Aug. 23, 1949. W. L. MacKENZIE 2,479,633

GUIDE MEANS FOR FLEXIBLE AMMUNITION BELTS

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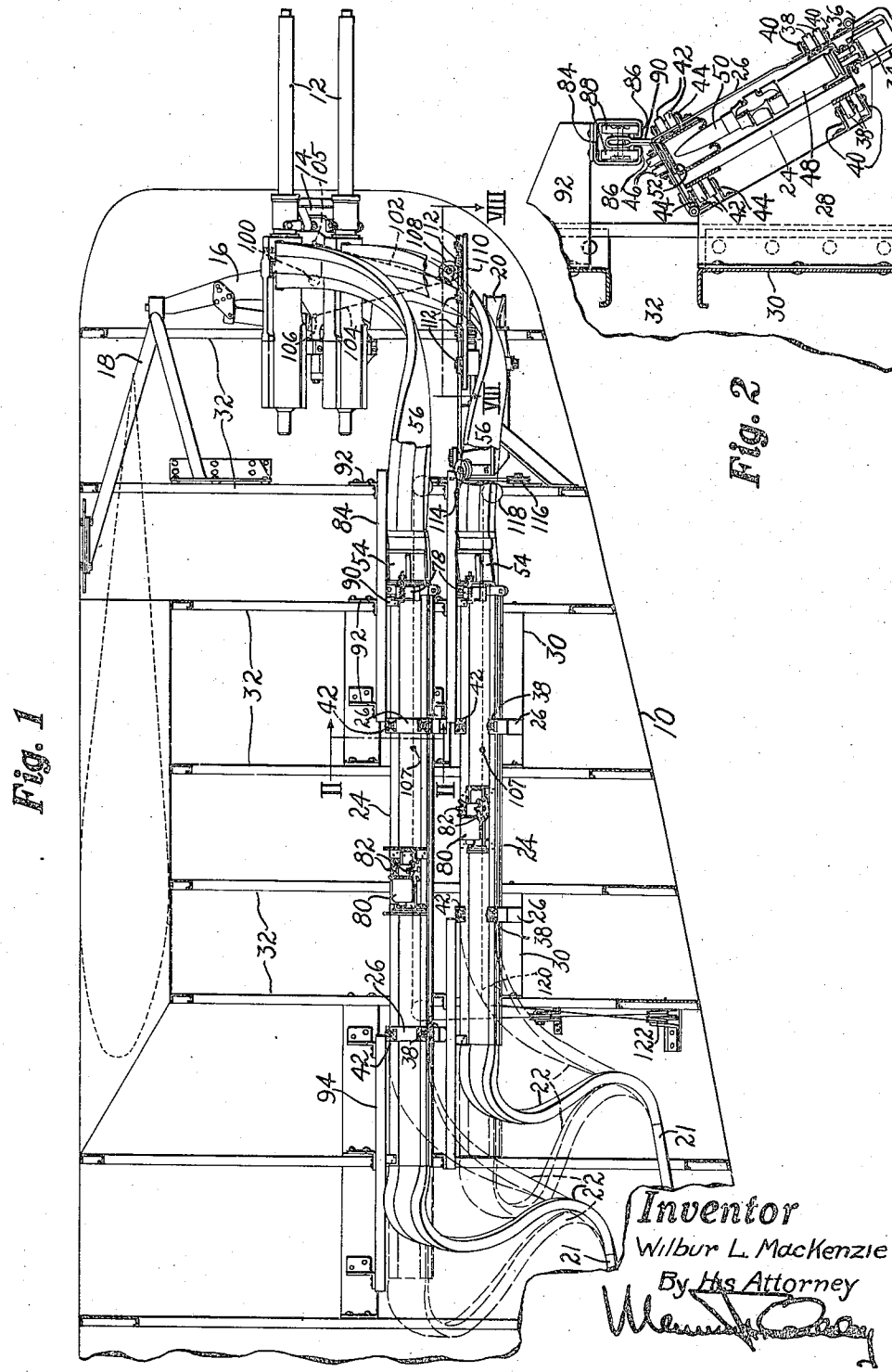

