



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
14.02.2007 Bulletin 2007/07

(51) Int Cl.:
B61B 7/04 (2006.01)

(21) Application number: **06016213.8**

(22) Date of filing: **03.08.2006**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

(72) Inventor: **Mugnier, Jean-François**
81505 Grand Junction
Colorado (US)

(74) Representative: **Hecké, Gérard et al**
Cabinet Hecke
WTC Europole
5 place R. Schuman
BP 1537
38025 Grenoble cedex 1 (FR)

(30) Priority: **18.01.2006 US 335242**
09.08.2005 US 707071 P

(71) Applicant: **POMAGALSKI S.A.**
38600 Fontaine (FR)

(54) **Operating method for a disengageable aerial ropeway**

(57) An aerial ropeway transport system (10) includes a rope (20) extending between at least two terminals (60,90) and a plurality of trains (120,128,140,142) carried by the rope. Each of the trains may include at least one carrier which is detachably attached to the rope.

The rope may be operated at a relatively high cruising speed. When a train approaches a terminal (60,90), however, the speed is reduced to a relatively low speed to facilitate simultaneous detachment and attachment of carriers.

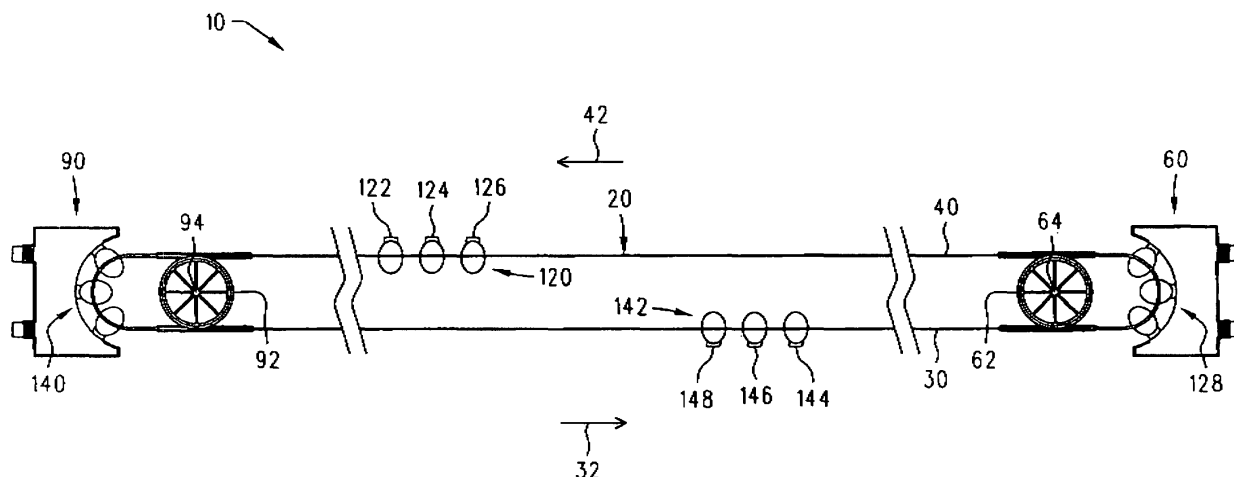


FIG. 1

Description

Background

[0001] Aerial ropeway transport systems are commonly used for transporting people or cargo. A typically system has two end terminals, or stations, each having a bullwheel for supporting a rope. Carriers for carrying the people or cargo are suspended beneath the rope. Rotation of the bullwheels causes the rope to move, along with the attached carriers, between the two terminals. Each terminal typically includes provisions for loading people and/or cargo onto carriers departing the terminal and for unloading people and/or cargo from carriers arriving at the terminal.

[0002] In a relatively simple type of aerial ropeway transport system, the carriers are permanently attached to the rope. In this type of system, loading and unloading must be performed while the carriers are moving through the terminal at the normal operating speed of the rope. A disadvantage of this type of system is that loading and unloading must be performed while the carriers are still moving. Also, the operating speed of the entire system must be kept low enough so that loading and unloading can be practically accomplished. This lowers the overall capacity of the system.

[0003] In a traditional "pulsed" system, carriers are typically arranged in relatively widely spaced trains of one or more carriers. When a train arrives at a terminal, the drive rope is slowed down or stopped to allow the passengers or cargo to be loaded and/or unloaded. After loading and/or unloading are completed, the rope is returned to its normal operating speed until the next train arrives. Thus, a pulsed system may be operated at a relatively higher speed when loading/unloading operations are not being carried out. One disadvantage of a pulsed system is that the entire system must be operated at the relatively slow loading/unloading speed (or stopped) for the entire time that it takes to complete loading and/or unloading of a train.

[0004] In a detachable system, the carriers are selectively detachable from the rope. In this manner, when a carrier arrives at a terminal, it can be detached from the rope and conveyed on a separate terminal conveyor system so that the carrier can be brought to a stop while the rope continues to move. Alternatively, instead of stopping, the carrier can be transported at a relatively slow speed in the terminal after detachment. In either case, the rope is permitted to operate at its relatively high speed without interruption. Detachable systems require fairly elaborate devices to detach carriers from the rope, convey them within the terminal and reattach the carriers after loading and/or unloading is completed. The provision of these devices generally necessitates larger and more complex terminals. Further, on high-speed systems, the required terminal size is even greater because additional room must be provided to allow for deceleration and acceleration of the carriers at an acceptable rate. Both the com-

plexity of the detach/attach devices and the size of the terminals contribute to the relatively high cost of a detachable system.

Summary

[0005] Figs. 1-15, in general, disclose an aerial ropeway transport system 10 having a rope 20 extending between at least two terminals 60, 90 and a plurality of carriers, e.g., 144, 146, 148, each of the plurality of carriers being detachably attached to the rope 20 at a first spacing "S" from one another. The plurality of carriers 144, 146, 148 may be caused to move at a relatively high speed by moving the rope 20 at the relatively high speed. The rope 20, and thus the plurality of attached carriers 144, 146, 148 may be decelerated to a relatively slow speed. The plurality of carriers 144, 146, 148 may be detached from the rope 20 at one of the terminals 60, 90 while the rope 20 is moving at the relatively slow speed. The rope 20 may be accelerated to the relatively higher speed after the plurality of carriers 144, 146, 148 have been detached from the rope 20. The first spacing "S" between the carriers 144, 146, 148 may be maintained after the plurality of carriers 144, 146, 148 have been detached from the rope.

[0006] Figs. 1-15 further disclose, in general, an aerial ropeway transport system 10 having a rope 20 extending between at least two terminals 60, 90 and a plurality of carriers, e.g., 144, 146. The plurality of carriers 144, 146 include at least a first carrier, e.g., 144 and a second carrier, e.g., 146, each of the plurality of carriers 144, 146 being detachably attached to the rope 20. The plurality of carriers 144, 146 may be caused to move at a relatively high speed by moving the rope 20 at the relatively high speed. The rope 20, and thus the plurality of attached carriers 144, 146, may be decelerated to a relatively slow speed. The first carrier 144 may be detached from the rope at one of the terminals, e.g., 60, while the rope 20 is moving at the relatively slow speed. The second carrier 146 may be detached from the rope 20 the terminal 60 after detaching the first carrier 144 from the rope 20 and while maintaining movement of the rope 20 at the relatively slow speed. The rope 20 may be accelerated to the relatively higher speed after the second carrier 146 has been detached from the rope 20.

[0007] Figs. 1-15 further disclose, in general, an aerial ropeway transport system 10 having a rope 20 extending between at least two terminals 60, 90 and a plurality of trains e.g., 142, 128. The plurality of trains 142, 128 may include at least a first train, e.g., 142 and a second train, e.g., 128. Each of the first train 142 and the second train 128 may include at least one carrier, e.g., 144, 130 respectively, that is selectively attachable to the rope 20. The rope 20 may have a first portion 30 which moves in a first direction 32 and a second portion 40 which moves in a second direction 42 opposite the first direction 32. The rope 20 may be caused to move at a relatively high speed. The rope 20 may be decelerated to a relatively

low speed. The first train 142 may be detached from the first portion 30 of the rope 20 at one of the terminals, e.g., 60, while the rope 20 is moving at the relatively low speed. The second train 128 may be attached to the second portion 40 of the rope 20 at the one of the terminals 60 while the rope 20 is moving at the relatively low speed. After the detaching and attaching described above, the rope 20 is accelerated to the relatively high speed.

Brief Description of the Drawings

[0008] Fig. 1 is a schematic plan view of an exemplary aerial ropeway transport system having two terminals, a rope extending between the two terminals and a plurality of trains.

[0009] Fig. 2 is a more detailed plan view of a portion of the aerial ropeway transport system of Fig. 1, including one of the terminals.

[0010] Fig. 3 is a detailed elevation view of one of the trains of the aerial ropeway transport system of Fig. 1.

[0011] Fig. 4 is detailed plan view of the terminal shown in Fig. 2.

[0012] Fig. 5 is an elevation view of the terminal of Fig. 4.

[0013] Fig. 6 is a front perspective view of an exemplary grip mechanism useable in conjunction with carriers of the trains of Fig. 1.

[0014] Fig. 7 is a top plan view of the grip mechanism of Fig. 6.

[0015] Fig. 8 is a front elevation view of the grip mechanism of Fig. 6.

[0016] Fig. 9 is a right side elevation view of the grip mechanism of Fig. 6.

[0017] Fig. 10 is schematic plan view of a portion of the aerial ropeway transport system of Fig. 1, including one of the terminals thereof at a first point in time.

[0018] Fig. 11 is schematic plan view of the portion of the aerial ropeway transport system shown in Fig. 10 at a second point in time.

[0019] Fig. 12 is schematic plan view of the portion of the aerial ropeway transport system shown in Fig. 10 at a third point in time.

[0020] Fig. 13 is schematic plan view of the portion of the aerial ropeway transport system shown in Fig. 10 at a fourth point in time.

[0021] Fig. 14 is schematic plan view of the portion of the aerial ropeway transport system shown in Fig. 10 at a fifth point in time.

[0022] Fig. 15 is schematic plan view of the portion of the aerial ropeway transport system shown in Fig. 10 at a sixth point in time.

Detailed Description

[0023] Fig. 1 illustrates an aerial ropeway transport system 10. With reference to Fig. 1, the aerial ropeway transport system 10 may include a first terminal 60 and a second terminal 90. A pair of bullwheels 62, 92 may be

located at or near each of the terminals 60 and 90, respectively. Each of the bullwheels 62, 92 is rotatably mounted for rotation about the axes 64 and 94, respectively. The axes 64 and 94 may be oriented in a direction extending out of and normal to the page, as viewed in Fig. 1. In actual use, the axes 64, 94 may, for example, be provided having a vertical orientation.

[0024] An "endless" rope 20 which may, for example, be a conventional wire rope may be at least partially supported by the bullwheels 62 and 92, as shown. Specifically, each of the bullwheels 62, 92 may include a circumferential groove sized appropriately to allow the rope 20 to engage therewithin in a conventional manner. As can be appreciated, when engaged in this manner, the rope 20 can be viewed as having a first portion 30 and an oppositely-disposed second portion 40.

[0025] At least one of the bullwheels 62, 92 may be operatively connected to a prime mover, e.g., an electric motor (not shown), such that the bullwheel can be drivingly rotated about its respective rotational axis 64, 94. Rotation of the bullwheel 62 and/or 92, in turn, causes the rope 20 to move. Each of the bullwheels 62, 92 may, for example, rotate in a counter-clockwise direction (as viewed in Fig. 1) thus causing the rope first portion 30 to move in the direction 32 and the rope second portion 40 to move in the opposite direction 42.

[0026] A train 142 of carriers, e.g., the carriers 144, 146, 148, may be attached to the rope 20 such that movement of the wire rope, as described above, will cause the train 142 to move between the terminals 60 and 90. Specifically, the train will move from the terminal 60 to the terminal 90 along the second portion 40 of the rope 20 and from the terminal 90 to the terminal 60 along the first portion 30 of the rope 20. In this manner, the aerial ropeway transport system 10 may serve to transport passengers between terminals 60 and 90. Each of the carriers on the system 10 may, for example, be capable of holding up to eight passengers.

[0027] Each of the carriers 144, 146, 148 within the train 142 may, for example, be of a conventional type used to carry passengers. The carriers may, for example, be common vehicles such as gondola cabins or open baskets (cabriolet), chairs or larger cabins as used in aerial tramways.

