

[54] **AMMUNITION BULK LOADER**

[72] Inventors: **Lester Frank Backus**, Charlotte;
Robert Parker Laurent, Essex;
Robert George Titmore, South
 Burlington, all of Vt.

[73] Assignee: **General Electric Company**

[22] Filed: **May 13, 1971**

[21] Appl. No.: **142,882**

[52] U.S. Cl. **89/34, 86/48, 89/33 BB**

[51] Int. Cl. **F41f 9/02**

[58] Field of Search **89/33-35, 45-47;**
86/47-48

[56] **References Cited**

UNITED STATES PATENTS

2,464,689 3/1949 Jackson **89/33 BB**

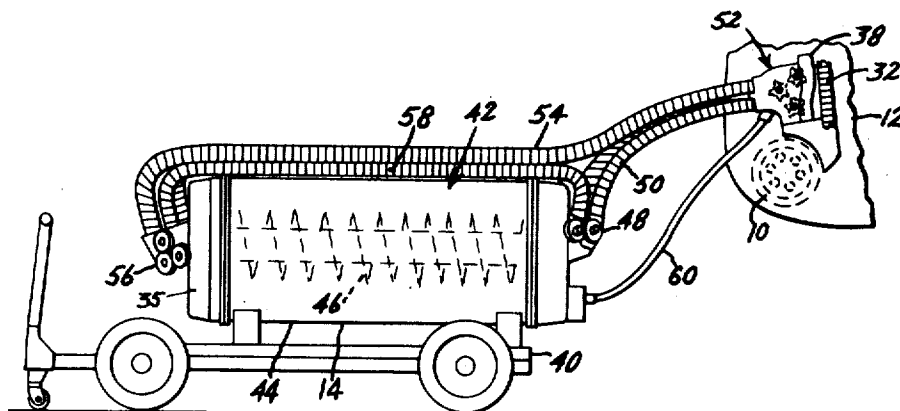
Primary Examiner—**Stephen C. Bentley**

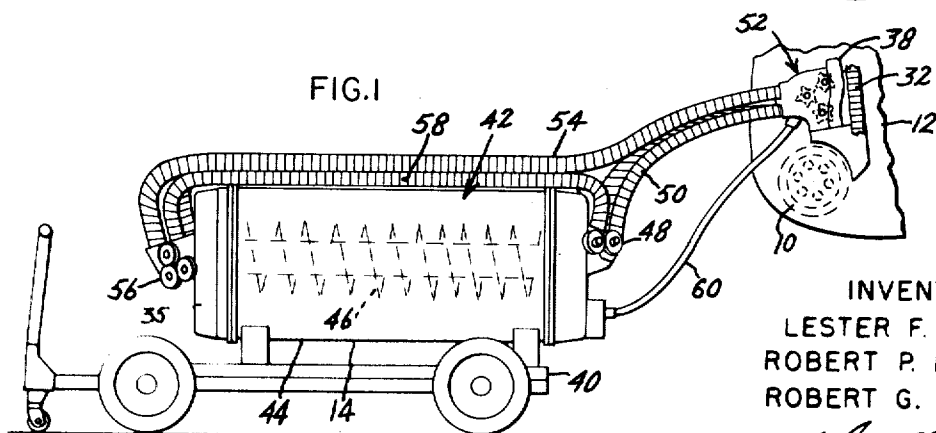
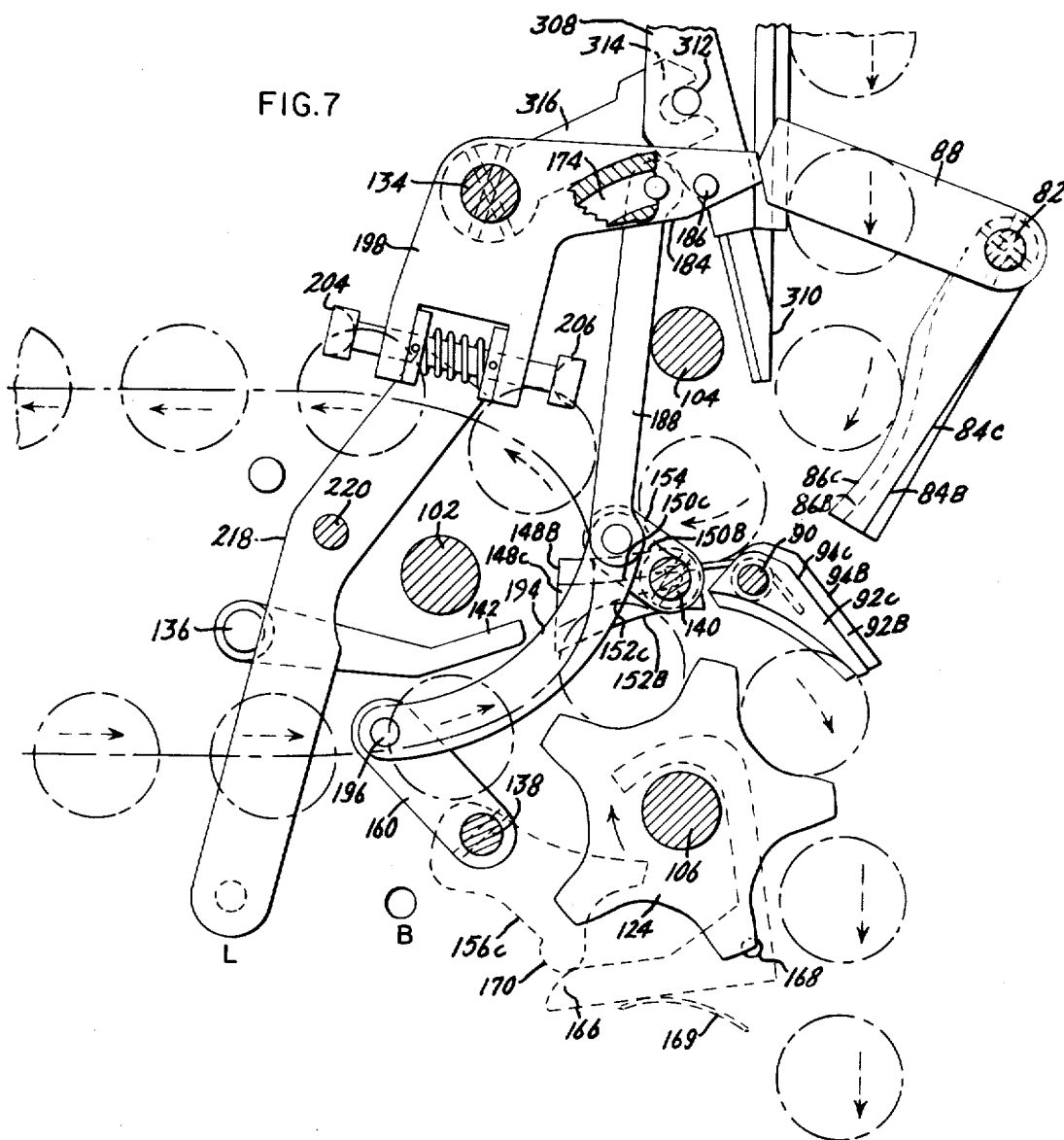
Attorney—**Bailin L. Kuch, Irving M. Freedman, Harry C. Burgess, Frank L. Neuhauser, Oscar B. Waddell and Joseph B. Forman**