Fig. 1

Fig. 2

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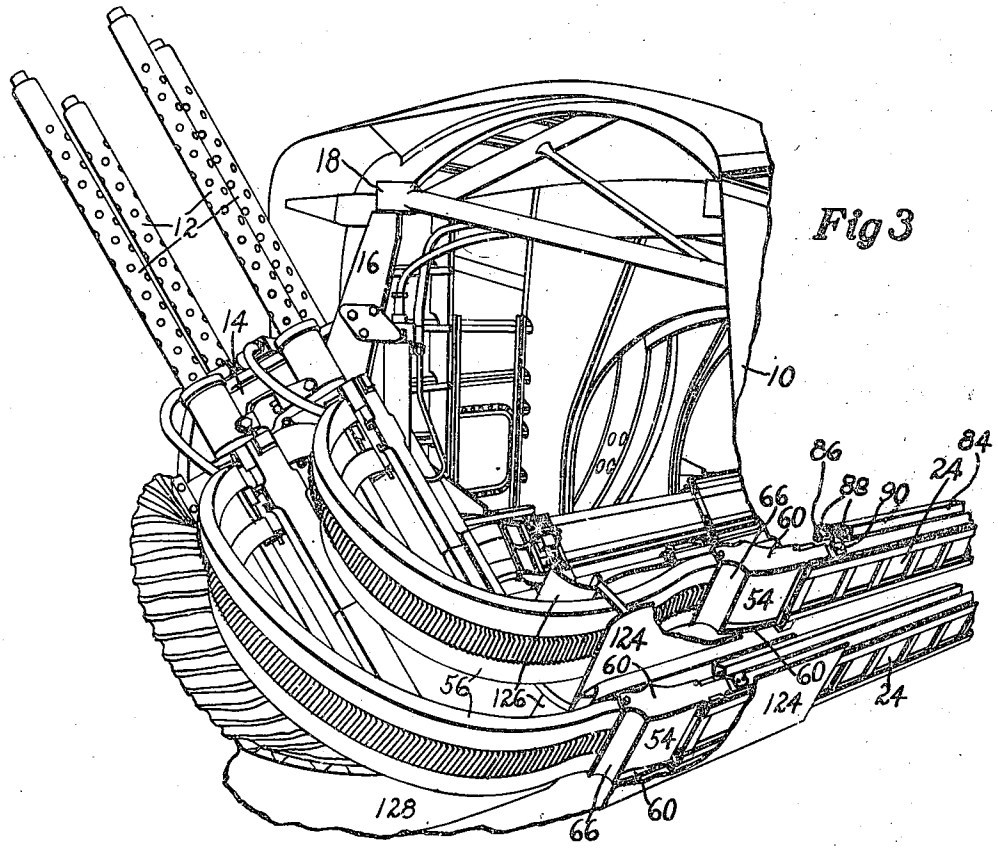

Fig 3

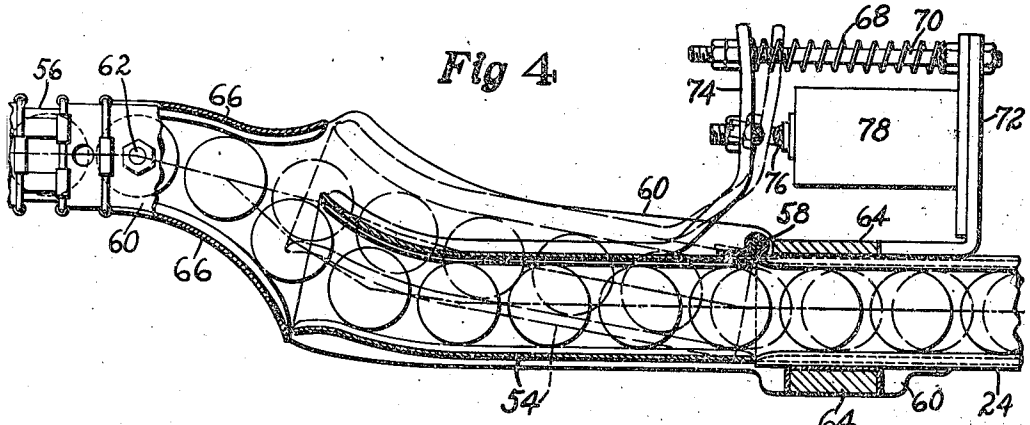

Fig 4.

