May 10, 1960 B. DARSIE ET AL 2,935,914

LINKLESS FEED SYSTEM FOR GUNS

Filed Aug. 5, 1957 7 Sheets-Sheet 1

Fig. 1.

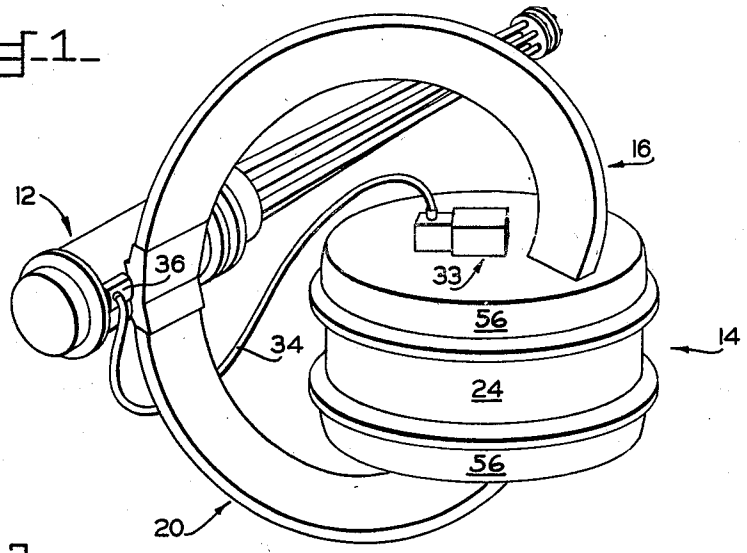


Fig. 2.

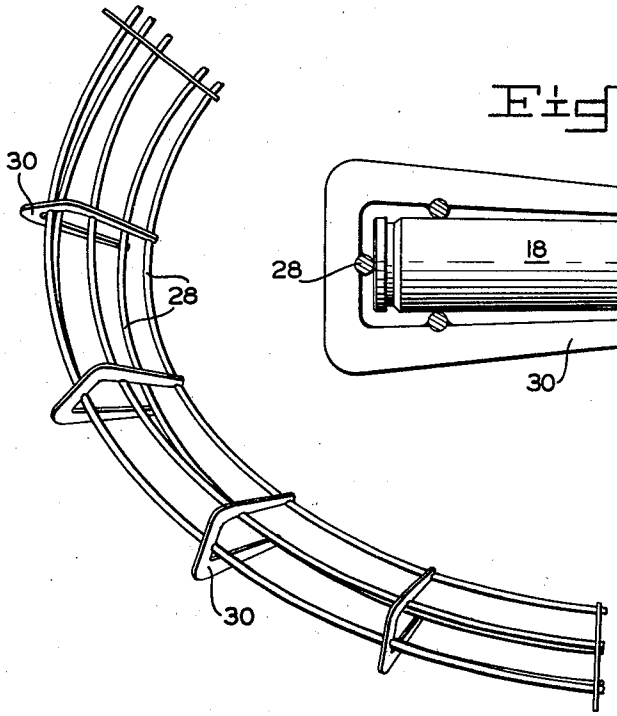


Fig. 3.

INVENTORS,
Roger H. Cosler
Burns Darsie
BY
W. E. Thibodeau & T. J. Lynch

May 10, 1960 B. DARSIE ET AL 2,935,914

LINKLESS FEED SYSTEM FOR GUNS

Filed Aug. 5, 1957 7 Sheets-Sheet 2

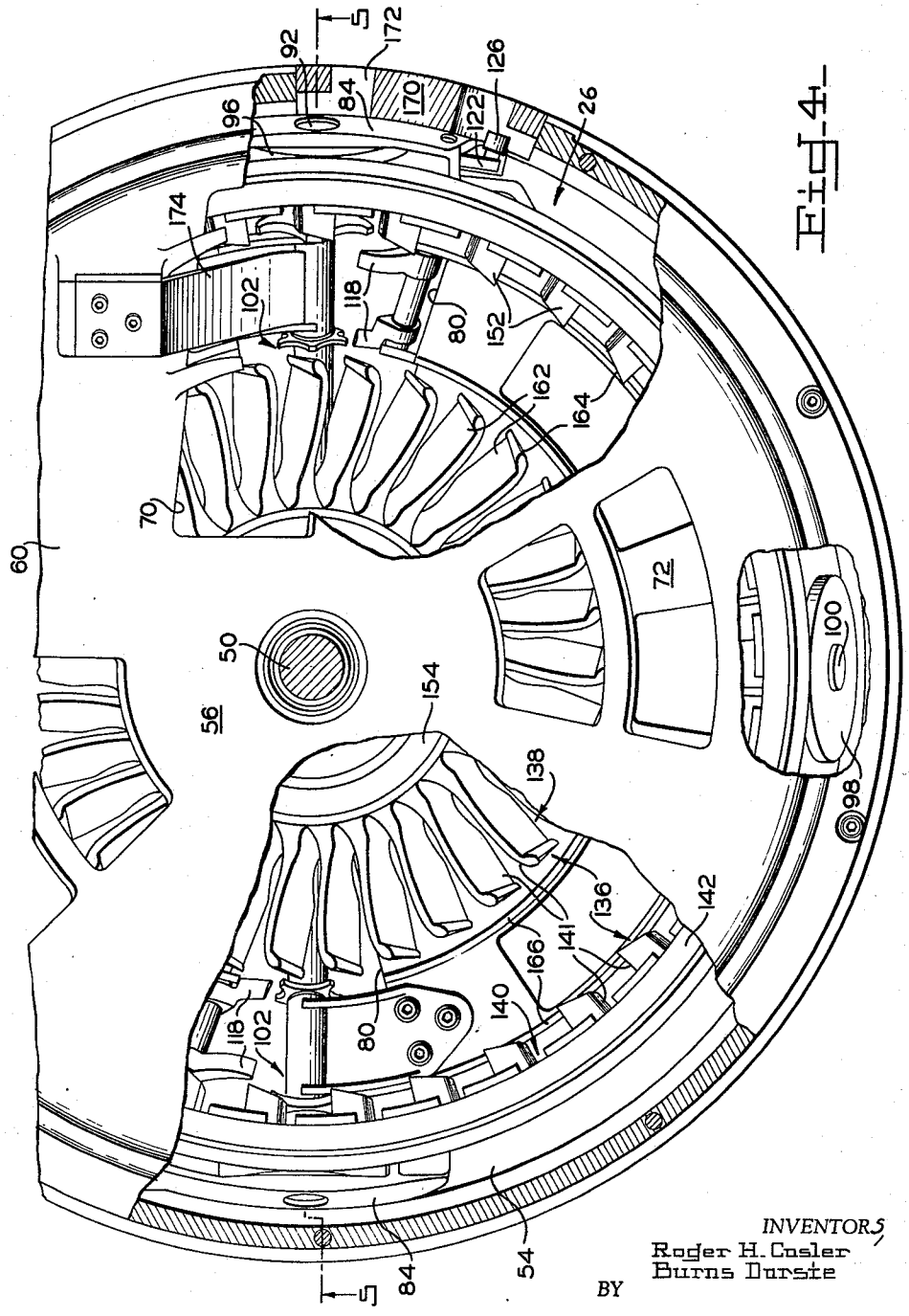


Fig. 4

INVENTORS,
Roger H. Cosler
Burns Durste

BY

W. E. Thibodeau & T. J. Lynch

May 10, 1960 B. DARSIE ET AL 2,935,914

LINKLESS FEED SYSTEM FOR GUNS

Filed Aug. 5, 1957 7 Sheets-Sheet 3

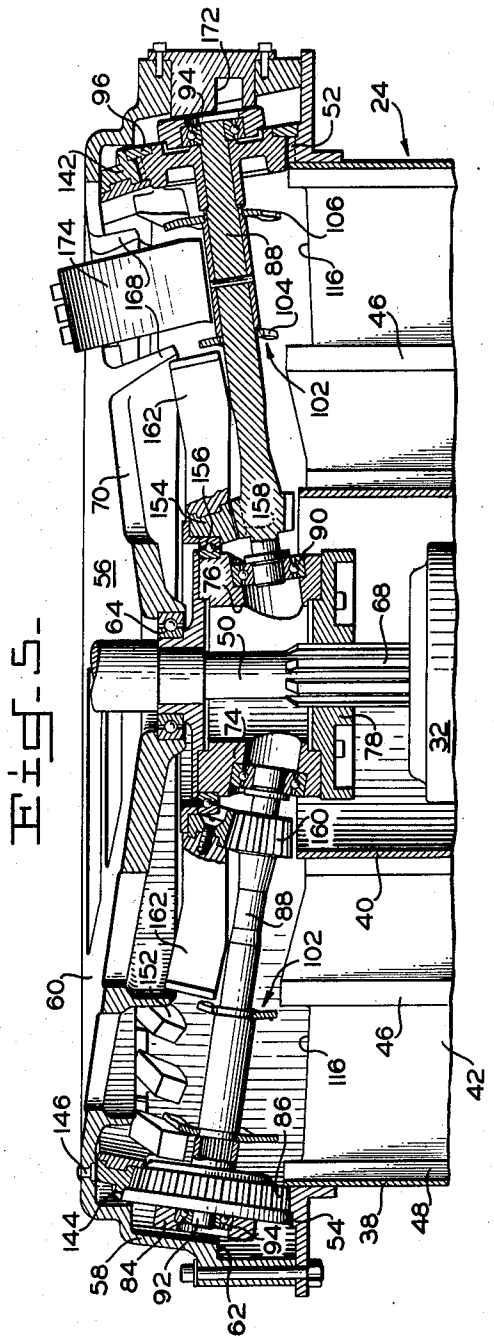


Fig. 5.