[57] **ABSTRACT**

An ammunition handling system is disclosed including a double-ended serial storage device with a controlled conveyor adapted to rapidly transfer ammunition into a gun and storage system in an aircraft and to remove and store unfired rounds and fired cases in a radiation free environment.

6 Claims, 10 Drawing Figures

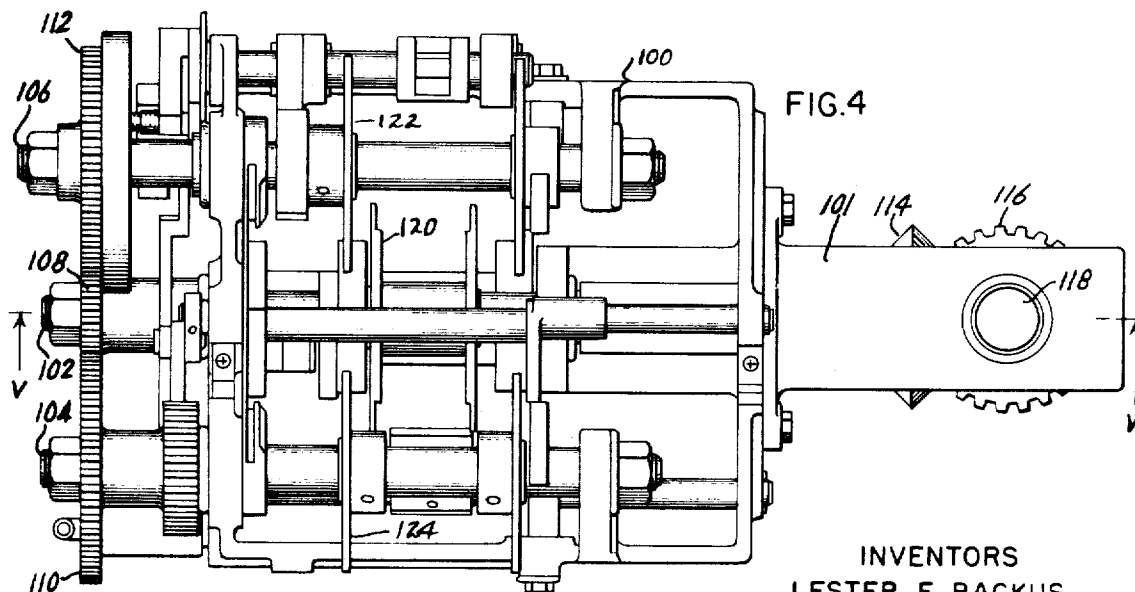
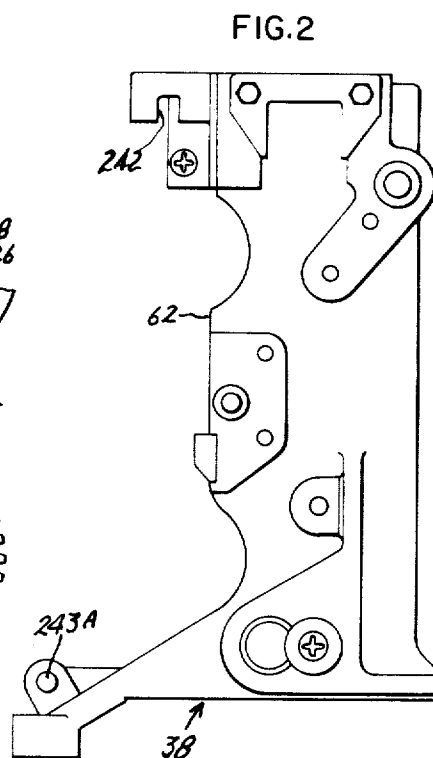
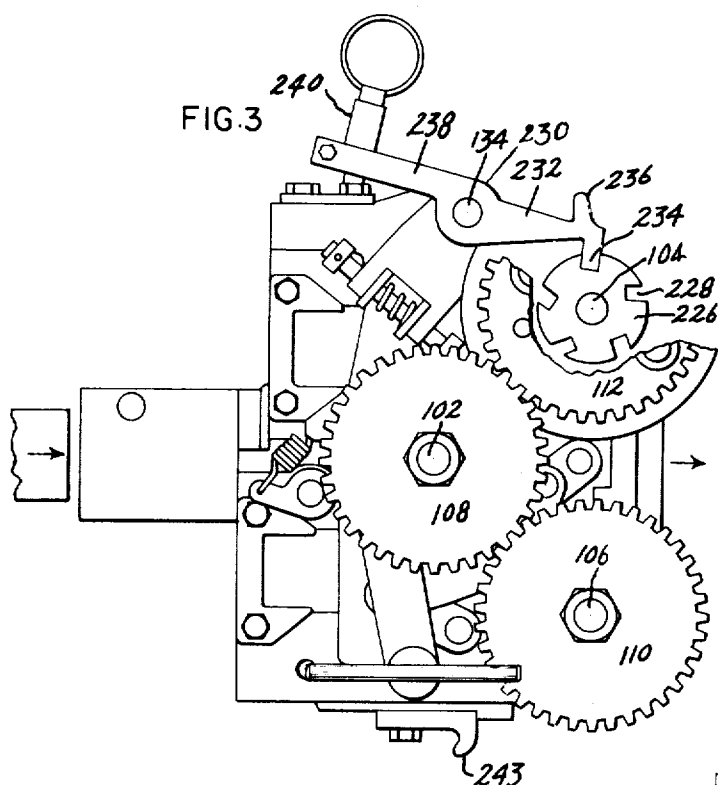