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Fig. 5

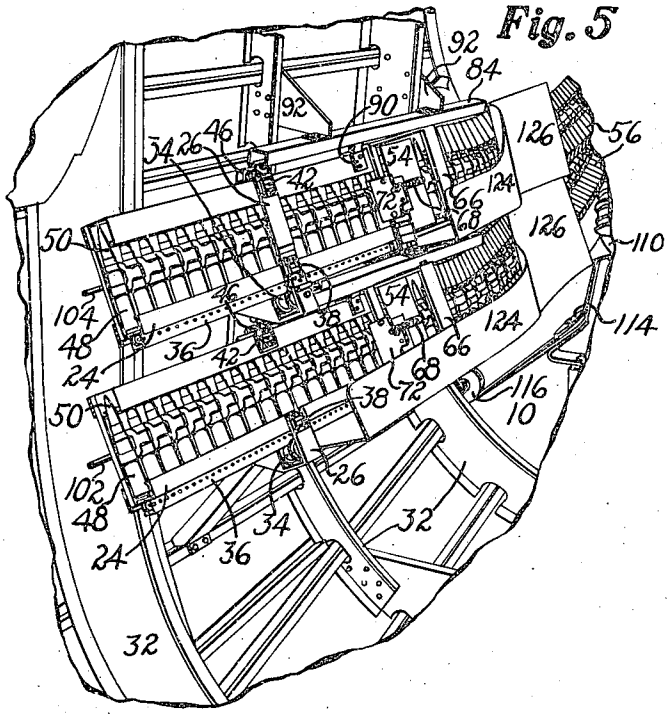
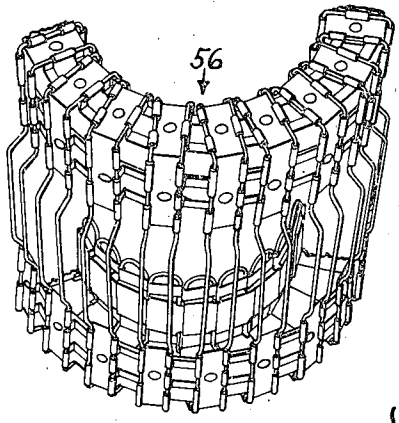


Fig. 6



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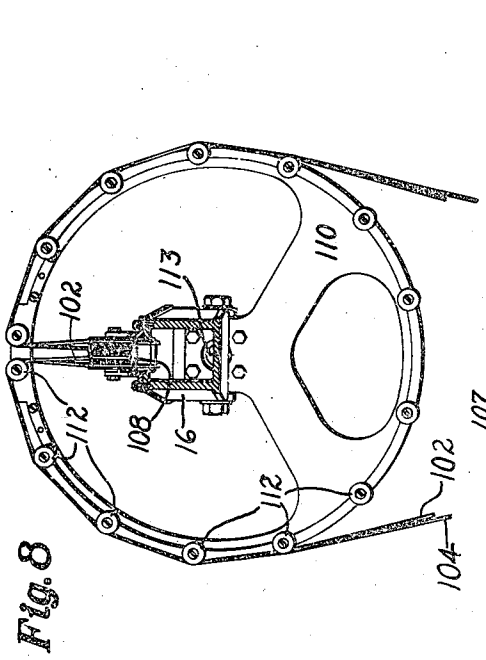

Fig. 8

Fig. 7

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GUIDE MEANS FOR FLEXIBLE AMMUNITION BELTS

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Application July 3, 1944, Serial No. 543,344

8 Claims. (Cl. 89—33)

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The present invention relates to ammunition feeding means and is herein illustrated in its application to means for feeding and guiding cartridge belts to a plural gun assembly in the tail portion of an airplane. It will be apparent to those skilled in the art that embodiments of the illustrated ammunition feeding means in vehicles other than airplanes and also in fixed gun emplacements come within the scope of the present invention.

In feeding cartridge belts to a plural gun assembly mounted for target tracking movements it is desirable to provide flexible guiding means designed to direct the cartridge belts into the respective feedways of the guns without seriously impeding the movements of the guns. It is the usual practice to provide for this purpose flexible chutes comprising a series of interconnected links constructed and arranged to permit expansion and contraction of opposite side portions of the chute. While such chutes have a considerable range of flexing movements the strain and wear on the flexible chute caused by the feeding of the cartridge belt is substantially reduced if the flexing action of the chute is limited and sharp curvatures and abrupt convolutions are avoided. Furthermore, when the gun assembly is mounted in a small space it is essential that flexing movements of the chutes be reduced to the minimum in order to avoid contact of the chutes with each other and with adjacent mechanism in extreme positions of the gun assembly.