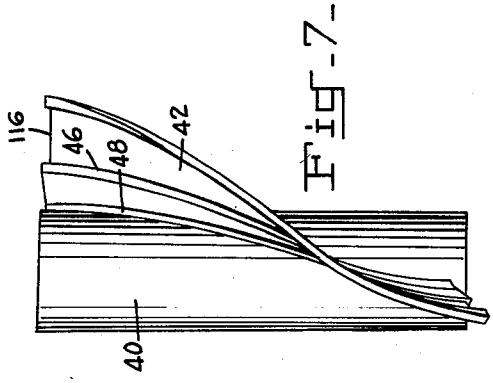


Fig. 7.

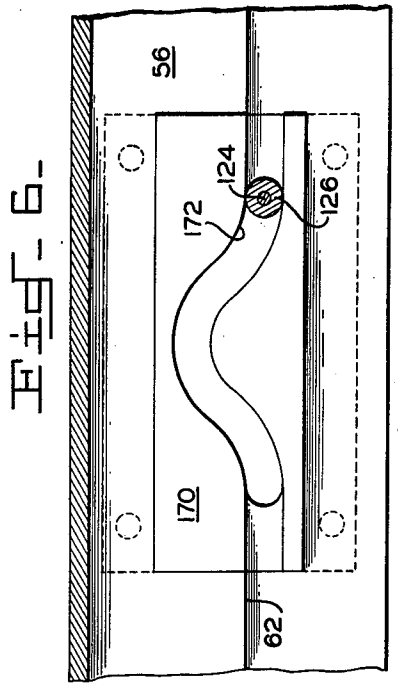


Fig. 6.

INVENTORS
Roger H. Casler
Burns Darsie

BY

W. E. Thibodeau & T. J. Lynch

May 10, 1960 B. DARSIE ET AL 2,935,914

LINKLESS FEED SYSTEM FOR GUNS

Filed Aug. 5, 1957 7 Sheets-Sheet 4

Fig. 8

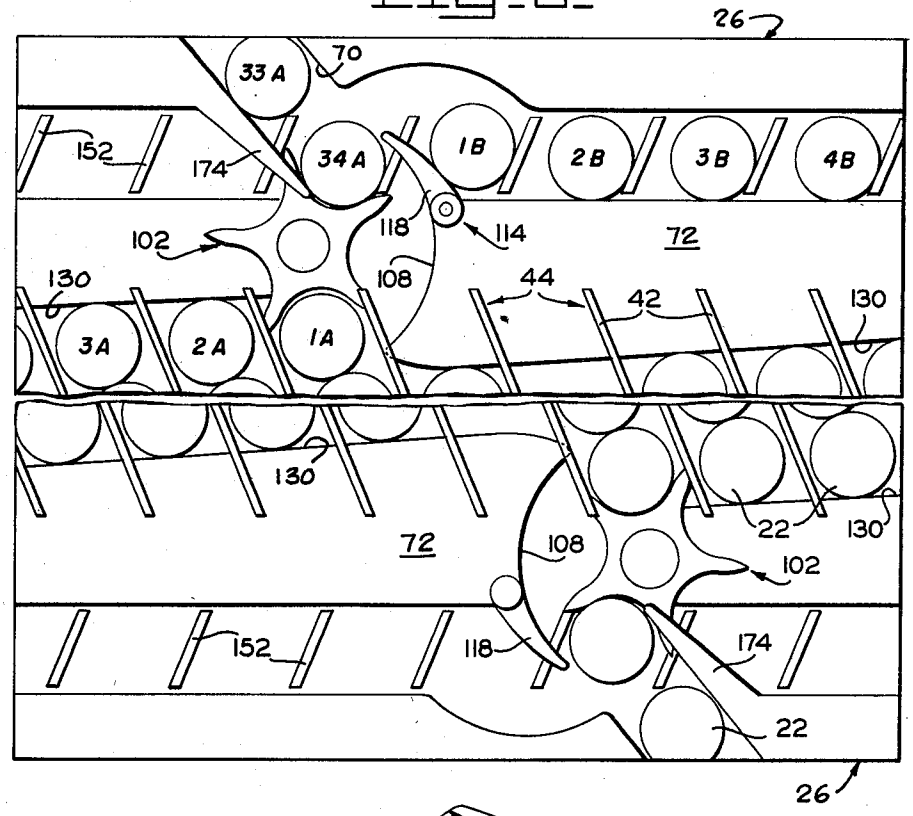
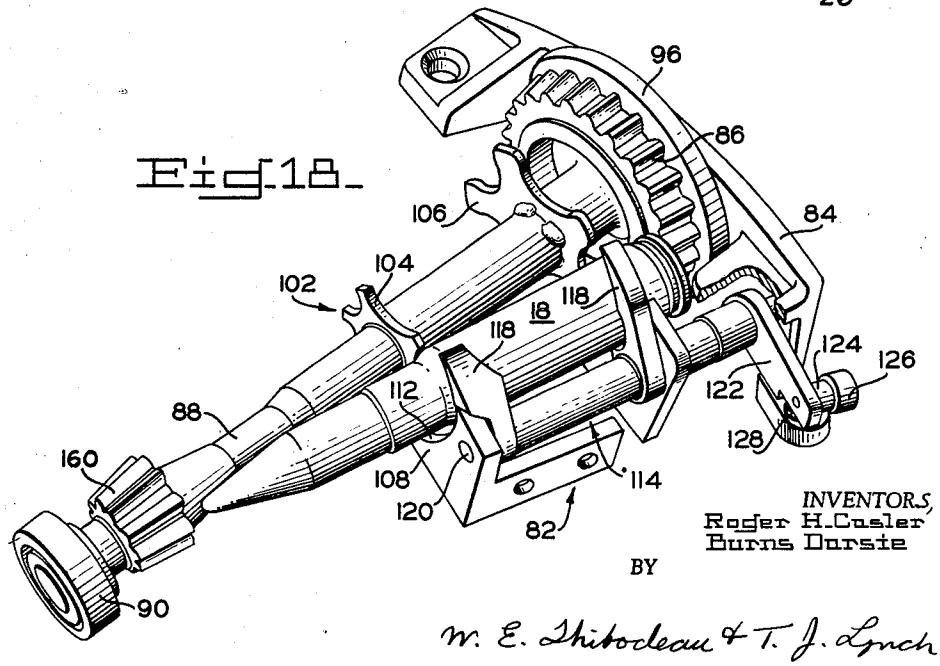


