell advancing devices consists of a sprocket wheel 39 over which the cartridges and links travel in much the same manner as a chain over a sprocket. The sprocket wheel is turned through one tooth, by a lever arm 40 which drives the sprocket through a pawl 41 and ratchet 42 arrangement which in turn is actuated by the flexible cable 34 from the piston 27. As soon as

the cartridge has been advanced, an escapement mechanism bears directly upon the cartridge in such a manner as to keep the belt from falling back, while the piston and the lever arm return to the rest position.

The escapement mechanism is conveniently associated with one or more of the ratchet mechanisms; and comprises a detent device working in conjunction with the ratchet mechanism to prevent the cartridges from falling back after they have been lifted by the ratchet, and also to resist the inertia of the moving cartridges from carrying them past more than one tooth of the ratchet. The position of the escapement in Figure VIII may be considered the rest position, wherein a lever **44** is pivoted at **45** to a bracket on the chute and has a roller **46** bearing on one cartridge while a second lever **47** is pivoted to the opposite end **48** of the lever **44** and carries a roller **49** engaging the following cartridge. The two levers and rollers are urged to fold together by a spring **50**, this closing movement being limited by a cam **51** on the lever **47**. As shown, the levers can open up from the extreme closed position shown.

As the cartridges move counterclockwise with the sprocket **39**, the roller **46** rides down into the valley between two cartridges, thus lifting the second roller **49** clear of the approaching cartridge shown as substantially level with the sprocket. When the first roller **46** rides up on the next cartridge the second roller **49** drops down behind the following cartridge until the position of rest is again reached.

As previously mentioned, the total lift from the ammunition container to the gun is accomplished in four stages. First, the ammunition is brought to the mouth of the container. Second, it goes through a loop and enters the lower portion of the chute, which lower portion is stationary with respect to the traverse ring and the ammunition box. Third, the belt goes through a second loop and enters the middle chute, which middle chute is stationary with respect to the guns and hence movable in elevation with respect to the lower chute. Fourthly, it goes through the upper chute where the belt makes a right angle turn in the plane of the belt to enter the guns with the nose of the cartridge pointing forward.

The first stage of the lift is accomplished by one of the ratchet motors placed in the mouth or exit of the ammunition container. It lifts the cartridge belt to the top of the container where the exit is located. The second ratchet motor is located at the bottom of the lower chute where it lifts the belt from the first loop and pushes it through the chute to the second loop. The third motor is located between the middle and upper chutes, where it serves to draw the belt from the second loop into and through the middle chute and feeds it into the upper chute. Here, the regular gun feeding mechanism takes over to accomplish the fourth stage of the process of lifting the cartridges from the ammunition container to the gun.

The second phase of the ammunition feed problem is the accomplishment of the lifting of the cartridges without interfering with the operation of the turret. As mentioned previously, it is not feasible to allow the entire ammunition container to move with the guns so that some provision must be made for the movements of the turret in traverse and in elevation.

Since the ammunition containers are attached to the traverse ring, the containers move with the turret in traverse. The cartridge belt is led up to the gun so that it does not interfere with or is not interfered with by the movement of the guns in elevation. This is accomplished by leading the belt to a point near the axis of rotation of the turret in elevation. This is done in such a manner that the apex of the dihedral angle formed by the intersection of the planes of the cartridge belt as it approaches and as it leaves the center of the turret is on or near the axis of rotation of the turret in elevation. Thus, the effect on the cartridge belt of elevating the turret is merely to cause the belt to fold about whichever of the shells is at the apex. This is a perfectly normal movement of the belt and is accomplished without difficulty. In practice, the folding does not take place exactly at the axis, but about six inches therefrom and a small loop is provided for compensation. After executing this fold, the cartridges are able to move with the gun but have their longitudinal axes perpendicular to the axis of the gun, while to be useful, the axes must be parallel to that of the gun with the noses forward. It is necessary to turn the belt through a right angle lying in the plane of the belt. In order to have the shells come out of this turn in alignment with the gun breech the belt is led forward and then reversed in direction, with the noses of the shells on the inside of the arc and a very compact arc will be realized.

It will be noticed that the belt is made to flex in its normal manner and even these flexures take place with the assistance of guiding chutes and sprockets, so that there is no chance of the belt binding or entering the gun in other than the normal manner. It would also be noticed that although the ammunition feed derives its power from the gun, it does not in any way affect the operation of the gun, since the source of power is the gas remaining in the barrel after the bullet has left the gun.

Having thus described my invention and the present preferred embodiments thereof, I desire to emphasize the fact that many modifications may be resorted to in a manner limited only by a just interpretation of the following claim.

