United States Patent

[11] 3,612,255

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[73] Assignee **General Electric Company**

[54] **ENDLESS CONVEYOR SYSTEM**
12 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **198/189,** 198/137
[51] **Int. Cl.** **B65g 17/00**
[50] **Field of Search** 198/189, 203, 137, 22; 89/33.16

[56] **References Cited**

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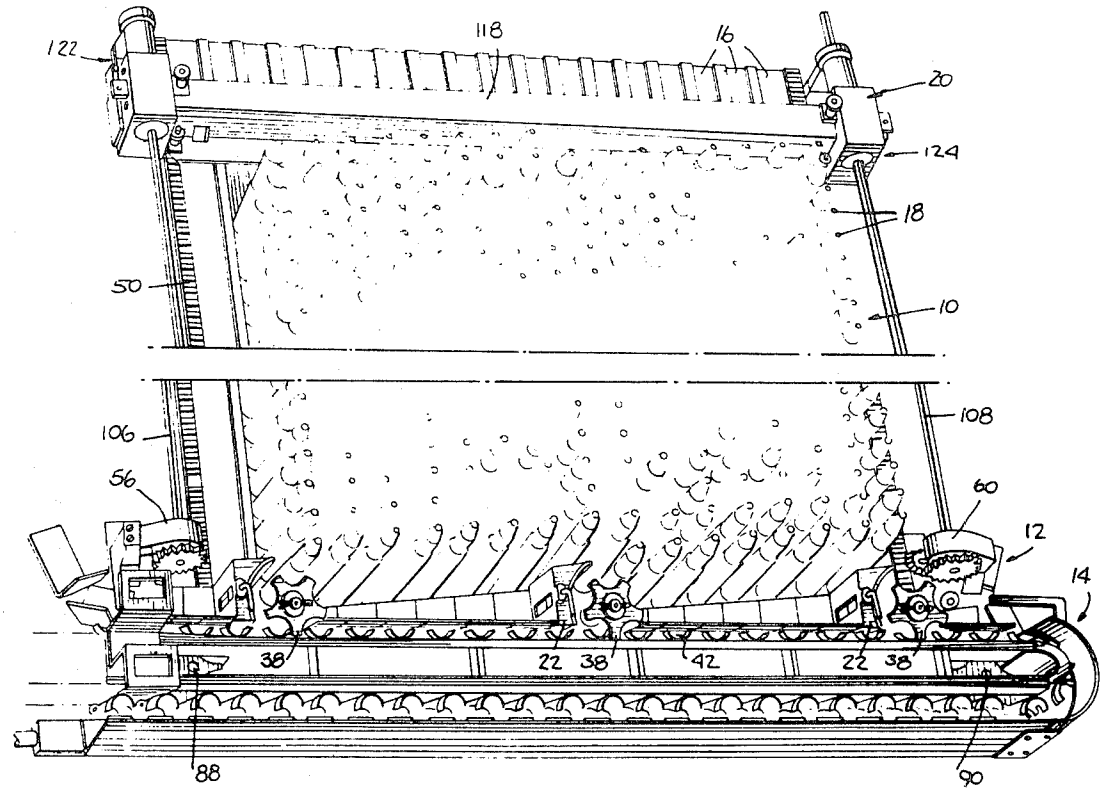
ABSTRACT: An endless conveyor system includes a train of links, each link being coupled to its next adjacent link by a pivot member, the distance between the center lines of immediately adjacent pivot members being fixed, the pivot members being guided between the distal pairs of mutually confronting guide surfaces but not guided between the distal ends of the pair of guide surfaces, i.e., the turnarounds, the distance between the centerlines of the pairs of guide surfaces being the same as the distance between the center lines of the pivot members, and both runs being engaged by the driving means.