Fig. 18



INVENTORS,
Roger H. Casler
Burns Darsie

BY

W. E. Thibodeau & T. J. Lynch

May 10, 1960 B. DARSIE ET AL 2,935,914

LINKLESS FEED SYSTEM FOR GUNS

Filed Aug. 5, 1957 7 Sheets-Sheet 5

Fig-10

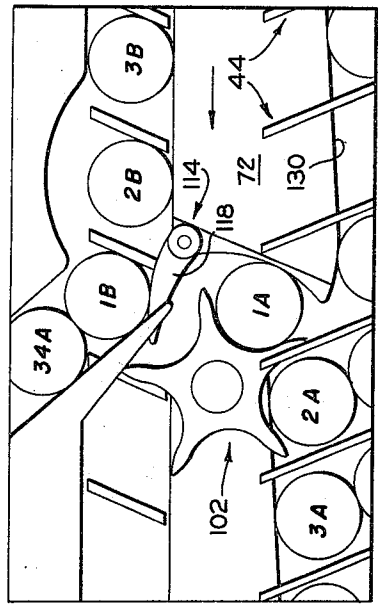


Fig-12

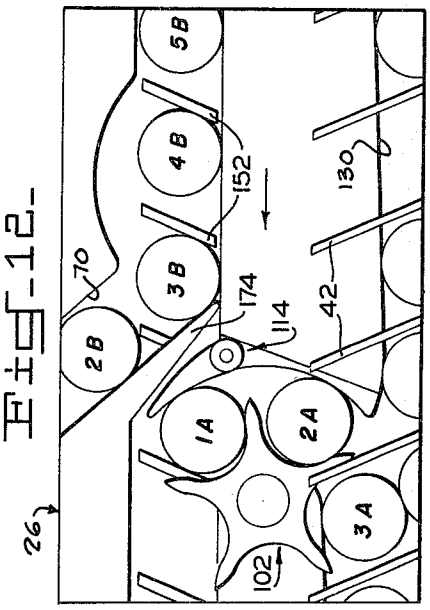


Fig-9

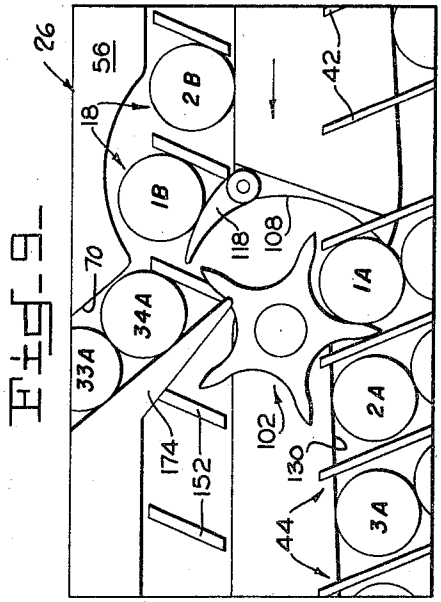
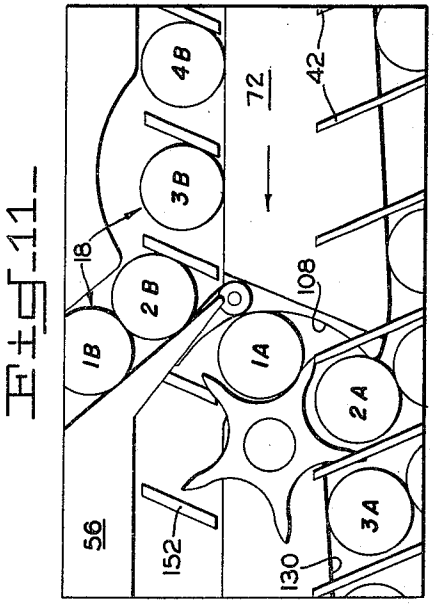


Fig-11



INVENTORS,
Roger H. Cusler
Burns Darsie

BY

W. E. Thibodeau & T. J. Lynch

May 10, 1960 B. DARSIE ET AL 2,935,914

LINKLESS FEED SYSTEM FOR GUNS

Filed Aug. 5, 1957 7 Sheets-Sheet 6

Fig. 13.

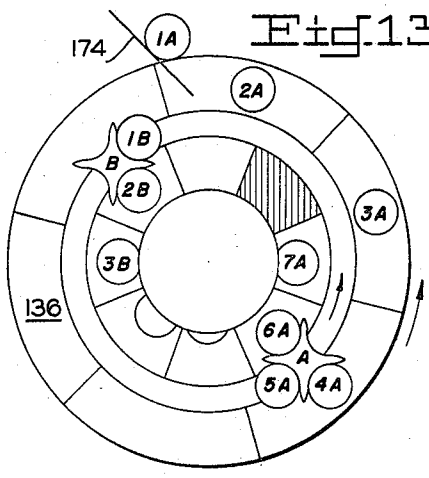


Fig. 14.

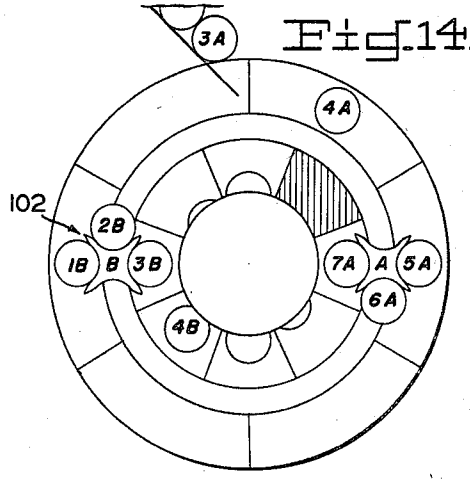


Fig. 15

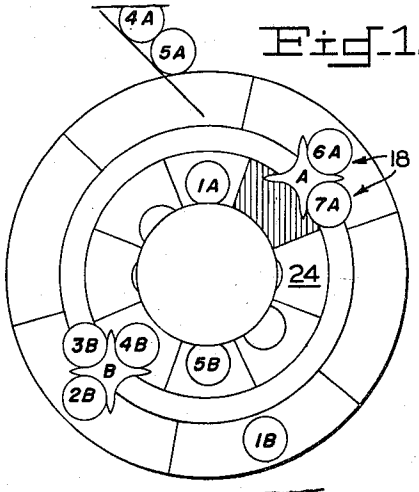


Fig. 16.

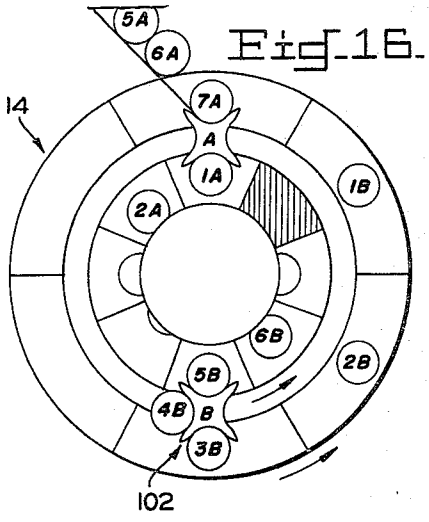
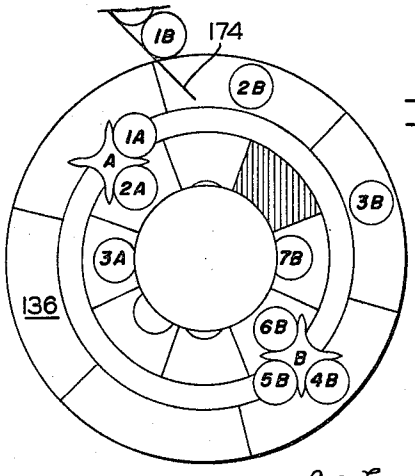


Fig. 17.



INVENTORS,
Roger H. Cosler
Burns Darsie

BY

W. E. Thibodeau & T. J. Lynch

May 10, 1960 B. DARSIE ET AL 2,935,914

LINKLESS FEED SYSTEM FOR GUNS

Filed Aug. 5, 1957 7 Sheets-Sheet 7

Fig. 19

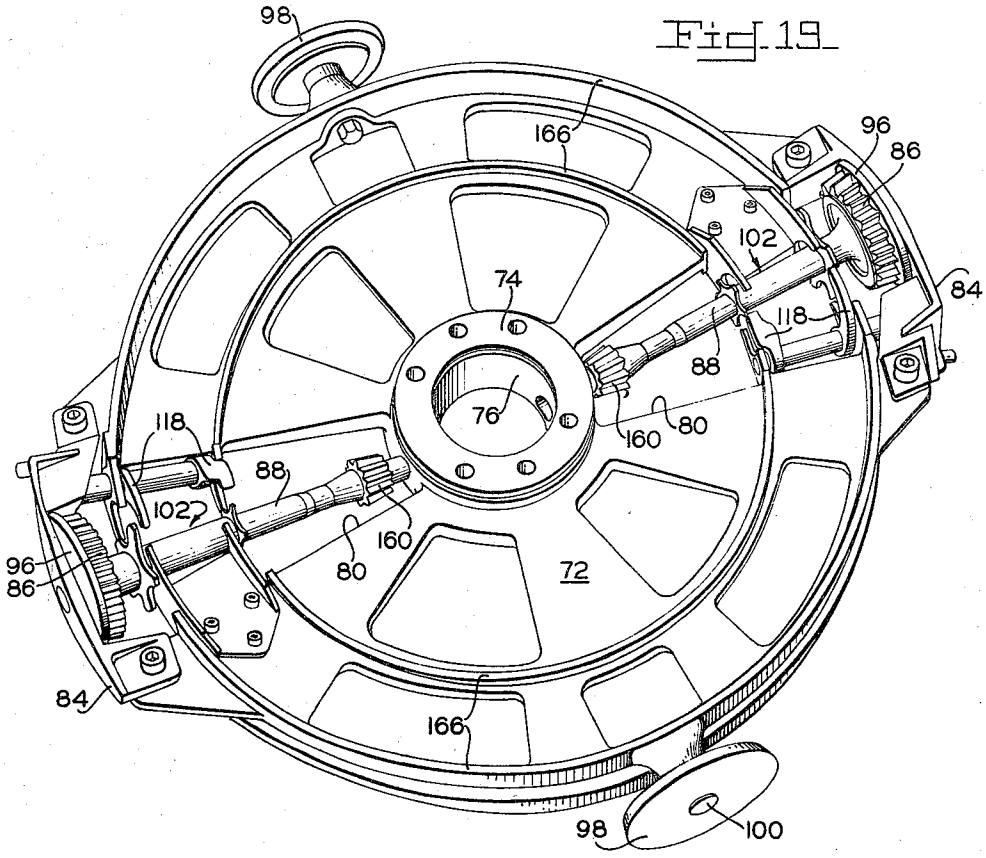
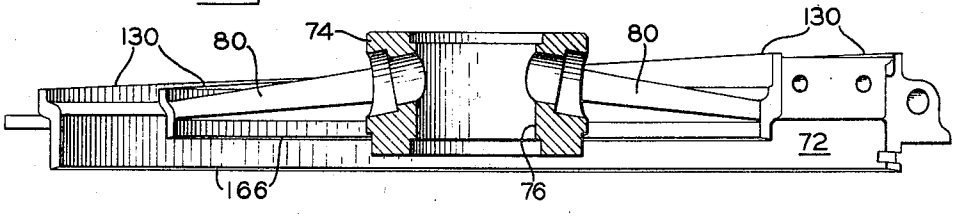


