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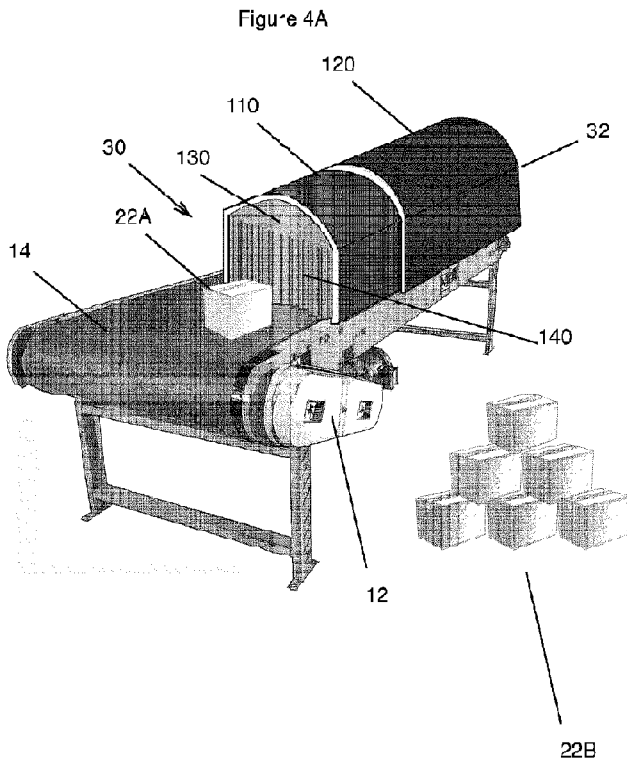
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(54) Title: TRANSPORTER AND CAGE



(57) Abstract: An encoding cage (100) is provided having one or more shells. The shells (110 and 120) may comprise emitters (90A-90D) for generating RF signals to program tags situated in containers. The cage may be mountable on a transporter for transporting RF tags through the cage. The transporter (10) and cage may be connected to a server for programming the emitters and the transporter. The transporter may also comprise a lifter (60) for elevating or tilting the containers.

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## TRANSPORTER AND CAGE

### Field of the Invention

Systems, devices, and methods for bulk encoding RFID tags are presented. Examples  
5 of encoder cages, transporters, and lifters systems are described herein.

### Background

Ultra High Frequency (UHF) passive Radio Frequency Identification (RFID)  
assembled tags are growing increasingly popular in the retail and consumer markets,  
10 particularly for tagging apparel, due to its cost effectiveness, ease of use, scalability,  
and reliability. To improve supply chain visibility, many retailers would like apparel  
suppliers to affix RFID tags to items at the point of manufacture or distribution point.  
This results in the need to encode or program the tagged items at a later point in time,  
often after they have been packaged. A method referred to as “bulk encoding” is in  
15 development in the RFID industry. Generally, the bulk encoding process refers to the  
process of encoding or writing information to the affixed RFID tag when there is one  
or more tags within a container.

A bulk encoding system is described in U.S. Pat. No. 6,700,547 featuring a tunnel  
20 using an electromagnetic field comprising an antenna with a remote interrogator to  
detect when an RFID tag passes in the proximity of the antenna. U.S. Pat. No.  
6,696,954 features a network of antennas forming a portal or passage type detection  
area. More particularly, the network of antennas comprises a plurality of antenna  
loops arranged to form a rectangular network, the antennas transmitting and receiving  
25 electromagnetic signals having three-dimensional components. U.S. Patent  
Application 2012/0212327 discloses that antennas formed under the tunnel are  
positioned in such a way to distribute the RF energy within the tunnel creating better  
RFID tag communications.

30 Several companies are producing commercial bulk encoding systems including Impinj  
and its STP™ Source Tagging Platform, and Alien® and its Blastwrite™ technology.  
These current systems have a firmware located on the RFID transponders that  
communicate with the RFID tag to command them to encode themselves with the  
information the RFID transponder is providing them. For example, the Impinj Monza

5<sup>TM</sup> chip is configured, when commanded by the RFID transponder, take the serial number located on the chip and self-serialize encode itself into the Electronic Product Code (EPC) portion of the chip. Since the RFID tags and transponders are configured to work together, the old method of bulk encoding tags using RFID based Low Level Transponder Protocol (LLRP) has become antiquated and slow to encode but is still useful for RFID transponders and RFID tags that don't work in unison as the mentioned Impinj Monza 5<sup>TM</sup> chip does.

Some prior art systems have certain limitations including: one) RFID tags outside the cage may be encoded in another container not involved in the system; two) the conveyor is traveling too fast and the RFID tags in the container will exit the cage before all RFID tags in that particular container are encoded; three) radio frequency settings on the RFID transponder are not correct or tuned to the proper settings - thus some of the tags do not receive all the intended communications; four) the metal bottom of the conveyor/transporter system will detune the RFID tag antenna on the bottom of the container thus rendering the RFID tag non-communicative; five) the tunnel system entry size is not adjustable because it is typically manufactured with stainless steel and is preformed and mounted over the conveyor system such as the TAGSYS RFID<sup>TM</sup> UHF Tunnel 65x65 or the Venture Research Inc. RFID Conveyor Tunnels; six) after an encoding session, there is no mechanism for container or variable adjustments or retries.

### Summary

As shown and discussed below, an encoding cage is provided having one or more shells. The shells may comprise emitters for generating RF signals to program tags situated in containers. The cage may be mountable on a transporter for transporting RF tags through the cage. The transporter and cage may be connected to a server for programming the emitters and the transporter. The transporter may also comprise a lifter for elevating or tilting the containers.

A bulk encoding process for encoding RFID tags in a container on a transporter is presented. The process uses a specially programmed server to determine encoding settings for the tags in the container, applying those settings during a first encoding pass, and determining whether a sufficient number of tags were programmed properly

using the settings. The server (or an operator) may determine whether a sufficient percentage of tags were encoded, and if not, run an optimization algorithm to improve the encoding of the tags on a second encoding pass.

### Brief Description

Figure 1 illustrates a transport, containers, and a rectangular encoding cage.

Figures 2A and 2B illustrate containers containing products, packaging, and RFID tags.

Figure 3A illustrates a cage, two shells, and two emitter frames.

Figure 3B illustrates a cage, emitter frame, transporter, and server.

Figure 3C illustrates a cage and a cross section of an example of the materials composing the cage.

Figure 4A illustrates a first configuration of a transporter, containers, and a domed (mailbox style) cage.

Figure 4B illustrates a second configuration of a transporter, container, and a domed (mailbox style) cage.

Figure 4C illustrates an alternate view of the second configuration.

Figure 5A and 5B illustrate the cage in a contracted and expanded position.

Figure 6A illustrates a transporter comprising a lifter.

Figure 6B illustrates a second configuration of a transporter comprising a lifter.

Figure 6C illustrates a second view of the second configuration.

Figure 6D illustrates a third view of the second configuration.

Figure 7A and 7B illustrates a transporter comprising two lifters.

Figure 8A illustrates a container with the bottom right corner tilted up.

Figure 8B illustrates a container with the bottom right corner tilted down.

Figures 9A and 9B illustrates an emitter, table, and an RFID tag.

Figure 10 illustrates a bulk encoding process flow.

Figure 11 illustrates a height adjuster and lifter.

Figure 12 illustrates a process for an optimization algorithm.

### Detailed Description

Figure 1 illustrates a system 1 comprising a cage 100 and a transporter 10 for encoding RFID tags inside a container 20 containing products. The transporter

carries the containers into the cage, wherein tags inside the container may be programmed by emitters in the cage.

The transporter 10 may be a conveyor, slider, or other container moving apparatus.

5 The transporter may comprise a drive mechanism 12 for moving a belt 14. The transporter 10 may also comprise a frame 16 and legs 18 that may be made of a conductive material like metal, or a nonconductive material like plastic. The frame comprises a container transportation section extending from a lead portion 11A of the frame, under the encoding cage, to a trail portion 11B of the frame.

10

The container 20, is further illustrated in Figures 2A and 2B. As shown, a container 20 may comprise products 24 and RFID tags 70-70C. The container 20 may be a box, carton, or other shipping or storing container. The container 20 may comprise products (articles for sale or shipment, such as hard drives, socks, lamps, etc.) As  
15 shown, container 20 holds six packages of paper towels (only three packages are visible). Each product may be packaged separately or multiple products may be packaged within one or more packages (here, each package holds two products—two paper towel rolls). Each package may comprise one or more Radio Frequency Identification (RFID) Tags (70A-C). The products may be oriented in any manner in  
20 the container, but horizontal (Figure 2A) and vertical (Figure 2B) orientations are most common since they take the most advantage of the volume of the container. The container may also comprise cushioning materials to prevent damage to the products during shipping and handling.

25 Each RFID tag may comprise a memory that can be programmed by an emitter to comprise a code corresponding to the product, the package, and/or both, an antenna for receiving radiation to power and program the tag, a capacitor to store energy, and other electrical components depending on the configuration of the tag. The RFID tag may be placed within the packaging of the product.

30

As shown in Figures 3A -3C, the cage 100 may comprise two or more shells (110 and 120), each shell having an inner and outer surface (111 & 113). The shells may be mounted and RF coupled one on top of the other to form a single cage. The shells may comprise a slide rail (91A and 91B). The transporter may comprise a grooved

channel (92A and 92B) in which the slide rails that mount to the transporter can be extended in length to provide an adjustable RF cage during the RFID tag encoding process. The width of the opening of the shells may be adjustable by virtue of the flexibility of the shells themselves to accommodate different container sizes and  
5 different transporters. Each of the shells may be similar in shape to compose an RF absorbent cage.

As shown in Figure 3C, each one of the shells may comprise a sandwich of RF absorbent polyester and PVC sheets of material adhered together. The shells may be  
10 rigid or flexible. To provide an explicit example of the shell construction, the shell may comprise an X" x Y" x Zmm Red PALIGHT PVC sheet (111), an X" x Y" radio frequency absorbent -50dB cloth sheet comprised of a nickel/copper coated polyester cloth (112), and a X" x Y" x Bmm White PALIGHT PVC sheet (113) spray glued  
15 together (or attached by alternate techniques) to form as single RF shell (110). X may be 30" to 60" such as 48". Y may be 70"- 110" such as 96". Z may 18" to 36", such as 24", and B may be 2mm to 9mm such as 3 mm. The shells may be mounted and RF inductively coupled one on top of one another to form a single RF cage. The shells may be of similar shape to provide an RF absorbent shield that sits attaches to  
the transporter.

20 Still referring to Figures 3A-3C, the cage 100 may comprise emitters (90A-90D) for emitting an RF signal to program the RF tags with information (e.g. the tags may be programmed with a time, identification number, manufacturing location, etc.) An emitter may take the form of RFID interrogator. The emitter may be a transceiver  
25 configured to send signals to an RFID tags to cause the tag to respond. The emitter may also be configured to program the RFID tags. The emitter may be configured to receive an RFID signal from the tag, and be able to determine which tag from a group of tags issued a response. The emitters may be able to receive and execute  
30 instructions from the server, and transmit information received by the emitter to the server.

Each shell may comprise an emitter frame (82A and 82B), and each emitter frame may comprise emitter mounts for receiving emitters. The emitter frame may comprise wiring or other electronic information transmittal equipment. The emitter

frame may be an inter-skeletal frame that allows mounting of adjustable RFID emitters. The frame may be made of a ductile material that allows for changes in the positioning of the emitters, and the emitter mounts may allow for rotation or other adjustments along the x, y, z planes. The emitters may be electrically connected to the transporter frame, such that control signals may pass from a server 90 (Figure 3B) or the transporter to the emitters. The emitter frame (82A or 82B) may also comprise the connectors so that electronic signals may pass to and from the emitters to the transporter or to the server.

10 The cage 100 may be connected to (fit over, integral with, or be attached to) the emitter frame 82A and 82B. As shown in Figure 3B, the cage 100 may also attach to the transport frame with brackets (85A-85D) and/or connectors (87A-87D). Brackets may supply a mechanical force to keep the emitter frame 82A/82B and transporter frame in close physical proximity (e.g. snapfit, clamps, etc.) and the connectors may be configured to allow electric or electronic communications to pass into and out of the cage. In the illustration shown in Figure 3B, the brackets and connectors feature an integral design with bracket 85A fitting into mount 86A and connector 87A sliding into a socket. Mounts 86B-86D and their reciprocal sockets work in a similar manner. The cage may comprise no sockets and mounts, one socket and mount, or as many as needed to provide a secure electric and mechanical connection.

Figure 3B also illustrates a server 90 connected to the transporter 10. The server 90 may be connected through wireless technology as well. In some configurations, the server can control the speed of the drive mechanism 12, the height and angle of the lifters (60A and 60B - Figure 7), the emitter emission timing and signal strength, etc. The server may comprise computer hardware commonly found in servers such as memory, tangible computer readable storage media (such as a hard drive or network attached storage), processor, network card, case, power supply, optical drive, motherboard, graphics card, monitor, keyboard, mouse, and other computer equipment. The computer readable media may comprise software, instructions, and/or algorithms and routines for causing the processor to execute instructions or carryout processes or process flows. The server may control other components in the system such as the emitters, the cage, the lifter, or the transporter.