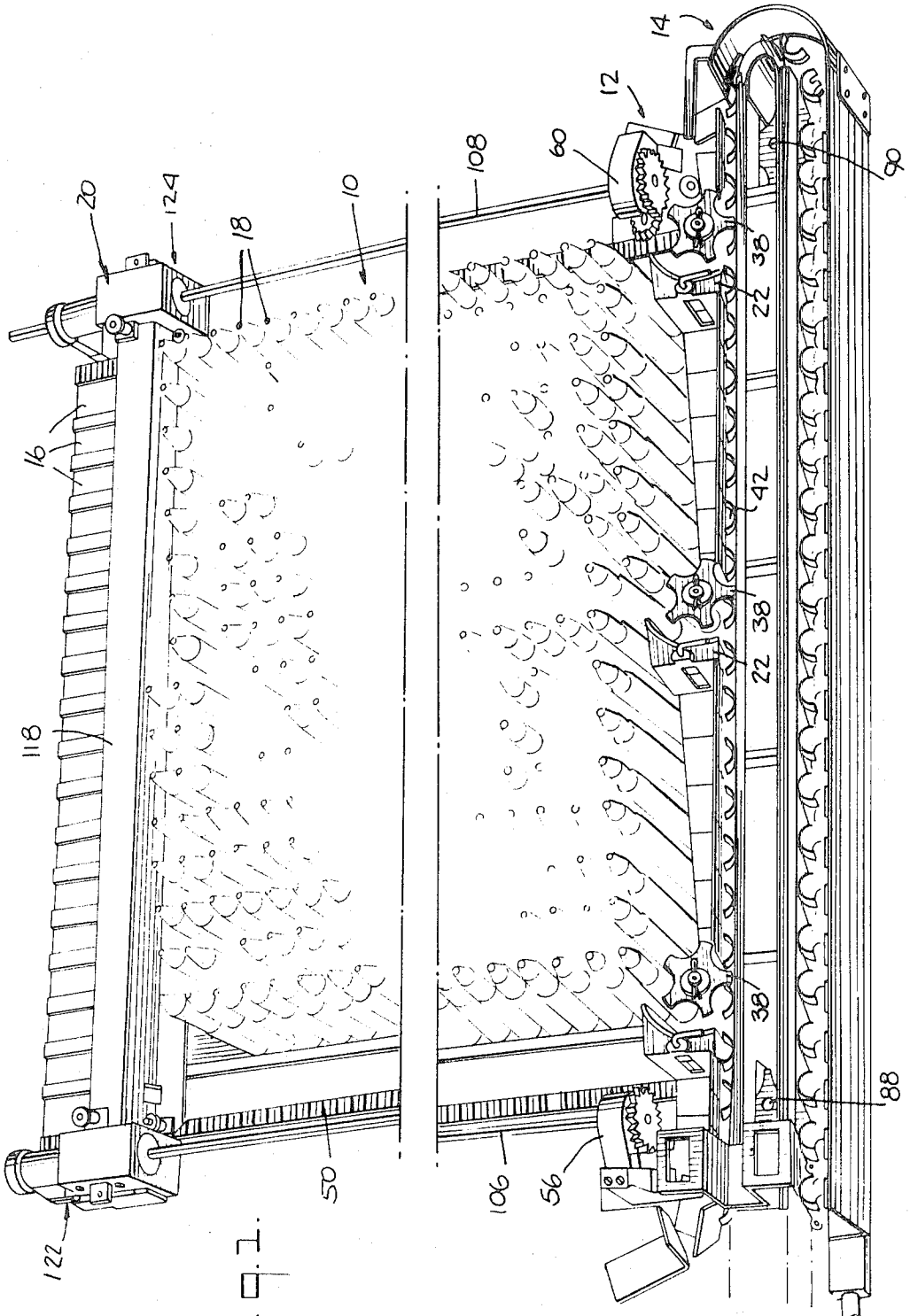


Fig. 1.

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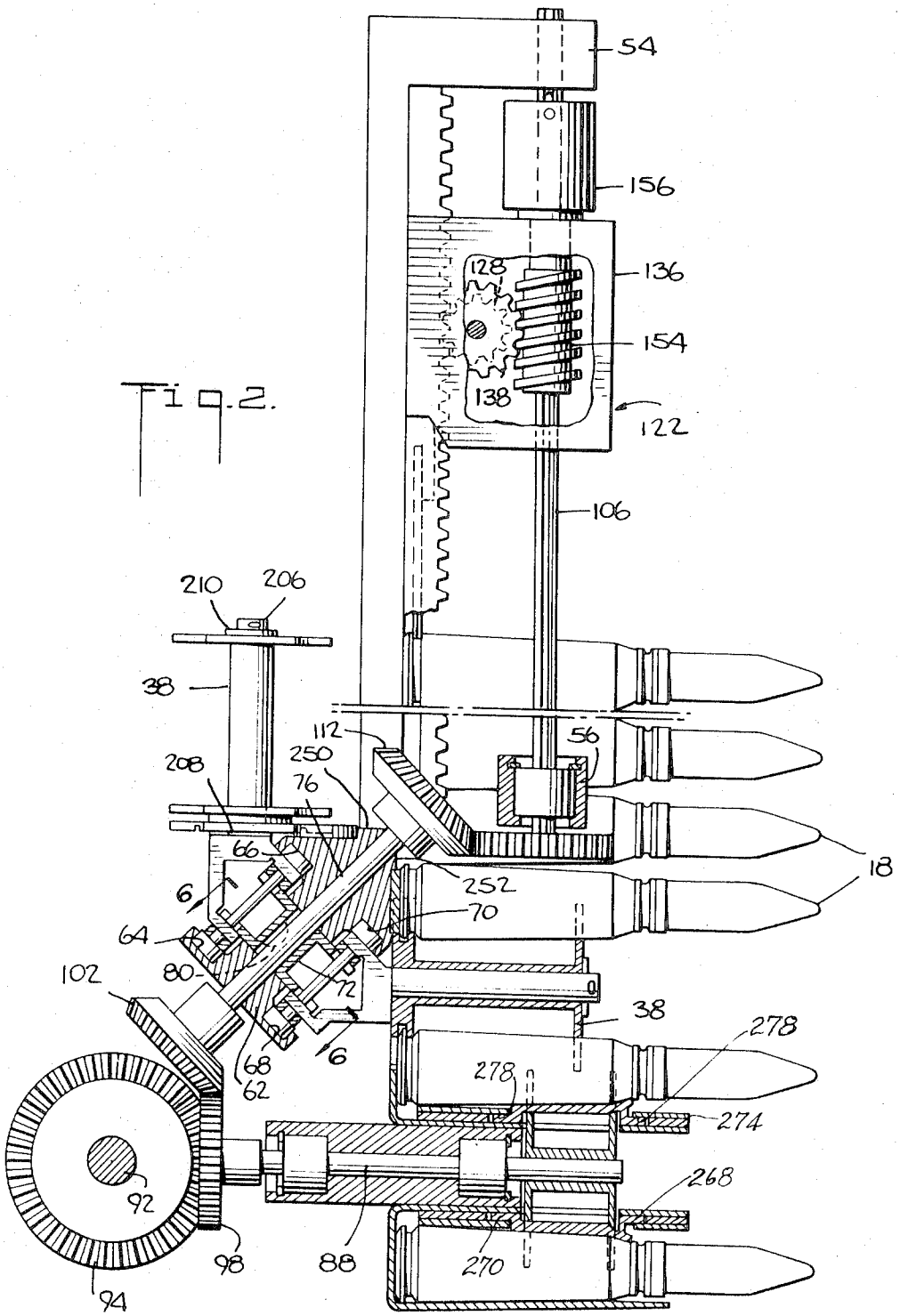
Fig. 2.