[0028] The train 142 is illustrated in further detail in Fig. 3. With reference to Fig. 3, each of the carriers 144, 146, 148 within the train 142 may generally include a cabin portion (e.g., the cabin portion 160 of the carrier 144), suspended by a hanger (e.g., the hanger 162 of the carrier 144) from a grip mechanism (e.g. the grip mechanism 170 of the carrier 144). As will be explained in further detail herein, the grip mechanism is 170 selectively engageable with and detachable from the rope 20. Each of the carriers 144, 146, 148 may include one or more bumper rails, e.g., the bumper rail 136 illustrated in conjunction with the carrier 144 in Fig. 3. The bumper rails serve to help guide the carriers when they travel through one of the terminals 60, 90, as will be discussed in further detail

herein.

[0029] When the train 142 is in transit, as shown in Fig. 3, the grip mechanism 170 suspends the carrier 144, via the hanger 162, from the rope 20 such that the carrier 144 moves with the rope 20. It is to be understood that the carriers 146, 148, as well as all other carriers operating on the system 10, may be configured in the same manner as that described above with respect to the carrier 144.

[0030] The carriers 144, 146, 148 may be spaced at a spacing "S", Fig. 3. The spacing "S" may, for example, be between about 10 and about 15 feet. As will be discussed further herein, this spacing is maintained at all times throughout operation of the system 10. In order to maintain a secure spacing between the carriers 144, 146, 148 of the train 142, adjacent carriers within the train may be connected by a permanent articulated "spacing upholding linkage" at the level of the grip mechanism attaching each carrier to the rope 20. A linkage 164, for example, may be connected between the grip mechanism 170 of the carrier 144 and the adjacent grip mechanism of the carrier 146. Similarly, a linkage 166 may extend between the grip mechanisms of the carriers 146 and 148, as shown. The linkages 164, 166 may be attached to the carriers in an articulated manner in order to allow the carriers to navigate a curve while still remaining connected. Note, for example, in Fig. 4, that the carriers 130, 132, 134 are arranged in a curved configuration. The articulated connection discussed above allows the carriers to remain connected to one another and consistently spaced from one another even when in such a curved configuration (although the spacing uphold linkages are not shown in Fig. 4 for purposes of illustrative clarity).

[0031] The spacing uphold linkages described above are not to be confused with the "stabilization linkage" that is sometimes used on the lower part of the hangers (e.g., the hanger 162, Fig. 3) on traditional systems, which is designed to prevent the carriers of a same train hitting each other if they were to oscillate in opposite directions. The addition of a "spacing uphold linkage", as described above, doesn't preclude the additional use of a "stabilization linkage", if so required.

[0032] It is noted that the train 142 is shown and described herein having three carriers for illustration purposes only. The train 142 (as well as all other trains on the system 10) could, alternatively, contain any number of carriers. For purposes of the description presented herein, the term "train" is intended to mean either a single carrier or a plurality of carriers connected together in a series relationship with each of the carriers being individually attached or attachable to the rope).

[0033] Fig. 2 illustrates the first terminal 60 in further detail, it being understood that the second terminal 90 may be configured in a substantially similar manner. With reference to Fig. 2, the terminal 60 may include an attach mechanism 66 located adjacent the bullwheel 62 and associated with the second portion 40 of the rope 20. A

detach mechanism 68 may be located adjacent the bullwheel 62 and associated with the first portion 30 of the rope 20, as shown. A rail 80 may extend between the detach mechanism 68 and the attach mechanism 66, as shown.

[0034] The terminal 60 may further include a loading & unloading platform 70 and a personnel entry portal 72 and exit portal 74 to provide access to the platform. The loading and unloading platform 70 may include a loading and unloading rim 76 as shown. The loading and unloading rim 76 may have a profile corresponding to the profile of a portion of the rail 80 (in the exemplary embodiment illustrated, the rail and the loading and unloading rim 76 each have a curved profile in this area).

[0035] In general terms, the detach mechanism 68 serves to detach a carrier (e.g., one of the carriers 130, 132, 134 of the train 128) from the first portion 30 of the rope 20 and transfer the carrier onto the rail 80. The carriers 130, 132, 134 are shown in Fig. 2 in a stopped position suspended from the rail 80 after they have been removed from the rope 20 by the detach mechanism 68. As can be appreciated, the carriers, in this position, are located immediately adjacent the loading and unloading rim 76 of the platform 70 of the terminal 60 to facilitate passenger loading and unloading.

[0036] After loading and unloading have been completed, the attach mechanism 66 serves to attach a carrier (e.g., one of the carriers 130, 132, 134) to the second portion 40 of the rope 20.

[0037] Figs. 4 and 5 illustrate the terminal 60 in even further detail. With reference to Figs. 4 and 5, it can be seen that the detach mechanism 68 may include a ramp 100 located adjacent the rail 80. In a similar manner, the attach mechanism 66 may also include a ramp 102. An outer floor guide 108 may be provided in the loading and unloading platform 70 adjacent the rim 76. Outer floor guide 108 may include outwardly flared portions 110, 112, at its leading and trailing ends, respectively. An inner floor guide 114 may be provided in the loading and unloading platform 70 as shown. Inner floor guide 114 may include inwardly flared portions 116, 118, at its leading and trailing ends, respectively. Outer and inner floor guides 108, 114 contact the bumper rails of carriers traveling through the terminal (e.g., the bumper rail 136, Fig. 3) in order to help control the movement of the carriers and prevent unwanted swaying. A person 86 is illustrated in Fig. 5 standing on the loading and unloading platform 70 waiting to board the carrier 132.

[0038] A terminal conveyor system (not shown), may also be housed within the terminal 60. The terminal conveyor system is used to move a train, e.g., the train 142, Fig. 1, along the rail 80 (Fig. 2) while the carriers in the train are detached from the rope 20. As will be discussed in further detail herein, the rope 20 slows to a relatively slower "terminal speed" before the detach/attach operations are carried out. The rope 20, does not, however, come to a complete stop. Accordingly, the terminal conveyor system also serves to decelerate a train that has

just been detached from the rope 20 from the rope terminal speed to a complete stop, e.g., in the stopped position shown in Fig. 4. The terminal conveyor system is also used to accelerate a train from the stopped position to the rope terminal speed prior to reattaching the train to the cable. The terminal conveyor system may be any type of conveyor system, for example, a conventional type of system that uses rotating rubber tires to engage the friction plate of a carrier grip, e.g., the friction plate 224 of the carrier 144 grip mechanism 170, e.g., Fig. 6.

[0039] It is noted that, although not shown in the drawings, the system 10 may also include various support members, towers, sheaves and other hardware to support and drive the rope 20 as will be readily understood by one of ordinary skill in the art.

[0040] As noted previously, each of the carriers may include a grip mechanism, e.g., the grip mechanism 170 of the carrier 144, Fig. 3. Each grip mechanism may be a device designed to secure carriers to the rope 20 but also able to be disconnected from it, via the detach mechanism 68 and to be reattached on it, via the attach mechanism 66 (Fig. 2). In this manner, each carrier is able to be completely stopped at the terminal 60 or 90 to facilitate loading and unloading while the rope 20 continues moving.

[0041] Figs. 6-9 illustrate the grip mechanism 170 of the carrier 144 in further detail, it being understood that the remaining grip mechanisms associated with the other carriers in the system may be configured in a substantially identical manner. As shown, for example, in Fig. 6, grip mechanism 170 may include a frame 172. Hanger 162 may be attached to a bearing block 174 which, in turn, may be rotatably mounted on a spindle portion (not shown) of the frame 172. In this manner, the bearing block 174 is able to rotate relative to the frame about the axis 176, Figs. 8-9. As can be appreciated, this rotatable mounting of the bearing block 174 allows the hanger 162, along with the attached carrier 144, to move in the directions generally indicated by the arrow 178 relative to the grip mechanism 170 and the rope 20, Fig. 3.

[0042] Referring to Fig. 9, frame 172 may include a stationary jaw 180. Adjacent the stationary jaw are a pair of spaced bearing blocks 182, 184 (Fig. 6). A pair of compressible needles 186, 188 may be located adjacent the bearing blocks 182, 184, respectively, as shown. Frame 172 may further include a pair of support arms 190, 192 as best shown in Fig. 7.

[0043] Grip mechanism 170 may further include a lever arm 200. A movable jaw 208 may be located at a first end of the lever arm 200 as shown. A compression roller 210 may be rotatably mounted to a second end of the lever arm 200. Lever arm 200 may include a pivot portion 202, Fig. 6, located between the first and second ends of the lever arm 200, but much closer to the first end (i.e., the movable jaw 208) than to the second end (i.e., the compression roller 210). The lever arm pivot portion 202 may be pivotally mounted between the frame bearing blocks 182, 184 such that the lever arm 200 is pivotable

relative to the frame 172 about a pivot axis 204, Fig. 9. As can be appreciated, this mounting arrangement allows the lever arm to move in the directions generally indicated by the arrows 206, 207, Fig. 9, relative to the frame 172 of the grip mechanism 170. With reference, for example, to Fig. 6, lever arm 200 may further include a pair of outwardly extending supports 212, 214 rotatably mounted to the lever arm 200 near the compression roller 210.

[0044] A pair of coil springs 216, 218 may be mounted between the lever arm supports 212, 214 and the support arms 190, 192 of the lever arm 200 as best shown in Fig. 7. As can be appreciated, mounted in the manner described above, the coil springs 216, 218 will bias the lever arm 200 in the direction 206, Fig. 9. In other words, the springs 216, 218 will bias the movable jaw 208 of the lever arm 200 in a downward direction and the compression roller 201 in an upward direction, as viewed in Fig. 6.

[0045] As discussed previously, the grip mechanism 170 is selectively engageable with and detachable from the rope 20. When the grip mechanism 170 is attached to the rope, as shown in Figs. 6-9, the force provided by the springs will bias the movable jaw 208 in the direction 206, Fig. 9, thus causing the rope 20 to be tightly gripped between the movable jaw 208 and the stationary jaw 180. In this manner, the carrier 144 will be carried along due to movement of the rope 20. The flexible needles 186, 188, Fig. 6, serve to provide smoother passage of the grip mechanism 170 under compression sheaves.

[0046] To detach the grip mechanism 170 from the rope 20, a downward force 194, Fig. 9, may be applied to the compression roller 210, thus causing the lever arm 200 to pivot in the direction 207 about the pivot axis 202 and the moveable jaw 208 to retract from the rope 20. In a manner as will be described in further detail herein, the downward force discussed above may be supplied by a fixed ramp with which the compression roller 201 is brought into contact when it is desired to detach the grip mechanism 170 from the rope 20. The grip mechanism 170 may be provided with a lateral roller 196 rotatably attached to "trumpet arm" of the frame 172 as shown, for example, in Fig. 6. When the compression roller 210 is brought into contact with a fixed ramp, as discussed above, the lateral roller 196 may also be brought into contact with a separate fixed ramp in order to provide an upward stabilizing force 198, Fig. 9. Without this stabilizing force, application of the downward force 194 to the compression roller 210 might cause the entire grip mechanism 170, hanger 162 and carrier 144 to pivot in the direction 207 about the rope 20 instead of causing the pivot arm 200 to pivot relative to the frame 172.

[0047] With continued reference to Figs. 6-9, grip mechanism 170 may further include a pair of principal rollers 220, 222 rotatably attached to the frame 172, as shown. Principal rollers 220, 222 may be provided in order to support the carrier 144 (e.g., on the rail 80, Fig. 4) after it has been detached from the rope 20. A friction plate 224 may be attached to the frame 172 of the grip

mechanism 170, as shown. Friction plate 224 may be provided for engagement with a supplementary drive means for accelerating, decelerating or maintaining movement of the carrier 144 after it has been detached from the rope 20 in a manner as will be described in further detail herein.

[0048] It is noted that the preceding description of the grip mechanism 170 is provided for exemplary purposes only. In actual use, any type of detachable grip mechanism could alternatively be used.

[0049] During operation of the system 10, the speed of the rope 20 may be varied in order to optimize performance. Specifically, the rope 20 may be operated at one of at least two different speeds - a relatively fast cruising speed and a relatively slow terminal speed. The relatively slow terminal speed is used when one or more trains (e.g., the train 142, Fig. 1) is either entering or exiting a station, i.e., when one or more trains is being either detached or attached to the rope 20. The relatively fast cruising speed is used at all other times, except when the system is accelerating or decelerating between the relatively slow and relatively fast speeds.