INVENTORS:
LESTER F. BACKUS,
ROBERT P. LAURENT,
ROBERT G. TITEMORE,

BY

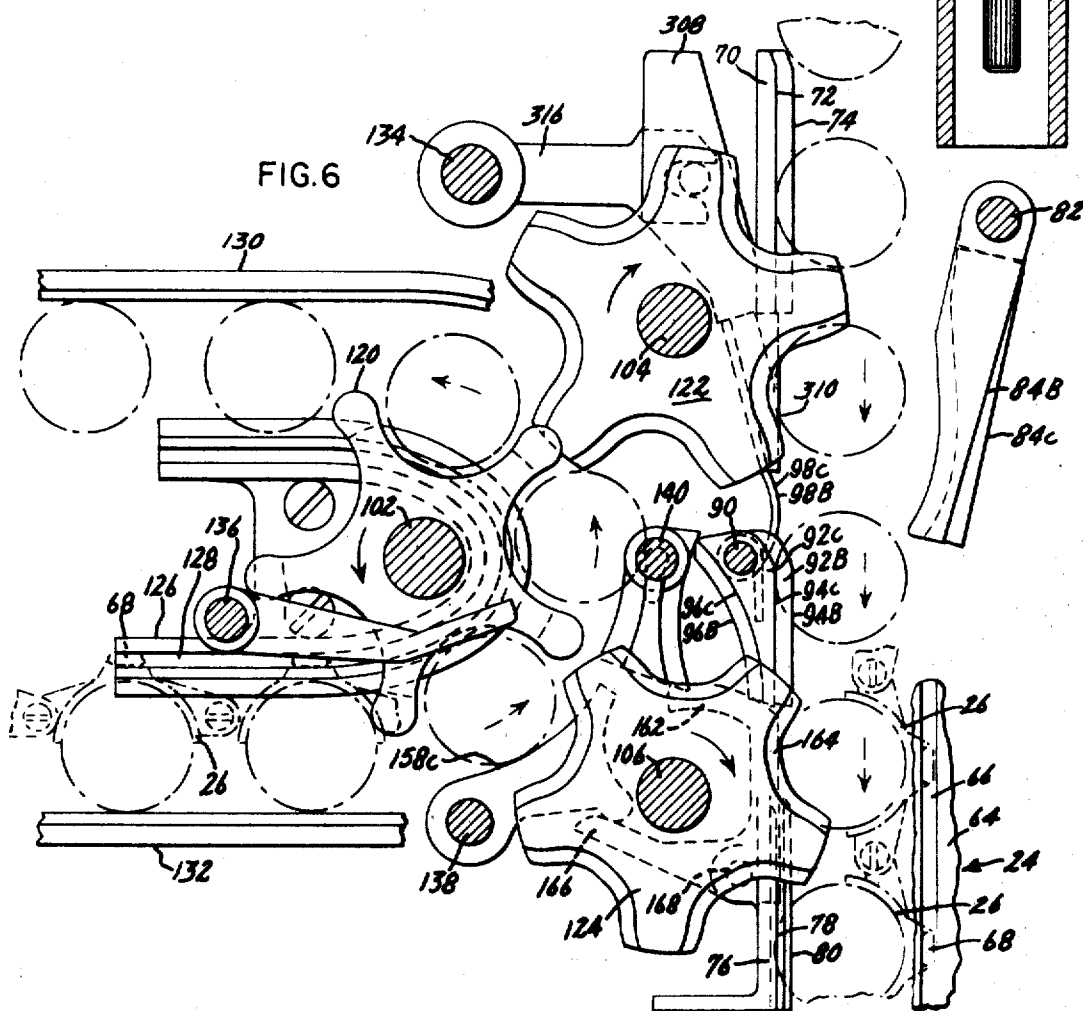
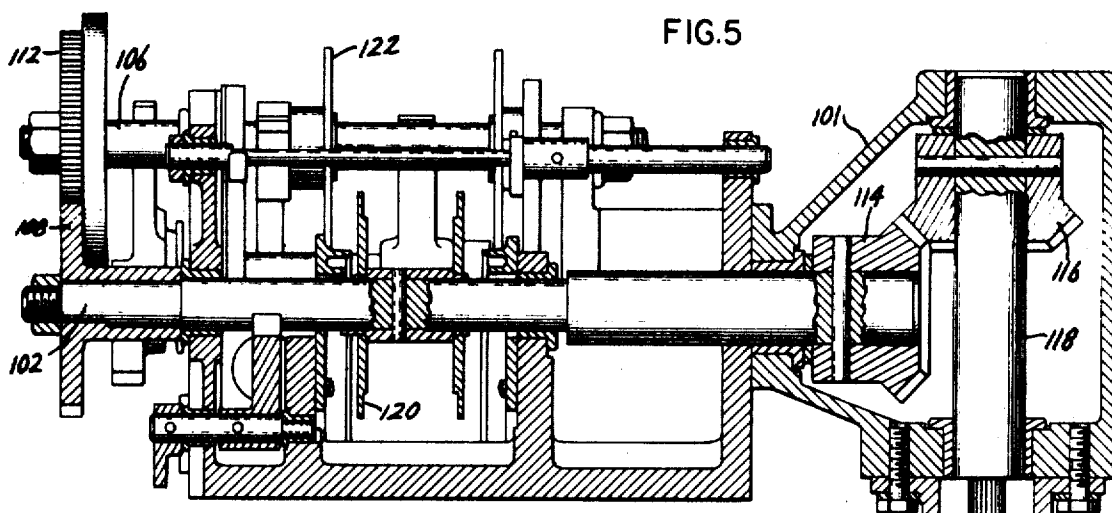
THEIR ATTORNEY.