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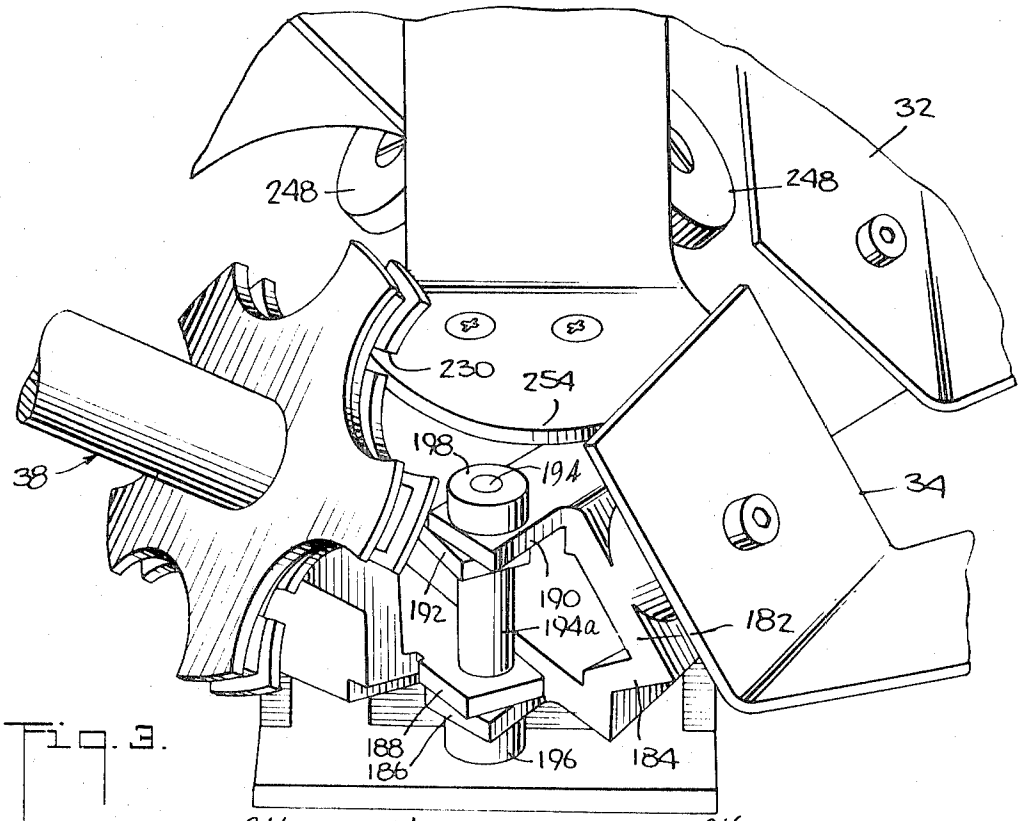

Fig. 3.