[0050] The use of a relatively slow terminal speed for detach/attach operations allows for a relatively simplified and less expensive station design (compared, for example to a high-speed detach/attach operation as might be used in a typical detachable chairlift or gondola lift operation). The use of the relatively fast cruising speed, however, provides for optimization of operation since the system need only run at the slow speed during periods of time when attach/detach operations are being carried out.

[0051] In one exemplary embodiment of the invention, a train of carriers parked at a station will be reattached to the rope 20 only when another train reaches the station. In this manner, the arriving train may be detached from the rope 20 at the same time that the previously parked train is being attached to the opposite portion of the rope 20. Further, this process is repeated at the same time at all active terminals on the system. In other words, with reference to Fig. 1, a train 140 may be parked at the terminal 90 and a train 128 parked at the terminal 60. The train 120 (including, for example individual carriers 122, 124, 126) will arrive at the terminal 90 at the same time that the train 142 (including, for example, the individual carriers 144, 146, 148) arrives at the terminal 60. At the same time that the train 120 is being detached from the rope second portion 40 at the terminal 90, the train 142 is being detached from the rope first portion 30 at the terminal 60, the train 140 is being reattached to the rope first portion 30 at the terminal 90 and the train 128 is being reattached to the rope second portion 40 at the terminal 60.

[0052] It is noted that reference is made above to four trains on the system for exemplary purposes only. There may, of course, be more than four trains running on the system. Typically, there will always be an even number of trains. The trains are spaced equidistantly along the

line in order that two trains reach the two opposite terminals, or any other terminals along the line, at the same time. The synchronous operation of the system 10 (i.e., one train being detached as another is attached simultaneously at both terminals) contributes to the efficiency of the system. Since all of the detach and attach operations are performed simultaneously on the system 10, the amount of time that the system must be operated at the relatively slow terminal speed is minimized.

[0053] It is further noted that, although the system 10 has been described having two active end terminals 60, 90, there could be other active terminals on the system where loading and unloading may take place, i.e., intermediate terminals located between the end terminals 60 and 90. If such active intermediate terminals are used, then they will operate in the same synchronous manner with respect to the terminals 60 and 90, in a manner as described above. Generally, the system will include two additional trains for each additional intermediate terminal. These additional trains will be parked in the intermediate terminal until the next online trains reach the intermediate terminal to take the place of the parked trains as the parked trains depart.

[0054] It is further noted that, although not shown in the drawings, there may also be one or more "passive" terminals on the system 10 where loading and unloading does not take place. Passive terminals are generally used in order to provide angle on the line (in other words, to allow the rope 20 to follow a path other than a straight line between the two end terminals). An angle station of this type generally requires one set of attach and detach mechanisms on both legs of the turn as well as two transit rails. This is because detachable grip mechanisms, such as the grip mechanism 170 discussed herein, generally cannot remain attached to the rope when the rope travels around a bullwheel or pulley. Accordingly, the carriers on each side of the line must be detached, transported around the angle on a rail (similar to the rail 80, Fig. 4) and then reattached to the rope.

[0055] An example of the operation of the system 10 will now be described with reference generally to Figs. 10-15. For purposes of the example, the following parameters will be assumed. The system 10 is a two terminal layout (as shown in Fig. 1) having a first terminal 60 with the bullwheel 62 and a second terminal 90 with the bullwheel 92. The distance between the axis of rotation 64 of the bullwheel 62 and the axis of rotation 92 of the bullwheel 90 is 603 meters. The relatively high cruising speed of the rope 20 is 5 meters per second. The relatively low terminal speed of the rope 20 is 1 meter per second. The acceleration and deceleration rate for the rope is 0.5 meters per second per second. The length "A" of the detach mechanism 66 and of the attach mechanism 68 (Fig. 2) is 7 meters. The distance "B" from the front of the detach and attach mechanisms 66, 68 to the bullwheel axis 64 is 4 meters. The prior information applies to the terminal 90 as well.

[0056] The number of trains on the system is 6 (al-

though, for purposes of illustrative clarity, only 4 are shown in the drawings). Generally, at any given time, 4 of these will be "active", i.e., attached to and moving with the rope 20 and 2 will be "passive", i.e., disconnected from the rope 20 and stationary at one of the stations. There are 3 carriers per train. Each carrier can carry up to 8 passengers. The distance between two carriers in a train is 3 meters.

[0057] Referring to Fig. 2, a first rope portion deceleration zone "D" is defined on the first portion 30 of the rope 20 and extends between a point 230 and a point 232, as shown. A first rope portion cruising (relatively high) speed zone "C" is defined extending from the beginning of the deceleration zone "D" (i.e., the point 230) to the end of the acceleration zone (not shown) of the opposite terminal 90. A second rope portion terminal (relatively low) speed zone "E" is defined on the second portion 40 of the rope 20 and extends between a point 234 and a point 236, as shown. A second rope portion acceleration zone "F" is defined on the second portion 40 of the rope 20 and extends from the end of the terminal speed zone "E" (i.e., the point 236) to a point 238. A second rope portion cruising (relatively high) speed zone "G" is defined extending from the end of the acceleration zone "F" (i.e., the point 238) and the beginning of the deceleration zone (not shown) of the opposite terminal 90. The terminal 90 may include a similar, but reversed, configuration (e.g., for the terminal 90, the acceleration zone "F" is on the rope first portion 30 and the deceleration zone "D" is on the rope second portion 40).

[0058] With continued reference to Fig. 2, for purposes of the example presented below, the point 230 may be located at a distance of 28 meters from the bullwheel axis 64. The point 232 (which coincides with the front end of the detach mechanism 68) may be located at a distance of 4 meters from the bullwheel axis 64. Accordingly, the deceleration zone D extends for a distance of 24 meters. The point 234 (which coincides with the front end of the attach mechanism 66) may be located at a distance of 4 meters from the bullwheel axis 64. The point 236 may be located at a distance of 10 meters and the point 238 at a distance of 34 meters from the axis 64. Accordingly, the terminal (relatively slow) speed zone "E" extends for a distance of 6 meters and the acceleration zone "F" extends for a distance of 24 meters, beyond the end of the terminal (relatively slow) speed zone "E".

[0059] To begin the example, with reference to Fig. 10, the three carriers 130, 132, 134 of the train 128 are stopped in front of the loading/unloading platform 70 in terminal 60 supported by the rail 80. In this position, passengers may load into or unload from the carriers. The terminal conveyor system is idle. The rope 20 is running at 5 meters per second; accordingly, the train 142 (Fig. 11) is approaching terminal 60 at the cruising (relatively high) speed of 5 meters per second. When the first carrier 144 of the train 142 reaches the point 230, Fig. 2 (28 meters from the axle 64 of the bullwheel 62), the train 142 enters the deceleration zone "D". At this point, the

rope begins to decelerate at a rate of 0.5 meters per second per second.

[0060] The rope 20 reaches the (relatively slower) terminal speed of 1 meter per second when the first carrier 144 of the train 142 reaches the point 232, Fig. 2 (i.e., a distance of 4 meters from the axle 64) which is also the entrance of the detach mechanism 68, as shown in Fig. 11.

[0061] Four seconds before the condition of Fig. 11 is reached, the terminal conveyor system of terminal 60 is put into motion at an acceleration rate of 0.5 meters per second per second to reach the terminal (relatively slow) speed of 1 meter per second. This causes the first carrier 130 of the train 128 to reach the point of entrance of the attach mechanism 66 at the same time that the first carrier 144 of the train 142 reaches the entrance to the detach mechanism 68, as shown in Fig. 11.

For the next 7 seconds, the first carrier 144 of the train 142 is detached from the rope 20 via the detach mechanism to reach the position indicated in Fig. 12. The detach operation involves the grip mechanism 170, Fig. 6, of the carrier 144 coming into contact with the ramp 100 (Fig. 4) of the grip opening mechanism 68. Specifically, movement of the carrier 144 relative to the ramp 100 causes the ramp 100 to apply a downward force 194 (Fig. 9) to the compression roller 210 of the grip mechanism 170. At the same time, the grip mechanism lateral roller 196 comes into contact with another contact surface (not shown) in order to provide an upward stabilizing force 198. As previously discussed, the downward force 194 on the compression roller 210 causes the grip mechanism lever arm 200 to pivot in the direction 207 (Fig. 9), thus causing the movable jaw 208 located at the opposite end of the lever arm 200 to also pivot in the direction 207 and move out of contact with the rope 20. With reference to Fig. 5, as the grip mechanism 170 begins to engage the ramp 100, the principal rollers 220, 222 (Fig. 6) of the grip mechanism 170 also engage with and begin riding on the rail 80. As can be appreciated with reference to Fig. 5, the rail 80 includes an initial lower portion 104 and a raised portion 106 which is vertically elevated relative to the lower portion 104. The rail transitions from the lower portion 104 to the raised portion 106, beginning at about the point 107 (the opposite end of the rail, adjacent the detach mechanism 66 includes a similar structure). After the grip mechanism 170 releases the rope 20, as described above, the principal rollers 220, 222 of the grip mechanism 170 reach the point 107 after which continued movement of principal rollers along the rail 80 causes the grip mechanism 170 to lift off of the rope 20. Subsequently, the grip mechanism compression roller 210 moves out of contact with the ramp 100, allowing the moveable jaw 208 to return to its closed position (without the rope being present) due to the action of the springs 216, 218.

[0062] The first carrier 144 is then driven for 10 seconds by the terminal conveyor along the rail 80 to its loading/unloading location in front of the loading/unload-

ing platform at a distance of 9 meters from the end of the detach mechanism 68 as shown in Fig. 15. It is noted that, when moving along the rail 80, movement of the carriers is stabilized due to contact between the carrier bumper rails (e.g., the bumper rail 136 of the carrier 144, Fig. 3) and the outer and inner floor guides 108, 114, Fig. 4.

[0063] Three seconds behind the first carrier 144, the same procedure begins for the second carrier 146. Specifically, the second carrier 146 is driven for 7 seconds until it is detached from the rope 20 via the detach mechanism 68 to reach the position indicated in Fig. 13. The terminal conveyor system then transits the second carrier 146 to a position 6 meters from the end of the detach mechanism 68, as shown in Fig. 15.

[0064] Finally, three seconds behind the second carrier 146 (6 seconds behind the carrier 144), the same procedure occurs again for the third carrier 148. Specifically, the third carrier 148 is driven for 7 seconds until it is detached from the rope 20 via the detach mechanism to reach the position indicated in Fig. 14. The terminal conveyor system then transits the third carrier 148 to a position 3 meters from the end of the detach mechanism 68, as shown in Fig. 15. Loading and/or unloading of the train 142 may then be carried out.

[0065] As shown in Fig. 11, at the same time that the first carrier 144 of the train 142 reaches the entrance to the detach mechanism 68 (as described above), the first carrier 130 of the train 128 reaches the entrance to the attach mechanism 66 and is attached to the rope 20 (this takes 7 seconds) and then carried by the rope 20 at a speed of 1m/s for 6 seconds.

[0066] The attach operation is essentially the reverse of the process described above with respect to the detach operation. To begin the attach operation, the grip mechanism of the carrier 130 comes into contact with a ramp (not shown) of the attach mechanism 66. Contact between the grip mechanism compression roller (similar to the compression roller 210, Fig. 6) and the attach mechanism ramp causes the moveable jaw (similar to the jaw 208, Fig. 6) to move to its open position. The grip mechanism of the carrier 130 is then lowered onto the rope due to the contour of the rail 80. After being lowered onto the rope, the compression roller of grip mechanism moves out of contact with the attach mechanism ramp, allowing the moveable jaw to return to its closed position thus securely gripping the rope 20. Thus, after leaving the rail 80, the grip mechanism and, accordingly, the entire carrier 130 is again fully supported and driven by the rope.

[0067] Three seconds behind the first carrier 130, the same procedure occurs for the second carrier 132 which is placed onto the rope 20 three meters behind the first carrier 130 and is carried by the rope at a speed of 1m/s for 3 seconds. Finally, three seconds behind the second carrier 132, (6 seconds behind the first carrier 130), the same procedure occurs again for the third carrier 134 which is placed onto the rope 3 meters behind the second

carrier 132 of the first train 128 (6 meters behind the first carrier 130)

[0068] When the last carrier (third carrier 134) of the first train 128 has been secured onto the rope, the last carrier (third carrier 148) of the second train 142 has also been completely released from the rope 20. At this point, the front of the first train 128 (i.e., the first carrier 130) has reached the point 236, Fig. 2, and the wire rope begins to accelerate at a rate of 0.5 meters per second per second for 8 seconds to reach its cruising (relatively high) speed of 5 meters per second. With reference to Fig. 2, the rope 20 reaches its cruising speed as the first carrier 130 reaches the point 238.