Fig. 20



INVENTORS
Roger H. Cusler
Burns Darsie
BY
S. J. Rotondi & A. T. Dupont

United States Patent Office 2,935,914
Patented May 10, 1960

2,935,914

LINKLESS FEED SYSTEM FOR GUNS

Burns Darsie, Rockford, Ill., and Roger Herman Casler, Washington, Conn., assignors to the United States of America as represented by the Secretary of the Army

Application August 5, 1957, Serial No. 676,454

19 Claims. (Cl. 89—33)

This invention relates to systems for supplying cartridges to automatic guns.

In the past, the most satisfactory means of storing cartridges for use by automatic guns and of conveying the cartridges to the guns and the empty cases therefrom have been by belts formed by cartridge-carrying links.

However, with the rate of fire of automatic guns being increased, there are resulting increases in acceleration and deceleration in the supply systems, and it is not uncommon now for guns to accelerate from 0 to 6000 rounds per minute in .2 second and decelerate at the same rate. Because of these rapid changes in motion, link belts have become unsatisfactory as separation and breakage frequently occur.

It is, therefore, a broad object of this invention to provide for automatic guns a cartridge supplying system whereby cartridges are transferred from a storage drum and moved by in-line contact through a chute to the gun with the empty cases being returned to the drum by chute means also by in-line contact. It is another broad object of this invention to provide for automatic guns a cartridge supplying system wherein the cartridges and cases are accelerated and decelerated during transfer between the gun and a storage drum in a manner to minimize the forces of such acceleration and deceleration.

It is still another broad object of this invention to provide a closed linkless supply system for moving stored cartridges from a supplier to a gun and returning the empty cartridge cases to the supplier with the supplier being synchronized to the gun and the supplier and gun being provided with motor units which are joined for mutual assistance.

It is a specific object of this invention to provide a supply system whereby cartridges are removed from one end of a storage drum and the empty cases returned to the opposite end to occupy the spaces created by the removal of the cartridges.

It is another specific object of this invention to provide for such supply system cartridge chutes comprised of spaced-apart rods which slidingly support the cartridges and cases during movement to and from the gun.

It is a further object of this invention to provide for such a supply system a storage drum including radially-disposed partitions which extend from one end of the drum to the other to form storage spaces for the cartridges and empty cases and which are helically formed so that the axes of the cartridges and cases in such storage spaces are normal to the axis of the drum.

It is still a further object of this invention to provide for such supply system and storage drum a pair of reversible transfer mechanisms which scoop cartridges from one end of the storage spaces and transfer them through the chute to the gun and place the empty cases in the opposite ends of such storage spaces.

It is another and still further object of this invention to provide for each of such transfer mechanisms in such a supply system a transmission mechanism which pushes the cartridges toward the gun from the feeding side of the drum and carries away from the return chute the empty cases therein, and a scoop disc which scoops successive layers of cartridges from the drum and places them in the transmission mechanism or moves the empty cases from the transmission mechanism and places them in the drum and which rotates at half the velocity of the transmission mechanism.

It is still another and further object of this invention to provide for such transfer mechanisms a motorized scoop disc having a pair of diametrically-opposed inner transfer mechanisms rotatably responsive to rotation of the scoop disc for transferring cartridges from the drum to a cooperating transmission mechanism driven by such scoop disc at approximately twice the speed thereof to alternately receive from the two inner transfer mechanisms a bank of cartridges for direct transfer by the transmission mechanism to the feed chute and a bank held in storage for subsequent transfer to the feed chute whereby the amount of force required to accelerate the cartridges to the speed of the gun during transfer from the supply drum to the feed chute is much less than that which would have been required if the cartridges were accelerated immediately to the speed of the gun.

The specific nature of the invention as well as other objects and advantages thereof will clearly appear from a description of a preferred embodiment as shown in the accompanying drawings in which:

Fig. 1 is a perspective view of the supplier of this invention joined to a gun;

Fig. 2 is an enlarged perspective view of a portion of the chute;

Fig. 3 is an enlarged cross-sectional view of the chute with a cartridge received therein;

Fig. 4 is an enlarged top view of the supplier with the cover partially broken away to show the transfer mechanism therein;

Fig. 5 is a view taken along line 5—5 of Fig. 4;

Fig. 6 is an elevational view of the cam channel in the cover;

Fig. 7 is a perspective view of one of the partitions in the drum;

Fig. 8 illustrates diagrammatically the flow of cartridges and empty cases through the supplier;

Figs. 9–12 illustrate diagrammatically the scheme whereby the cartridges are transferred from the drum to the feed chute;

Figs. 13–17 illustrate schematically the flow of the cartridges from the drum to the feed chute;

Fig. 18 is an enlarged perspective view of the inner transfer device;

Fig. 19 is an enlarged perspective view of one of the scoop disc assemblies; and

Fig. 20 is a cross-sectional view of the other of the scoop disc assemblies with the inner transfer devices removed therefrom.

Shown in the figures is an automatic machine gun **12** actuated by an electric motor (not shown) and a cartridge supplier **14** having communication with the feeding mechanism of such gun by a feed chute **16**, which slidingly transfers cartridges **18** from the supplier to the gun, and a return chute **20**, which slidingly directs the empty cases **22** from the gun to the supplier.

Supplier **14** includes a drum **24**, which stores an initial supply of cartridges **18** and receives the empty cases **22** returned from the gun, and two similar transfer mechanisms **26** which are mounted on the opposite ends of such drum so as to be rotatable about the axis thereof, as hereinafter described. One of the transfer mechanisms **26** is mounted to the feeding end of drum **24** and is connected to feed chute **16** so as to move cartridges from drum **24** through such feed chute to gun **12**, as hereinafter explained. The other one of the transfer mecha-

nisms 26 is mounted to the return end of drum 24 and is connected to return chute 20 so as to transfer the empty cases 22 flowing through such return chute from gun 12 into drum 24.

Movement is imparted to the line of cartridges 18 in feed chute 16 by the cartridges transferred thereinto by the associated transfer mechanism 26, and the empty cases 22 are moved from gun 12 and through return chute 20 by the cartridges 18 moved into the gun. The transfer mechanism 26, mounted between return chute 20 and drum 24, uses the empty cases, as hereinafter explained, to move the supply of cartridges in the drum toward the feeding end thereof for transfer by the transfer mechanism mounted thereto to feed chute 16 whereby the cartridges and empty cases are moved in a closed conveyer system.

It is desirable that the cartridge cases in chutes 16 and 20 be in in-line contact. Because of the approximate two degrees of taper of the cartridge cases, such cases form a circle having a radius of 33.28 inches when in contact. Therefore, the chutes 16 and 20 are curved to form a circular path having such a radius and are constructed from five rods 28 which are spaced by a plurality of U-shaped formers 30 so as to make five-point sliding contact with the cartridge cases. Two of the rods 28 are arranged to engage the cartridge cases on opposite sides of the neck portions at the junctions thereof with the shoulders, and another two on opposite sides of the body portions adjacent the bases with the fifth slidingly contacting the bases, as is best shown by Figs. 2 and 3. Hereby, the cartridges 18 and the empty cartridge cases 22 are slidingly supported with a minimum of structure and weight and are easily accessible for unloading the chutes.