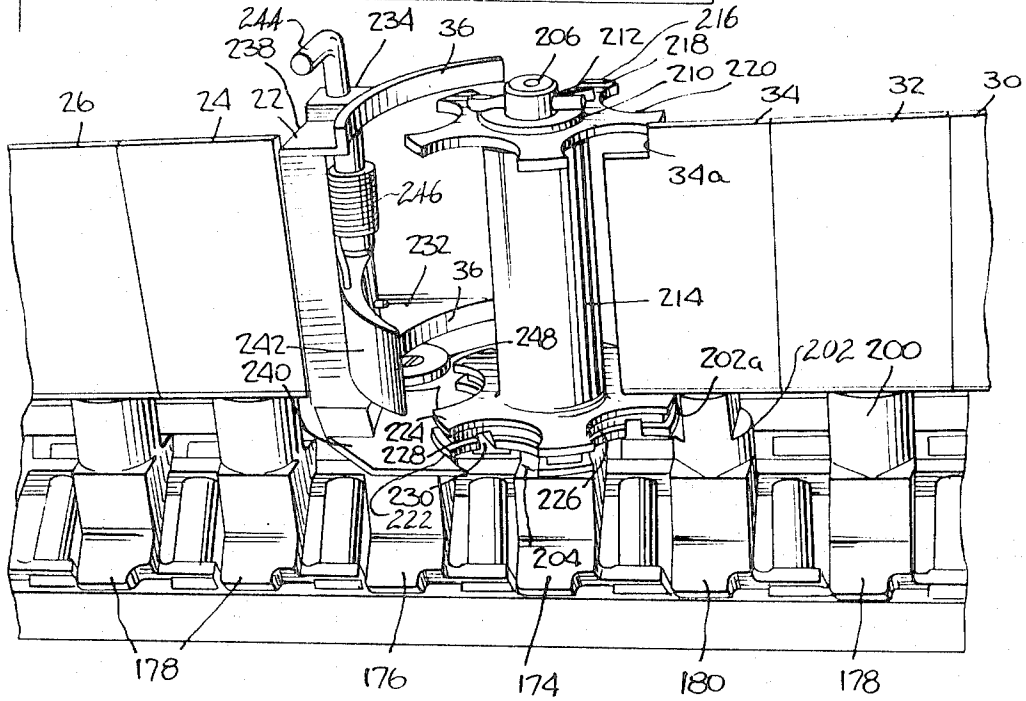

Fig. 4.

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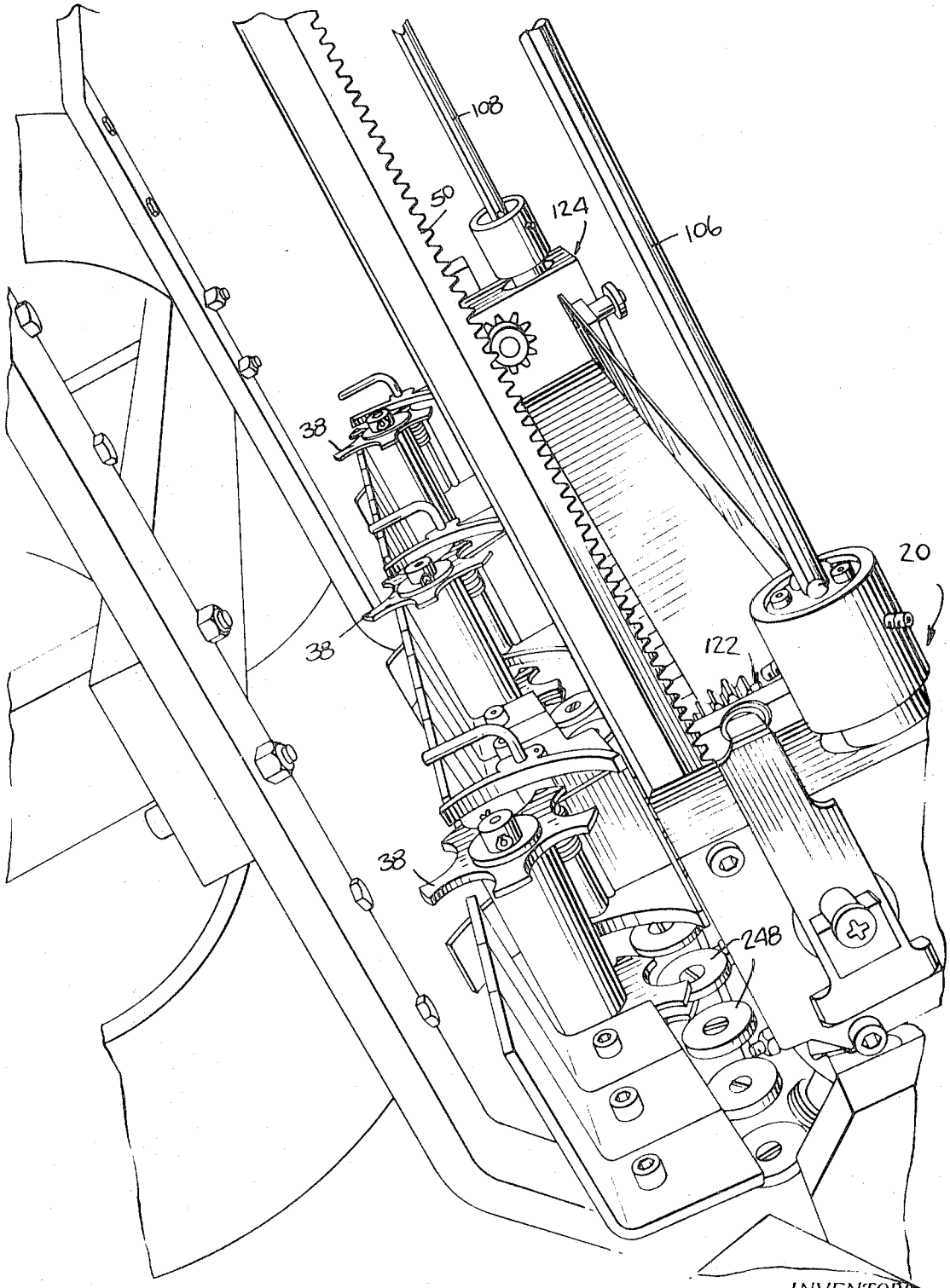

Fig. 5.