[0069] After reaching its cruising (relatively high) speed, the rope 20 will run at that speed for the next 48 seconds. At this point, the first carrier of the next train will reach the point 230 (Fig. 2) and the cycle will be repeated. During this 48 second run time, the train 142 may be loaded and/or unloaded without interfering with the high-speed operation of the system.

[0070] As previously mentioned, the system described in the above example uses a total of 6 trains - four active two passive. It is calculated that the system described in the above example would be capable of conveying 1123 people per hour; whereas, a traditional pulse system (as previously discussed) with the same configuration (layout, speed, carrier size, etc.) would be capable of conveying only an estimated 591 people per hour (it is noted that the traditional pulse system would have total of four trains, all of which are active, since the traditional pulse system does not use inactive trains). Accordingly, the system 10 described herein provides significantly improved capacity. The system 10 also allows for substantial reduction of the travel time between terminals relative to a traditional pulse system. Again, given the example set forth herein, the travel time between terminals for the system 10 is calculated to be about 2 minutes and 34 seconds. It is estimated that the travel time for a traditional pulse system having the same configuration would be about 4 minutes and 52 seconds.

[0071] It is noted that the specific distances, speeds, accelerations, times, etc. discussed above are provided only for purposes of the example set forth. In practice, other values and arrangements may readily be used.

[0072] The timing of the system 10, as described herein, may be controlled by an electronic control device, e.g., a conventional computer or PLC. The location of the trains on the system may, for example be tracked by various sensors as will readily be understood by one of ordinary skill in the art. The system 10 described herein provides greatly increased capacity because the attach/detach (relatively slow) terminal speed is only used during a short period, to detach and simultaneously attach the carriers. In a traditional pulsed transport system, on the other hand, the slower terminal speed must be used for a much longer period of time - i.e., the entire time necessary to load and unload passengers and/or cargo.

[0073] The system described herein also allows for

more compact and less expensive terminals relative to a conventional detachable carrier system due, primarily, to the fact that the present system 10 allows attach/detach operations to be carried out at a slower speed.

[0074] It is noted that, although the system 10 has been described herein primarily as a system for transporting people, the system could alternatively be used to transport luggage, cargo, supplies, etc.

[0075] While illustrative and presently preferred embodiments have been described in detail herein, it is to be understood that the inventive concepts may be otherwise variously embodied and employed and that the appended claims are intended to be construed to include such variations except insofar as limited by the prior art.

Claims

1. A method for providing an aerial ropeway transport system comprising a rope extending between at least two terminals and a plurality of carriers, each of said plurality of carriers being detachably attached to said rope at a first spacing from one another, **characterized by** the following steps:

causing said plurality of carriers to move at a relatively high speed by moving said rope at said relatively high speed;
decelerating said rope, and thus said plurality of attached carriers, to a relatively slow speed;
detaching said plurality of carriers from said rope at one of said terminals while said rope is moving at said relatively slow speed;
accelerating said rope to said relatively higher speed after said plurality of carriers have been detached from said rope;
maintaining said first spacing between carriers after said plurality of carriers have been detached from said rope.

2. The method of claim 1 **characterized in that**:

said plurality of carriers comprises a first carrier and a second carrier; and
said first carrier is attached to said second carrier.

3. The method of claim 1 wherein said ropeway transport system further comprises a second plurality of carriers, said method being **characterized by**:

attaching said second plurality of carriers to said rope at the same time that said plurality of carriers are detached from said rope.

4. The method of claim 1 wherein said ropeway transport system further comprises a second plurality of carriers, said method being **characterized by**:

detaching said second plurality of carriers from said rope at the other one of said terminals while said rope is moving at said relatively slow speed.

5. The method of claim 1 **characterized by**:

stopping said plurality of carriers at said one of said terminals after said detaching said plurality of carriers from said rope.

6. A method for providing an aerial ropeway transport system comprising a rope extending between at least two terminals and a plurality of carriers, said plurality of carriers comprising at least a first carrier and a second carrier, each of said plurality of carriers being detachably attached to said rope, **characterized by** the following steps:

causing said plurality of carriers to move at a relatively high speed by moving said rope at said relatively high speed;
decelerating said rope, and thus said plurality of attached carriers, to a relatively slow speed;
detaching said first carrier from said rope at one of said terminals while said rope is moving at said relatively slow speed;
detaching said second carrier from said rope at said one of said terminals after detaching said first carrier from said rope and while maintaining movement of said rope at said relatively slow speed;
accelerating said rope to said relatively higher speed after said second carrier has been detached from said rope.

7. The method of claim 6 **characterized in that** said first carrier is attached to said second carrier.

8. The method of claim 6 wherein said ropeway transport system further comprises a second plurality of carriers, said second plurality of carriers comprising at least a third carrier and a fourth carrier, each of said second plurality of carriers being detached from said rope, said method being **characterized by** attaching said third carrier to said rope at the same time as said detaching said first carrier from said rope occurs.

9. The method of claim 8 **characterized by**:

attaching said fourth carrier to said rope at the same time as said detaching said second carrier from said rope occurs.

10. The method of claim 6 wherein said plurality of carriers comprises at least a third and a fourth carrier, said method being **characterized by**:

detaching said third carrier from said rope at the other one of said terminals at the same time as said detaching said first carrier from said rope occurs ;

detaching said fourth carrier from said rope at said other one of said terminals at the same time as said detaching said second carrier from said rope occurs.

11. The method of claim 6 **characterized by** stopping said first carrier at said one of said terminals after said detaching said first carrier from said rope. 10

12. A method for providing an aerial ropeway transport system comprising a rope extending between at least two terminals and a plurality of trains, said plurality of trains comprising at least a first train and a second train; wherein each of said first train and said second train comprises at least one carrier that is selectively attachable to said rope, said rope having a first portion which moves in a first direction and a second portion which moves in a second direction opposite said first direction, said method being **characterized by**: 15
20

causing said rope to move at a relatively high speed;

decelerating said rope to a relatively low speed;

detaching said first train from said first portion of said rope at one of said terminals while said rope is moving at said relatively low speed; 30

attaching said second train to said second portion of said rope at said one of said terminals while said rope is moving at said relatively low speed; 35

after said detaching and said attaching, accelerating said rope to said relatively high speed.

13. The method of claim 12 **characterized in that** said detaching said first train and said attaching said second train occur substantially simultaneously. 40

14. The method of claim 12 **characterized in that** said first train has only one carrier. 45

15. The method of claim 12 **characterized in that** said first train comprises a plurality of carriers.

16. The method of claim 15 **characterized in that**: 50

said plurality of carriers comprises at least a first carrier and a second carrier; and
said first carrier is attached to said second carrier. 55

17. The method of claim 12 wherein said plurality of trains further comprises at least a third train, **characterized by**

detaching said third train from said rope at the other one of said terminals at the same time as said detaching said first train from said rope occurs.

18. The method of claim 12 **characterized by** stopping said first train at said one of said terminals after said detaching said first train from said rope.