It is an object of the present invention to provide, in an assembly of guns constructed and arranged for target tracking movements, an arrangement of ammunition guiding means which will facilitate the feeding of ammunition, reduce the wear and strain on the guiding means, and obviate contact of adjacent guiding members with each other and with other adjacent mechanism, particularly when the guns are mounted in a small space as, for example, in the tail portion of an airplane.

With the above object in view, the present invention, in one aspect thereof, contemplates the combination with a plural gun assembly mounted in a vehicle for target tracking movements of ammunition chutes freely mounted in opposite sides of the vehicle for movement longitudinally thereof, and means operated by target tracking movements of the guns for effecting equal and opposite movements of said chutes longitudinally of the vehicle. In the illustrated organization two ammunition chutes constructed and arranged to guide ammunition to two guns in a gun mount

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are connected together by a cable which is also connected to the gun assembly, said cable being operable by target tracking movements of the gun assembly to effect equal and opposite movements of said chutes corresponding to similar equal and opposite movements of the delivery ends of said chutes with the feedways of the respective guns. In the illustrated organization a series of chutes is provided for guiding ammunition from an ammunition trough to each of the guns, said series comprising a flexible chute mounted in the feedway of the gun and a rigid chute positioned relatively to the ammunition receiving end of the flexible chute and mounted for longitudinal movement relatively to the gun mount. Preferably the cable is connected to the rigid chutes and the ammunition receiving ends of the flexible chutes receive their movement relatively to the gun mount from the rigid chutes. In its specific application to the illustrated four gun assembly comprising two upper and two lower guns and a single cradle on which the guns are mounted the invention comprises four chutes and means operated by target tracking movements of the gun assembly for moving said chutes relatively to the gun assembly, said means comprising a first cable secured to the upper left gun, the lower right gun, and to the two chutes which feed ammunition to said guns, respectively, and a second cable secured to the lower left gun and the upper right gun and to the two chutes which feed ammunition to the latter two guns, respectively.

To assist in the maintenance of a constant slack in the flexible chutes connected to the respective guns the illustrated organization, in accordance with a further feature of the invention, includes a member mounted in fixed relation to the gun mount providing a flexing point for a flexible chute and dividing the chute into two sections, namely, a straight section extending from the ammunition receiving end of the flexible chute to the flexing point established by said member, and an arcuate section extending from the flexing point to the ammunition delivery end of the chute. It will be understood that the length of said sections of the flexible chutes will vary in proportion to the target training movements of the gun assembly. In accordance with a further feature of the invention, suitable means is provided for supporting and guiding the straight section of the flexible chute.

These and other features of the invention will now be described with reference to the accompanying drawings and pointed out in the appended claims.

In the drawings,

Fig. 1 is a side elevation of the tail portion of an airplane provided with a plural gun assembly and ammunition feeding means embodying the features of the present invention, the fuselage being shown in central longitudinal section;

Fig. 2 is a section on the line II—II of Fig. 1;

Fig. 3 is a perspective view showing the gun assembly and a portion of the ammunition feeding mechanism in an extreme position;

Fig. 4 is an enlarged plan view, partly in section, illustrating a portion of one of the cartridge belt guiding assemblies;

Fig. 5 is a perspective view illustrating portions of the two cartridge belt guiding assemblies at one side of the airplane;

Fig. 6 is an enlarged perspective view illustrating a portion of one of the flexible cartridge belt guides;

Fig. 7 is a diagrammatic view illustrating the mechanism whereby the cartridge belt guides are moved in response to target-tracking movements of the gun assembly; and

Fig. 8 is a section on the line VIII—VIII of Fig. 1.

The illustrated gun assembly is mounted for locomotion in a vehicle herein illustrated as an airplane.

Referring to Fig. 1, the numeral 10 indicates the tail portion of the fuselage of an airplane and the numeral 12 indicates two guns of a four-gun assembly projecting rearwardly from the tail end of the airplane, said guns, as herein illustrated, being .50 cal. machine guns of known construction. The four guns 12 are supported on one cradle 14 pivotally mounted on a bent column 16 for swinging movement heightwise of the airplane, hereinafter referred to as movements in elevation, said column being pivotally mounted in supporting brackets 18 and 20 for swinging movement about an axis extending heightwise of the plane to provide for widthwise swinging movements of the guns, hereinafter referred to as movements in azimuth.