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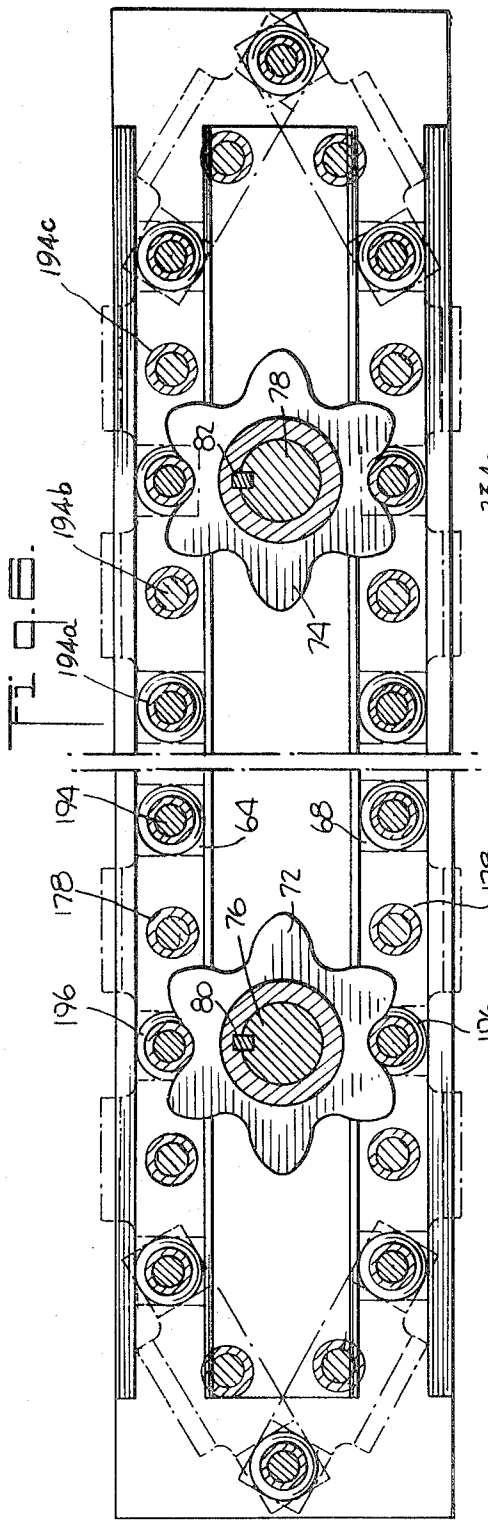

FIG. 6.

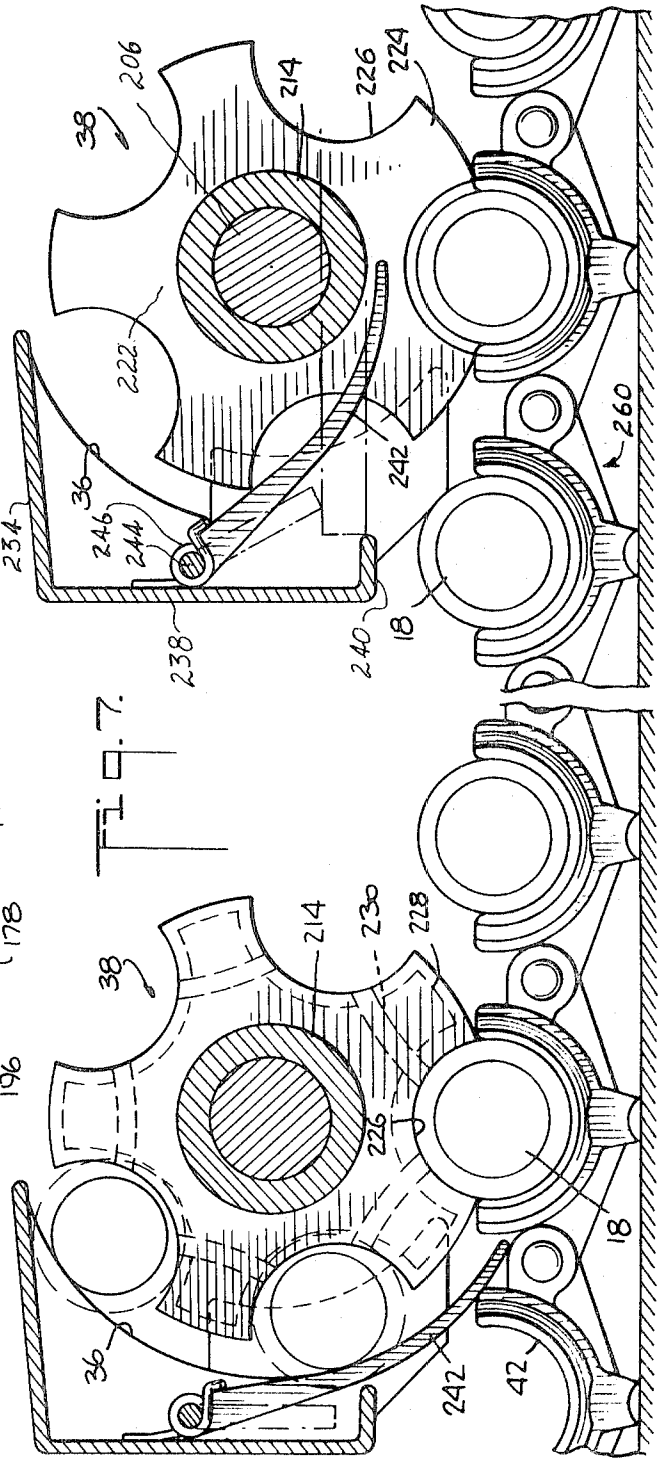

FIG. 7.

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ENDLESS CONVEYOR SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to endless conveyor systems, and particularly to such systems for supplying cartridges to automatic guns.