Figure 4A illustrates a domed (mailbox style) cage 100 having a first 110 and second shell 120, one slightly larger than the other such that the first shell 110 may slide into and out of the second shell 120. Each shell may comprise a frame with one or more emitters.

5

The cage in Figure 4A also comprises an entrance door 30 for blocking or attenuating radiation created by the emitters inside of the shell. As shown, the door 30 prevents or mitigates radiation inside the cage from reaching the containers outside the cage.

10 An exit door (element 32 illustrates the position of the exit door) may be provided at the rear of the cage for preventing radiation from escaping the rear of the cage. Thus

each cage may comprise two doors, an entrance door and an exit door. The doors or “flaps” may comprise a layer of 13oz scrim banner material, for example the material used in making large banners at office product stores. Other materials that offer

15 enough flexibility to allow containers to pass through, elastic enough to “close the door” the door after the container passes through it, and comprise a sufficient level of RF “absorbability” may be used. For example, materials that can absorb up to -50dB of RF may be used. The material may be comprised of a nickel/copper coated

polyester cloth. Ranges in absorbency cloth can be from -25 dB to -90dB, but since most RFID tags do not respond past -50dB, an absorbability greater than -50db isn’t

20 usually needed. The doors or flaps may be manufactured as a single sheet of scrim, and then cut into strips (that are attached at the top of the sheet). Thus each sheet of scrim would comprise a plurality of alternating slits and strips 140. The width of the strip may depend on the size of containers going through the door. Each door may

25 comprise two RF absorbent sheets (scrim). The two sheets may be interlaced such that the slit portions of the first sheet are positioned in the centers of each strip in the second sheet, and the strip portions of the first sheet are positioned in the slit portions of the second sheet. In such a configuration, there would be no gaps (created by the slits) wherein RF radiation could pass through the door.

30 The end cap 130 may be attached to the beginning of the front shell 110. The rear shell 120 may also comprise an end cap. Shells 110 and 120 may comprise zero, one, or two or more end caps. If there are more than two shells, the middle shells may or may not have end caps. Similarly, the cage may comprise internal doors for sectioning radiation sent by the emitters to the front and rear shell for example. The

end caps may comprise a sandwich of RF absorbent polyester and PVC sheets of material adhered together, and may comprise the same material thickness as the shells.

- 5 The shells 110 & 120, belt 14, and doors (30 and 32) may act together to limit radiation to the internal volume of the cage (behind the door 30, above the belt 14, under the shells (110 and 120), and in front of the rear door 32). Alternatively described, a radiation volume may be defined by a plane or arc extending substantially from the doors, the shells, and the belt (i.e. the space inside the cage). In
- 10 some embodiments, when the emitters are emitting RF radiation, the ambient RF radiation will be higher inside the radiation volume as compared to outside the radiation volume. The difference between the internal RF radiation and the external radiation for a cage featuring doors may be -70% or an order of magnitude of -50 to -90%. In comparison, for a cage not featuring an entrance and exit door, the radiation
- 15 outside of the door may be -10% for the same level of internal radiation. In some configurations, the cage and doors will reduce radiation such that the containers outside the cage (such as container 22A or container pallet 22B) will not receive enough radiation for any of their tags to be programmed.
- 20 Figure 4B illustrates a cage 100 employing doors 30, and an on-ramp 21 for sending containers to the transporter 10. The transporter 10 may comprise a wiring harness 27 for transporting electronic signals to and from the drive mechanism 23, and/or the cage 100. As shown, Figure 4A and Figure 4B feature different drive mechanisms (elements 12 and 23 respectively), but in both cases, the drive mechanism is
- 25 responsible for causing the belt 12 to snake (move) around rollers 25A and 25B, causing the containers on the belt to move towards the cage 100.

Figure 4C illustrates the same embodiment as shown in Figure 4B except the view is illustrated from a different angle. For example, server 90 is shown in Figure 4C, but

30 was not visible in Figure 4B, while drive mechanism 23 is not visible in Figure 4C.

Figures 5A and 5B illustrate the cage in a contracted (Figure 5A) and extended position (Figure 5B). The cage 100 may be movable manually, or it may contain a pneumatic, hydraulic, electric, magnetic, or mechanical shell mover 50 for causing the

cage to extend or contract. Moving the cage to an extended position may cause the emitters within the cage to move as well. Moving the emitters can change interference and timing associated with exposing the tags to RF radiation as they pass through the cage. The server 90 (Figure 3B) may be configured to determine an optimal length for the cage 100 between an extended and contracted position so that a greater number of tags are encoded properly. The server 90 may be configured to send a signal to the shell mover 50 to position the first shell 110 at a given distance along the Y axis (push the first shell into the second shell or pull the first shell away from the second shell.) An exemplary shell mover 50 uses a spring 51 and pneumatic piston 52 to move the shell 110. In this example, both the spring and piston attached by way of mounts. In such a configuration, shell 110 may slide along the frame 16 (of the transporter 10), while shell 120 is fixed in place. The opposite arrangement is also possible.

Figure 6A illustrates a transporter employing a lifter 60 configured to lift the containers away from the frame. The cage (shown disconnected from the frame) may attach generally between points 61A-D. The lifter 60 may be positioned at different locations along the belt 14 with appropriate changes to the cage positioning. In the configuration shown, the lifter may include a roller 62 used to lift the belt 14 a distance (around 2-24 inches) away from the frame. The roller may be substantially cylindrical in shape having a circular cross section and a length. The roller may be mounted to the transporter frame in a sunken position wherein only a portion of the diameter of the cylinder extends past the frame or in an elevated position wherein all of the cylinder is raised about the frame. For example, the lifter could be positioned so half of the diameter of the cylinder is raised about the frame. The lifter may be positioned such that the belt forms an inclined plane extending from the lead portion and cresting at the lifter, and a declined plane descending from the lifter and extending to the tail portion.

The height of the lifter may be adjusted manually, or by a servo motor for example. The server 90 (Figure 3B) may be able to adjust the height of the lifter. In this regard, the system may comprise one or two height adjusters per lifter 65A and 65B. When the height of the height adjust is increased the slope formed from the inclined plane (between the lead portion and the lifter) increases, and the slope formed from the

declined plane (between the tail portion and the lifter) decreases (becomes more negative.) The server, user, or other operator may lift or lower either side of the lifter to create a tilt across sides 83A and 83B of the container shown in Figure 8B. In some configurations, the tilt may have a locking mechanism so that the height adjuster

5 raises the lifter evenly on both sides regardless as to which height adjuster is lifted. The height adjuster may comprise a paddle for a user to grab onto to apply a pulling or pushing force. Below the mount (62B of Figure 6C), a plurality of concentric cylinders may be connected such that as the user pulls on the paddle, the cylinders slide past one another and lock into place. For example, if the height adjuster

10 comprises five cylinders and the cylinders are labelled C1-C5 (in increasing diameter) C1 may be attached to the bottom of the mount 62B, and C5 may be attached to the transporter frame 16. C1 may be connected to C2, C2 connected to C3, etc. When a pulling force is exerted on the paddle, cylinders C1-C4 may raise until a ring or notch in C4 reaches a groove inside C5—snapping C4 in place. If additional force is

15 exerted on the paddle, C3 may slide past C4 until C3 reaches the groove of C4. This process may be repeated until all five cylinders are extended and locked into place. To lower the height, the user may push down on the cylinder so that the ring or notch of C1 pushes past the groove of C2 moving the height of the lifter down one level. The process can be repeated until the lifter is at the lowest position. In this exemplary

20 configuration, the height adjuster would have 5 different heights, and each side of the lifter would be independently adjustable. Such a configuration may be called a five level, independent, five cylinder, dual paddle height adjuster. Alternatively with multiple levels per cylinder, more or less cylinders, fixed tilt, and non-paddle configurations may be used.

25

In an alternative configuration (for example see Figure 11), the height adjuster may comprise a screw column mounted to the bottom of the mount 62B – a screw column being the non-head portion of a screw (a cylinder with a rotating incline plane). The height adjuster may also comprise a nut tube (a tube having an internal inclined plane

30 configured to screw onto the screw column.) The tube may comprise a hexagonal or multi-sided outer surface such that a wrench may be used to rotate the tube. The bottom of the tube may attach to the transporter frame with a rotation collar, such that the tube may rotate freely at the point of attachment while staying locking in place in the Z axis. For example, the tube may comprise a lip that the collar fits over. The

collar may be screwed or welded into the frame blocking positive or negative Z movement of the tube. If the collar is slightly larger than the lip, the nut tube may be free to rotate. Some configurations may feature bearings to decrease the angular force required to rotate the tube with the wrench. In actuation, when a user or (the server  
5 through an automated rotator) causes the tube to rotate clockwise (could be counter clockwise in other configurations), the screw cylinder will move into the tube, lowering the height of the height adjuster. The tube may be rotated until the minimum height is the height of the tube. To raise the height adjuster, the tube may be rotated in the opposite direction. In this configuration, the height adjuster would  
10 have a plurality of various heights that it can set the lifter. Since gravity will exert a downward force on the tube via the screw cylinder, the tube may tend to rotate and lower the height adjuster on its own or especially in response to vibrations. To prevent “downward drift” of the lifter, the bottom of the tube may comprise two pin holes such that a pin may extended through the side of the tube. The collar may also  
15 comprise two pin holes. Since the collar does not rotate (in this example), extending the pin through both collar pin holes and tube pin holes will prevent downward drift and lock the tube in place. Some configurations may feature four pin holes in the tube, such that each half rotation of the tube may be locked in place. Alternatively, the tube and collar may only comprise one pin hole each, and placing the pin through  
20 both holes can still lock the tube in place. Alternative locking methods (other than pins and pin holes) may be used depending on the design configuration of the embodiment. For example, if the inclined plane of the screw features a rough surface, mechanical friction may be sufficient to prevent downward drift. Or, the top of the tube may comprise a hole and a thumb screw that screw into the holes and strikes the  
25 screw cylinder increasing rotation friction between the tube and the screw cylinder.

Figure 6B illustrates an alternative view of the lifter 60 and the belt 14. As shown, the lifter 60 comprises two mounting brackets (62A and 62B), a roller 63, and an axel 64. The roller 63 may be free spinning or it may be mounted to the drive mechanism  
30 12 (or other rotation force generator). Figure 6C shows a close up view of the distal side of the roller of Figure 5B. Figure 6D shows a side view of the lifter 60.

As shown in Figure 7A, when a container of products rolls over the lifter 60 (and enters the cage 100), the container 20 is lifted away from the frame 16. Without the

lifter, the proximity of the frame 16 may reduce the ability of the emitters to properly encode the tags, particularly if the frame is made of a conductive material like metal. By lifting the tags away from the frame, a greater percentage of tags can be encoded properly. Additionally, since the emitters generate an RF field, tags that are oriented

5 sideways or parallel (zero degrees) to the field (Figure 9A) created by the sideways emitter 90A may not receive much of the programming signal because only a small portion of the antenna of the tag is being energized by the radiation. In contrast, tags that are oriented more orthogonal (ninety degrees) to the RF field (Figure 9B) would receive more of the radiation signal with their antennas. To explain this principle in

10 more detail, consider that most RFID tags have an antenna that is generally flat (e.g. extending along the XY axis, but not much along the Z axis.) Assume that the tag is lying on a flat table (such as shown in Figure 9A), and there is an emitter 90A on the side of the table. The majority of the radiation created by the emitter will not strike the antenna of the tag, because the tag lies essentially parallel to the emitter. In

15 contrast, if the emitter is moved (or the tag) so that the radiation is more orthogonal (Figure 9B is about 30-35 degrees) more of the radiation will strike the antenna to power and program the tag. Since the tag can be situated in virtually any orientation, and there may be different products in the way blocking or attenuating some of the radiation, it is possible for a tag to move through a multi-emitter cage (such as the one

20 shown in Figure 1) without all of the tags being powered or programmed properly. However, if the transporter 10 were to adjust the orientation of the tags within the containers, and the emitters irradiated the tags while they were at different orientations, an improved percentage of correctly programmed tags can be realized.

25 In the configuration of Figure 6A, the product may be irradiated one or more times while the container is on the flat portion of the belt, one or more times while it is on the incline of the lifter 60, and one or more times while it is descending the lifter 60. For clarity, the cage of Figure 6A cage 100 was omitted, but it would attach near points 61A-61D. Thus tags that were on a zero degree (or close to a zero degree

30 angle) while the container was on the flat portion of the belt 14 may be at a higher angle (5-20 degrees) when the container ascends the upward ramp of the lifter. In addition, the tags may be irradiated again while the container descends downwardly on the back of the ramp of the lifter since that will again change the angle the tags have with the emitter.

Each container 20 that passes through the cage 100 may comprise different types of tags, different number of tags, tags oriented in different directions, etc. Moreover, the products that the tags are attached to may be made of differing materials that may absorb or reflect part of the RF field generated by the emitter. To help ensure that all tags that pass through the cage receive sufficient radiation (in part based on signal strength and orthogonality to the emitter) to be programmed, a transporter such as shown in Figure 7A may be used.