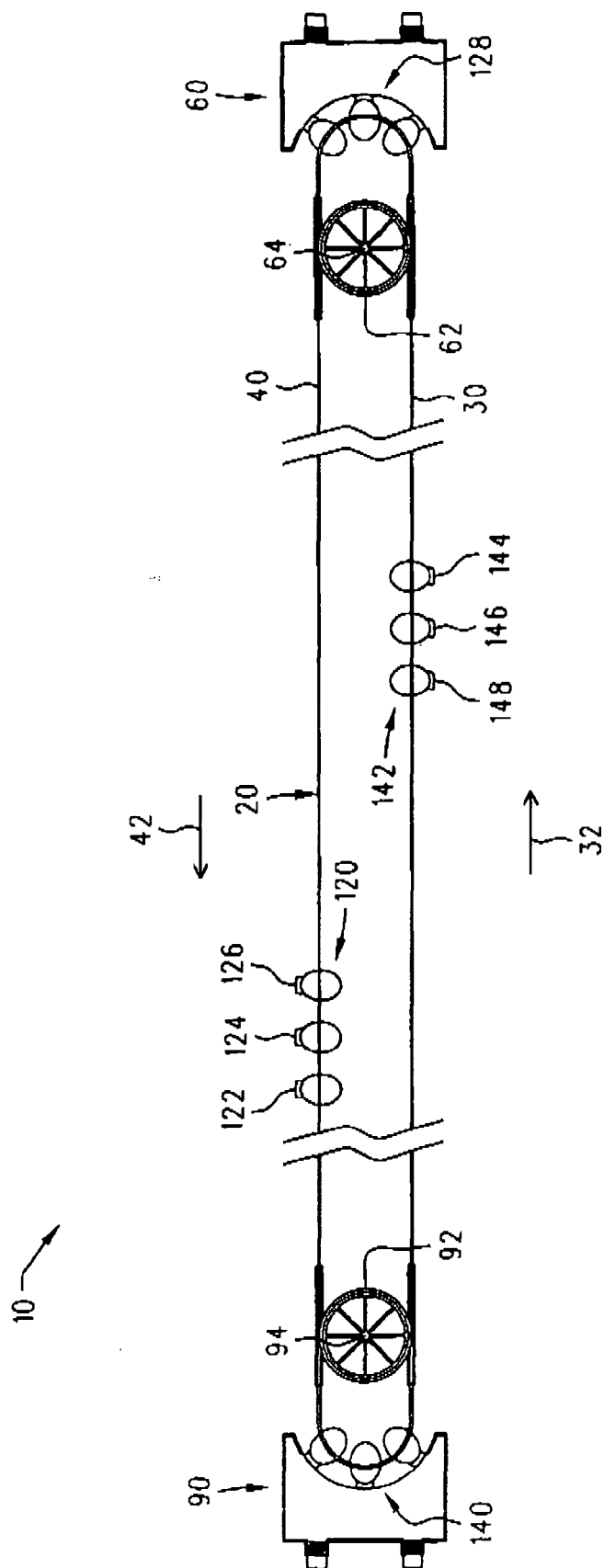


FIG. 1

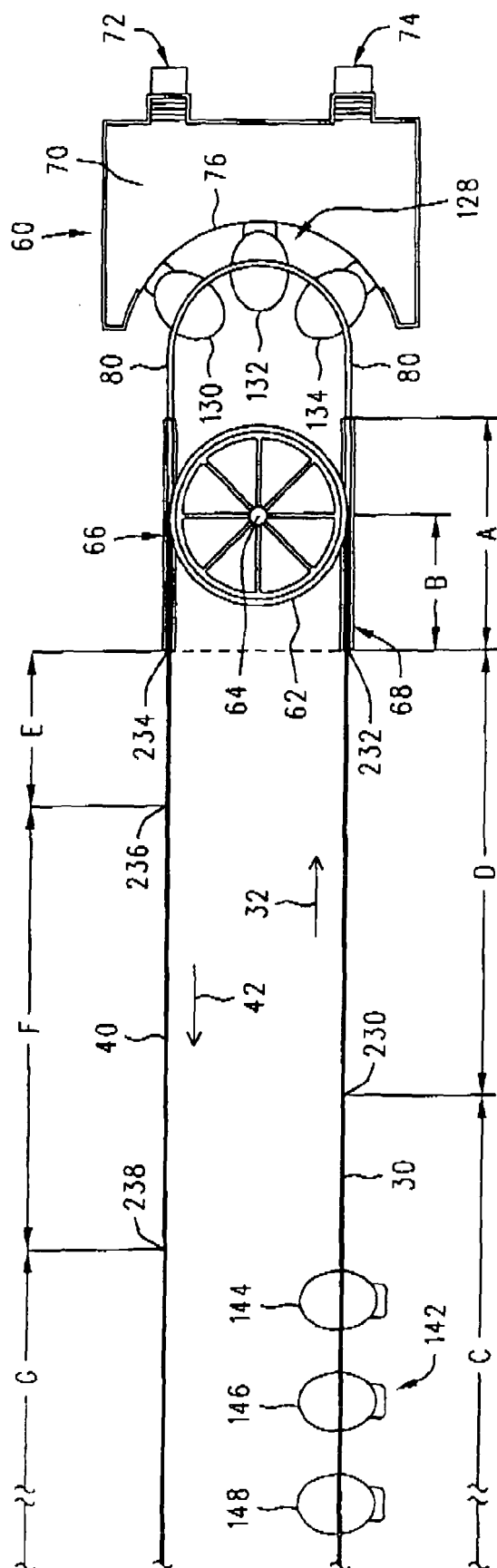


FIG. 2

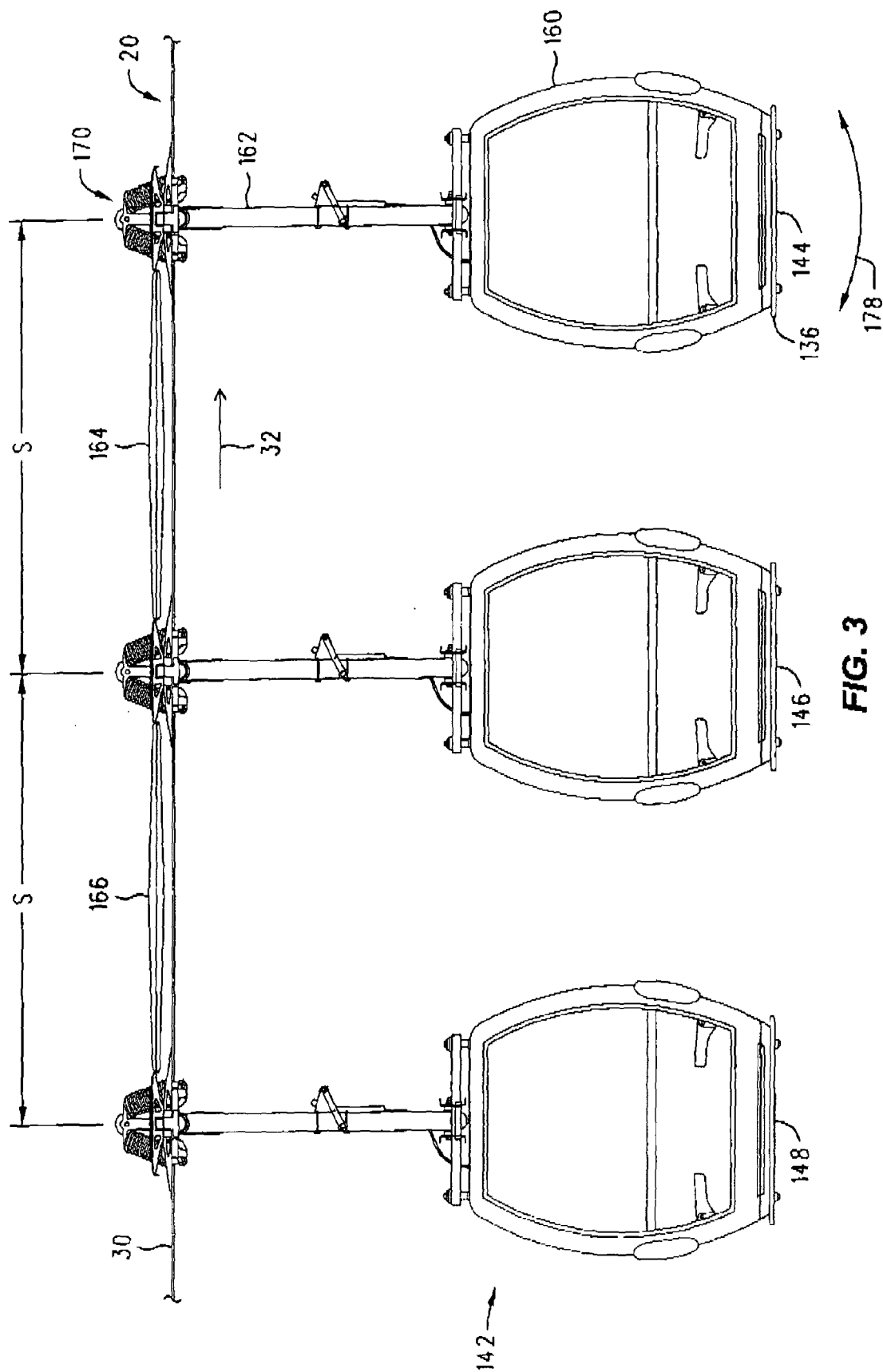


FIG. 3

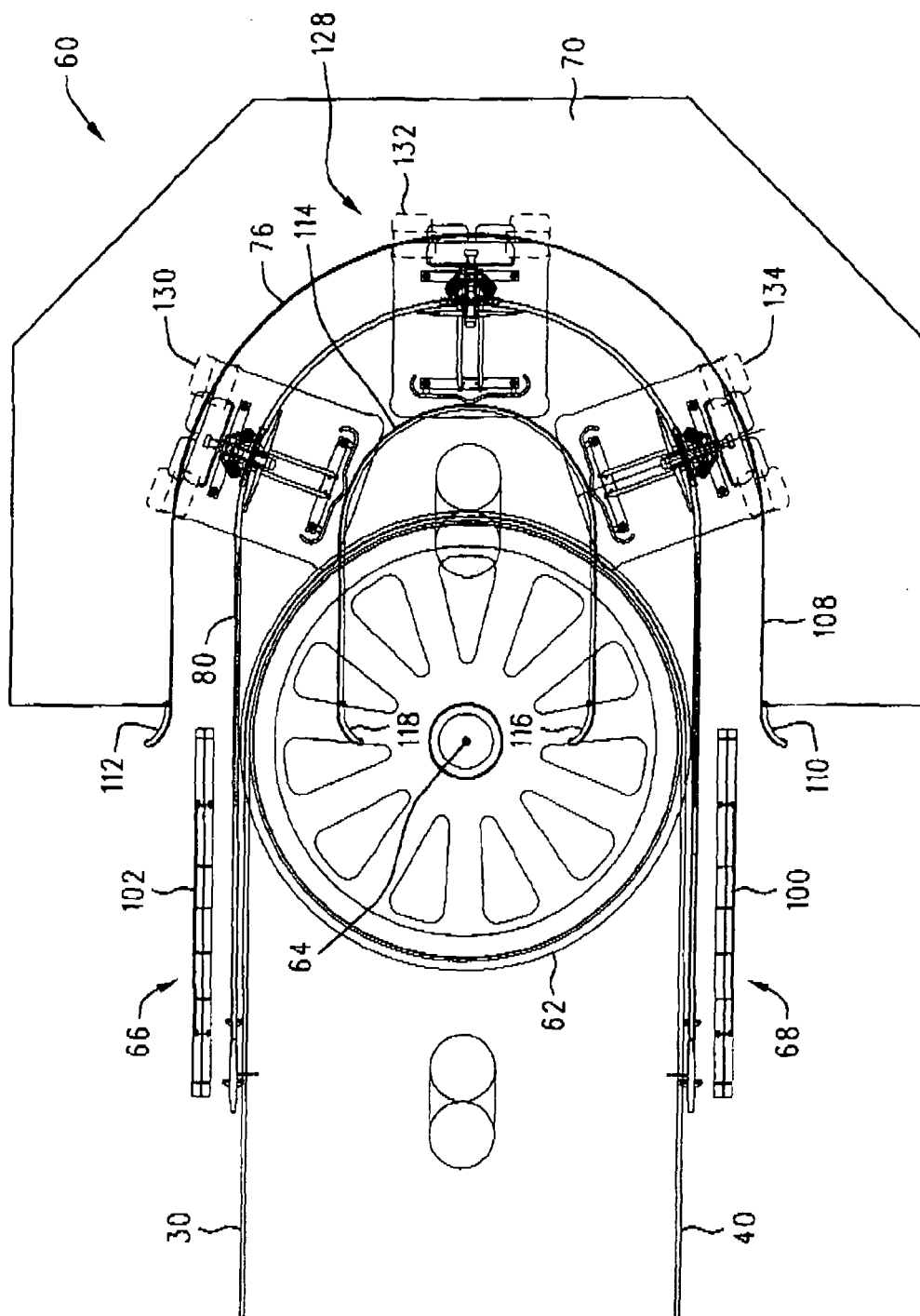