2. Background of the Invention

Aircraft armament now requires extremely high rates of fire, e.g., 60 to 12,000 shots per minute, in short or sustained bursts. While the modern Gatling-type weapon disclosed by H. McC. Otto in U.S. Pat. No. 2,849,921 on Sept. 2, 1958 and by R. E. Chiabrandy et al. in U.S. Pat. No. 3,380,343 on Apr. 30, 1968 is admirably suited to this task, the supplying of cartridges to the weapon becomes a more critical limitation as the individual mass and total number of cartridges to be accelerated and conveyed from the cartridge source to the weapon increased.

The original Gatling gun utilized an on-the-gun, gravity-feed hopper. Subsequently J. G. Accles in U.S. Pat. No. 290,622 on Dec. 18, 1883 disclosed a positive, helical magazine feed for the Gatling gun. Thereafter, under the lead of F. Bailey and H. P. Maxim, belt feeds, either continuous or link, became the mode. See "The Machine Gun Belt," by Col. Jim Crossman, in *The American Rifleman*, Dec. 1966, pp. 46–49. Departing from the belt approach, A. Miclaus, Jr. in U.S. Pat. No. 1,136,695 on Apr. 20, 1915 proposed a linear, linkless feed system. The magazine had a plurality of vertical storage channels, each containing a column of cartridges under downward spring bias. An endless conveyor belt below the magazine emptied each channel completely starting from the most remote channel, and serially conveyed the train of cartridges to the weapon. Recently, to supply a Gatling gun of the Otto type, B. Dorsie and R. H. Casler, in U.S. Pat. No. 2,935,914 on May 10, 1960 disclosed a linkless, positive, helical feed magazine, of drum shape, in the spirit of Accles. A feed chute permits the magazine to be spaced from the weapon. This type of magazine becomes quite complex, and the drum shape is uneconomical in its use of aircraft interior space.

SUMMARY OF THE INVENTION

Accordingly, it is an object of this invention to provide an endless conveyor system for a cartridge storage and feed system including a magazine of relatively flat, rectangular configuration, for storing and positively feeding cartridges to an endless stripping conveyor belt for delivery to a remote weapon. The system is of relatively simple construction and capable of high acceleration of the train of cartridges.

A feature of this invention is the provision of an endless conveyor including a train of links, each link being coupled to its next adjacent link by a pivot member, the distance between the centerlines of immediately adjacent pivot members being fixed, the pivot members being guided between two spaced-apart pairs of mutually confronting guide surfaces but not guided between the distal ends of the pair of guide surfaces, i.e., the turnarounds, the distance between the centerlines of the pairs of guide surfaces being the same as the distance between the centerlines of the pivot members, and both runs being engaged by the driving means.

RELATED CASE

Subject matter disclosed but not claimed in this application is disclosed and claimed in Ser. No. 826,814 filed concurrently by E. Ashley et al. The disclosure in this application is an abridgement of the disclosure in Ser. No. 826,814 to which reference may be had for a complete understanding of the complete system.

BRIEF DESCRIPTION OF THE DRAWINGS

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

FIG. 1 is a perspective view of a cartridge storage and feed system embodying this invention;

FIG. 2 is a left side view in elevation, in partial cross section, of the system of FIG. 1;

FIG. 3 is a perspective detail view of the turnaround of the scoop conveyor of FIG. 1;

FIG. 4 is a perspective detail view (from the front looking up) of a scoop and sprocket of the stripping conveyor of FIG. 1;

FIG. 5 is a perspective detail view of the left rear of the stripping conveyor of FIG. 1;

FIG. 6 is a view in cross section taken along plane 6—6 of FIG. 2 illustrating the guide and drive for the stripping conveyor;

FIG. 7 is a front detail view in elevation of the scoop and the delivery conveyor cradles.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The cartridge storage and feeding system shown in FIG. 1 includes a main plate assembly **10**, a stripping conveyor assembly **12** and a delivery conveyor assembly **14**. The main plate assembly includes a plurality of side-by-side channels **16**, each channel adapted to receive and to hold a column of cartridges **18**, and a pressure bar assembly **20** adapted to advance the cartridges contiguously forward into engagement with the stripping conveyor assembly **12**. The stripping conveyor assembly withdraws the leading cartridge from each column serially and transfers these cartridges as a train of cartridges to the delivery conveyor assembly, which delivers the cartridges serially to the weapon (not shown).

The stripping conveyor is an endless belt encircling the lower portion of the main plate assembly and consisting of a plurality of wedge and sprocket assemblies or series. Each wedge assembly includes a plurality of ramp elements **22**, **24**, **26**, **28**, **30**, **32**, **34** of which all except **22** are L-shaped. The leading element **22** is of maximum height and the trailing element **34** is of minimum height. The difference between the maximum and minimum heights is equal to the maximum diameter of the cartridge. The leading edge **36** of the lead element is arcuate, or scooped, and is spaced from a sprocket **38** having a plurality of cutouts **40** and which is carried ahead of the leading element.

It will be seen that each wedge assembly advances across the front of the main plate assembly from left to right, its ramp elements gradually lower the lead cartridges in each channel to a level whereat the leftmost cartridge, which rides off the trailing ramp element, rides into a sprocket cutout **40** and under the leading edge or scoop **36** of the adjacent leading element of left adjacent wedge assembly. The sprocket carries the scooped cartridge counterclockwise around and down and onto a cradle **42** of the delivery conveyor assembly. The upper run of the delivery conveyor assembly advances from left to right under the stripping conveyor assembly and receives the scooped cartridge therefrom.