Ammunition for the four-gun assembly is stored amidships and is fed to the guns through four separate systems of ammunition guides or chutes. To facilitate feeding, the ammunition is provided in belts, preferably of the disintegrating metallic link construction. The cartridge belts are fed, or drawn, through the chutes by the cartridge feeding mechanisms of the respective guns, assisted by automatically actuated feeding means located at an intermediate position lengthwise of each system of chutes. In tracking a target, the gun assembly has a wide range of movement and the ammunition chutes connected to the guns must be so constructed and arranged as to be movable with the gun assembly in its target tracking movements. To this end, that section of each system of chutes connected to the gun is of a flexible link construction such, for example, as that illustrated in Fig. 6. In order to avoid interference of the flexible chutes with each other and with the gun controlling and operating mechanisms, means is provided for moving the receiving ends of the flexible chutes lengthwise of the airplane, concomitantly with the target-tracking movements of the gun assembly, to maintain a substantially constant degree of slack in said flexible chutes. In the illustrated assembly, the movement of the receiving ends of the flexible chutes for the purpose above set forth is effected by two cables operated by movements of the gun assembly in azimuth and in elevation, the arrangement and operation of said cables being hereinafter described.

The construction and operation of two complete systems of ammunition guiding chutes at one side of the airplane are illustrated in Fig. 1. In each system the ammunition belt is fed from a trough (not shown), located approximately amidships, through a fixed rigid chute 21 extending rearwardly from said trough, then through a flexible chute 22 of the type illustrated in Fig. 6. The delivery end of the flexible chute is attached to a rigid chute 24 arranged to extend along the inside wall at one side of the fuselage. The rigid chute is supported for longitudinal movement in a plurality of brackets 26, one of which is illustrated in Fig. 2. Each bracket is arranged in an inclined position and secured to a plate 28 mounted on a panel 30 attached to the ribs 32 of the fuselage. For supporting the rigid chute 24 within the brackets 26 each bracket has pivotally mounted in the lower portion thereof a roll 34 having flanges at each end between which flanges a hollow tongue 36 extending downwardly from the rigid chute 24 is mounted. The lower portion of the rigid chute is positioned widthwise of the bracket by two rolls 38 pivotally mounted between angle brackets 40 and arranged to extend inwardly through openings in the bracket 26. Similarly, the upper portion of the rigid chute is positioned widthwise of the bracket 26 by rolls 42 pivotally mounted between angle brackets 44. For holding the rigid chute against heightwise movement rolls 46 are arranged to extend through an opening in the top of the bracket 26 for engagement with the upper surface of the rigid chute. The rigid chute is so constructed and arranged that the cartridge belt slides through it in upright position with the shell 48 of the cartridge supported on the base of the rigid chute and the projectile 50 positioned between the beaded marginal portions of a channel plate 52 secured in the upper portion of the rigid chute. The ammunition belt passes from the delivery end of the rigid chute 24 through a short chute or channel member 54 and from said short chute through a flexible chute 56 the delivery end of which is mounted in the feedway of one of the guns 12 as best shown in Fig. 3. Referring to Fig. 4, the channel member 54 is hinged on a pin 58 mounted in plates 60 secured to the flexible chute 56 by screws 62 and rigidly secured to the rigid chute 24 between the end portions of bars 64. The channel member 54 has a short range of swinging movement from its full line position in Fig. 4 to its position indicated by broken lines. During such movement of the channel member its delivery end moves laterally within the limits of the expanded end portion of a guideway or funnel formed by bent plates 66 secured to the end portions of the plates 60. Thus, in all positions of the swinging channel member 54 its delivery end registers with the guideway provided by the plates 66 and the movement of the cartridge belt proceeds without interruption in any position of said channel member. The channel member is normally retained in its full line position as illustrated in Fig. 4 by a spring 68 mounted on a pin 70 secured to an angle bracket 72 mounted on the rigid chute 24, said spring being arranged to bear against an end portion of a bent arm 74 secured to the channel member 54 and bifurcated to embrace the pin 70. When the channel member is in its normal position illustrated in Fig. 4 the cartridge belt travels in a curved path as it passes from the delivery end of the channel mem-