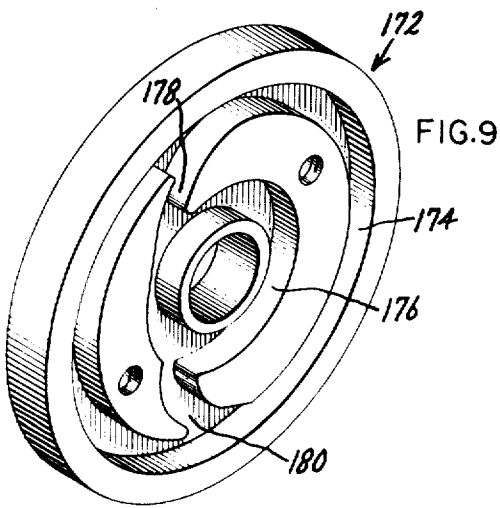
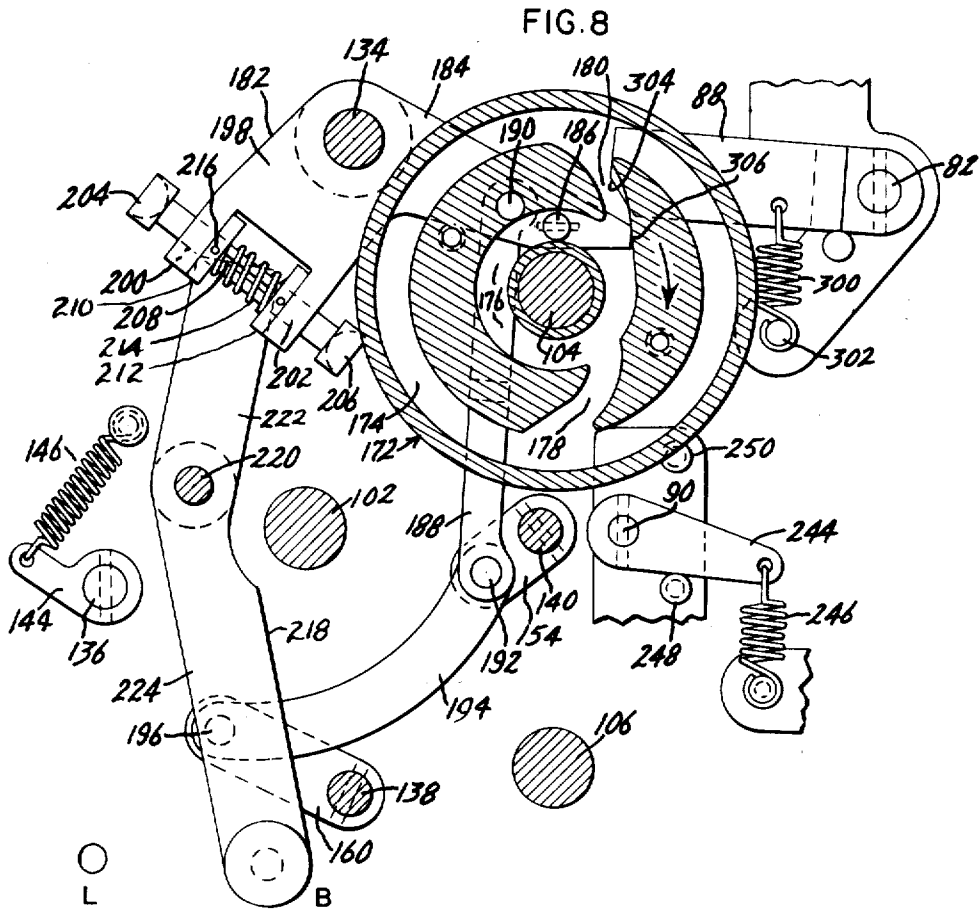