The transfer mechanisms 26 are driven, as hereinafter explained, by an electric motor 32, and such motor is connected by a gear train 33 and a flexible drive shaft 34 to a power takeoff 36 on machine gun 12 so that the machine gun and supplier 14 are synchronized together. By this arrangement, too, the motors of the gun and supplier assist each other in event an overload is placed on one or if one becomes inoperative.

Drum 24 includes an outer cylindrical shell 38 and an inner cylindrical shell 40 which are connected by a plurality of evenly-spaced partitions 42 disposed radially therebetween. The partitions 42 are so spaced that a row of radially-disposed cartridges 18 or empty cases 22 may be slidably moved from one end of drum 24 to the other. In the present embodiment, which is adapted for a machine gun of .60 caliber type, there are thirty-five of the partitions 42 which form an equal number of storage spaces 44 extending from one end of drum 24 to the other. One of the storage spaces 44 must be empty for a reason to be explained hereinafter.

As has been previously noted, the cases of the cartridges are tapered and, therefore, in order to have the rows of cartridges 18 and empty cases 22 in the storage spaces 44 stacked so that the axes are normal to the axis of drum 24, the partitions 42 are helically formed to reduce the contacting areas of the cases whereby the cartridges and empty cases may be placed in proper position, as explained hereinafter. With drum 24 being composed of thirty-five of the partitions 42, the opposite ends of each of such partitions are helically displaced at an angle of 107.65 degrees when the length of the partition is 25.13 inches, which is required for a row containing twenty-six cartridges. Such partitions, too, are contoured to prevent any longitudinal shifting of the cartridges by providing ovoid portions 46 which extend from one end of the partition to the other and are arranged to slidingly contact the cartridge cases at the junctions of the neck and shoulder portions while passing along the storage spaces 44. Provided on the sides of the partitions 42 which engage the outer shell 38 are oppositely extending foot portions 48 which slidingly contact the bases of the cartridges 18 adjacent the rims thereof to space the bases from such outer shell.

Motor 32 is mounted within inner shell 40 and is provided with a drive shaft 50 which extends both ways therefrom along the axis of drum 24. Attached to each of the ends of outer shell 38 is a ring gear 52 provided with an annular track portion 54 which is normal to the axis of drum 24 and which circles such ring gear outside of the teeth portion thereof. Each of the transfer mechanisms 26 is inclosed by a cuplike cover member 56 which is attachable at the open end to the outside of drum 24 and is composed of an annular rim portion 58 and a circular end portion 60. The rim portions 58 are increased in diameter adjacent the open ends and formed thereby are annular shoulders 62 which are spaced from the ends of drum 24 when the cover members 56 are mounted thereto. Mounted centrally to each of the end portions 60 is a ball bearing member 64 which receives one of the ends of drive shaft 50 to provide rotatable support therefor. The portions of the drive shaft 50 within the cover members 56 are splined, as noted at 68. Gear train 33 is connectable to one of the ends of drive shaft 50 extending through the associated cover member 56.

Provided through each of the cover members 56 in alignment with the circular layer of cartridges 18 or empty cases 22 at the ends of drum 24 is a port 70 through which the cartridges or empty cases may be passed. Feed chute 16 is connected to the cover member 56 mounted to the feeding side of drum 24 and return chute 20 is connected to the cover member mounted to the return side of the drum so as to be in communication with the ports 70.

As has been already noted, the transfer mechanisms 26 are similar in construction and, therefore, for clarity and brevity of recitation reference will be made in the following description to the transfer mechanism which is mounted to the feeding end of supplier 14, it being remembered that the function of the transfer mechanism mounted to the return end is the reverse of that mounted to the feeding end.

Such transfer mechanism 26 includes a circular scoop disc 72 having a hub portion 74 with a cylindrical hole 76 provided axially therethrough for receiving one of the extending portions of drive shaft 50. A sleeve 78 having internal splines matching the splined portion 68 on the drive shaft 50 is mounted over such spline portion and is received by hole 76. Sleeve 78 is connected to scoop disc 72 so that rotation of drive shaft 50 by motor 32 is transferred to such scoop disc. The radius of scoop disc 72 is substantially the same as that of outer shell 38 and the circular area of such scoop is interrupted by two diametrically-opposed wedge-shaped openings 80 which extend outwardly from hub portion 74. Each of the openings 80 receives an inner transfer device 82 by which successive layers of cartridges 18 in the end of drum 24 are scooped therefrom and transferred through the associated opening to the outside of the scoop disc, as hereinafter explained.

Each of the inner transfer devices 82 includes a bridge 84 which is mounted to the outside of scoop disc 72 at the perimeter thereof so as to bridge the outer end of each of the openings 80. Each of the bridges 84 also houses an outer pinion gear 86 which meshes with ring gear 52 for travel therearound as scoop disc 72 is rotated. Each of the outer pinion gears 86 is mounted on a shaft 88 adjacent one end thereof so that a portion of such shaft extends beyond the outer pinion gear to form an axle portion 92. The opposite end of shaft 88 is rotatably received by a ball bearing 90 mounted in hub portion 74, and axle portion 92 is rotatably received by a ball bearing 94 mounted in bridge 84. Bearings 94 and 90 are so disposed that the shafts 88 extend radially from the axis of drum 24 and angularly outward from scoop disc 72 for a reason to be hereinafter explained.

A wheel 96 is fixedly mounted to each of the axle portions 92 so as to travel around track 54 and assist in rotatably supporting scoop disc 72 on drum 24. Another pair of wheels 98 are rotatably mounted on a pair of axles 100 which extend radially inward from the perimeter of scoop disc 72, normal to the axis of shaft 88, to provide additional rolling support for scoop disc 72. Fixed to each of the shafts 88 adjacent outer pinion gear 86 is a sprocket unit 102 which includes an inner sprocket 104 and an outer sprocket 106 which are both of the five-tooth type. The inner sprockets 104 and outer sprockets 106 are arranged to engage the neck and base portions, respectively, of the end ones of the cartridges 18 in the storage spaces 44 of drum 24.

Inner sprockets 104 engage the neck portions of the cartridges 18 adjacent the shoulders thereof with the bases having contact with outer pinion gear 86 whereby such cartridges are held against longitudinal displacement while being moved by the sprocket unit 102. In order to obtain proper rolling contact between the sprockets 104 and 106 while rolling over the end cartridges in drum 24, the outer perimeters of such sprockets are arranged to form a cone having its apex on the axis of drum 24 as the pitch diameters of inner sprocket 104 and outer sprocket 106 should vary in proportion to the distances from the axis of drum 24, as is best illustrated by Fig. 5.

With sprocket unit 102 being of the five-tooth type, the cone angle is approximately 16 degrees, and as the axes of the cartridges in drum 24 are normal to the axis thereof, the sides of the sprockets 104 and 106 next to the drum should also be normal to the axis of the drum. Consequently, bearings 90 and 94 are so related that the axes of the shafts 88 incline approximately eight degrees outwardly from the plane normal to the axis of drum 24.

Each of the inner transfer devices 82 also includes a scoop 108 which is mounted to bridge 84. Provided on each of the scoops 108 is a pair of ramp portions 112 which are arcuately formed to cooperate with the sprocket units 102 in guiding the cartridges 18 picked up by such sprocket units from drum 24 through the associated openings 80 to the outside of scoop disc 72. Pivotally mounted to each of the scoops 108 so as to form an extension of the ramp portions 112 thereon is an extension member 114 provided with a pair of finger portions 118 which extend outwardly beyond such ramp portions to guide the cartridges 18 removed from the storage spaces 44 by the sprocket units 102 in a circular path to a pair of transmission mechanisms 136 which are fully described hereinafter. The ends of the partitions 42 are cut out, as noted at 116, to permit engagement of the sprocket units 102 with the end ones of the cartridges in the storage spaces 44.

The extension members 114 are each mounted on a rod 120 which is rotatably received by a pair of holes in the ramp portions 112 of the scoops 108. An arm 122 is fixedly mounted at one end to the outer end of each of the rods 120 and mounted to the free end of each of the arms 122, so as to extend outwardly therefrom, is a shaft 124 which rotatably supports a roller 126. The arms 122 are so fixed to the rods 120 that when the extension members 114 are in normal positions with the finger portions 118 thereon forming an extension of ramp portions 112, the rollers 126 are in rolling engagement with shoulder 62. Each of the rollers 126 is held in engagement with shoulder 62 by a spring-biased plunger 128 which is mounted in bridge member 84 so as to press against arm 122 adjacent the free end thereof.