FIG. 4

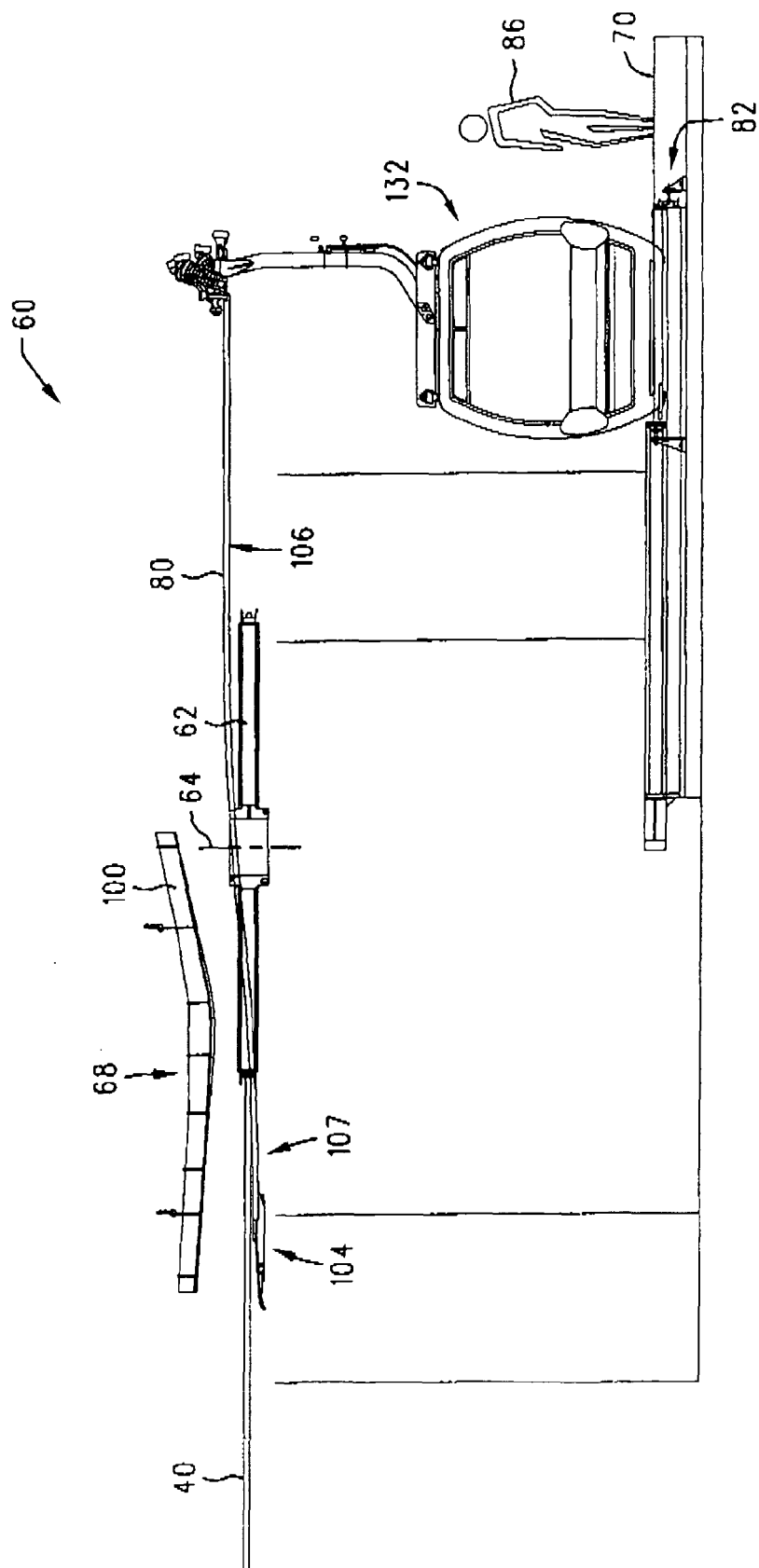


FIG. 5

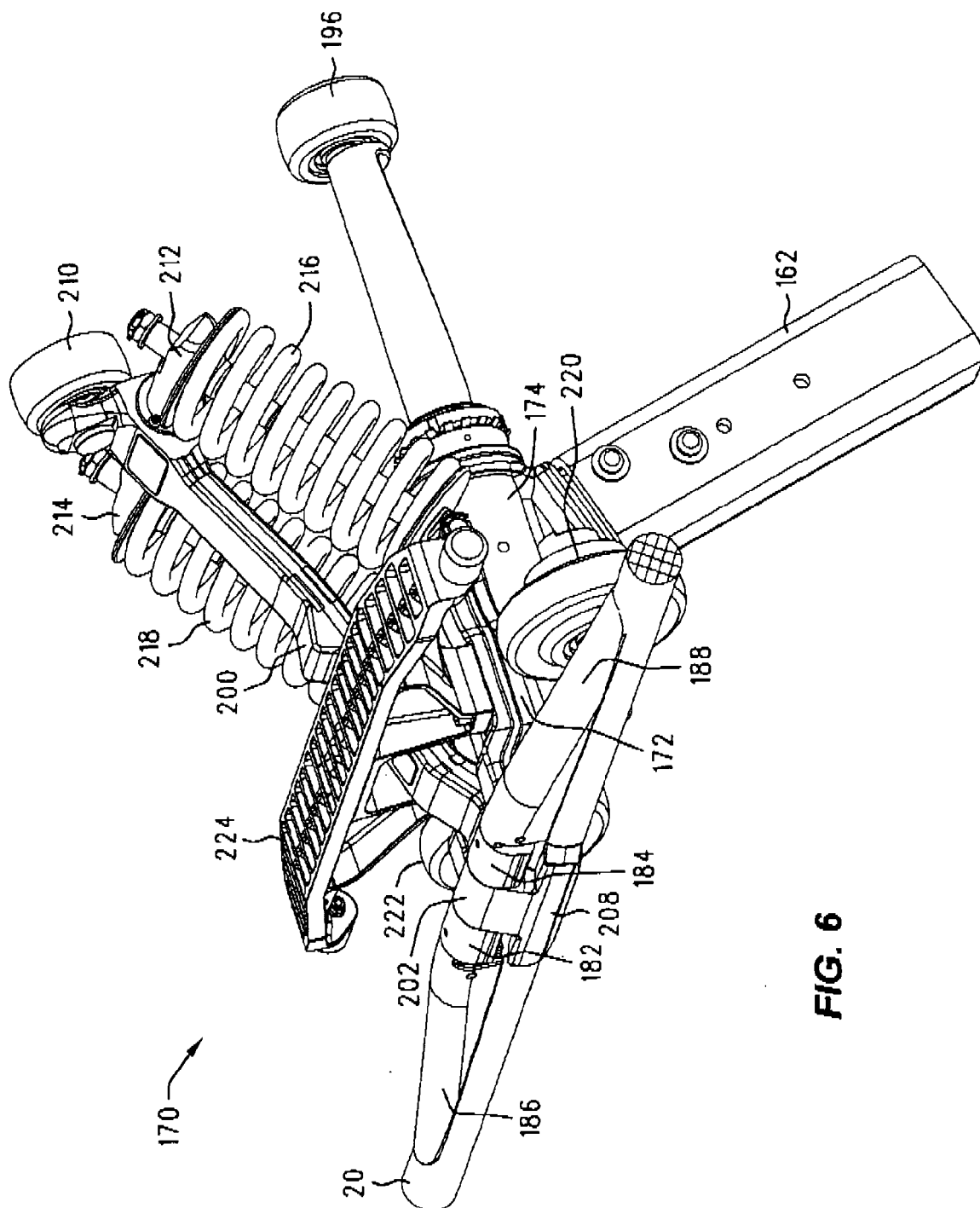


FIG. 6

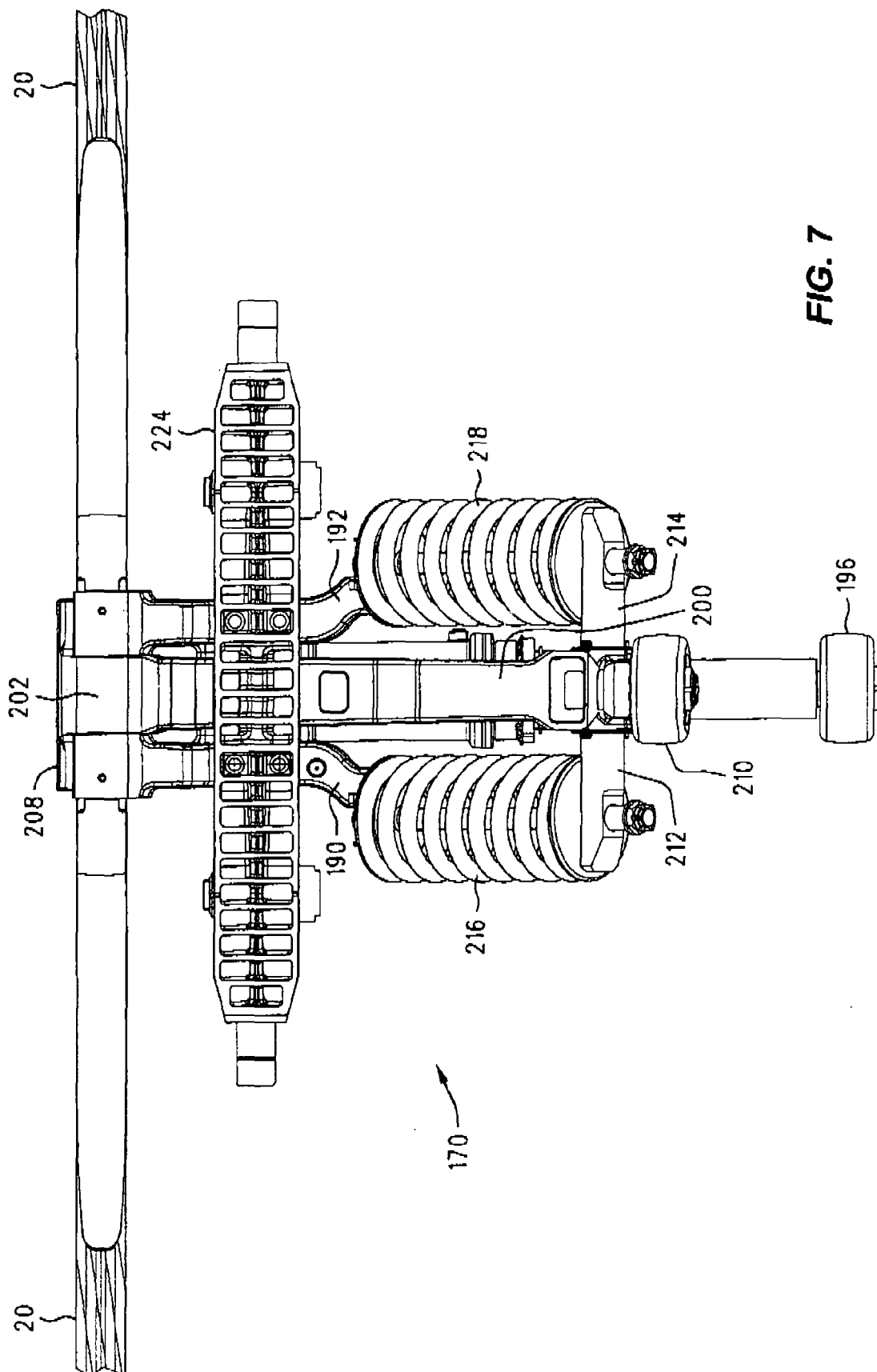


FIG. 7

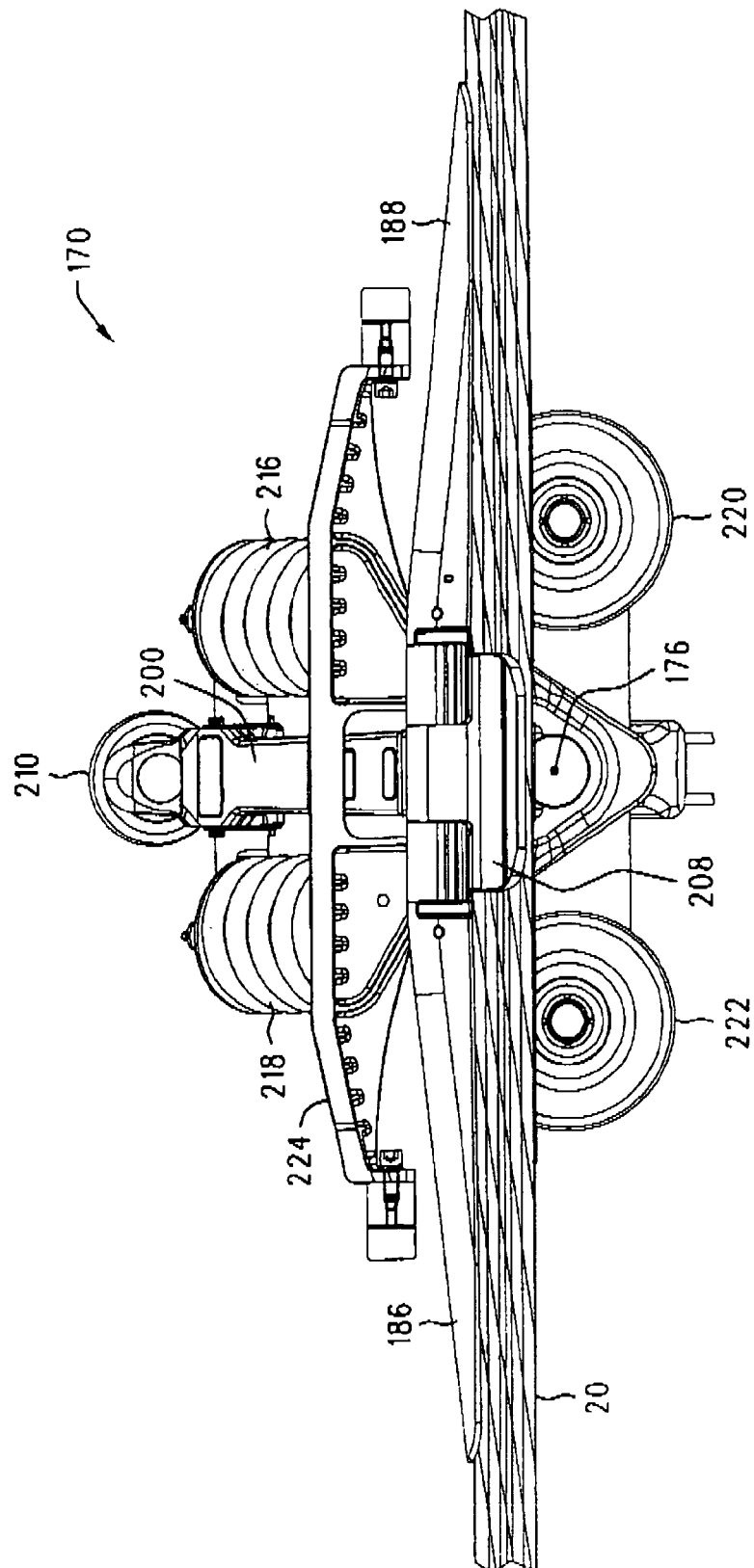