Figure 7A features a conveyor that comprises two lifters, each having a roller. Roller A features a diameter of  $X$  on side 67B, and a diameter of  $X + Y$  on side 67A. Roller B features a diameter of  $T + U$  on side 68D, and a diameter of  $T$  on side 68C.  $X$  may or may not equal  $T$ , and  $Y$  may or may not equal  $U$ . As shown, the uneven or trapezoidal shaped rollers (60A and 60B) cause the containers that roll over them to tilt based on the uneven nature of the rollers. Figure 7B shows the shape of roller configured to be used with Figures 7A. As shown, in Figure 8A and 8B, the container that passes through the cage may have one or two corners elevated as it passes over each of the lifters 60A and 60B (Figure 5B). If side 82A is orthogonal to lifter 60A, both corners 80A and 80B will be tipped upwards (towards the positive  $Z$  direction), and corners 80C and 80D will be tipped downwards (towards the negative  $Z$  direction). Tags inside the container will also change position accordingly. If, for example, the tags are in a horizontal position such that the side emitter in the cage cannot effectively power or program them, essentially rotating the tags counter clockwise a few degrees may provide the tags an improved capacity to receive the programming signal. In addition to tipping side 82A up and 82B down, lifter 60A may also tip corner 80B and 80C upwards on the way up the lifter 60A, and downwards on the way down the lifter. The emitters can send their programming signals at multiple times while the container is passing over the lifter 60A, affording the opportunity to program the tags when they have different tilts caused by the lifter 60A. If the container 20 is oriented so that corner 80A is closest to the right side of the transporter, corner 80A will be tipped upwards, and corner 80C will be tipped downwards. Corner 80B will rise before corner 80D, and corner 80B will be tilted downwards while corner 80D is tilted upwards. In addition, lifter 60A will raise the whole container at least a few inches upwards (positive  $Z$  direction).

Lifter 60B, as illustrated in Figure 7A, will cause the container to tilt as shown in Figure 8B. Namely side 83A will be tilted upwards and side 83B will be tilted downwards. Similarly corners 81C and 81B will be tilted towards the positive Z direction as the container progresses up the lifter 60B, and titled downwards as the container progresses down the lifter 60B. Corner 81C will be raised higher and dipped lower than 81B based on the gradient (trapezoidal shape) of the roller in lifter 60B. The same relationship would apply for corners 81D and 81A (the same relationship would apply in Figure 8A *mutatis mutandis*.)

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A process for bulk encoding RFID tags stored in containers may comprise the following. Providing a transporter comprising a frame and a belt; and providing a lifter and a height adjuster, the height adjuster configured to adjust upwards and downwards movement of the lifter. The encoding cage may be placed over the lifter and attaching the cage to the transporter. A container may be moved using the belt towards the encoding cage; and the belt placed over the lifter so that the belt is lifted above the frame. The process may further comprise transporting a container through the encoding cage; determining whether proximity of the frame to RFID tags inside the container is affecting encoding of the RFID tags; and raising the lifter if that determination is positive. The process may comprise setting the height adjuster to a first height; positioning an RFID tag comprising an antenna having an electrical length over the lifter; and raising the height adjuster until the frame's overall effect on the electrical length of the RFID antenna is less than a predetermined level. The predetermined level may be 5%, 10%, 20% or 50%. The process may comprise positioning a container comprising an RFID tag on top of the lifter; determining whether the frame is affecting communications between an emitter inside the cage; and raising the lifter to move the RFID further away from the frame, if the determination is positive.

20  
25  
30

Server 90 of Figure 3B may control various encoding settings including: the height of the height adjusters 65A and 65B, the speed and direction of the belt 14, the length of the cage (by virtue of moving the shells), and emitters settings. Each container that passes through the cage may comprise different products with RFID tags oriented in different manners. However, in most expected uses, a user will attempt to encode a

pallet of containers (anywhere from 5-500 containers) in order... meaning that container 1 will have similar contents to container 2, container 2 will have similar contents to container 3, etc. Since shipping may cause movement of the products or their tags, the contents of the container might not be the same. There may also be  
5 variances in each container based on the packer of the container. Because the contents of each pallet may vary (and indeed there may be variances from container to container), the encoding settings of the server may need to be set and/or determined on a per container basis. Size variations in tags 70A-70C may also cause variations.

10 The server may control encoding settings such as which of the emitters should be fired, the receive sensitivity (dBm) of the antenna, and the number of times the emitter attempted to encode the tag. The server can also determine which tags were encoded by which antenna by transmitting an emitter identifier to the tag, having the tag store this information, and querying the tag as to which emitter caused the tag to  
15 be encoded. The encoding of the tag may include additional information such as product numbers, date and time of encoding, location of encoding, URL, etc.

Relative Signal Strength Indication (RSSI) relates to the reflective power of the responding tag in dBm. The lesser the value, the better the power response from the  
20 tag. For example -28dBm has a better response strength than -50dBm because it's closer to 0. Zero is the best response from the tag because the tag reflects 100% of the radio wave antenna.

In many configurations, the time required to send the encoding signal to the tags in  
25 the cage is less than the amount of time it takes the container on the belt to exit the cage (and the belt speed may also be controlled by the server 90.) Therefore it is possible for the emitters to send two or more (could be upwards a few hundred) encoding attempts to the tags while the container is passing through the cage.

However, to increase the speed in which the belt moves (and the number of containers  
30 that can be processed per unit of time (e.g. containers/hour)), decreasing the number of emissions necessary to encode all the tags will allow for an increased speed of the belt. Also, less emissions (emitter firings) reduces energy consumption, decreases the chances for tags outside the cage to be accidentally encoded, reduces wear on the emitters, etc. To optimize the bulk encoding system, an optimal number of emissions

needed to encode the tags may be determined. To take an example, assume there are 100 tags in each container. Firing emitters 90A-90D once yields an encoding percentage of 40% for container A. Firing all four emitters five times raises the coding percentage to 65%. Firing the emitters 25 times raises the encoding  
5 percentage to 90%. And firing the emitters 50 times raises the encoding percentage to 100% for container A. However pallet A comprises 200 containers, each having slight variances in the tag positioning. Depending on the significance of the variation of the tags' positioning, a buffer may need to be added to the 50 times in order to ensure complete encoding of all tags. To determine the size of the buffer (5  
10 emissions, 10 emissions, 20 emissions, etc.) a statistically significant portion of the containers can be encoded and tested to determine how many emissions are necessary to have a statistically insignificant (e.g. less than three standard deviations for example) number of tags not be encoded.

15 Certain configurations of the server may also be able to change the receiver sensitivity (dBm) of each emitter and change the number of times each emitter fires. The server may trigger the emitters to work in a sequence emitter 90A, then emitter 90B, then emitter 90C, then emitter 90D, repeat. However, the amount of time required to have each emitter fire in a looping pattern may be more than an optimized sequence may  
20 require. The less number of emissions required, the faster the server can have the belt run, and the more containers/hour that can be processed.

In the example of Figure 3A, there are four emitters 90A on the top of the front shell, 90B on the side of the front shell, 90C on the top of the rear shell, and 90D on the side  
25 of the rear shell. Depending on the orientation of the tags, it may be that emitters 90A and 90C are the most effective, while emitters 90C and 90D are much less effective at encoding the tags. It follows that for such a container, the server can program the tags faster if it uses only emitters 90A and 90C.

30 Since the server may also be able to control the tilt and orientation of the containers as well as the emitters' transmit power and receive sensitivity, an emitter that is not effective at a particular elevation (relative to the tag) may become much more effective a second elevation (when the tag's angle or elevation is changed). Similarly

modifying the tilt of the container (by unevenly raising one or two of the lift's height adjusters) may transform an ineffective emitter into an effective one.

5 The server may use an optimization algorithm to determine optimal lift, emitter, belt speed, and tilt settings to maximize tag encoding. As an example, the server 90 may direct the belt to move at 30 ft/min. In this example, the height adjusters may be set to be even (no tilt), and there is only one lifter. In this exemplary configuration, the server may be configured to determine how many times within a set number (8 out of 25 for example) an emitter receives a response from a tag given a query or emission. An  
10 exemplary output is shown having 30 tags in the container. The resulting table shows which emitter was used to encode the tag, the tag's responding RSSI, and how many times the emitter saw the tag during the encoding process. For example, the server may select which emitter fires and how many times it fires. If the server determines that the tag is not read a sufficient number of times (greater than 50% or  
15 80% for example), it follows that the emitter is likely not in a good position to encode the tag either.

Table 1

Height even, no tilt, transmit power 13dBm and received sensitivity -55dBm

5

Emitters firing order: 90A, 90A, 90B, 90B, 90C, 90C, 90D, 90D

Tag ID (25 total)	Emitter NUMBER	Tag response RSSI	Number Of times the tag was read
#10	90D	-40	12
#2	90D	-40	5
#5	90D	-40	15
#17	90D	-40	12
#1	90A	-20	24
#13	90B	-20	18
#9	90C	-20	25
#21	90D	-20	12
#16	90A	-10	24
#12	90A	-10	25
#25	90A	-10	25
#4	90B	-20	20
#3	90D	-40	10
#18	90B	-40	2
#24	90B	-40	7
#6	90D	-40	6
#23	90C	-20	12
#14	90B	-20	9
#19	90C	-20	13
#7	90D	-20	6
#22	90A	-10	12
#20	90C	-10	13
#15	90C	-10	13
#8	90D	-20	10
#11	90C	-20	18

When the data in Table 1 is sorted by Tag Response RSSI from the smallest to the largest and then sort by Number of Time the tag was read would results in Table 2.

Table 2

Tag ID (25 total)	Emitter Number	Tag response RSSI	Number of times the tag was read
#12	90A	-10	25
#25	90A	-10	25
#16	90A	-10	24
#20	90C	-10	13
#15	90C	-10	13
#22	90A	-10	12
#9	90C	-20	25
#1	90A	-20	24
#4	90B	-20	20
#13	90B	-20	18
#11	90C	-20	18
#19	90C	-20	13
#21	90D	-20	12
#23	90C	-20	12
#8	90D	-20	10
#14	90B	-20	9
#7	90D	-20	6
#5	90D	-40	15
#10	90D	-40	12
#17	90D	-40	12
#3	90D	-40	10
#24	90B	-40	7
#6	90D	-40	6
#2	90D	-40	5
#18	90B	-40	2

5

As shown in Table 2, if the server applies a sort method on Table 1, and sets a minimum threshold (cutoff) of RSSI as any emitter response better than -30 dBm, then emitters 90A and 90C spent the most time communicating with the tags, and the tags had a better RSSI response with emitters 90A and 90C. Conversely, showing emitters 90B and 90D did not perform as well (lower RSSI). A faster belt speed can be utilized if the most active emitters (the one having the most tag reads) are utilized. The server may execute an optimization algorithm to determine which emitters are necessary, in what firing order, and what the transmit power should be. Figure 12

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shows an exemplary algorithm the server can execute to determine these three encoding settings.

5 Process 1002 determines a group of emitters having an RSSI greater than -30 dBm (e.g. closer to zero) and times read  $> 10$ . In the example based on Table 2, emitter 90A =5, 90B =2, 90C=6, and 90D=1 (box 1004). The server can be configured to select the top two emitters (90A and 90C). The server may average the RSSI of each (1006), yielding -12dBm for 90A and 17dBm for 90C (1008). The server may generate a new fire order based on best RSSI average (emitters 90A and 90C). Since 10 emitter 90A is in the front of the cage, and the emitter 90C is in the rear of the cage, the server may cause the emitters to fire in a sequence such as 90A, 90A, 90A, 90C, 90C, 90C. Other sequences such as 90A, 90C, 90A, 90C could be used as well. The server may increase the power to the 90C transmitter so that it may encode tags with a similar frequency as compared to emitter 90A. The server may solve the equation 15  $(\text{average RSSI Emitter 90A}/\text{average RSSI Emitter 90C}) = 12/17 = X \text{ percent increase} / \text{original emitter power} = X/20 \text{ dBm}$ . This equation reduces to  $12/17 = X / 20$ . Solving for X yields 14, meaning that if the server multiplies the original power of emitter 90C by 1.14 (increase the power by 14%) the ability of emitter 90C should be about the same as emitter 90A. The server may also determine a height adjuster 20 setting to change the angle or tilt of the container to turn the RFID tag antennas more orthogonally into the RF field generated by emitters 90A and 90C.

With the new encoding settings stored in the server, the server can direct the drive mechanism to reverse the belt, drawing the container back towards the front of the 25 encoding cage. The server may then load the new encoding settings for a second encoding attempt. The second attempt (or second pass) may provide increased speed and increased encoding percentage (e.g. close to 100%).