INVENTORS
LESTER F. BACKUS,
ROBERT P. LAURENT,
ROBERT G. TITEMORE,

BY

[Signature]
THEIR ATTORNEY.

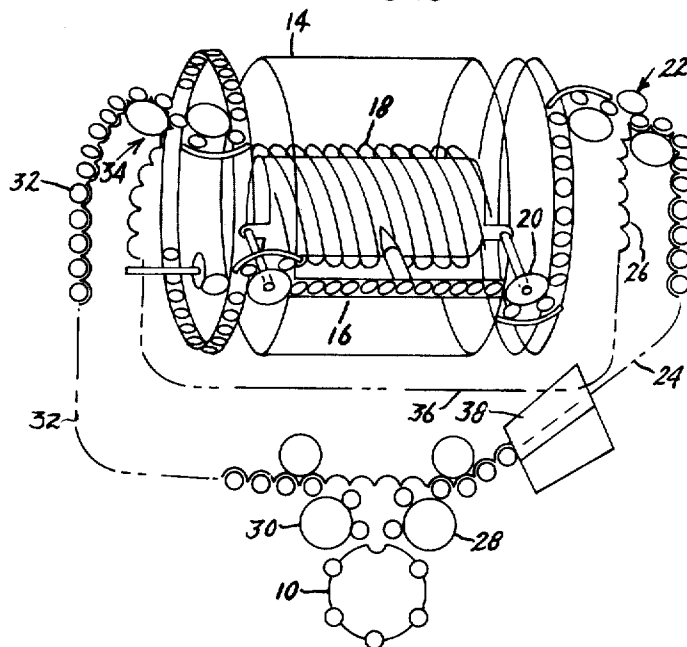




INVENTORS:
LESTER F. BACKUS,
ROBERT P. LAURENT,
ROBERT G. TITEMORE,

BY *Robert G. Titemore*
THEIR ATTORNEY.

FIG. 10



INVENTORS:

LESTER F. BACUS,
ROBERT P. LAURENT,
ROBERT G. TITMORE,

BY

Paul C. Smith

THEIR ATTORNEY.

AMMUNITION BULK LOADER

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to protectively loading and unloading ammunition, serial supply, storage systems for high rate of fire machine guns.

2. Prior Art

High rate of fire machine guns were initially disclosed by R. J. Gatling in U.S. Pat. No. 47,631 issued May 9, 1865 and others subsequently. Rounds of ammunition were loosely fed by gravity from a hopper through a throat to the bolts. An improved hopper was disclosed by L. F. Bruce in U.S. Pat. No. 247,158 issued Sept. 20, 1881. Belted ammunition was disclosed by F. L. Bailey in U.S. Pat. No. 173,751 issued Feb. 22, 1876, and belted ammunition for "Gatling" guns was disclosed by C. M. Broderick et al. in U.S. Pat. No. 504,516 issued Sept. 5, 1893. Positive linkless feeding for a "Gatling" gun was disclosed by J. G. Accles in U.S. Pat. No. 290,622 issued Apr. 22, 1890. The first modern "Gatling" gun was disclosed by H. McOtto in U.S. Pat. No. 2,849,921 issued Sept. 2, 1958. A modern linked drum-type storage device for the modern "Gatling" gun was disclosed by C. E. Houston et al. in U.S. Pat. No. 2,833,182 issued May 6, 1958. Now, conventionally, "Gatling" guns are either fed directly with linked ammunition and stripped of links as they enter the gun by a feeder-stripper of the type disclosed by R. W. Henshaw et al. in U.S. Pat. No. 3,333,506 issued Aug. 1, 1967; or are fed by an endless conveyor which is supplied by a drum of the type shown by E. W. Panicci et al. in U.S. Pat. No. 2,993,415 issued July 25, 1961. A production version of the M61, 20mm "Vulcan" gun with a linkless drum storage is shown on page 161 of "The Gatling Gun" by P. Wahl et al., Arco Publishing Co., Inc. 1565. A stripper-feeder is provided at the gun. Linked rounds of ammunition are fed through the feeder and stripped, the rounds pass through gun and into one end of the storage drum. Subsequently, the stored rounds pass out of the other end of the storage drum and into the gun; the rounds are fired and the cases are returned into said one end of the drum. When the gun is mounted in a naval airplane, this reloading may be done while the airplane is on the flight deck during a brief return between sorties. If the ammunition has electric primers, it is exposed to premature actuation by ambient electromagnetic radiation (RADHAZ). If live ammunition is unloaded from the aircraft, it is simply dumped into an open catch basin!