Provided on the inner side of each of the scoop discs 72 are two pairs of semicircular radially spaced cam wipers 130 extending from one side of one of the openings 80 to the scoop 108 which is mounted on the near side of the other one of the openings with the corresponding ones of the cam wipers in such pairs being in line with each other. The cam wipers 130 in each of the pairs are concentric with scoop disc 72 and are radially spaced so as to slidingly engage opposite ends of the body portions of the end cartridges 18 in drum 24 and contactly positioned such cartridges so that the axes thereof are normal to the axis of drum 24. Each of such pairs of cam wipers 130 also progressively develops inwardly towards the respective ends of the partition 42 and in the direction leading to the scoop 108 the distance of the diameter of cartridge 18.

The two scoop discs 72 are mounted on drive shaft 50 so that relative portions of the cam wipers 130 on such two scoop discs are moved simultaneously to opposite ends of the storage spaces 44 and so that the length of the storage spaces is maintained as a multiple of the diameter of the rounds. Thus, during a half-rotation of the scoop discs 72 the columns of cartridges 18 in the storage spaces 44 are moved progressively toward the feeding end of drum 24 in a double spiral, inasmuch as the two pairs of the cam wipers 130 on the scoop disc 72 mounted on the return end of supplier 14 progressively cam the cartridges 18 in the storage spaces toward the feeding end of the supplier and the cam wipers on the feeding end are simultaneously rotated to make room for the cartridges until they are in position to be picked up by the sprocket units 102.

The cartridges which are scooped from the open ends of the storage spaces 44 in drum 24 and moved by the two inner transfer devices 82 to the outside of the scoop discs 72 are received by a transmission mechanism 136. Such transmission mechanism 136 is mounted for rotation between scoop disc 72 and cover member 56 and includes an inner retainer assembly 138 and an outer retainer assembly 140 arranged, as hereinafter described, to provide thirty-three radially-disposed spaces 141 for receiving cartridges from the inner transfer devices 82. Outer retainer assembly 140 is composed of an outer ring gear portion 142 which meshes with the outer pinion gears 86 so as to be rotated thereby and an annular track portion 144 which encircles such ring gear portion around the outside thereof so as to be contacted by the wheels 96 and 98 to provide rolling contact between such outer assembly and scoop disc 72. Outer retainer assembly 140 is maintained in contact with the wheels 96 and 98 by a plurality of spherical buttons 146 which are mounted on the underside of end portions 60 of cover member 56 for contact with the outer side of outer ring gear portions 142 which is finished to provide a smooth engaging surface for the buttons.

Extending radially inward from the inner periphery of outer ring gear portion 142 are thirty-three base fins 152 which are spaced to receive therebetween the base portions of the cartridges 18. The base fins 152 are also twisted angularly around the longitudinal axis thereof to facilitate reception of the cartridges therein from the inner transfer devices 82 and extraction therefrom during rotation of outer retainer assembly 140 relative to scoop disc 72. The base fins 152 extend inwardly with the free ends being approximately in line with the outer ones of the cam wipers 130.

Inner retainer assembly 138 includes a hub portion 154 which is recessed at the inner side to receive a ball bearing member 156 which contacts hub portion 74 of scoop disc 72 to provide rolling support for such inner assembly.

Provided on the inside of hub portion 154 is an inner ring gear portion 158 which is driven by an inner pinion gear 160 fixedly mounted to each of the shafts 88. Extending outwardly from hub portion 154 are thirty-three nose fins 162 which are spaced to receive the neck and projectile portions of the cartridges received by the base fins 152 and which cooperate with such base fins to form the spaces 141. The nose fins 162 are twisted angularly similar to base fins 152 to facilitate the reception of the cartridges therebetween and the extraction of the cartridges therefrom. The free ends of the nose fins 162 are in approximate alignment with the inner ones of the cam wipers 130 whereby there is provided a clearance

164 between such nose fins and the base fins 152. Inner pinion gear 160 and inner ring gear portion 158 are so designed that inner retainer assembly 138 is driven at the same rate as outer retainer assembly 140 to maintain the base fins 152 and nose fins 162 in alignment.

Mounted to the inside of cover member 56 adjacent the side of port 70, which is on the far side thereof respective to the direction of rotation of the transmission mechanism 136, is a comb 174 which extends angularly downward into clearance 164 to cammingly engage the cartridges 18 in the rotating transmission mechanism and transfer such cartridges upwardly through port 70 and against the line of cartridges in feed chute 16 whereby the torque of such transmission mechanism is applied against such line of cartridges to contactably move the cartridges to gun 12. Comb 174 is positioned relative to the empty one of the storage spaces 44 in drum 24 so that the last one of the cartridges in the bank preceding the empty space is moved over the comb while the leading one of the cartridges in the bank formed after such empty space is moved under such comb as is especially well illustrated in Figs. 8–12.

As has already been explained and as is illustrated schematically by Figs. 13–17, the two outer layers of cartridges 18 in drum 24 are scooped simultaneously by the two diametrically-opposed inner transfer devices 82 which are mounted to the scoop disc 72 that rotates at one-half the rate of the cooperating transmission mechanism 136. Such figures show schematically how, while one of the inner transfer devices 82 is scooping up a layer of cartridges 18 from drum 24 and moving such cartridges directly into feed chute 16, the other one is scooping up another layer of cartridges and laying them in the spaces 141 in the transmission mechanism 136 to build up a storage bank during one revolution of scoop disc 72 with the functions of such inner transfer devices being reversed during the following revolution of such scoop disc.

As shown diagrammatically by Figs. 8–12, interferences would occur at times between the cartridges being transferred by comb 174 to feed chute 16 and the finger portions 118 if such finger portions were immovably fixed to the scoops 108. Consequently, there is provided in rim portion 58 of cover member 56 a plate 170 having therein a cam channel 172 which interrupts shoulder 62 and is disposed so as to receive the rollers 126 at one end and return such rollers into engagement with shoulder 62 at the other end. Cam channel 172 is so generated that the finger portions 118 are pivoted inwardly to a retracted position by the movement of the rollers 126 along such cam channel during rotation of scoop disc 72 while passing by comb 174. In addition, the empty one of the storage spaces 44 is coordinated with the movement of the extension members 114, as shown by Figs. 8–12, so that a cartridge 18 will not be in engagement with the finger portions 118 to interfere with the retraction thereof.

It will be noted in such figures that the paths of the cartridges designated as 34A, which is the last round from the bank A formed in front of comb 174 to go out port 70 into feed chute 16, and 1A, which is the first cartridge in bank A formed behind such comb, are separated sufficiently by virtue of the blank one of the storage spaces 44, to prevent interference therebetween as the sprocket unit 102 passes the comb. If there were a cartridge in the sprocket unit 102 between such cartridges 34A and 1A, it would have interfered with comb 174, cartridge 1B, which is the first cartridge in the bank B, and extension member 114. Figs. 8–12 also show how extension member 114, when in normal position, serves to guide the cartridges 18 into transmission mechanism 136 in a circular path about the axis of sprocket unit 102 and, moreover, how after round 34A has passed through port 70, finger portions 118 are retracted by cooperation of cam channel 172 to allow cartridges 1B and 2B to contact comb 174 at the proper point and how the finger portions 118 are returned to normal extended position in order to permit the passage of round 1A into transmission mechanism 136.

However, by leaving one of the storage spaces 44 empty to assist in preventing the aforementioned interference, there is an interruption in the flow of cartridges 18 picked up by the inner transfer devices 82 from the ends of the storage spaces 44. Therefore, so as to fill the consecutive spaces 141 in transmission mechanism 136 and obtain an uninterrupted delivery of the cartridges from the transmission mechanism to feed chute 16, there are two less spaces 141 in the transmission mechanism than there are storage spaces 44 in drum 24, and such transmission mechanism is speeded up correspondingly so that the spaces 141 therein register with the spaces in the sprocket units 102. For example, drum 24 of the selected embodiment has thirty-five of the storage spaces 44 therein. As one of the storage spaces 44 is empty transmission mechanism 136 is provided with thirty-three spaces and its speed is $^{68}/_{33}$ times the speed of the scoop disc. Thus, for one revolution of scoop disc 72, transmission mechanism 136 has to revolve $^{2}/_{33}$ times. This speed ratio is provided in large part by the shafts 88 being angularly related to the axis of drum 24 whereby the diameter of outer ring gear portion 142 is smaller than that of inner ring gear portion 158. The balance of the required speed adjustment is obtained through a special pitch relationship provided between outer ring gear portion 142 and the outer pinion gears 86.

Provided around the outside of scoop disc 72 is a pair of rails 166 which are concentric with such scoop disc and are interrupted by the openings 80. The rails 166 are arranged to contact one side of the body portions of the cartridges 18 while being carried by transmission mechanism 136. A pair of rails 168 on the inside of cover member 56 slidingly contact the opposite sides of the cartridges in transmission mechanism 136 to slidingly support the cartridges received by the spaces 141.