The movement of the container up and down the lifter, real world environmental 30 factors such as imperfect RFID tags, shifting products in the container, etc., may cause the consistency rate of any of the emitters to be less than 100%. For instance, observe that in the above table emitter 90A at transmit power of 23dBm encoded Tag 1. If the server instructs emitter 90A to fire 10 times, and the server keeps track of

each result (e.g. as part of the optimization algorithm) an updated table row may appear as follows (this assume only 5 tags in the container):

Table 3

Emitter 90A @ -40dB	RSSI	Lifter position	Tag 1	Tag 2	Tag 3	Tag 4	Tag 5
Round 1	23dBm	0	Y	N	N	N	N
Round 2	23dBm	0	Y	N	Y	N	N
Round 3	23dBm	0	Y	N	Y	N	N
Round 4	23dBm	2	Y	Y	Y	N	N
Round 5	23dBm	0	N	Y	Y	N	N
Round 6	23dBm	3	Y	Y	Y	N	Y
Round 7	23dBm	0	Y	N	Y	N	N
Round 8	23dBm	0	N	N	N	N	N
Round 9	23dBm	0	Y	N	N	N	N
Round 10	23dBm	3	Y	Y	N	N	Y

5

It may be determined from table 3 that position 3 yields the best results (as part of the optimization algorithm) may allow the server to determine an ideal power level (RSSI level) to use for each emitter.

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Figure 10 illustrates a process flow for the bulk encoding process. Some of the steps are optional and some steps may be executed in a different order than shown. In step 900, the container enters the cage (the cage, transporter, and container of Figure 4A could be used). The system may comprise a camera or a barcode reader to recognize the container type as containing a particular product from a particular manufacturer.

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In such configurations, the server may load a previously container profile associated with that container. The container profile may contain encoding settings such as belt speed, cage length, emitter selection, emitter power, etc. The server may also comprise a human interface apparatus (e.g. keyboard and mouse) to allow a user to specify which profile to select manually. In configurations not featuring a container profile, process flow to recognize containers, or simply in cases where the container type is not recognized, default encoding settings may be loaded 912. In

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configurations employing container recognition wherein the container is recognized, a container profile may be loaded 908. In some configurations, a user may specify to the server, the number of tags in the container. The server may issue an encoding command to the emitters 916. This command may include multiple firings at

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different transmit powers and sensitivity for each emitter. The first attempted encoding may be referred to as a first pass. The emitters may query the tags to determine which ones were encoded by which emitter, and transmit the results to the server. The server may determine which tags were encoded 918 and with what  
5 emitter and communication count, and if not the server may determine what percentage of tags were not encoded 926. The server may slow down, reverse, or stop the belt if it needs additional time to run an encoding settings optimization algorithm 930. If all the tags were encoded 922, the server may cause the container to pass through the cage, and move the next container into the cage using the belt. Using the  
10 data collected by the emitters, the server may run the optimization algorithm 934 to determine optimized encoding settings 938. The server may load 944 these settings and use them to improve the percentage of correctly encoded tags. The updated settings may be saved a container profile 940. With the updated encoding settings loaded, the server may attempt a second encoding 916 (second pass encoding). At  
15 this point the process repeats until all the tags are encoded -- the server optimizing the encoding settings until a set of encoding settings is determined that will encode all the tags in the container. To prevent an infinite loop from occurring, the server may perform a check to see whether any of the settings are changed between loops 938 and whether there is a change in the number of tags being encoded 942. If the settings are  
20 the same and the tags are the same, the server may exit the loop and determine some tags cannot be encoded. In some configurations, the optimization algorithm will provide the server operator a maximum loop attempts.

**It is hereby claimed.****Claims**

1. A transporter for bulk encoding RIFD tags inside containers, the transporter comprising a frame, a drive mechanism, a belt, and a lifter;  
the frame comprising a container transportation section extending from a lead portion of the frame, under an encoding cage, to a tail portion of the frame;  
the drive mechanism configured to provide a rotational force to force the belt to rotate around the container transportation section of the frame;  
the belt being attached to the transporter and configured to move a container placed on the belt towards the encoding cage while the drive mechanism is in operation, said belt comprising a length and width;  
the lifter connected to the frame and positioned underneath the encoding cage, the lifter comprising a first roller;  
the belt extending over the roller such that movement of the belt causes the roller to rotate; and  
the first roller comprising a length and a diameter; wherein the belt is lifted away from the frame a portion of the diameter; such that the belt is elevated above the frame.
2. The transporter of Claim 1, wherein the lead portion comprises a second roller, and the tail portion comprises a third roller, wherein the belt wraps around the first roller, a second roller, and a third roller.
3. The transporter of Claim 1, wherein the transporter comprises brackets and connectors for connecting the encoding cage to the transporter.
4. The transporter of Claim 1, wherein the lifter is connected to the frame with two mounts, and the length of the first roller is substantially the width of the belt.
5. The transporter of Claim 1, wherein the first roller lifts the belt a distance above the belt at least half of the diameter of the first roller.
6. The transporter of Claim 1, wherein the first roller causes the belt to form an inclined plane extending from the lead portion and a declined plane extending to the tail portion.
7. The transporter of Claim 6, further comprising a height adjuster connected to the lifter to allow the lifter to be raised or lowered.

8. The transporter of Claim 7, wherein raising the lifter with the height adjuster causes the inclined plane to increase in slope.
9. A process for bulk encoding RFID tags stored in containers comprising:
  - providing a transporter comprising a frame and a belt;
  - providing a lifter and a height adjuster, the height adjuster configured to adjust upwards and downwards movement of the lifter;
  - placing an encoding cage over the lifter and attaching the cage to the transporter;
  - moving a container using the belt towards the encoding cage; and
  - placing the belt over the lifter so that the belt is lifted above the frame.
10. The process of Claim 9, further comprising:
  - transporting a container through the encoding cage;
  - determining whether proximity of the frame to RFID tags inside the container is affecting encoding of the RFID tags; and
  - raising the lifter if that determination is positive.
11. The process of Claim 9, further comprising:
  - setting the height adjuster to a first height;
  - positioning an RFID tag comprising an antenna having an electrical length over the lifter; and
  - raising the height adjuster until the frame's overall effect on the electrical length of the RFID antenna is less than a predetermined level.
12. The process of Claim 10, wherein the predetermined level is 10%.
13. The process of Claim 9, further comprising:
  - positioning a container comprising an RFID tag on top of the lifter;
  - determining whether the frame is affecting communications between an emitter inside the cage; and
  - raising the lifter to move the RFID further away from the frame, if the determination is positive.
14. A bulk encoding process comprising:
  - placing a container on a transporter, the transporter comprising a belt moving at a belt speed;
  - causing the transporter to move the container into an encoding cage;
  - loading settings in a server to encode RFID tags in the container;
  - directing emitters to encode the RFID tags using the settings;

- querying the RFID tags to determine whether all the tags were encoded;
  - executing an optimization algorithm;
  - determining optimized settings;
  - loading optimized settings;
  - directing the emitters to encode the tags using the optimized settings; and
  - querying the RFID tags to determine whether any more tags were encoded.
15. The process of Claim 14, wherein the optimization algorithm causes the server to determine which emitters are more effective at encoding the tags, and directing only those emitters to encode the tags.
  16. The process of Claim 15, wherein the optimization algorithm causes the server to increase relative signal strength to the emitters which were determined to be more effective at encoding tags.
  17. The process of Claim 14, comprising recognizing the container using a scanner; and selecting a container profile based on the recognized container.
  18. The process of Claim 17, comprising saving the more optimized settings as a container profile.
  19. The process of Claim 14, comprising determining which tags in the container were not encoded.
  20. The process of Claim 14, comprising slowing down the belt speed of the transporter after the server has determined that not all of the tags have been encoded.
  21. The process of Claim 14, comprising executing the optimization program a second time, determining more optimized settings, loading the more optimized settings, and directing the emitters to encode the tags using the optimized settings.
  22. The process of Claim 21, comprising causing the transporter to move a second container into the encoding cage, directing the transporter to increase the belt speed, and encoding the container using the more optimized settings.
  23. A bulk encoding process comprising:
    - placing a container on a transporter, the transporter comprising a belt moving at a belt speed;
    - causing the transporter to move the container into an encoding cage;
    - loading settings in a server to encode RFID tags in the container;
    - directing emitters to encode the RFID tags using the settings;
    - querying the RFID tags to determine how many tags were not encoded;

- slowing down the belt speed;
  - executing an optimization program;
  - determining optimized settings;
  - loading optimized settings;
  - directing the emitters to encode the tags using the optimized settings; and
  - querying the RFID tags to determine whether all the tags were encoded.
24. The process of Claim 23 comprising:
- executing the optimization program a second time if all the tags were not encoded;
  - determining more optimized settings;
  - loading the more optimized settings; and
  - directing the emitter to encode the tags used the more optimized settings.
25. The process of Claim 24 comprising:
- causing the transporter to move a second container into the encoding cage;
  - directing the transporter to increase the belt speed; and
  - encoding the container using the more optimized settings.
26. The process of Claim 23, wherein the optimization algorithm causes the server to determine which emitters are more effective at encoding the tags, and directing only those emitters to encode the tags.
27. The process of Claim 26, wherein the optimization algorithm causes the server to increase power to the emitter which were determined to be more effective at encoding tags.
28. The process of Claim 23, comprising recognizing the container using a scanner; and selecting a container profile based on the container.
29. The process of Claim 28, comprising saving the more optimized settings as a container profile.