I claim as my invention:

1. Mechanism for advancing a cartridge belt to a gun comprising a gun mount for movement in traverse and elevation, a container curved substantially about the axis of traverse movement of the gun and constructed and arranged to move with the gun in traverse, the belt being contained in the container so that its cartridges are in substantially radial relation to said axis, the container having an outlet for the belt, a first chute fixed relative to the container and extending from adjacent said outlet in the general direction of the gun, the first chute being adapted to contain and direct the belt so that its cartridges are substantially tangent to circles concentric with said axis, belt advancing means on the container and first chute operable to maintain a slack twisted loop in the belt between said outlet the first chute wherein the cartridges are twisted into positions at right angles to the plane of elevation of the gun, a second chute constructed and arranged to move in traverse and elevation with the gun and adapted to direct the belt into the gun, the second chute having its belt receiving end spaced from and related to the belt discharging end of the first chute to allow a slack loop of the belt to hang between the chutes adjacent the axis of elevation movement of the gun, belt advancing means on the second chute for advancing the belt and for

maintaining the second named loop, and means for operating the first and second named belt advancing means in unison.

2. A mechanism for transporting linked cartridges from a container to a position adjacent a gun, the mechanism comprising spaced chutes adapted to guide the linked cartridges from the container to a position adjacent the gun, supporting means for each chute, one of said supporting means being movable with respect to the other supporting means, sprocket means on each chute adapted to engage the linked cartridges therein and adapted to advance the same, means on the chutes for engaging the linked cartridges to maintain a slack loop in the linked cartridges extending between the spaced chutes, and means for intermittently moving the linked cartridges including power transmitting means interconnecting the sprocket means, and power means operatively connected with said power transmitting means.

3. A mechanism for transporting linked cartridges from a container to a position adjacent a gun, the mechanism comprising spaced chutes adapted to guide the linked cartridges from the container to a position adjacent the gun, supporting means for each chute, one of said supporting means being movable with respect to the other supporting means, sprocket means on each chute adapted to engage the linked cartridges therein and adapted to advance the same, means on the chutes for engaging the linked cartridges to maintain a slack loop in the linked cartridges extending between the spaced chutes, and means for intermittently moving the linked cartridges including a cylinder and piston mechanism adapted to be operated by the muzzle blast of said gun, and means operatively connecting said cylinder and piston mechanism with said sprocket means on the chutes so that said cylinder and piston mechanism simultaneously operates said sprocket means.

4. A mechanism for transporting linked cartridges from a container to a position adjacent a gun, the mechanism comprising spaced chutes adapted to guide the linked cartridges from the container to a position adjacent the gun, supporting means for each chute, one of said supporting means being movable with respect to the other supporting means, sprocket means on each chute adapted to engage the linked cartridges therein and adapted to advance the same, means on the chutes for engaging the linked cartridges to maintain a slack loop in the linked cartridges extending between the spaced chutes, and means for intermittently moving the linked cartridges including a cylinder and piston mechanism adapted to be operated by the muzzle blast of said gun, means operatively connecting the sprocket means of said chutes, and a resilient impulse transmitting connection between said cylinder and piston mechanism and the last named means whereby said cylinder and piston means is operable to simultaneously operate said sprocket means.

5. A mechanism for transporting linked cartridges from a container to a position adjacent a gun, the mechanism comprising spaced chutes adapted to guide the linked cartridges from the container to a position adjacent the gun, supporting means for each chute, one of said supporting means being movable with respect to the other supporting means, sprocket means on each chute adapted to engage the linked cartridges therein and adapted to advance the same, means on the chutes for engaging the linked cartridges to maintain a slack loop in the linked cartridges extending between the spaced chutes, and means for intermittently moving the linked cartridges including a ratchet means at each sprocket means for operating the same, a cylinder and piston means adapted to be operated by the muzzle blast of said gun, and means operatively connecting said ratchet means with the cylinder and piston means to be operated thereby.

6. A mechanism for transporting linked cartridges from a container to a position adjacent a gun, the mechanism comprising spaced chutes adapted to guide the linked cartridges from the container to a position adjacent the gun, supporting means for each chute, one of said supporting means being movable with respect to the other supporting means, sprocket means on each chute adapted to engage the linked cartridges therein, ratchet means at the sprocket means operable to intermittently advance the same, a power operated mechanism connected with the ratchet means operable for producing simultaneous advancement of the sprockets, and escapement means at the sprocket means for resisting over travel of the linked cartridges and operable to maintain a slack loop in the linked cartridges extending between the spaced chutes.

7. An ammunition advancing mechanism for transporting linked cartridges from a container to a position adjacent a gun movable in elevation relative to said container, said mechanism comprising a first chute adapted to extend from the container and operable to guide the linked cartridges therefrom, means for supporting the first chute to be stationary with respect to the container, a second chute, means for supporting the second chute to adapt it for movement in elevation with the gun, the linked cartridges being adapted to extend from the first chute to the second chute, a cartridge advancing means on each chute, members on the chutes for engaging the cartridges to provide a slack loop in the linked cartridges which extend between the chutes to allow free flexing of the linked cartridges during the movement of the second chute relative to the first chute, and guide means stationary with respect to the second chute adapted to turn the linked cartridges to a given position with respect to the gun after delivery from the second chute.

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