Operation

Gun 12 is prepared for operation when supplier 14, feed chute 16 and return chute 20 are filled with cartridges 18. Gun 12 is fired by closing the electric circuit to the motor thereof by a switch mechanism (not shown) which at the same time energizes motor 32 of supplier 14. Thereafter, supplier 14 is synchronized to the needs of gun 12 by gear train 33 and flexible drive shaft 34.

When motor 32 is energized, the cartridges 18 in feed chute 16 are forced toward gun 12 by the pressure applied thereagainst by the transmission mechanism 136 on the feed side of supplier 14. As gun 12 fires, the cartridges 18 moved thereinto from feed chute 16 are replaced in the system by the cartridges in return chute 20 until the empty cases 22, placed in return chute 20 by the ejection mechanism of gun 12, reach drum 24 and thereby the cartridges in such return chute increase the supply of cartridges in the system.

Because the transfer mechanism 26 on the return side of supplier 14 rotates with that on the feed side, the empty cases 22 are moved down comb 174 into the rotating transmission mechanism 136 and are picked up therefrom by the inner transfer devices 82 to be placed into the ends of the storage spaces 44 in drum 24 from which the cartridges 18 are scooped by the inner transfer devices at the feeder side. As the empty cases 22 are laid into the ends of the storage spaces 44, they are progressively cammed toward the feeder end by the rotating cam wipers 130 the distance of the diameter of cartridge 18 and thereby the cartridges in the storage spaces ahead thereof are moved into position to be scooped up by the inner transfer devices 82 on the feeder side. Thus, the cartridges 18 and empty cases 22 move in a double spiral from the return to the feed side of drum 24.

By this mechanism, it is seen that the forces of acceleration and deceleration imparted to the line of cartridges

18 and empty cases 22 in the system during transfer between gun 12 and drum 24 are considerably reduced by the speed of the scoop discs 72 being one-half that of the transmission mechanisms 136 which produces a gradual acceleration and deceleration during the transition of the cartridges and cases between the substantially zero velocity thereof in the drum and the high degree of velocity when moving in feed chute 16 and return chute 20 at gun speed.

It is also noted that, because the transfer mechanisms 26 are identical, the feeder system of the present invention may be reversed, if found desirable, by changing the direction of rotation of electric motor 32. Further, it is apparent that subject system provides an improved means for feeding a gun without the use of links and for disposing of the empty cases with subject system being rugged in construction and positive in operation.

Although a particular embodiment of the invention has been described in detail herein, it is evident that many variations may be devised within the spirit and scope thereof and the following claims are intended to include such variations.

We claim:

1. A cartridge supplier for a gun, including a drum for storing a supply of cartridges stacked in a plurality of rows extending from one end of said drum to the other, said rows being helically disposed whereby each cartridge is supportingly positioned by the adjacent ones thereof in the rows for right angular disposition relative to the longitudinal axis of said drum, and a closed conveyer system extending through said drum and the gun for feeding the cartridges to the gun and returning empty cases therefrom to said drum to continuously move the supply of cartridges therein towards the gun.

2. A cartridge supplier for a gun operable at a predetermined rate, including a drum for storing a supply of cartridges, a closed conveyer system extending through said drum and the gun for feeding the cartridges to the gun and returning empty cases therefrom to said drum to continuously move the supply of cartridges therein towards the gun, and a pair of similar transfer mechanisms adapted to remove the cartridges from said drum and replace the empty cases therein at approximately one-half gun rate.

3. A cartridge supplier for a gun having an operating motor, said supplier including a drum for storing a supply of cartridges, a closed conveyer system extending through said drum and the gun for feeding the cartridges to the gun and returning empty cases therefrom to said drum to continuously move the supply of cartridges therein towards the gun, motor means for driving said conveyer system, and means for synchronizing said conveyer system to the needs of the gun and for connecting the operating motor to said motor means to provide cooperation therebetween.

4. A cartridge supplier for a gun, including a drum for storing a supply of radially disposed cartridges in helical rows, and a closed conveyer system extending through said drum and the gun for feeding the cartridges to the gun and returning empty cases therefrom to said drum to continuously move the supply of cartridges therein towards the gun, and including transfer means for gradually accelerating the cartridges during movement from said drum to the gun and decelerating the empty cases during movement from the gun to said drum, and cam means engageable with the empty cases moved to said drum for moving the supply of cartridges therein towards the gun.

5. A cartridge supplying device for a gun, including a drum for storing a supply of cartridges, radial partitions in said drum extending from one end thereof to the other to form spaces for separating the supply of cartridges into rows slidingly received by said spaces, and said partitions being helically formed whereby the cartridges in said spaces are positionable so that the axes of the cartridges are normal to the axis of said drum while being guided by said partitions therethrough, means for delivering cartridges from one end of said spaces to the gun, similar means for delivering empty cases from the gun to the opposite ends of said spaces, and rotatable cam means cooperating with the empty cartridge cases delivered to said spaces for continuously moving the rows of cartridges in said spaces towards said one end of said spaces and in spiral arrangement for pickup by said cartridge delivering means.

6. The device of claim 5 wherein said rotatable cam means includes cam wipers disposed for sliding engagement with the cartridges and empty cases in said spaces and being disposed to position the engaged empty cases so that the axes thereof are disposed normal to the axis of said drum, and having an angular development whereby the empty cases and cartridges are moved the distance of the diameter thereof towards the gun during one-half revolution of said cam wipers.

7. The device of claim 5 wherein said rotatable cam means is comprised of two pairs of semicircular cam wipers having sliding engagements with the cartridges and empty cases in said spaces when said cam wipers are rotated for moving the cartridges and empty cases in a double spiral towards the gun.

8. A cartridge supplying device for a gun operable at a predetermined rate, including a drum for holding a supply of cartridges disposed radially therein in a plurality of layers, chute means having communication with one end of said drum for slidingly conveying said cartridges to the gun and with an opposite end of said drum for slidingly conveying the empty cases thereto from the gun, a first scoop device rotatably mounted to said one end of said drum for scooping successive layers of cartridges therefrom at approximately one-half gun rate, a first transmission mechanism for receiving the cartridges scooped up by said first scoop device and forcing them through said chute means to the gun at gun rate, a second scoop device rotatably mounted to said opposite end of said drum, a second transmission mechanism for receiving empty cases from the gun and moving them to said second scoop device for placement thereby in successive layers in said drum to move the supply of cartridges towards said first scoop device in position to be picked up thereby.

9. A cartridge supplying device for a gun, including a drum for holding a supply of cartridges disposed radially therein in a plurality of layers, chute means having communication with one end of said drum for slidingly conveying the cartridges to the gun and with an opposte end of said drum for slidingly conveying the empty cases thereto from the gun, a first scoop device rotatably mounted to said one end of said drum for scooping successive layers of cartridges therefrom, a first transmission mechanism for receiving the cartridges scooped up by said scoop device and forcing them through said chute means to the gun, a second scoop device rotatably mounted to the opposite end of said drum, a second transmission mechanism for receiving empty cases from the gun and moving them to said second scoop means for placement thereby in successive layers in said drum, and cam means disposed for rotation with said second scoop device and for engagement with the empty cases placed in said drum for moving the supply of cartridges towards said first scoop means in position to be scooped thereby.

10. A cartridge supplying device for a gun, including chute means for delivering cartridges to the gun and empty cases therefrom, a drum comprising a cylindrical outer shell, a cylindrical inner shell and a plurality of helical partitions for dividing the space between said outer and inner shells into equal helical storage spaces extending from one end of said drum to the other for slidably receiving radially-disposed rows of cartridges,

a motor mounted within said inner shell, a transfer mechanism including a scoop device mounted to one end of said drum for rotation by said motor, a scoop portion extending from said scoop device into said drum to scoop therefrom the end ones of the cartridges in said storage spaces, cutout portions in said partitions for receiving said scoop portion to permit the engagement thereof with the end ones of the cartridges away from the dead center thereof, sprocket means mounted to said scoop device for rotation thereby and disposed to successively engage the cartridges scooped from said drum, means for transferring rotation of said scoop device to said sprocket means for moving the cartridges scooped from said drum away therefrom, a transmission mechanism engaged with said sprocket means for rotation thereby and disposed to receive the cartridges from said sprocket means and force the cartridges through said chute means to the gun, and a similar transfer mechanism mounted to the oppoiste end of said drum for actuation by said motor and disposed for receiving the empty cases from said chute means and placing them in the opposite ends of said storage spaces.