FIG. 8

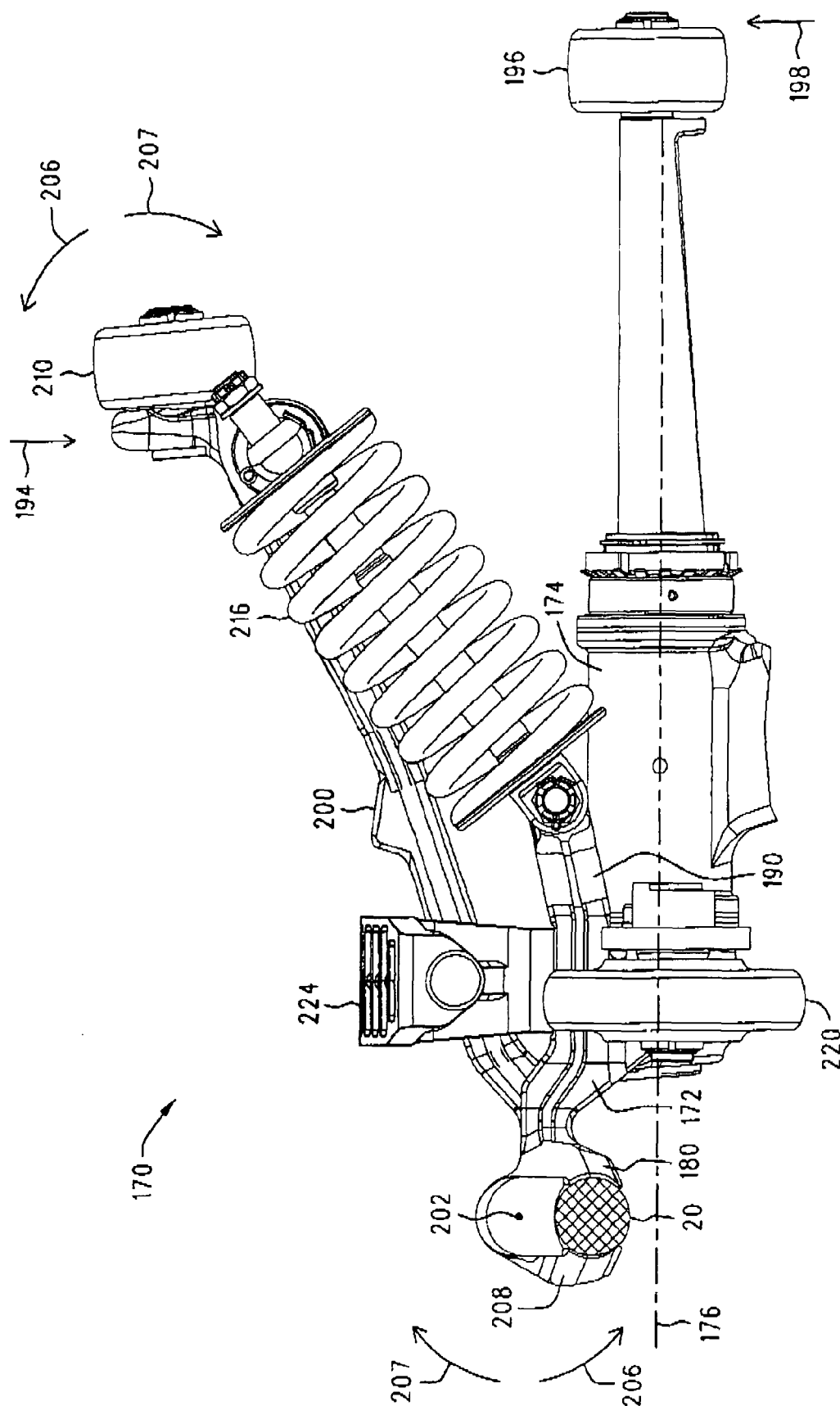


FIG. 9

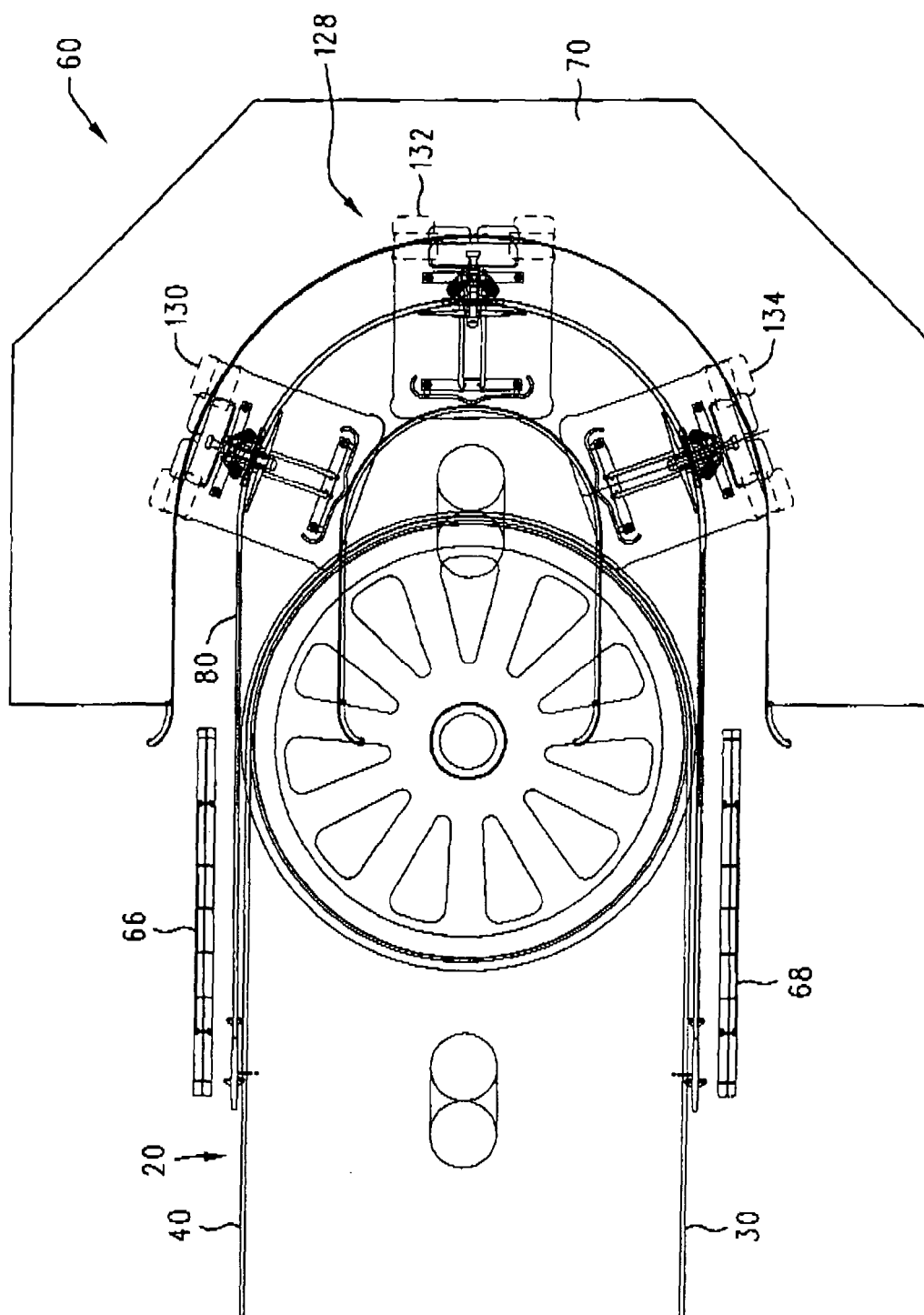


FIG. 10

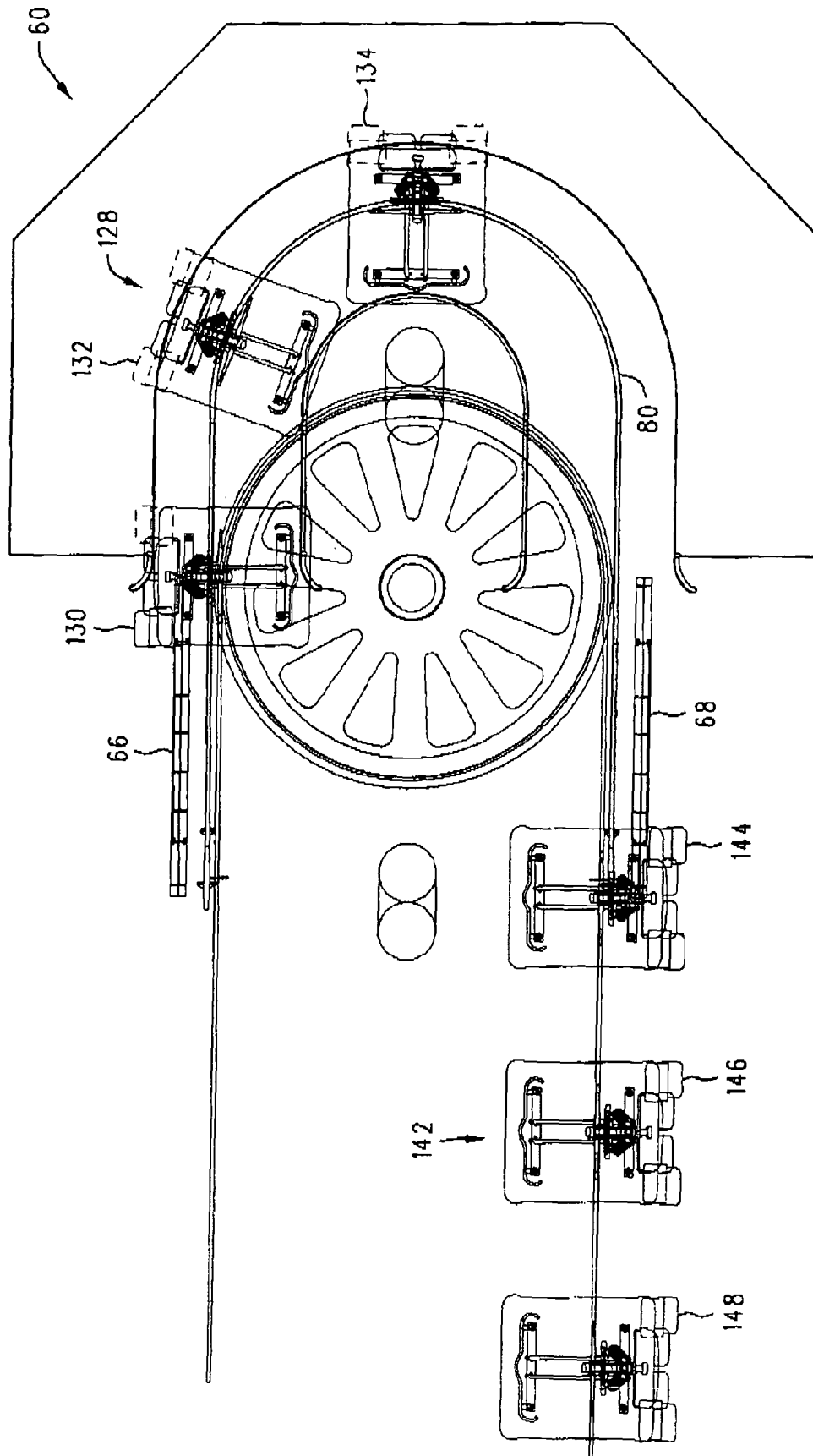


FIG. 11