ber through the funnel provided by the bent plates 66. During the firing of the gun the cartridge belt is drawn through the series of guideways above described, by mechanism (not shown) operated by the recoil of the gun. The tension imparted to the cartridge belt by the feed mechanism in the gun straightens that portion of the belt passing through the channel member 54 and the adjacent funnel thereby swinging the channel member into its broken line position illustrated in Fig. 4. The bent arm 74, moving with the channel member 54 acts against a plunger 76 to close a switch mounted in a box 78 secured to the angle bracket 72. The closing of said switch causes the operation of a motor 80 (Fig. 1) secured to the rigid chute 24. Said motor operating through suitable gearing (not shown) actuates a pair of sprockets 82 the teeth of which project through an opening in the rigid chute 24 for engagement with the cartridges mounted therein. The operation of the sprockets 82 assists in the feeding movement of the cartridge belt thus relieving the recoil mechanism of the gun which, as commonly constructed, is not designed to draw a cartridge belt through a series of guideways as long as that herein illustrated. After a very brief period of operation of the sprockets 82 the tension on the portion of the cartridge belt passing through the channel member 54 and the adjacent guideway is relieved sufficiently to permit the spring 68 to return the channel member to its full line position illustrated in Fig. 4, whereupon a spring (not shown) in the switch box 78 opens the switch and causes the operation of the sprockets 82 to be arrested. It will be understood that the sprockets 82 will be operated intermittently at frequent intervals during the firing of the gun and will relieve the ammunition feeding mechanism of the gun of the greater part of the burden of feeding the ammunition belt. The above-described mechanism for assisting in the feeding of the ammunition belt, together with the swinging channel member for operating the switch is provided in each of the four ammunition feeding systems provided for the four-gun assembly illustrated in the drawings. In order to support the weight of the rear end portion of the rigid chute 24 in its rearmost position, together with the added weight of the channel member 54, the receiving end portion of the flexible chute 56, and a cartridge belt mounted therein, a trolley rail 84 (Figs. 1 and 2) is provided for the rigid chute, said trolley rail being herein illustrated as an inverted channel member having flanges 86 extending inwardly from its opposite sides to support a pair of rolls 88 carried by a short arm 90 secured to and extending upwardly from the top of the rigid chute 24. The rail 84 extends longitudinally of the fuselage in parallel relation to the rigid chute 24 and is fixed to plates 92 (Fig. 5) secured to the ribs 32. A similar trolley rail 94 adjacent to the receiving end portion of the rigid chute 24 supports said chute together with the flexible chute 22 and the ammunition belt mounted therein when the rigid chute and the flexible chute are in the position shown by broken lines in Fig. 1.

The mobile construction and arrangement of the rigid chutes 24, and the receiving end portions of the flexible chutes 56 attached to the rigid chutes permits the maintenance of a substantially constant degree of slack in said flexible chutes. In the illustrated organization the movement of the chutes is effected automatically by means actuated by movement of the gun assembly

in azimuth and in elevation. The description of the chute moving mechanism will be prefaced by a brief description of the arrangement of the delivery ends of the flexible chutes 56 to the gun assembly. Referring to Fig. 1, the axis on which the cradle 14 rocks for movement of the gun assembly in elevation is indicated at 100 and it will be seen that the upper chute 56, shown in Fig. 1, enters the feedway of the upper gun at a point approximately above the axis 100, while the delivery end of the lower flexible chute 56 is directly below the delivery end of the upper chute and below the axis 100. This arrangement is duplicated on the opposite side of the gun assembly. It will be seen that an upward movement of the gun assembly causes the delivery ends of the upper chutes to move forwardly of the airplane with a downward component while the lower chutes move rearwardly with an upward component. Thus, the distance from the delivery ends of the upper chutes to the delivery ends of the rigid chutes 24 would be shortened if the chutes 24 remain stationary, thus increasing the slack in the upper chutes 56 while the distance from the delivery ends of the lower chutes 56 to the delivery ends of the lower rigid chutes 24 would be increased and the degree of slack in the lower flexible chutes would be decreased with a straightening or tautening effect on said flexible chutes. Similarly, movement of the gun assembly in azimuth causes the delivery ends of the two flexible chutes at one side of the gun assembly to move forwardly while the delivery ends of the flexible chutes at the opposite side of the gun assembly move rearwardly with slackening and tautening effects on the flexible chutes similar to the effects described above. The longitudinal movements of the chutes during target tracking movements of the gun assembly serve to counteract said slackening and tautening tendencies, thus maintaining a substantially constant degree of slack in all of the flexible chutes at all times. As herein illustrated, the longitudinal movements of the chutes are effected by two cables 102 and 104 (Figs. 1 and 7) the ends of which are secured to the cradle 14 at points 105 and 106 while intermediate portions of each cable, generally indicated in Fig. 7 by the numeral 107, are secured to the rigid chutes 24. Now tracing the path of the cable 102, one end of said cable is secured to the cradle at the point 105 located between the rocking axis 100 of the cradle and the muzzle ends of the guns 12. The cable 102 extends downwardly from said point to a pulley 108 (Fig. 8) mounted on a plate 110 secured to the base of the column 16, thence rearwardly and about a series of pulleys 112 mounted on the plate 110 and spaced equally distant from the axis 113 of the column 16. In its path from the plate 110 forwardly of the airplane the cable 102 passes over a series of pulleys 114, 116 and 118 (Fig. 1), and passes from the pulley 118 through the space between the lower rigid chute 24 seen in Fig. 1 and the side wall of the fuselage and toward the receiving end of said rigid chute to a pulley 120. From this point the cable extends downwardly to a pulley 122, then across the bottom of the fuselage. The further course of the cable 102 does not appear in Fig. 1 but is illustrated diagrammatically in Fig. 7 where it appears that after crossing the fuselage the cable 102 extends to the upper rigid chute 24 on the opposite side of the fuselage and, thence, in a course similar to that above described, back to the cradle 14 to which it is secured at the point 106 between the rocking