11. A cartridge supplying device for a gun, including chute means for delivering cartridges to the gun and empty cases therefrom, a drum comprised of a cylindrical outer shell, a cylindrical inner shell, and a plurality of helical partitions for dividing the spaces between said outer and inner shells into equal helical storage spaces extending from one end of said drum to the other for slidably receiving radially-disposed rows of cartridges, a motor mounted within said inner shell, a transfer mechanism including a scoop device mounted on one end of said drum for rotation by said motor, sprocket means mounted to said scoop device for rotation thereby to successively engage the end ones of the cartridges in said storage spaces for removal therefrom, means for transferring rotation of said scoop device to said sprocket means for moving the cartridges removed from said storage spaces by said sprocket means away from said drum, a transmission mechanism engaged with said sprocket means for rotation thereby, said transmission mechanism being cooperable with said sprocket means for receiving the cartridges therefrom, means for transferring the cartridges from said transmission mechanism to said chute means for delivery to the gun, a similar transfer mechanism mounted to the opposite end of said drum and actuated by said motor for receiving the empty cases passed from the gun to said chute means and placing the empty cases in the opposite ends of said storage spaces, and cam means mounted to said scoop device for cooperation with the empty cases placed in said storage spaces for moving the cartridges therein in a double spiral towards the other one of said transfer mechanisms and into position to be picked up by said sprocket means.

12. A cartridge supplying device for a gun operable at a predetermined rate, including a drum for storing layers of cartridges in radial disposition, a closed conveyer system extendng through said drum and the gun for feeding the cartridges to the gun and returning empty cases therefrom to said drum to continuously move the supply of cartridges therein towards the gun and including a transfer mechanism comprising a scoop disc mounted for rotation at one end of said drum, a pair of inner transfer devices mounted to said scoop disc for removing the two layers of cartridges adjacent thereto from said drum during one rotation of said scoop disc at approximately one-half gun rate, and a transmission mechanism for receiving the cartridges from said inner transfer devices and alternately delivering the cartridges received therefrom directly to the gun and to a storage bank for subsequent delivery to the gun at gun rate to reduce the force required to accelerate the cartridges up to the speed of the gun during transfer from said drum.

13. A cartridge supplying device for a gun, including a drum for storing layers of cartridges in radial disposition, a closed conveyer system extending through said drum and the gun for feeding the cartridges to the gun and returning empty cases therefrom to said drum to continuously move the supply of cartridges therein towards the gun and including a first transfer mechanism comprising scoop means mounted for rotation at one end of said drum, a pair of inner transfer devices mounted to said scoop means for simultaneously removing two successive layers of cartridges from said drum, a transmission mechanism for receiving cartridges from said inner transfer devices and alternately delivering the cartridges directly to the gun and to a storage bank therein for subsequent delivery to the gun and thereby reducing the forces required to accelerate the cartridges up to the speed of the gun, a similar second transfer mechanism mounted to the opposite end of said drum for receiving the empty cases from the gun and reducing the forces of deceleration produced when the empty cases are transferred to said drum, with said first and second transfer mechanisms being reversible to change the direction of movement of the cartridges and the empty cases in said conveyer system.

14. A cartridge supplying device for a gun, including a drum for storing layers of cartridges therein in radial disposition, a closed conveyer system extending through said drum and the gun for feeding the cartridges to the gun and returning empty cases therefrom to said drum to continuously move the supply of cartridges therein towards the gun and including a first transfer mechanism comprising a scoop disc mounted for rotation at one end of said drum, a pair of inner transfer devices mounted to said scoop means for removing successive layers of cartridges from said drum and a transmission mechanism which receives cartridges from said inner transfer devices for alternately delivering the cartridges directly to the gun and to a storage bank for subsequent delivery to the gun and thereby reducing the forces of acceleration required to transfer the cartridges from the drum to the gun, a similar second transfer mechanism mounted to the opposite end of said drum for receiving the empty cases from the gun and reducing the forces of deceleration produced during the transfer of the empty cases from the gun to said drum, cam means mounted to said scoop disc of said second transfer mechanism for cooperation with the empty cases delivered to said drum for continuously moving the supply of cartridges towards said first transfer mechanism in a double spiral, and similar cam means mounted to said scoop disc of said first transfer mechanism for maintaining the cartridges and empty cases in contact during movement thereto and for placing the cartridges in position to be removed by said inner transfer devices.

15. A cartridge supplying device for a gun, including a drum for holding a supply of cartridges disposed radially therein in a plurality of layers, chute means for slidingly conveying cartridges to the gun, scoop means rotatable respective to said drum for removing successive layers of the cartridges from said drum, a transmission mechanism rotatable by said scoop means and having radial fins spaced to receive cartridges from said scoop means and transfer the torque of said transmission mechanism to successive ones of the cartridges engaged thereby, and a comb for disengaging the cartridges from said transmission mechanism and converting rotational movement of the cartridges therein to in-line movement in said chute means for moving the preceding cartridges therein to the gun.

16. A cartridge supplying device for a gun, including chute means leading to and from the gun, a drum comprising an inner cylindrical shell, an outer cylindrical shell and a plurality of partitions for concentrically joining said inner and outer shells and forming storage spaces for slidingly receiving rows of cartridges and the cases

of the cartridges after being fired by the gun, a ring gear mounted to each end of said drum concentric therewith, a motor mounted within said inner shell and having a shaft in alignment with the axis of said drum, a first transfer mechanism mounted to one end of said drum and comprising a disc centrally engaged to said drive shaft for rotation thereby, a pair of diametrically-opposed inner transfer devices mounted to said disc, each of said inner transfer devices including a scoop mounted through an opening in said disc for scooping successive layers of cartridges from said drum, a sprocket unit cooperable with said scoop for rotatably moving the cartridges engaged by said scoop to the opposite side of said disc, pinion gears engaged with said sprocket units and meshed with said ring gear for transferring rotation of said disc to said sprocket unit, a transmission mechanism engaged by gear means to said pinion gears for rotation thereby at a rate greater than that of said disc, radial spaces in said transmission mechanism for consecutively receiving the cartridges removed from said drum by said sprocket units, a comb extending into said transmission mechanism for camming the cartridges therefrom into said chute means for passage to the gun, and a similar second transfer mechanism mounted to the opposite end of said drum for receiving the fired cases from said chute means and placing the cases in said drum at the oppoiste ends of the rows from which the cartridges are removed by said first transfer mechanism.

17. The device of claim 16 including cam means mounted to said disc of said second transfer mechanism for engagement with the fired cases placed in the rows for moving the rows continuously towards said first transfer mechanism, and similar cam means mounted to said disc of said first transfer mechanism for synchronized rotation with said cam means of said second transfer mechanism to maintain the rows of cartridges and fired cases in contact and position the cartridges for pick up by said inner transfer devices of said first transfer mechanism.

18. The device of claim 16 wherein one of said spaces in said drum is left empty of cartridges or empty cases and said transmission mechanism is provided with two less spaces than said drum and whereby said gear means and said pinion gears cooperate to rotate said transmission mechanism

$$\frac{2(X-1)}{X-2}$$

times the rate of said scoop mechanism wherein X represents the number of spaces in said drum, and including an extension member pivotally mounted to said scoop for reception between said base and nose fins for directing the movements of the cartridges moved by said sprocket unit to said transmission mechanism, an arm mounted to said extension member, a cover for said transfer mechanism, an annular shoulder around the inside of said cover, a roller mounted to said arm for contact with said shoulder to maintain said extension member in normal position, a cam channel interrupting said shoulder for receiving said roller when said extension members are adjacent said comb and said empty one of said spaces to pivot said extension member away from interference with the movement of the cartridges transferred by said comb to said chute.

19. A cartridge supplier for a gun, including a drum for storing a supply of cartridges provided with tapered cases, a closed conveyor system extending through said drum and the gun for feeding the cartridges to the gun and returning the empty cases therefrom to said drum to continuously move the supply of cartridges therein towards the gun, a plurality of radial partitions in said drum each extending from one end thereof to the other and spaced to form spaces for storing the supply of cartridges in rows moveable from one end of said drum to the other, said partitions being helically formed to position the cartridges angularly relative to the adjacent ones in the rows and to maintain the relative angular positions of the cartridges so that the longitudinal axes thereof remain normal to the longitudinal axis of said drum while the cartridges are slidingly guided therethrough by the partitions.

References Cited in the file of this patent

UNITED STATES PATENTS

1,244,794	Stuart	Oct. 30, 1917
1,413,694	Vollmer	Apr. 25, 1922
1,629,652	Browning	May 24, 1927
2,310,884	Trevaskis	Feb. 9, 1943
2,477,264	Pearson et al.	July 26, 1949

FOREIGN PATENTS

557,359	Italy	Feb. 14, 1957