Figure 1

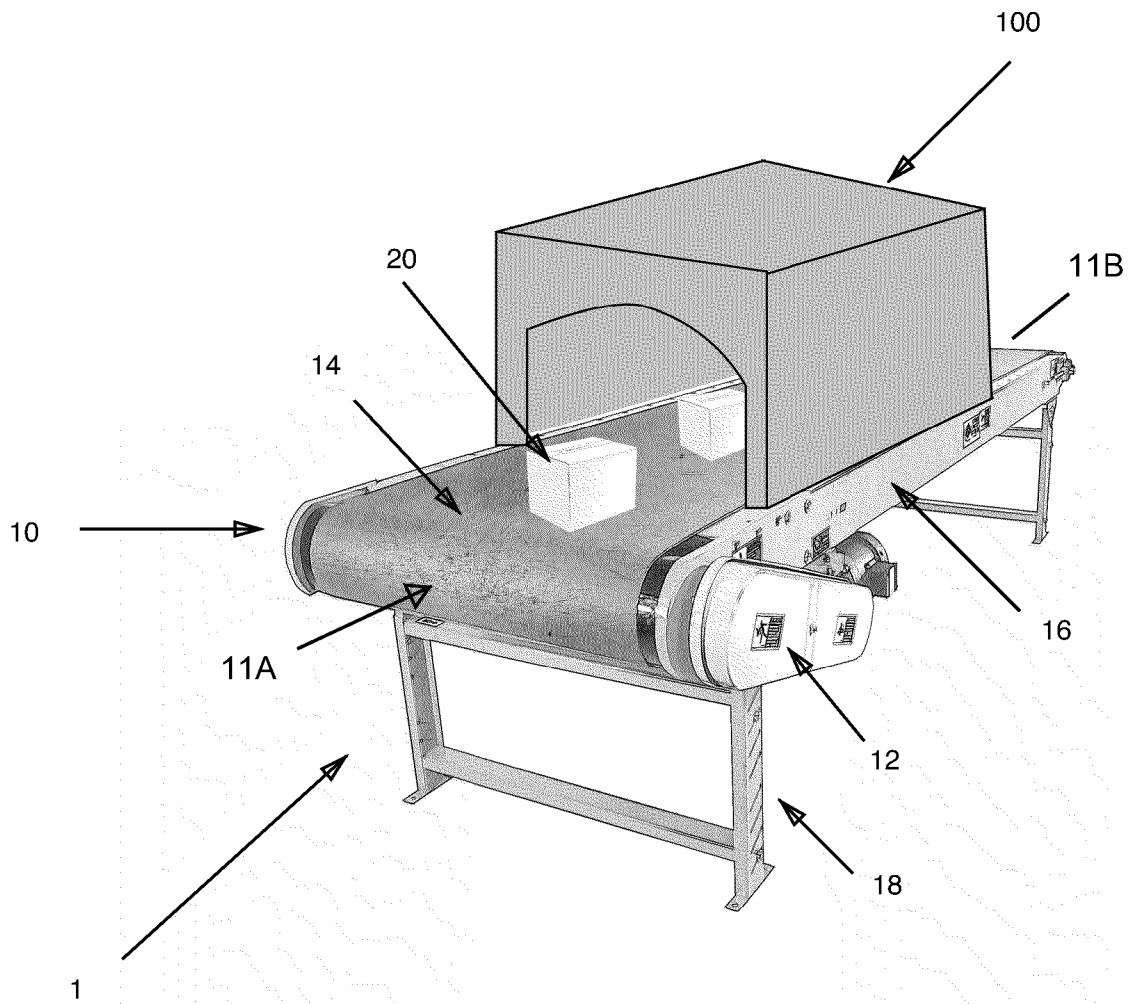


Figure 2A

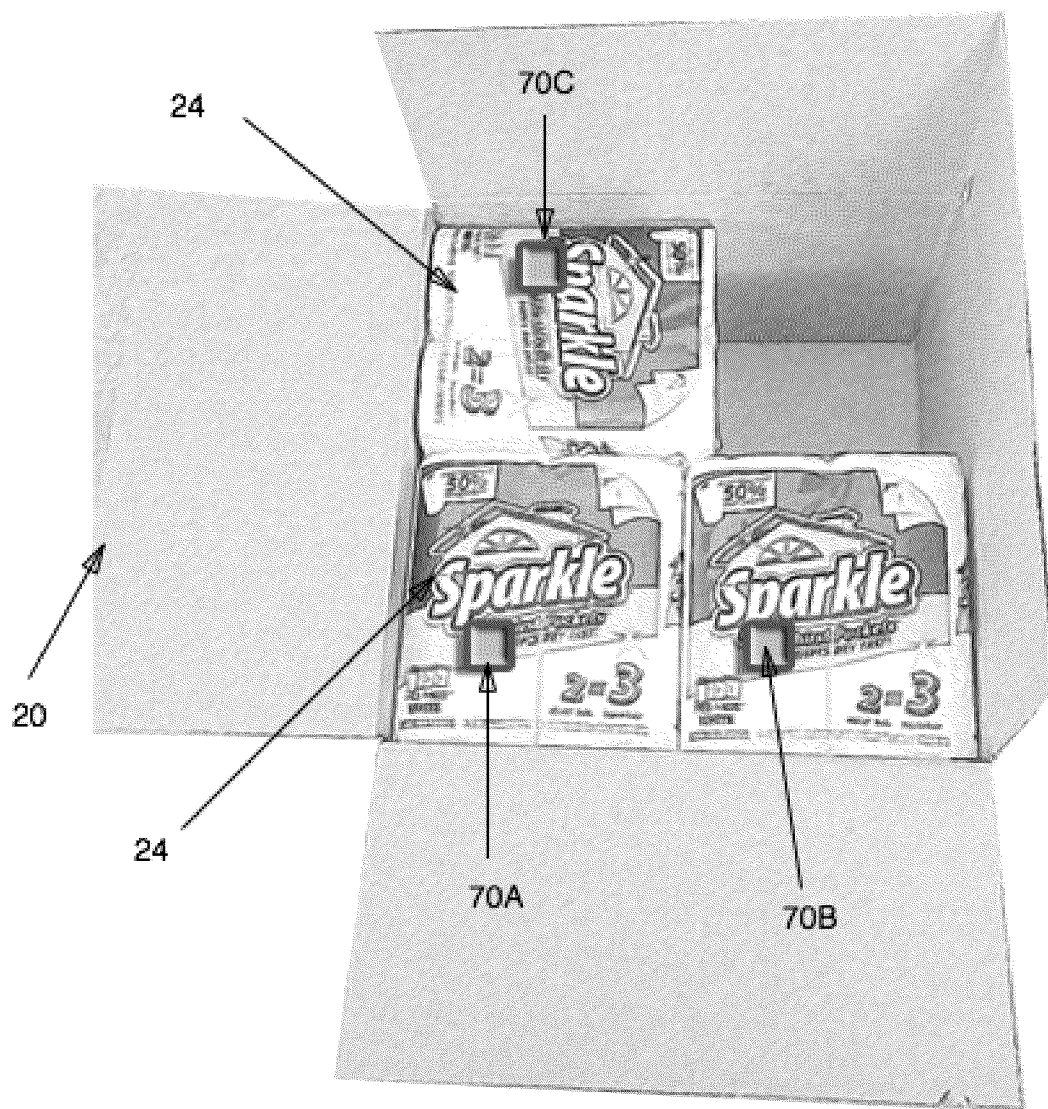


Figure 2B

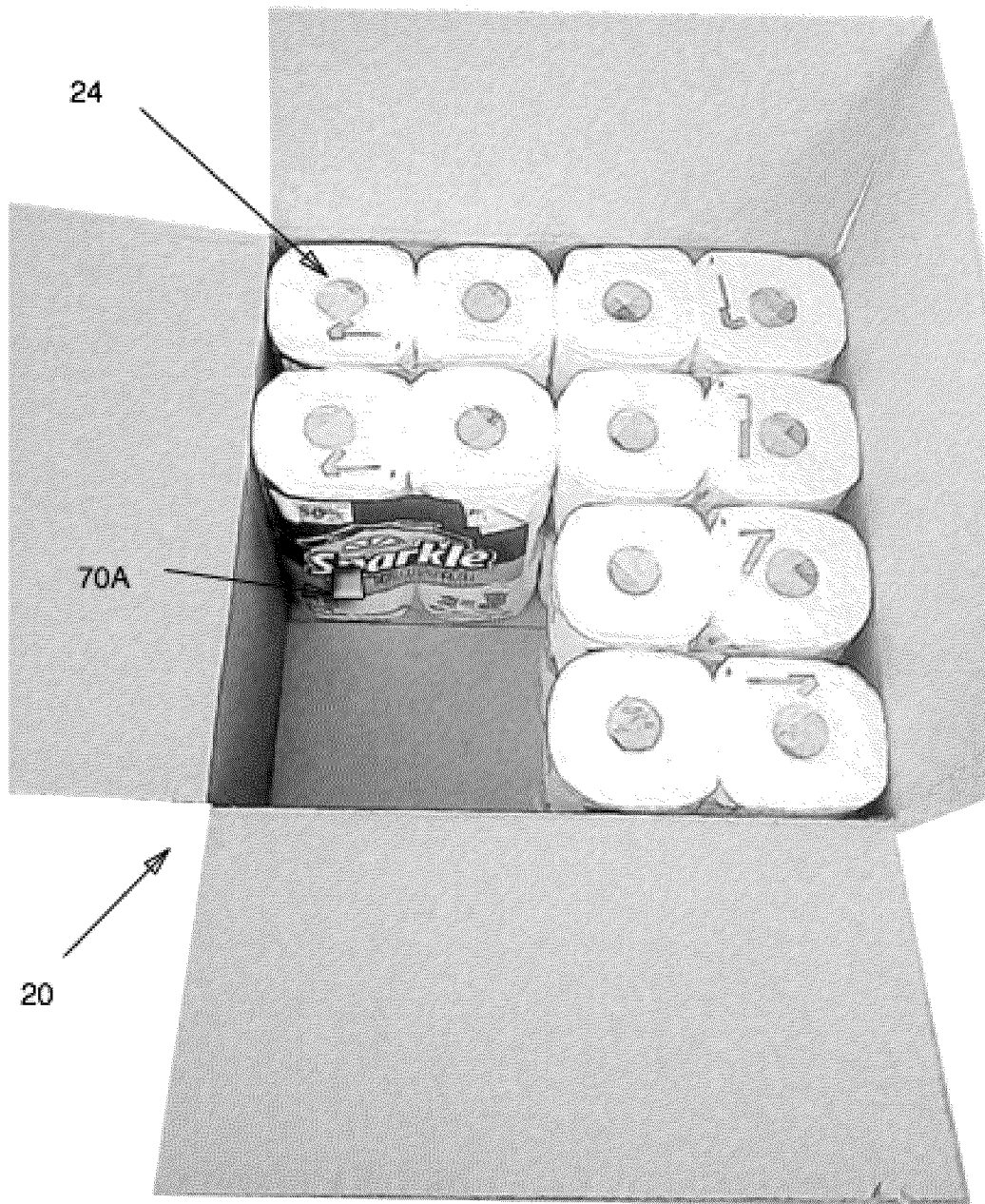


Figure 3A

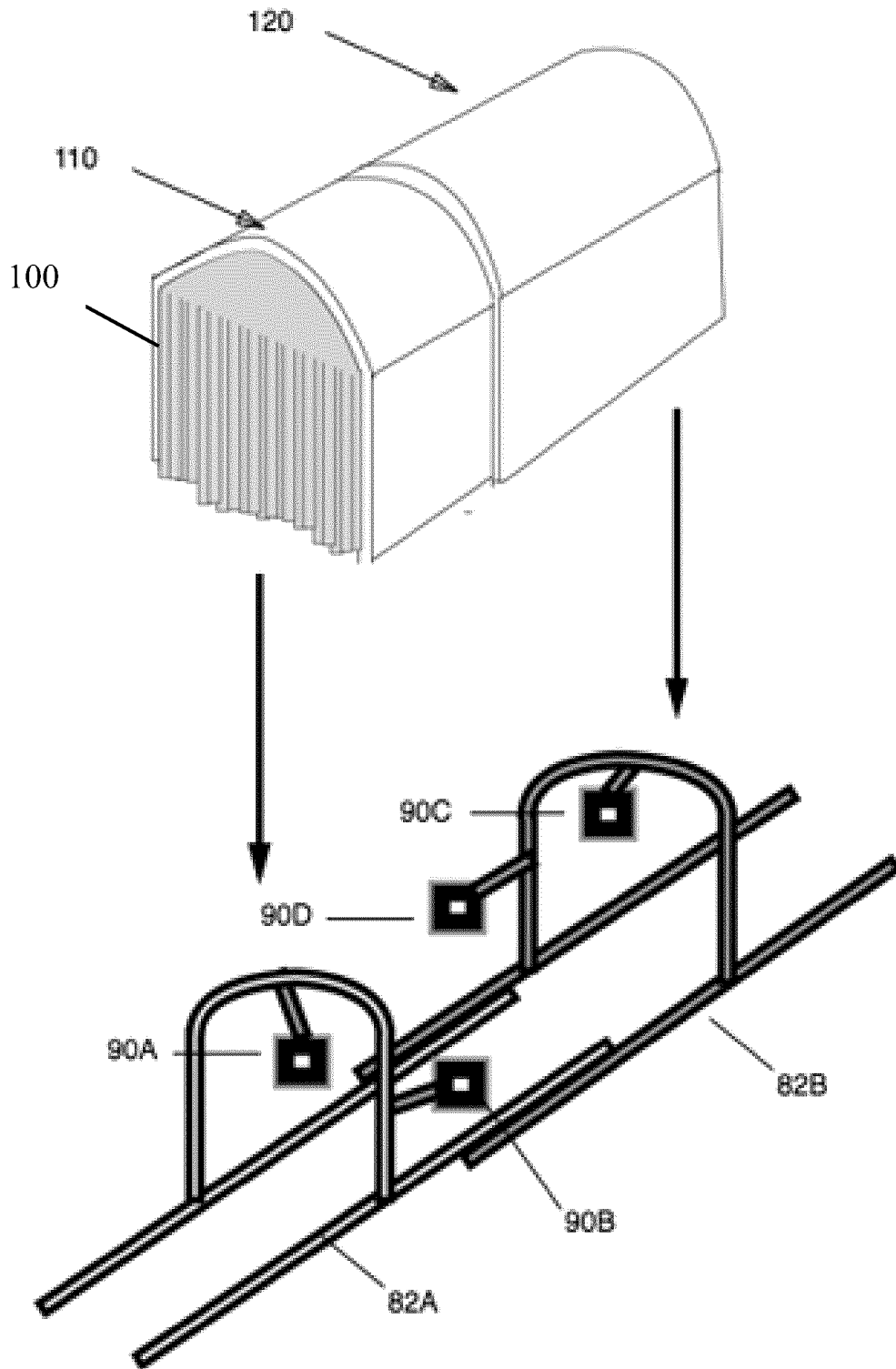


Figure 3B

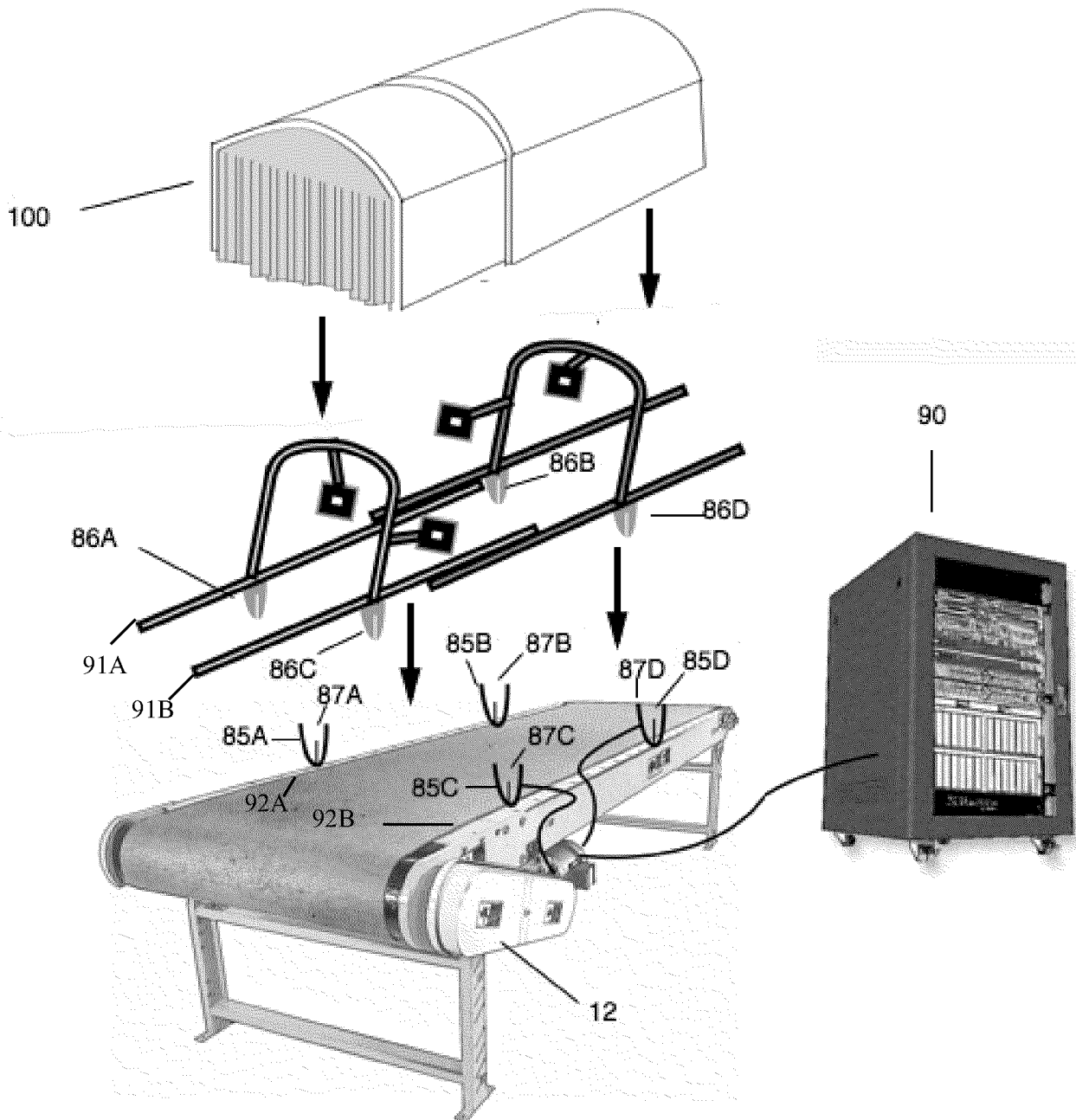


Figure 3C

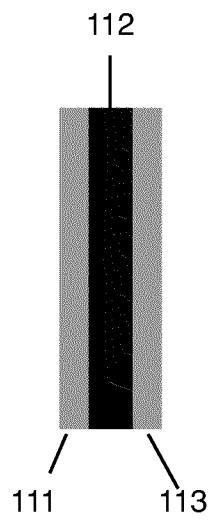