The stripping conveyor assembly **12** includes an endless chain of links of substantially modified double-U-construction driven by the sprockets **72** and **74**. In each wedge assembly or series, the sprocket **38** is carried by a link **174**, the leading element **22** is carried by a link **176**, the elements **24**, **26**, **28**, **30** and **32** are carried by a respective link **178**, and the element **34** is carried by a link **180**. Each link has a central web portion **182** with a boss extending therefrom, and angled web extension portion **184**, a lower sidewall having a trailing extension **186** and a leading extension **188**, and an upper sidewall having a trailing extension **190** and a leading extension **192**. A pin **194** having a sleeve **194***a* interconnects the extension of immediately adjacent links, and has a lower roller **196** and an upper roller **198**. An intermediate pin **194***b* having a sleeve **194***c* is fixed within each link to provide a full complement of pins **194** and **194***b* to be driven by the sprockets **72** and **74**. The rollers **196** and **198** are adapted to ride in the rear guide surfaces **64**, **66**, and the front guide surfaces **68**, **70**. The

bosses **200** on the links **178** are cylindrical and respectively support the elements **24, 26, 28, 30** and **32** spaced from the respective web portions. The bosses **202** on the links **180** support the element **34** spaced from the respective web portion, and has a cutout **202***a* to clear the adjacent sprocket. The element **34** also has a cutout **34***a* to clear the adjacent sprocket. The bosses **204** on the links **174** have a respective shaft **206** upstanding therefrom on which the sprocket **38** is mounted for rotation between a lower thrust washer **208** and an upper washer **210** and is captured by a cotter pin **212**. The sprocket **38** includes a central tube portion **214**, an upper end plate **216** having five teeth **218** and five cutouts **220**, and a lower end plate **222** having five teeth **224** and five cutouts **226**. The lower plate **222** has a peripheral groove **228** therein, and each tooth **224** has an arcuate groove **230** in its lower surface. The leading element **22** is substantially a hollow box, including a rear wall **232**, a front wall **234**, a top wall **236**, a sidewall **238** and a rear wall extension **240**. The edges of the sidewall are arcuately shaped to provide the leading edges **36**. The front surface of the rear wall extension **240** is immediately behind the rear surface of the lower end plate **222** of the sprocket. An arcuate guide finger **242** is fixed on a pivot rod **244** which is journaled through and between the front and rear sideplates **238, 232**. A spring **246** biases the finger away from the sprocket. The leading edges **36** and the inner face of the guide finger are concentric with the sprocket. A plurality of regularly spaced-apart disks or buttons **248** are fixed to the upper surface **250** and the front surface **252** of the horizontal beam **62**. As each sprocket **38** is transported transversely across the main plate assembly by the train of links **178**, the buttons sequentially engage the lower level of the cutouts **226**, like cogs, and cause the sprocket to rotate about its shaft **206**.

It will be noted that the train of links **178** passes between the rear guide surfaces **64, 66** and the front guide surfaces **68, 70**, i.e., around the returns, without any guidance. This is accomplished by (1) making the distance between the centerlines of adjacent link pins **194** equal to the distance between centerlines of the rear guide surfaces **64, 66** and the front guide surfaces **68, 70**; and (2) meshing the drive means, i.e., sprocket **72** and/or **74**, with both lengths of the train. The dynamic characteristics of the linkage during turnaround are such that the center of gravity of the link decelerates at a uniform rate and then accelerates at a uniform rate. The path of the center of gravity forms a true semicircle. Also, the link rotates about its center of gravity. Thus the link is under control both geometrically and dynamically.

The buttons **248** adjacent the front and rear lengths of the train of links **178** serve to synchronize the rotation of sprockets thereon. However, the sprockets swing away from the horizontal beam when going around the returns. To maintain synchronization of the rotation of the sprockets between the front and rear lengths a left cam plate **254** and a right cam plate **256** are respectively mounted to the ends of the beam. In going around a return, as a sprocket lower plate cutout **226** leaves the last button adjacent one length, one of the arcuate grooves **230** in the sprocket lower plate engages the edge of the cam plate **254** or **256** and remains engaged until a lower plate cutout engages the first button adjacent the other length. While an even number of links **178** has been shown, an odd number may be utilized. Further, while a sprocket and rod drive combination has been shown, a rack may be formed on each link, and be driven by a gear.

What is claimed is:

1. An endless conveyor system comprising:

an endless train of link assemblies,

each said link assembly being coupled to its immediately adjacent link assembly by and including a pivot means having an axis of rotation,

the respective axes of rotation of immediately adjacent pivot means being spaced apart a first distance;

a first and a second pair of mutually confronting, spaced-apart, guide surfaces,

at any position of said train some of said pivot means being disposed between and guided by said first pair of guide surfaces for movement of said respective axes of rotation along a first plane of travel, and others of said pivot means being disposed between and guided by said second pair of guide surfaces for movement of said respective axes of rotation along a second plane of travel;

the mutually adjacent distal ends of said first and second planes of travel, between which a turnaround is traveled by a traveling pivot means, being spaced apart by said first distance; and

driving means concurrently engaged with at least one of said link assemblies whose respective pivot means is disposed between said first pair of guide surfaces, and with at least one of said link assemblies whose respective pivot means is disposed between said second pair of guide surfaces;

whereby, after a traveling one of said pivot means departs one of said pairs of guide surfaces during a turnaround it does not engage any guide surface until it enters the other one of said pairs of guide surfaces.