BRIEF DESCRIPTION OF THE INVENTION

Accordingly, it is an object of this invention to:

- reduce the weight, complexity, maintenance and cost of the airborne equipment;
- eliminate links and their direct and logistic costs;
- reduce ammunition storage space and weight;
- provide more efficient and reliable aircraft arming and dearming with a minimum of time and reduction of personnel; and
- provide reliability, safety and RADHAZ protection.

A feature of this invention is the provision of an ammunition handling system including double-ended serial storage device with a controlled conveyor adapted

both to rapidly transfer ammunition into a gun and storage system in an aircraft and to remove and store unfired rounds and fired cases in a radiation hazard free environment.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects, features and advantages of the invention will be apparent from the following specification thereof taken in conjunction with the accompanying drawing in which:

FIG. 1 is a general view in elevation showing a "bulk loader" embodying this invention coupled to an aircraft system;

FIG. 2 is a view in elevation of the adapter unit which is fixed to the aircraft system in lieu of the conventional feeder/stripper.

FIG. 3 is a view in side elevation of the interface unit of the "bulk loader" which is adapted to be coupled to the adapter unit of FIG. 2;

FIG. 4 is a view in elevation of the interface unit of FIG. 3;

FIG. 5 is a bottom view in cross section of the interface unit of FIG. 4 taken along the plane V—V;

FIG. 6 is a side view in elevation of the adapter and interface units as coupled together illustrating the by pass mode of operation;

FIG. 7 is a side view in elevation of the structure of FIG. 6 illustrating the load mode of operation; and

FIG. 8 is a side view in elevation of a part of the structure of FIG. 6 illustrating the mode shift linkage;

FIG. 9 is a perspective view of the mode shift cam; and

FIG. 10 is a schematic diagram of the gun and ammunition storage system in the aircraft.

DESCRIPTION OF THE INVENTION

As shown in FIG. 1 and 10, a Gatling type gun 10 is mounted in the fuselage 12 of an aircraft. The double ended linkless feed system includes a drum assembly 14 having an outer drum with a plurality of longitudinal partitions 16 projecting inwardly from the inner surface, and a helix 18 mounted for rotation within the drum. Rounds are stored between the partitions and advanced by the helix to an exit scoop disc assembly 20 which passes them via an exit unit 22 to a feed chute 24 and thence to the gun. The chute is preferably flexible, but functionally of the type illustrated in U.S. Pat. No. 3,429,221 issued to R. G. Kirkpatrick on Feb. 25, 1969, and has an endless chain of rounds conveyor elements 26. The rounds are removed from the conveyor elements by a feed transfer unit 28, are fired in the gun 10, and the cases are returned to the conveyor elements by an exit transfer unit 30. The conveyor elements carry the cases through a return chute 32 to an entrance unit 34 which removes the cases from the elements and transfers them into the drum, while the conveyor elements continues through the element return chute 36 to the exit unit 22. An adapter unit 38 straddles the feed chute 24, and is fixed in the aircraft.

The "bulk loader" is carried on a wheeled skid 40 and includes a drum assembly 42 with an outer drum 44 and an inner helix 46. An exit unit 48 is coupled to a feed chute 50, which is coupled to an interface unit 52, which is coupled to a return chute 54, which is coupled to an entrance unit 56, which is coupled to an element

return chute 58, which is coupled to the exit unit 48 so as to pass rounds and cases out of and into the drum assembly. A flexible shaft 60 is coupled between the drum assembly 42 and the interface unit 52 to transfer power from the drum assembly 42 to the system in the aircraft.

The adapter unit 38 includes a housing 62 in which are fixed an element conveyor guide 64 having two opposed rabbets 66 adapted to respectively receive the two opposed guide lugs 68 on each conveyor element 26; and spaced therefrom an upper rounds guide 70 having a pair of spaced apart rails 72 and 74 to respectively bear against the round's case body and the case's neck, and a lower rounds guide 76 having a similar pair of spaced apart rails 78 and 80. The guide structure is functionally similar to that shown in FIG. 3 of U.S. Pat. No. 3,429,221, *supra*.

A shaft 82 is journaled through the housing 62 and has a pair of stripping gates 84C and 84B fixed thereto with respective control surfaces 86C and 86B, and a crank arm 88 also fixed thereto, so that swing of the arm provides swing of the gates. A shaft 90 is also journaled through the housing 62 and has a pair of control gates 92C and 92B fixed thereto to respective bypass control surfaces 94C and 94B and respective load control surfaces 96C and 96B. A pair of torsion springs 98C and 98B are respectively fixed to the gates 92C and 92B and are journaled on the shaft 90.

The feed chute 24 is interrupted by the adapter unit 38, but the guides 64, 70, 162, 76, 94B, 94C and torsion spring 98C and 98B serve as functional continuations for the endless chain of conveyor elements passing through the chute.