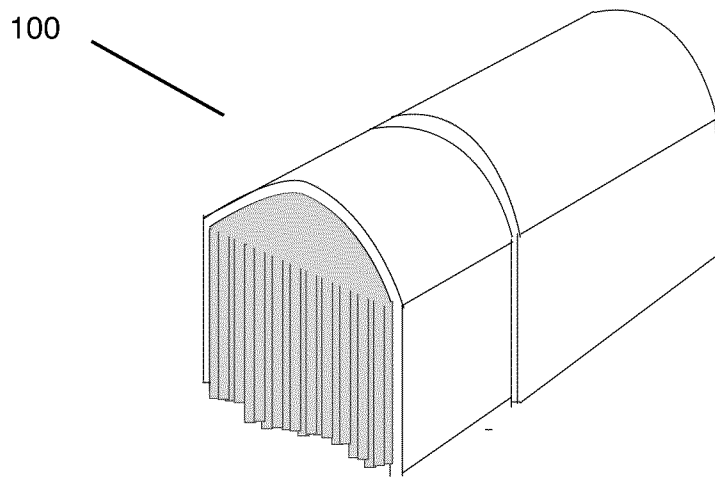


Figure 4A

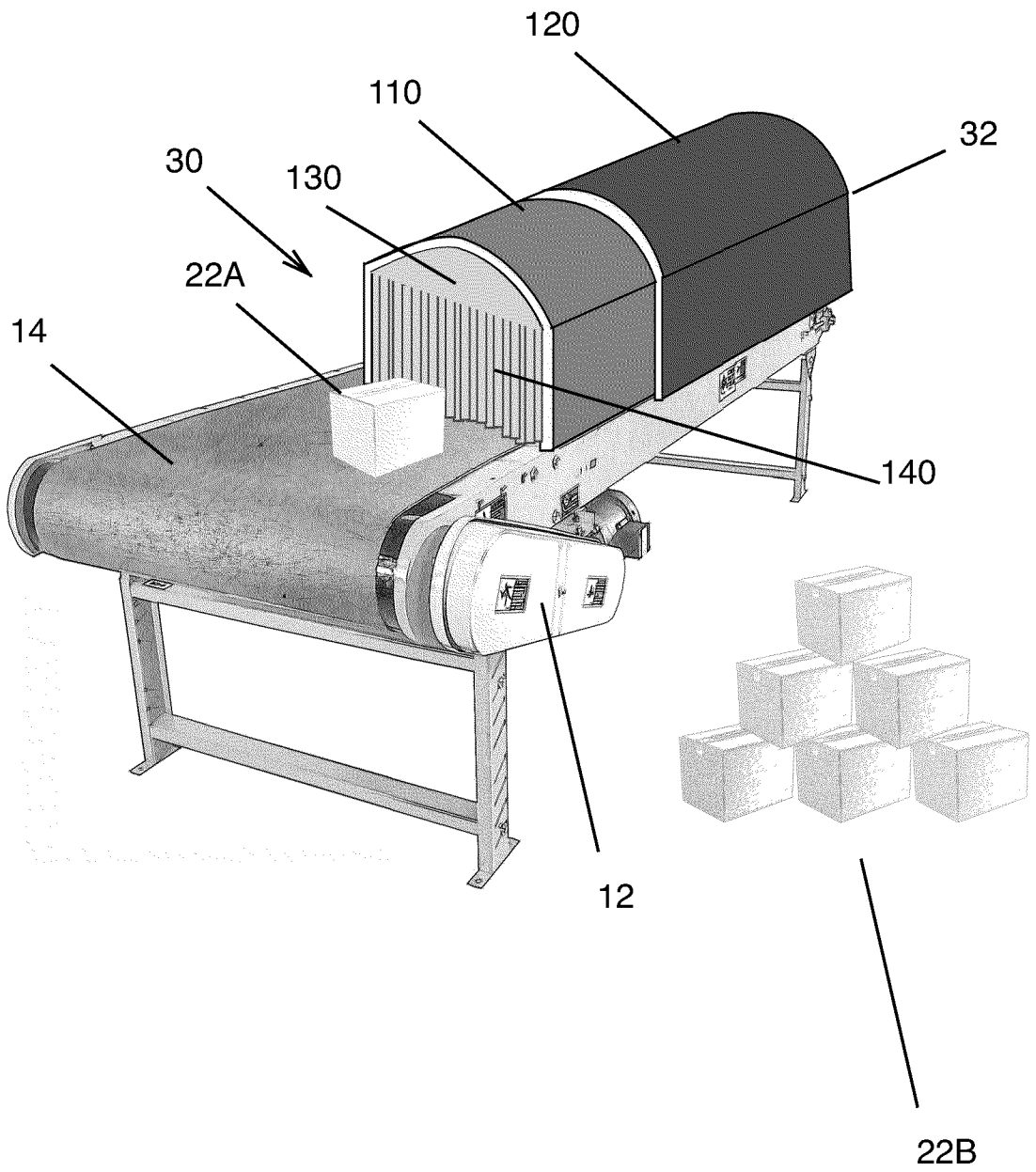


Figure 4B

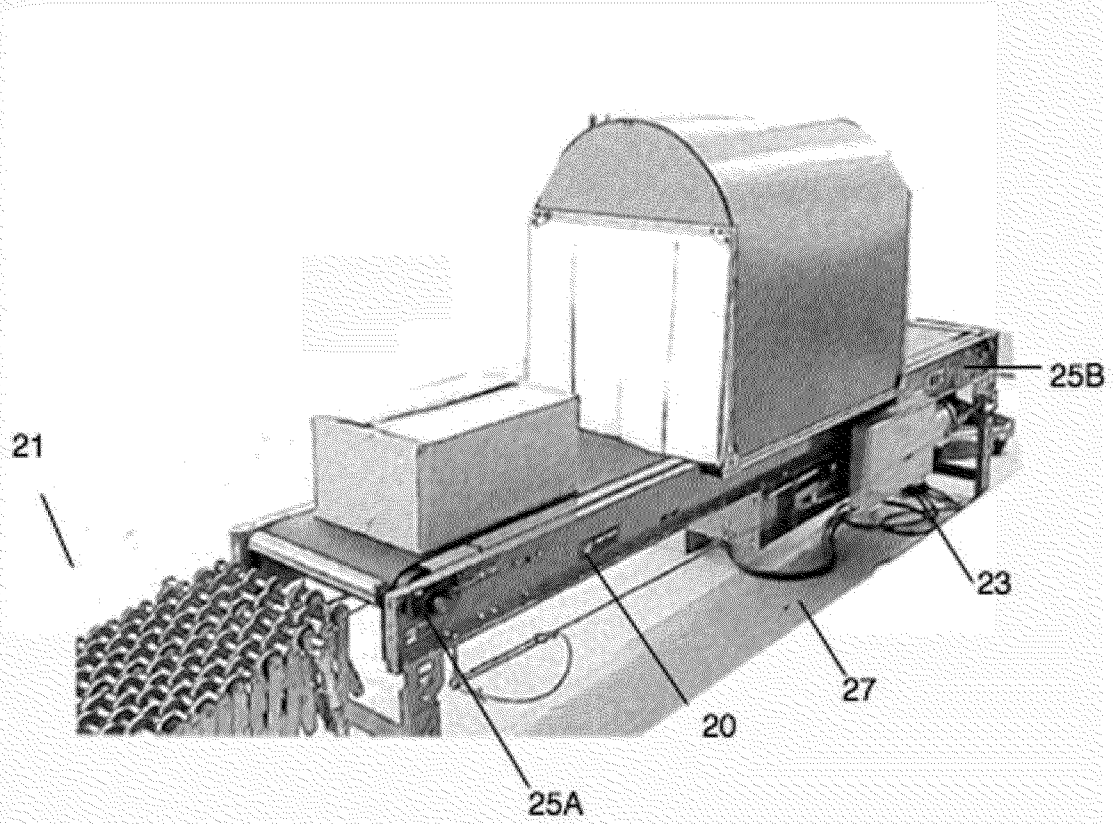


Figure 4C

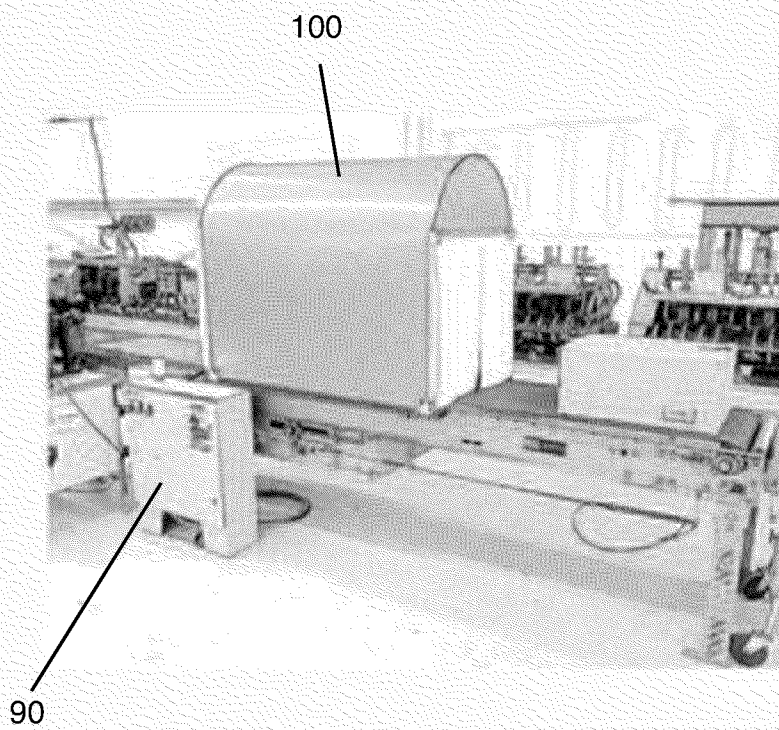


Figure 5A

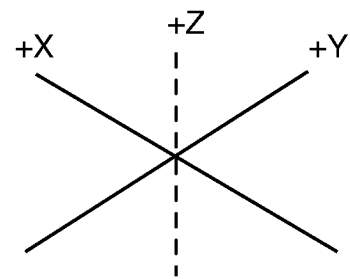
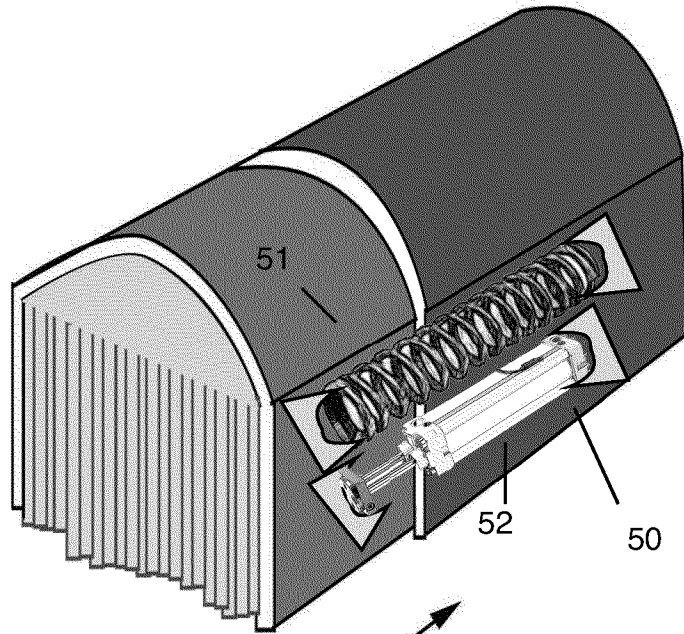