axis 100 of the cradle and the breech ends of the guns. It will be seen that the two ends of the cable are spaced equally distance from the axis 100, thus insuring equal movements of the opposite ends of the cable and a constant tension on the cable in all positions of the gun assembly in elevation. Similarly, the concentric arrangement of the pulleys 112 on the plate 110 relatively to the vertical axis of the gun assembly insures a constant tension on the cable 102 during all movements of the gun assembly in azimuth. It will be understood that the arrangement and operation of the cable 104 corresponds to the arrangement and operation of the cable 102 above described. It will be seen by reference to the diagrammatic showing in Fig. 7 that the organization of the cable mechanism is such that when in the course of the target tracking movement of the gun assembly the muzzle ends of the guns move downwardly, the cables cause the upper rigid chutes 24 together with the receiving ends of the flexible chutes to move toward the gun assembly and the lower chutes to move away from the gun assembly thus counteracting the respective slackening and tautening tendencies of such movement of the gun assembly on the flexible chutes and maintaining a substantially constant slack therein. Similarly, when the guns are tilted upwardly the lower rigid chutes move toward the gun assembly and the upper chutes away from the gun assembly. It will also be seen that movement of the gun assembly in azimuth causes the plate 110 to turn with the column 16 (Fig. 8), thus winding the cables at one side of said plate about the concentric pulleys mounted thereon and causing a corresponding unwinding action of the cables at the opposite side of said plate. This action of the plate 110 moves the two rigid chutes 24 together with the ends of the flexible chutes at one side of the airplane toward the gun assembly and the two rigid chutes at the opposite side of the airplane away from the gun assembly. This action of the plate 110 counteracts the respective slackening and tautening tendencies on the flexible chutes by movement of the gun assembly in azimuth and maintains a constant slack in said flexible chute. From the above description it will be understood that I have provided means for automatically moving the rigid chutes 24 in synchronous relation to the target tracking movements of the gun assembly thus insuring the maintenance of a substantially constant degree of slack in the four flexible chutes 56 in any and all positions of the gun assembly.

It has been found that in the handling of the flexible chutes 56 the best results are achieved by providing, for each chute, a fixed guide member about which the chute flexes, thus dividing the chute into two sections: a straight section extending from the guide member to the receiving end of the chute and an arcuate section extending from the guide member to the delivery end of the chute. In an extreme position of the gun assembly, such as that illustrated in Fig. 3, the straight sections of the two flexible chutes at one side of the gun assembly are relatively short and the arcuate sections correspondingly long and, conversely, the two flexible chutes at the opposite side of the gun assembly have relatively short arcuate sections and long straight sections, but the curvature of the arcuate sections of all four flexible chutes is substantially the same. Referring to Figs. 3 and 5, the straight section of each flexible chute 56 is supported and guided by a plate 124 secured to the ribs 32 and bent to form a channel member within which the chute is retained. Each channel member has a relatively wide arcuate extension 126 which provides a fixed guide about which the chute 56 flexes, said guide defining the division between the straight section and the arcuate section of the chute. In order to prevent contact of the lower flexible chutes with the plate 110 a guard rail 128 extends about said plate.