The interface unit 52 includes a housing 100 and a right angle gear box housing 101. Three shafts 102, 104 and 106 are journaled through the housing. Gears 108, 110 and 112 are respectively fixed to these shafts, and a miter gear 114 is additionally fixed to the shaft 102 and disposed in the gear box housing. A miter gear 116 is meshed with the gear 114 and is fixed on a power input shaft 118 which is journaled in the housing 101 and which is coupled to the flexible shaft 60. An element turnaround sprocket 120 is fixed to the shaft 102, as rounds unload sprocket 122 is fixed to the shaft 104, and a rounds load sprocket 124 is fixed to the shaft 106. A conveyor element guide 126 having a pair of opposed rabbets 128 to receive and guide the lugs 68 of the conveyor elements of the feed chute 50 and the return chute 54, and an upper rounds guide 130 and a lower rounds guide 132, each having respective case body and case neck rails, are fixed in the housing. Four shafts 134, 136, 138 and 140 are also journaled in the housing. A pair of stripping gates 142 is fixed to the shaft 136. A crank arm 144 is also fixed to the shaft 136, and its distal end is coupled to one end of a helical tension spring 146 whose other end is fixed to the housing, thereby spring biasing the distal ends of the gates 142 against the rounds as they are conveyed in through the feed chute 50 by the conveyor elements. A pair of control gates 148C and 148B are fixed on the shaft 140 and have respective bypass/load control surfaces 150C and 150B and load control surfaces 152C and 152B. One end of a link 154 is also fixed to the shaft 140. A bypass control gate 156C is fixed on the shaft 138 and has a respective bypass/load control surface 158C. One

end of a link 160 is also fixed to the shaft 138. A bypass crank-guide 162 having a rounds guide surface 164 and a tail 166 is pivotally mounted at 168 to the guide 76 within the sprocket 124 and biased by a leaf spring 169 counter clockwise to bring its guide surface 164 out of the sprocket to bear against rounds in the conveyor elements. The tail 166 is engaged by a cam surface 170 on the gate 156C and adapted to be swung counter-clockwise to withdraw the guide surface 164 within the sprocket 124.

A cam 172 is fixed on the shaft 104, and has a load mode, outer annular track 174, a bypass mode, inner annular track 176, a load to bypass switchover track 178, and a bypass to load switchover track 180. A crank 182 is fixed to the shaft 134 and has one arm 184 overlying the cam 172 and carrying a cam followed 186 which extends into the tracks of the cam. One end of the link 188 is also pivotally coupled at 190 to the arm 184 and its other end is pivotally coupled at 192 to the link 188 and the arm 154. A link 194 has one end pivotally coupled at 192 to the link 188 and the arm 154, and its other end pivotally coupled at 196 to the distal end of the arm 160. The crank 182 has another arm 198 with a clevis distal end having two bores 200 through which is journaled a rod 202 having enlarged ends 204 and 206. The rod has a diametral, longitudinally extending slot 208 therethrough and carries two washers 210 and 212 and a helical compression spring 214. Each of the washers has a transverse, diametral pin 216 passing through the slot 208. A crank arm 218 is pivotally mounted at 220 to the housing, has a first arm 222 whose distal end overlies the clevis of the arm 198, and has a second arm 224 serving as a mode control handle which may be swung to and from the load mode disposition shown in FIG. 7 from and to the bypass mode disposition shown in FIGS. 6 and 8.

A timing disk 226 is also fixed to the shaft 104 and has a plurality of cut-outs 228 equal in number to the plurality of cut-outs on the sprockets 122 & 124. A crank arm 230 is pivotally mounted on the shaft 134, has a first arm 232 with a first tooth 234 and a second tooth 236, and has a second arm 238 with a handle 240. The tooth 234 is adapted to engage any one of the cut-outs 228, the tooth 236 is adapted to engage a cut-out 242 in the housing of the adapter unit 38. When one tooth is fully engaged, the other tooth is fully clear, when one tooth is partly engaged, the other tooth is also partly engaged. The interface housing also includes a pair of lugs 243 adapted to engage a pair of pins 243A fixed to the adapted unit housing.

An arm 244 has one end fixed to the shaft 90 in the adapter unit and its other end coupled to one end of a helical tension spring 246 whose other end is coupled to the housing 62. The swing of the arm 244 is limited by and between two stop pins 248 and 250 fixed to the housing.

The crank arm 88 is biased counter-clockwise by a helical tension spring 300 which is coupled between the arm and a pin 302 fixed to the housing. The distal end of the arm has a cam surface 304 adapted to be engaged by the distal end 306 of the arm 184 of the crank 182. A guide 308 is mounted for reciprocation in the adapter unit and has a control surface 310 and a pin 312. The pin 312 is adapted to be engaged by a clevis 314 formed on the distal end of a crank arm 316 whose other end is fixed to the shaft 134 on the interface unit.

The "bulk loader" drum assembly 42 may be loaded with live rounds of ammunition in any convenient, radiation hazard free location, by removing the entrance unit 56 and inserting the rounds by hand, or otherwise, into the entrance scoop disk assembly 35, which distributes the rounds sequentially and cyclically into each of the spaces provided by the longitudinal partitions 16. After loading, the entrance unit 56 is restored to the drum assembly, and the "bulk loader" may be brought to the aircraft. The interface unit is coupled to the adapter unit by engaging the lugs 243 with the pins 243A and engaging the tooth 236 with the cut-out 242, thereby, also, releasing the shaft 106 for rotation.