Figure 5B

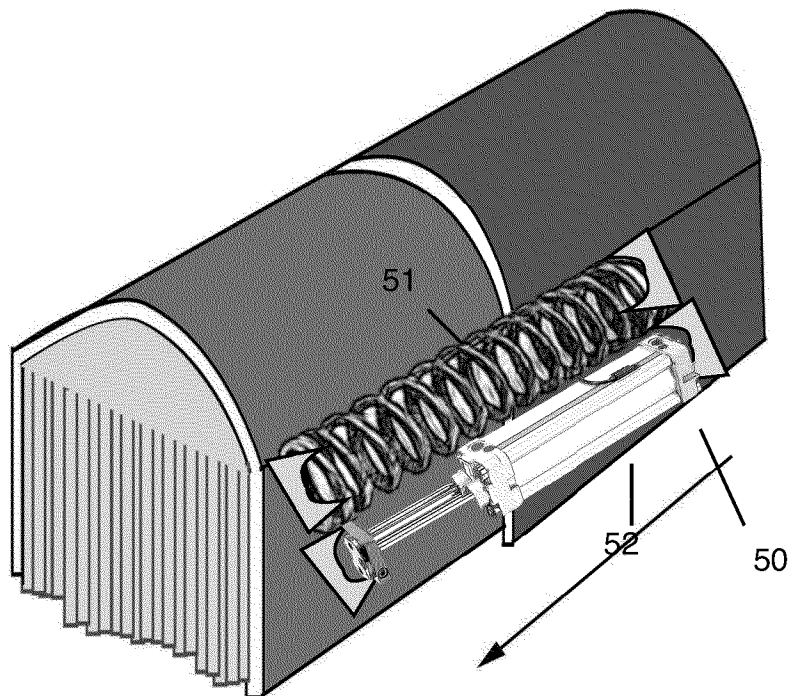


Figure 6A

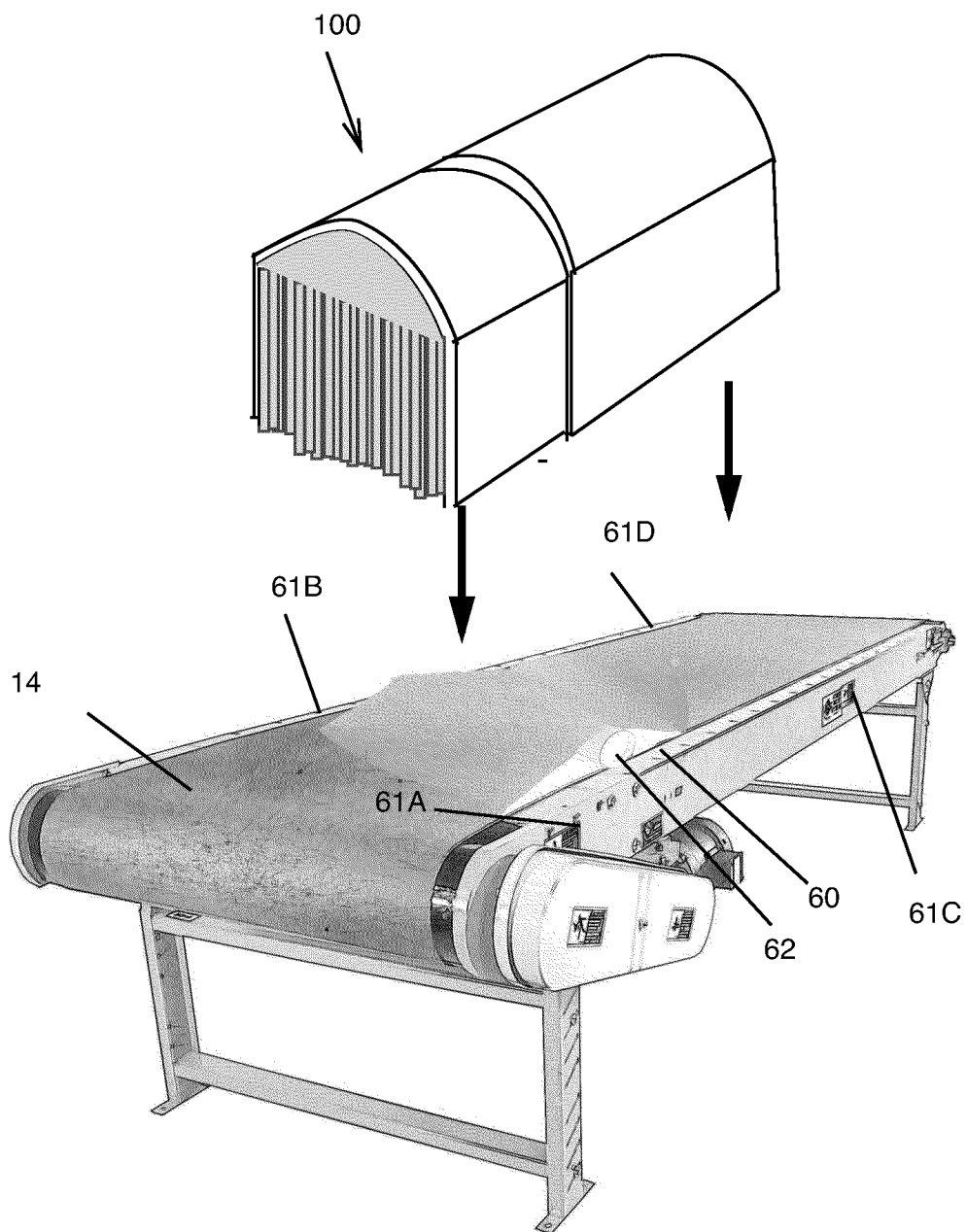


Figure 6B

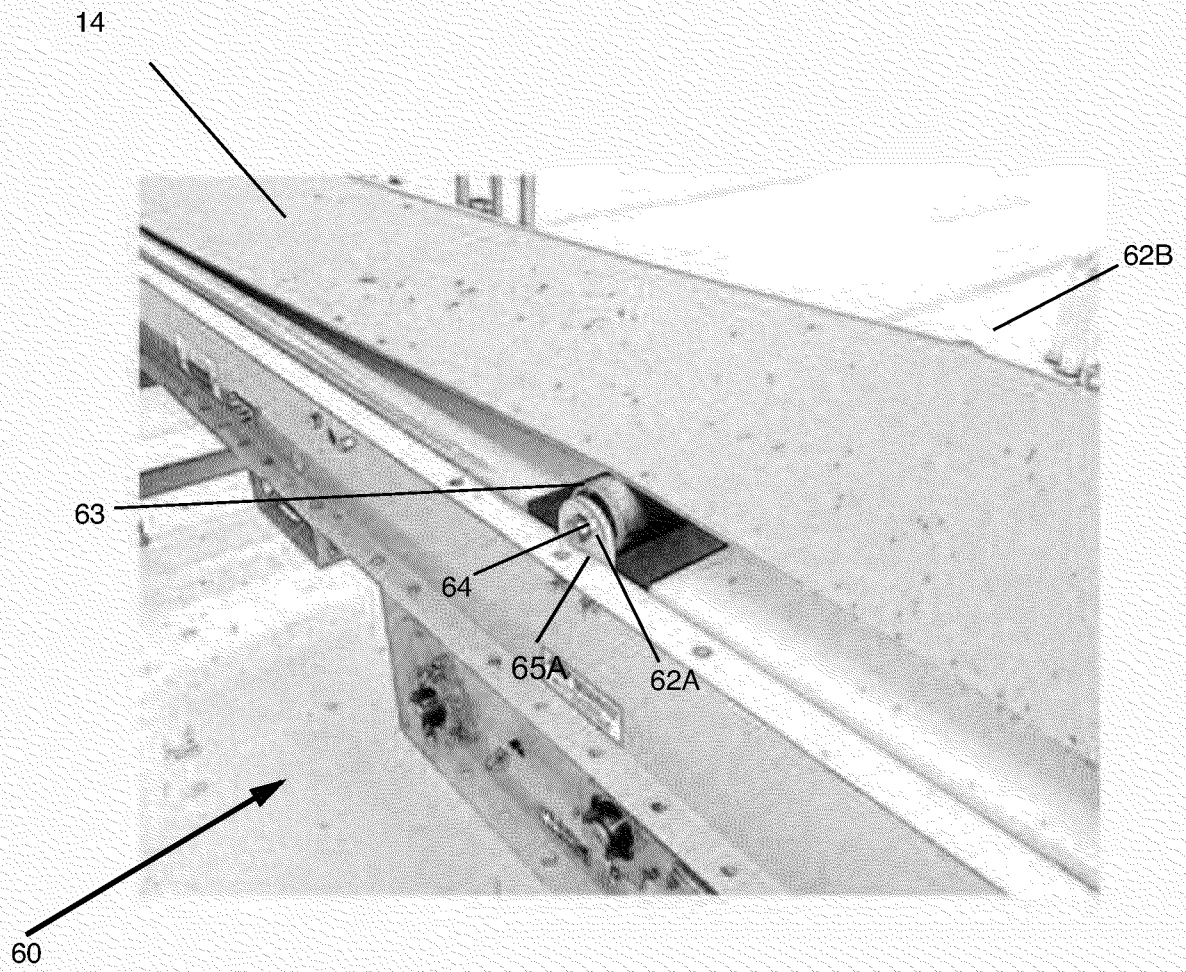


Figure 6C

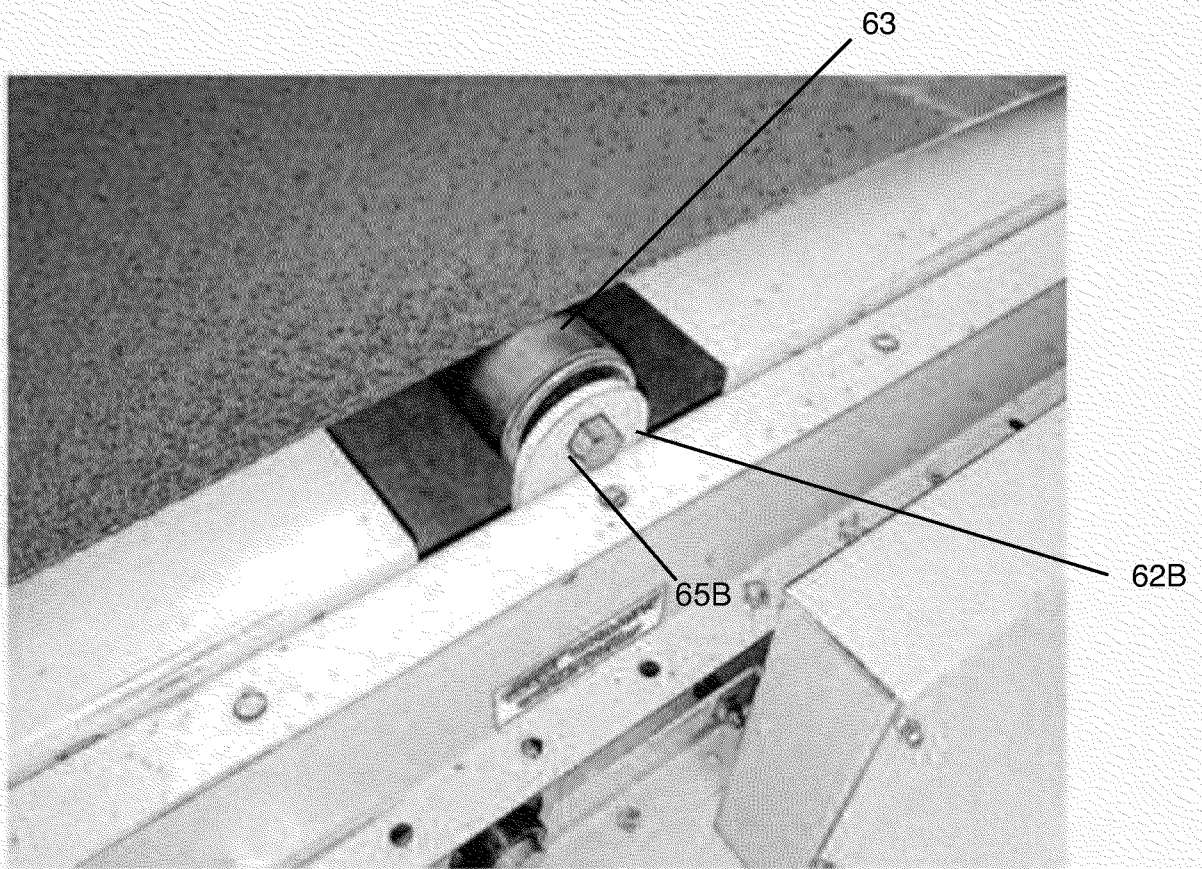


Figure 6D