While my invention is herein illustrated in its application to a four-gun assembly mounted in the tail portion of an airplane, it is to be understood that the invention is not limited in its scope to the illustrated embodiment thereof but is applicable to gun assemblies mounted in other types of vehicles.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. A plural gun assembly, a vehicle in which said gun assembly is mounted, means for guiding ammunition to said guns including two ammunition chutes freely mounted in opposite sides of the vehicle for movement longitudinally thereof, and means operated by target tracking movements of the guns for effecting equal and opposite movement of said chutes longitudinally of the vehicle.

2. A plural gun assembly, a vehicle in which said gun assembly is mounted, two ammunition chutes freely mounted at opposite sides of said vehicle for movement longitudinally thereof and a cable connecting said ammunition chutes to each other and to the gun assembly, said cable being operable by target tracking movements of the gun assembly to effect equal and opposite movement of said chutes longitudinally of the vehicle.

3. A four-gun assembly comprising two upper and two lower guns, a vehicle in which said gun assembly is mounted, ammunition feeding means including four chutes, two at each side of the vehicle, and means operated by target tracking movements of the gun assembly for moving said chutes longitudinally of the vehicle, said means comprising a first cable secured to the upper left gun, the lower right gun and to the two chutes which feed ammunition to said guns respectively, and a second cable secured to the lower left gun and the upper right gun and to the two chutes which feed ammunition to the latter two guns respectively.

4. A four-gun assembly comprising two upper and two lower guns, a vehicle in which said gun assembly is mounted, ammunition feeding means including four rigid chutes, two at each side of the vehicle, means operated by target tracking movements of the gun assembly for moving said chutes longitudinally of the vehicle, said means comprising a first cable secured to the upper left gun, the lower right gun and to the two chutes which feed ammunition to said guns respectively, and a second cable connected to the lower left gun and the upper right gun and to the two chutes which feed ammunition to the latter two guns respectively, and four flexible chutes constructed and arranged to receive ammunition from the four rigid chutes and to conduct said ammunition to the four guns respectively.

5. Means for guiding ammunition to a four gun assembly, both the guiding means and the assembly being mounted in a vehicle, said guiding means comprising four flexible ammunition chutes, one for each gun, said chutes being lo-

cated two at each side of the vehicle, one above the other, means operated by target tracking movements of the gun assembly for moving the ammunition receiving ends of said flexible chutes to maintain a substantially constant degree of slack therein, and four guide members, one for each flexible chute, constructed and arranged to space each two adjacent chutes in predetermined relation to each other.

6. Means for guiding ammunition to a four gun assembly, both the guiding means and the assembly being mounted in a vehicle, said guiding means comprising four flexible ammunition chutes, one for each gun, said chutes being located two at each side of the vehicle, one above the other, means operated by target tracking movements of the gun assembly for moving the ammunition receiving ends of said flexible chutes to maintain a substantially constant degree of slack therein, and four guide members, one for each flexible chute, constructed and arranged to space each two adjacent chutes in predetermined relation to each other and to provide for each flexible chute a fixed flexing point located in predetermined relation to the gun assembly.

7. The combination with a gun, of a cradle mounting said gun, a column on which said cradle is mounted for movement to cause tracking movement of the gun in elevation, bearings mounting the column for rotary movement to effect tracking movements of the gun in azimuth, means for guiding ammunition to the gun, said means comprising a flexible chute the ammunition-delivery end of which communicates with the gun, and a line operated by target tracking movements of the gun in azimuth and in elevation for moving the ammunition-receiving end of said chute to maintain a substantially constant degree of slack in said chute.

8. The combination with a gun, of a cradle mounting said gun, a column on which said cradle is mounted for movement to cause tracking movement of the gun in elevation, bearings mounting the column for rotary movement to effect tracking movements of the gun in azimuth, means for guiding ammunition to the gun, said means comprising a flexible chute the ammunition-delivery end of which communicates with the gun, a fixed guideway in which said flexible chute is mounted, and a line operated by target tracking movements of the gun in azimuth and in elevation for moving the ammunition-receiving end of said chute to maintain a substantially constant degree of slack in said chute.

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