2. A system according to claim **1** wherein:

each of said pivot means includes a respective roller having a diameter of a second distance and equal to and disposable in the spacing between said first pair of guide surfaces and the spacing between said second pair of guide surfaces.

3. A system according to claim **2** further including:

a first additional pair of mutually confronting guide surfaces, spaced apart said second distance, and parallel to and spaced from said first pair of guide surfaces by a third distance;

a second additional pair of mutually confronting guide surfaces, spaced apart said second distance, and parallel to and spaced from said first pair of guide surfaces by said third distance; and

each of said pivot means includes an additional respective roller having a diameter of said second distance equal to and disposable in the spacing between said first additional pair of guide surfaces and the spacing between said second additional pair of guide surfaces.

4. A system according to claim **2** wherein:

said train has an even number of link assemblies;

said rollers of at least one-half less two of said number of link assemblies being disposed between said first pair of guide surfaces;

said rollers of at least the remaining half less two of said number of links being disposed between said second pair of guide surfaces; and

said rollers of at least the remaining half less two of said number of links being disposed between said second pair of guide surfaces.

5. A system according to claim **4** wherein:

the lengths of said first and second pairs of guide surfaces is equal including: one-half said number of link assemblies less one multiplied by said first distance.

6. An endless conveyor system according to claim **3** further including:

a shaft mounted on one of said links;

a sprocket journaled on said shaft;

said sprocket having a plate with a plurality of radially spaced-apart cutouts therein;

a plurality of disks, spaced apart and mounted adjacent said guide surfaces;

whereby as said sprocket-carrying link advances, said sprocket cutouts sequentially engage said disks causing said sprocket to rotate about said shaft.

7. An endless conveyor system according to claim **6**, wherein:

said sprocket plate has a plurality of radially spaced-apart grooves formed therein; and further including

two cam plates, one disposed adjacent each end of said guide surfaces,

whereby as said sprocket leaves the last of said disks and its link enters the turnaround, one of said grooves engages one of said cams to preclude free rotation of said sprocket until second link leaves said turnaround and said sprocket engages the first of said disks.

8. A cartridge storage and feed system comprising:

a magazine assembly having a plurality of channels, each channel for storing a column of cartridges;

an endless stripping conveyor assembly for withdrawing the leading cartridge from the respective leading end of each of said plurality of channels including:

an endless train of link assemblies,

each said link assembly being coupled to its immediately adjacent link assembly by and including a pivot means having an axis of rotation,

the respective axes of rotation of immediately adjacent pivot means being spaced apart a first distance;

a first and a second pair of mutually confronting spaced-apart, guide surfaces,

at any position of said train some of said pivot means being disposed between and guided by said first pair of guide surfaces for movement of said respective axes of rotation along a first plane of travel, and others of said pivot means being disposed between and guided by said second pair of guide surfaces for movement of said respective axes of rotation along a second plane of travel,

the mutually adjacent distal ends of said first and second planes of travel, between which a turnaround is traveled by a traveling pivot means, being spaced apart by said first distance; and

driving means concurrently engaged with at least one of said link assemblies whose respective pivot means disposed between said first pair of guide surfaces, and with at least one of said link assemblies whose respective pivot means disposed between said first pair of guide surfaces, and with at least one of said link assemblies whose respective pivot means is disposed between said second pair of guide surfaces;

whereby, after a traveling one of said pivot means departs one of said pairs of guide surfaces during a turnaround it does not engage any guide surface until it enters the other one of said pairs of guide surfaces.

9. A system according to claim 8, wherein:

each of said pivot means includes a respective roller having a diameter of a second distance and equal to and disposable in the spacing between said first pair of guide surfaces and the spacing between said second pair of guide surfaces.

10. A system according to claim 9, further including:

a first additional pair of mutually confronting guide surfaces, spaced apart said second distance, and parallel to and spaced from said first pair of guide surfaces by a third distance;

a second additional pair of mutually confronting guide surfaces, spaced apart said distance, and parallel to and spaced from said first pair of guide surfaces by said third distance; and

each of said pivot means includes an additional respective roller having a diameter of said second distance equal to and disposable in the spacing between said first additional pair of guide surfaces.

11. An endless conveyor system according to claim 10, further including:

a shaft mounted on one of said links;

a sprocket journaled on said shaft;

said sprocket having a plate with a plurality of radially spaced apart cutouts therein:

a plurality of disks, spaced apart and mounted adjacent said guide surfaces;

whereby as said sprocket-carrying link advances, said sprocket cutouts sequentially engage said disks causing said sprocket to rotate about said shaft.

12. An endless conveyor system according to claim 11 wherein:

said sprocket plate has a plurality of radially spaced-apart grooves formed therein; and further including

two cam plates, one disposed adjacent each end of said guide surfaces,

whereby as said sprocket leaves the last of said disks and its link enters the turnaround, one of said grooves engages one of said cams to preclude free rotation of said sprocket until second link leaves said turnaround and said sprocket engages the first of said disks.