The interface unit control handle 224 may be initially swung to the bypass mode disposition, as shown in FIG. 6. In the bypass mode, rounds are taken from the "bulk loader" drum assembly 42 by the exit unit 48 and respectively placed in conveyor units which conveyor units travel through the feed chute 50 to the interface unit and return through the return chute 54 to the entrance unit 56. As the rounds are brought into the interface unit they are retained in their conveyor elements by the rounds guides 132, further retained by the broad control surface 158C of the counter-clockwise swung control gate 156C bearing on the middle length of the round's case and by the rotating sprocket 124, further retained by the control surfaces 150C and 150B of counter-clockwise swung gates 148C and 148B bearing on the case and case necks, further retained by the control surfaces of the rotating sprocket 122, and further retained by the rounds guides 130. Meanwhile conveyor elements 26 are carrying either live rounds or empty cases from the aircraft drum assembly 14 through the feed chute 24 into the adapter unit 38 and thence to the gun 10 and returned through the return chute 32 to the drum assembly. As the rounds are brought into the adapter unit they are retained in their conveyor elements by the rounds guides 72 and 74, further retained by the control surface 310 on the gate 308 which has been lowered — extended by the clockwise rotated crank 316, further retained by the springs 98C and 98B, further retained by control surfaces 94C and 94B of the gates 92C and 92B, further restrained by the control surface 164 of the gate 162 which has been biased clockwise by the leaf spring 169, and further retained by the guide rails 78 and 80.

When it is desired to exchange rounds or cases between the "bulk loader" and the aircraft, the interface unit control handle 224 is swung to the load mode disposition, as shown in FIG. 7. The end of the arm 222 bears against the rod enlargement 206 and through the spring 214 biases the crank 182 for counter-clockwise rotation. The cam follower is presently in the inner track 176 of the cam 172 and when it is aligned with the track 180 the spring bias causes it to ride through to the outer track 174, permitting the crank 182 to rotate counter-clockwise, and through the links 188 and 194 causing clockwise rotation of the gates 150C and 150B and clockwise rotation of the gate 156C. The clockwise rotation of the gate 156C, via the projection 170 and the tail 166, causes the counter-clockwise rotation of the gate 162. Also, the counter-clockwise rotation of the crank 182 causes counter-clockwise rotation of the crank 316 to effect the raising-withdrawal of the guide 308. When the rounds leave the rails 132 they are

pushed out of their conveyor elements by the clockwise biased gates 142, are carried by the sprocket 124 along the control surfaces 152C and 152B, and push counter-clockwise against, and open, the gates 92B and 92C via their control surfaces 96C and 96B, and are deposited in the conveyor elements travelling between the guides 64 and the lower rails 78 and 80. Meanwhile the cases being carried from the aircraft drum supply are retained by the guide rails 72 and 74 until they are stripped from their conveyor elements by the control surfaces 86C and 86B of the gates 84C and 84B which have been swung clockwise by the arm end 306 acting on the cam 304 of the arm 88, and are carried by the sprocket 122 and deposited in the conveyor elements in the interface unit and brought under the rails 130 for passage into the return chute 54.

When it is desired to return to the bypass mode, the handle 224 is swung to the bypass mode disposition, causing the end 222 to bear against the rod enlargement 204, to bias the crank 182, to bias the cam follower 186 to ride in the track 178 to the inner track 176 to cause the gates to restore to their respective bypass position.

The system can be shifted between modes at any time at the operator's convenience. When the interface unit is to be disengaged, power is removed from the system, the handle 240 is pulled to withdraw the tooth 236 from the adapter housing cut-out 242 and to engage the tooth 234 in one of the cut-outs 228 to lock up the "bulk loader" conveyor elements and sprockets. The lugs 243 are withdrawn from the pins 243A, and the interface unit is separated from the adapter unit. The aircraft is free to take off, and the "bulk loader" may be unloaded of cases and reloaded with live rounds at a subsequent convenient occasion and location. It may be noted that if only part of the aircraft's supply of live rounds had been fired, only these cases need be removed and replaced.

What is claimed is:

1. A weapon system comprising a weapon;

a first endless loop ammunition handling system coupled to said weapon for serially passing rounds of ammunition into, through and out of said weapon;

a second endless loop ammunition handling system;

system transfer means coupled to and between said first and second system having a first mode of function wherein rounds contained in said first system are recirculated in said first system and rounds contained in said second system are recirculated in said second system; and a second mode of function wherein rounds contained in said first system are serially transferred to said second system and rounds contained in said second are serially transferred to said first system.

2. A weapon system according to claim 1 wherein:

said first system includes a first endless conveyor system;

said second system includes a second endless conveyor system; and

said system transfer means includes first gate means for isolating said first and second conveyor systems, and second gate means for withdrawing rounds from said first conveyor means and transferring such rounds to said second conveyor means

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and for withdrawing rounds from said second conveyor means and transferring such rounds to said first conveyor means.

3. A weapon system according to claim 1 wherein: said system transfer means is divisible into first and second portions whereby said first system and said first portion may be separated from said second system and said second portion.
4. A weapon system according to claim 2 wherein: said second system includes a double ended helical storage drum.
5. A weapon system according to claim 1 wherein: said first system includes a first endless conveyor system; said second system includes a second endless conveyor system; and said system transfer means includes a first sprocket means interengaging said first and

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- second conveyor systems, a second sprocket means interengaging said first and second conveyor systems, first gate means, for deflecting rounds from said first conveyor system into said first sprocket means and thence into said second conveyor system, and second gate means for deflecting rounds from said second conveyor system into said second sprocket means and thence into said first conveyor system.
6. A weapon system according to claim 5 wherein: said system transfer means is divisible into first and second portions whereby said first system and said first portion may be separated from said second system and said second portion.

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