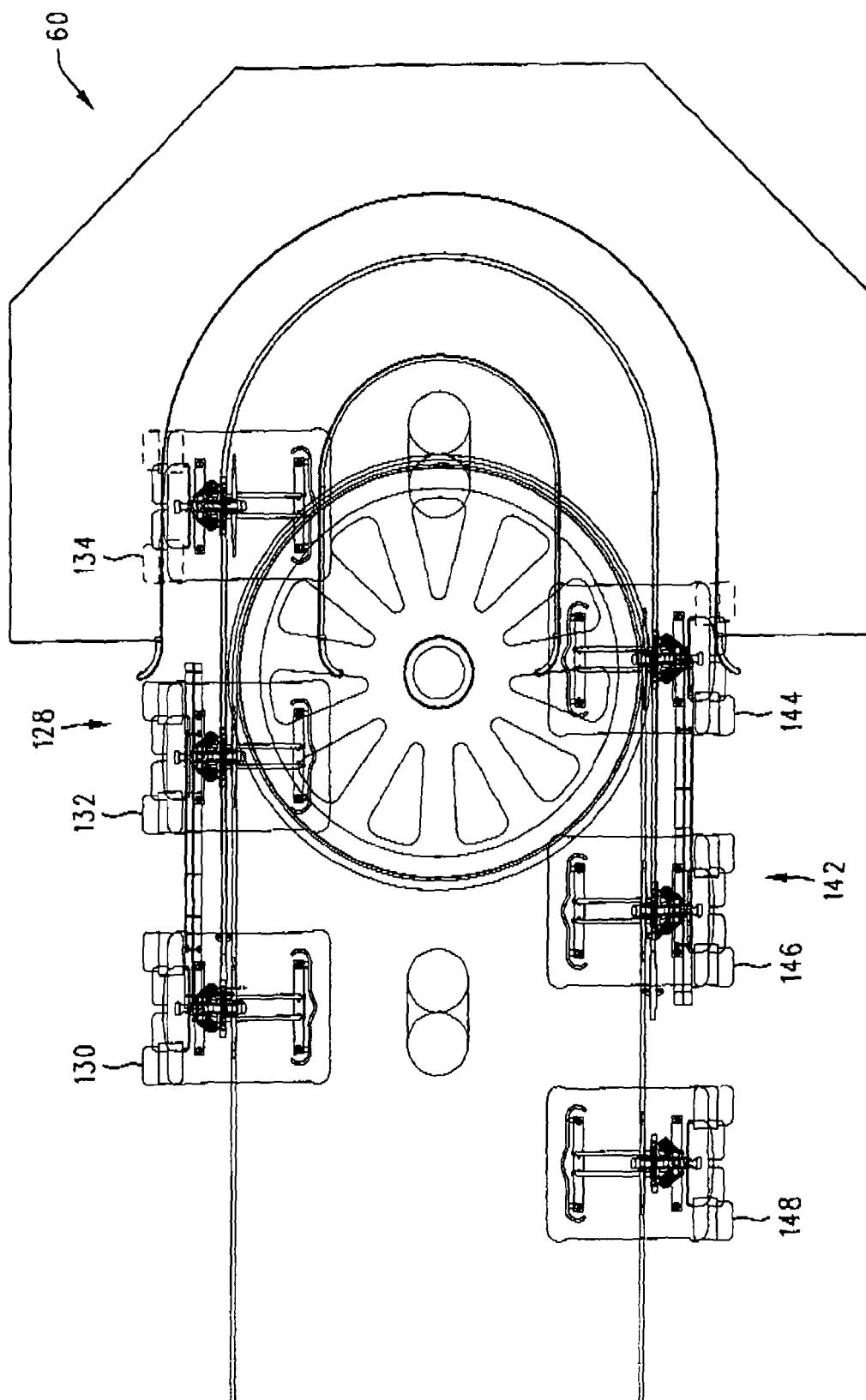


FIG. 12

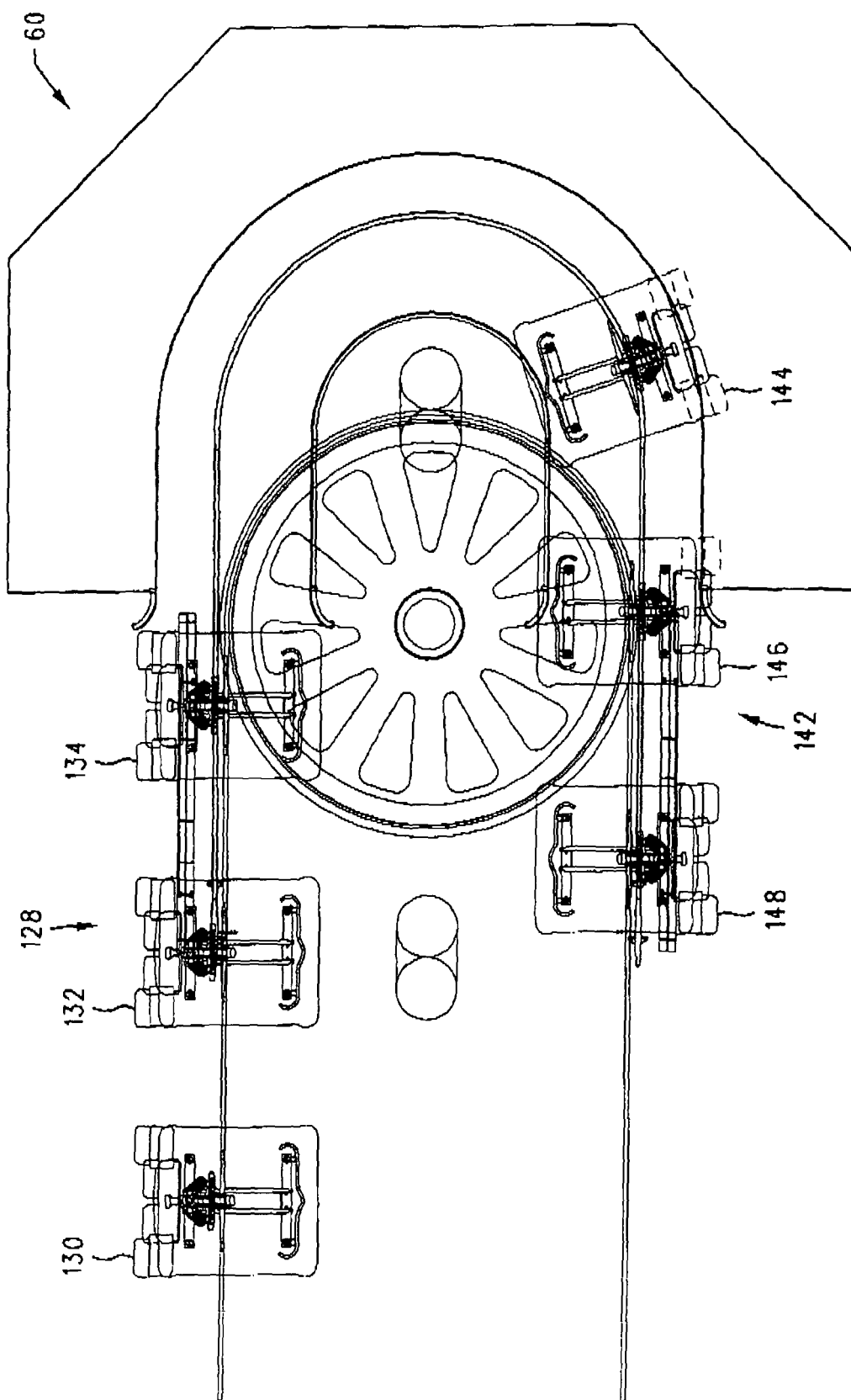


FIG. 13

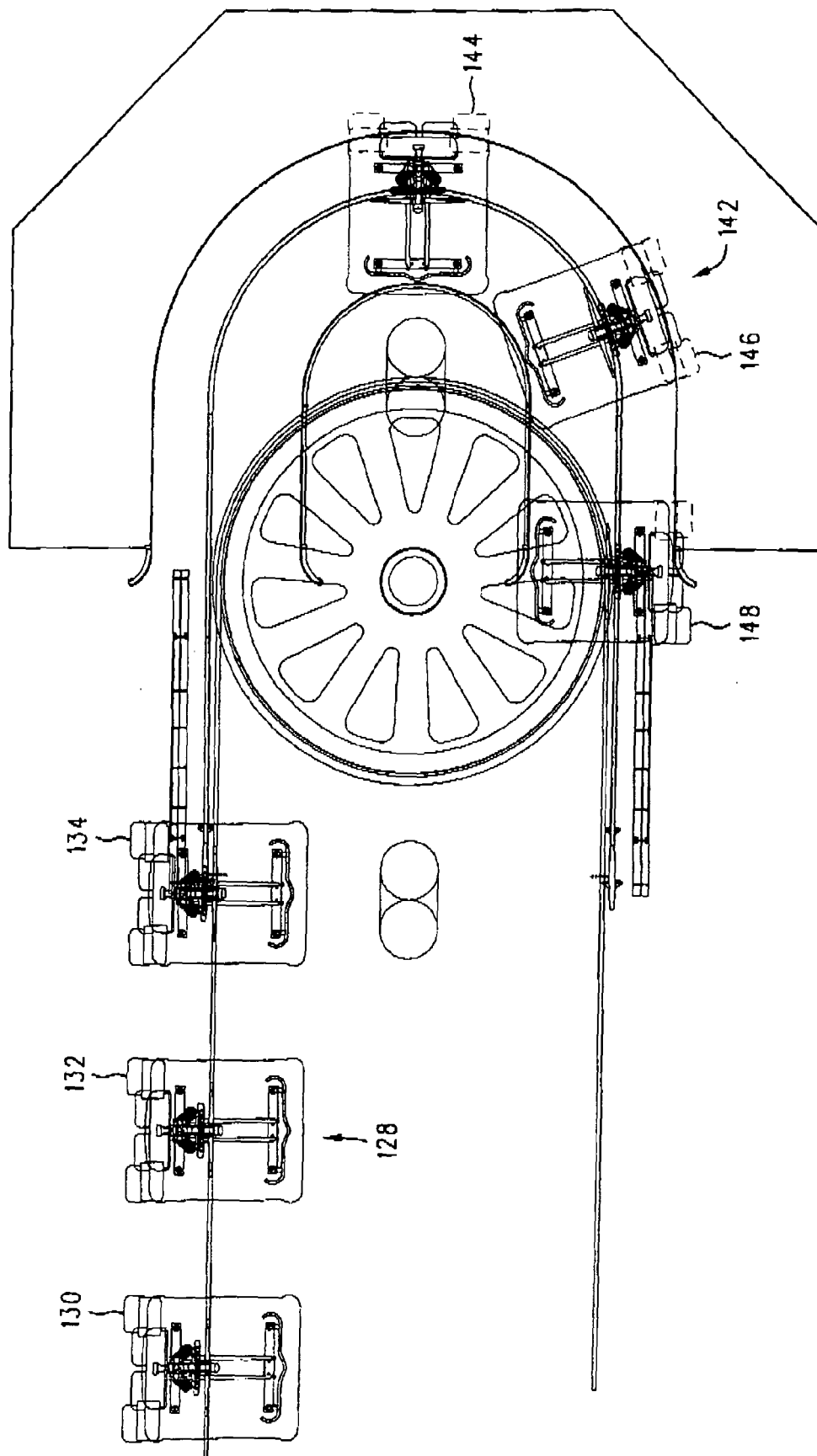


FIG. 14

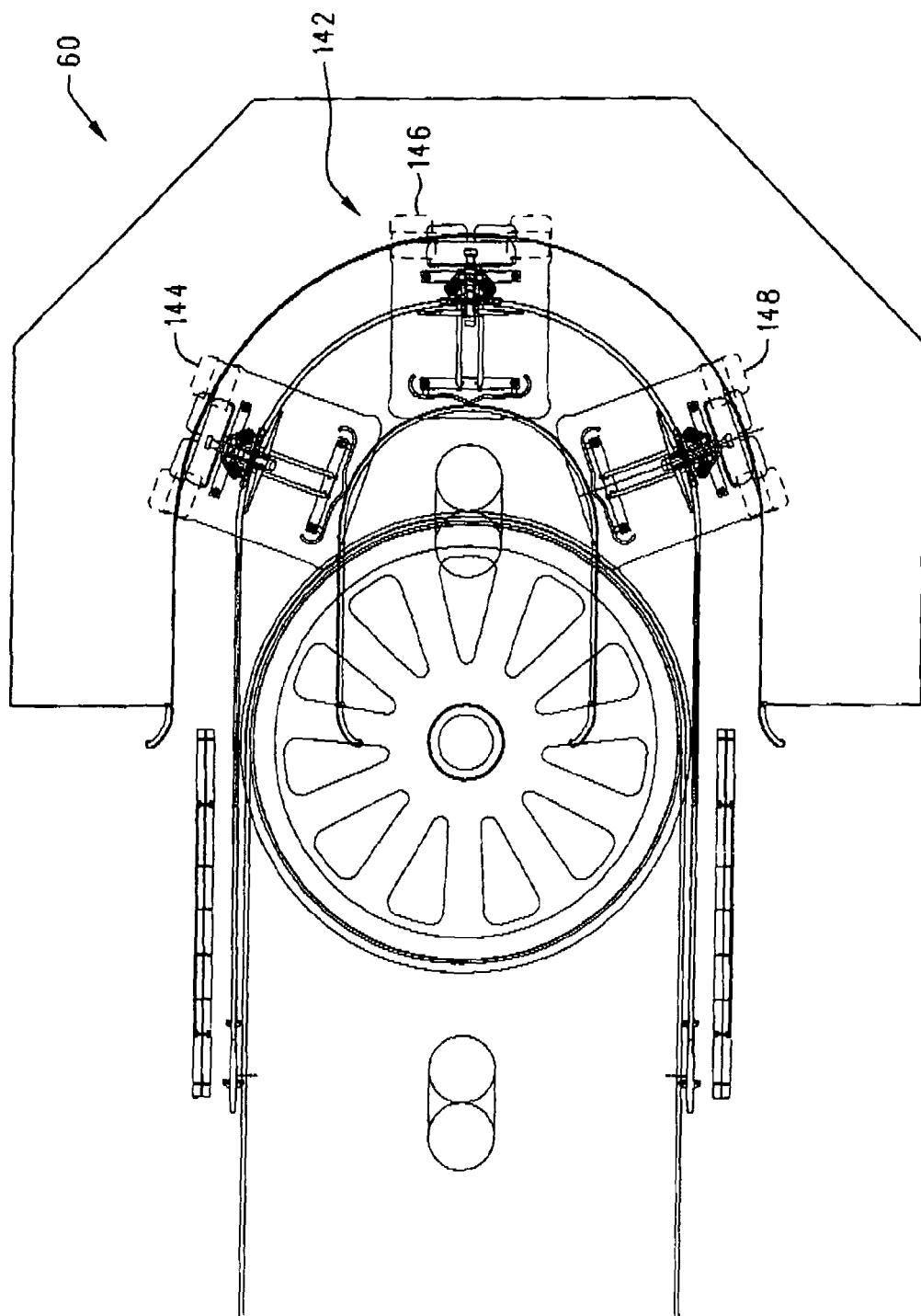


FIG. 15