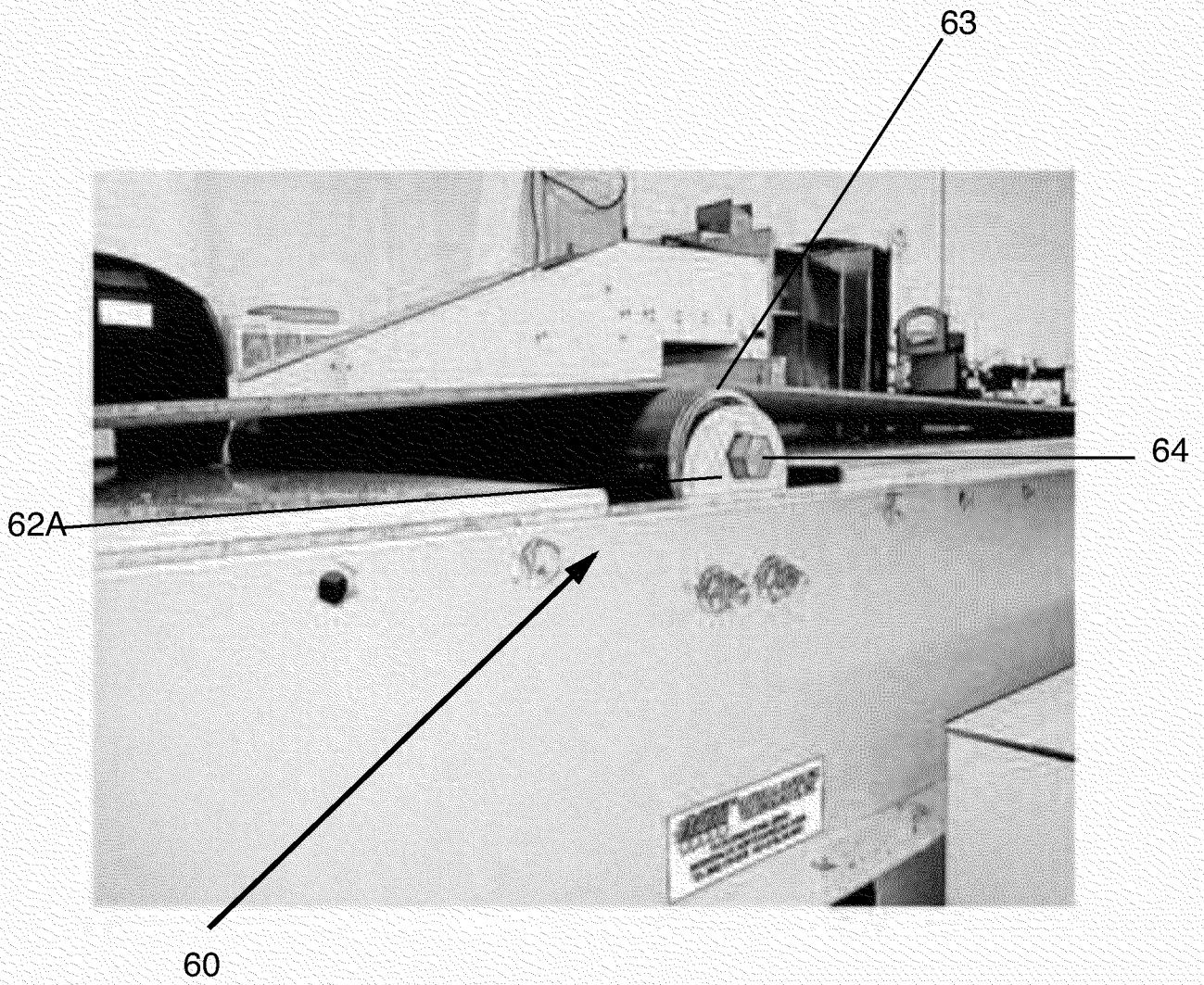


Figure 7A

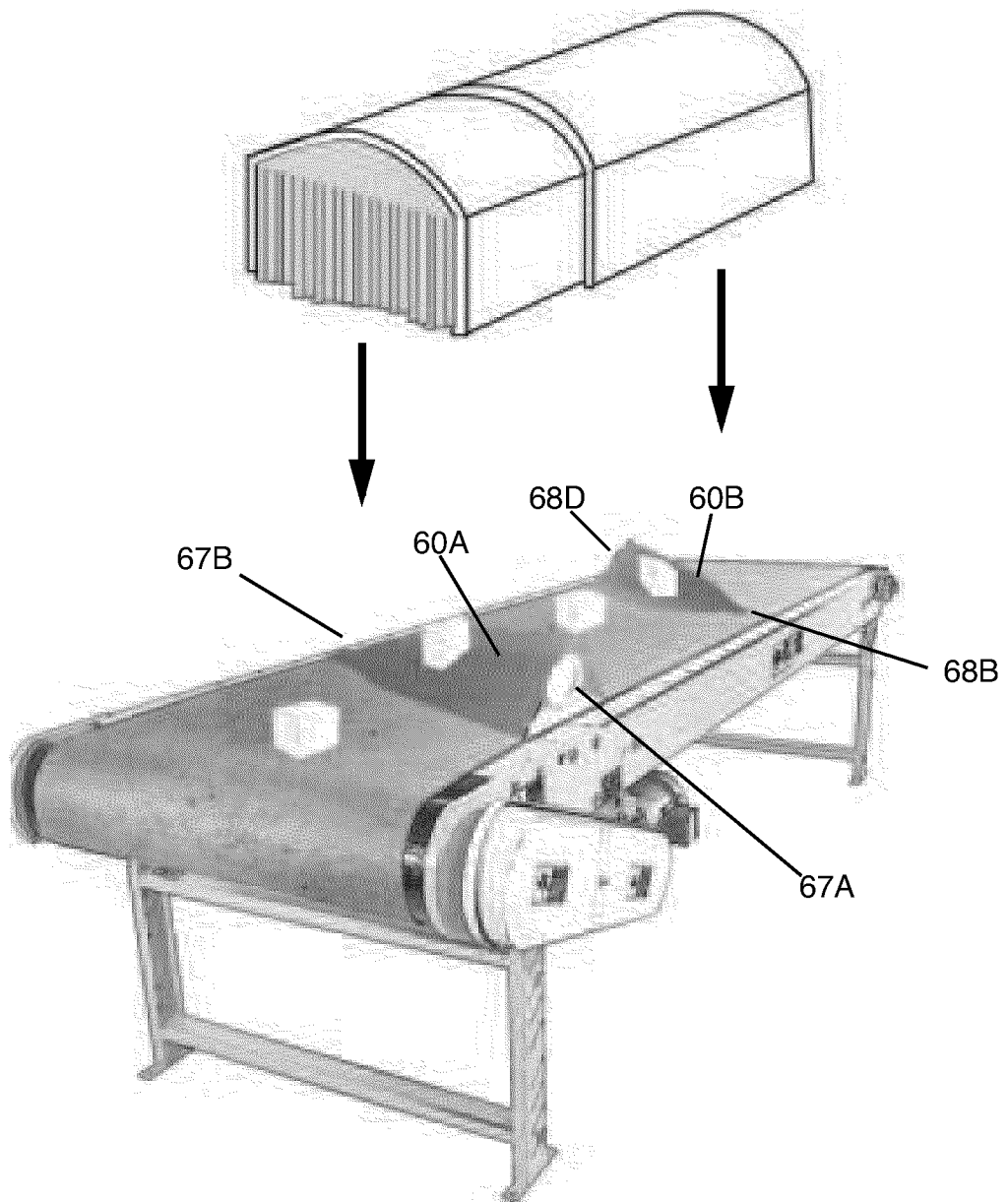


Figure 7B



Figure 8A



Figure 8B

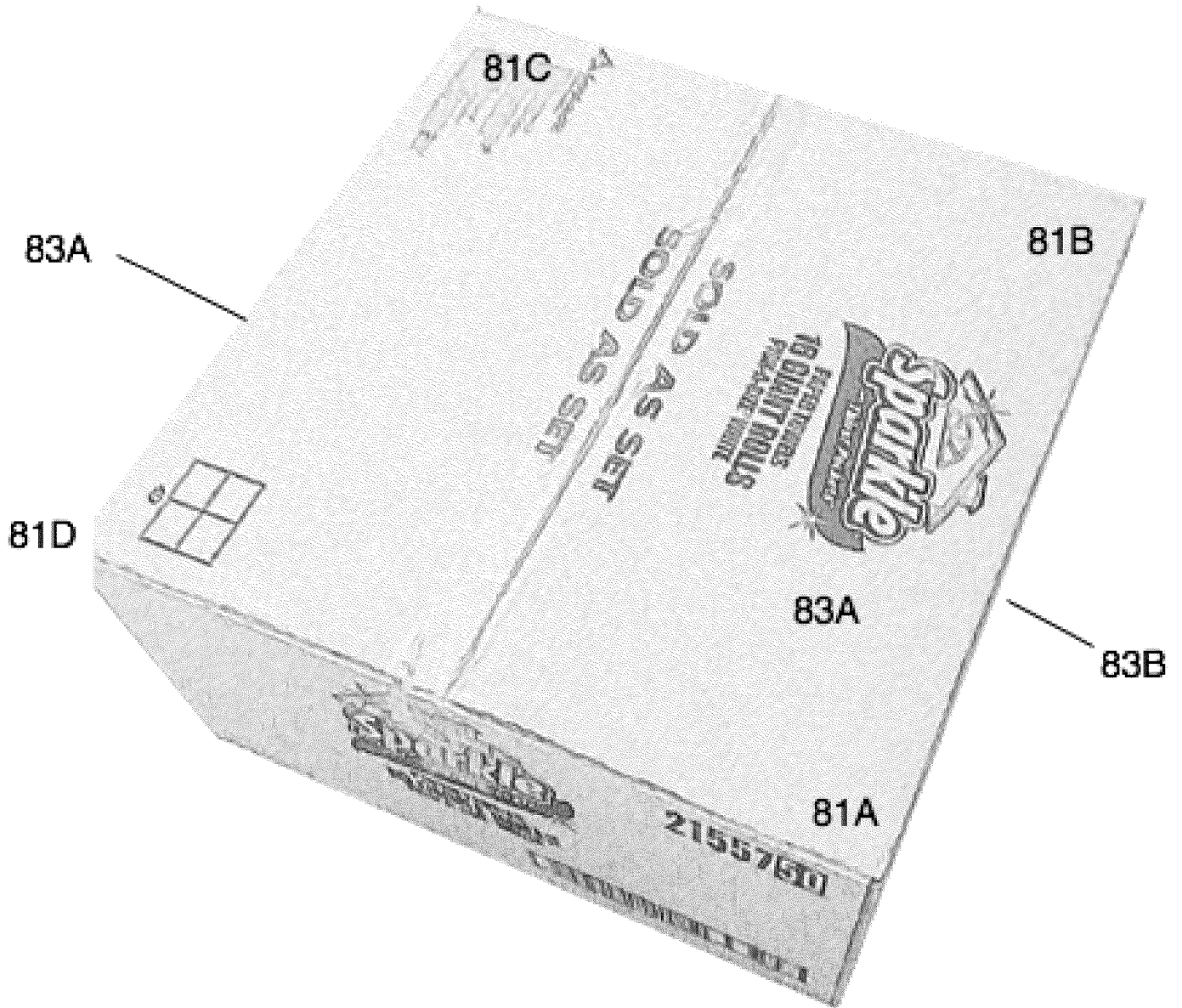


Figure 9A

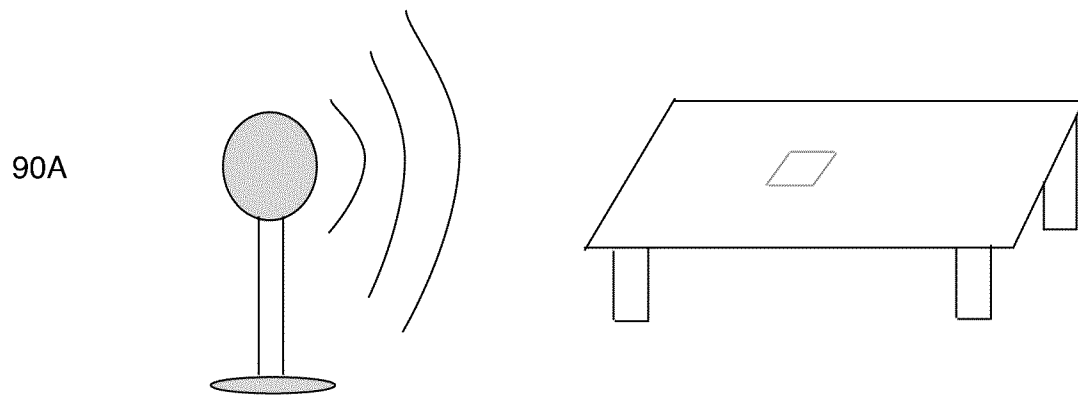


Figure 9B

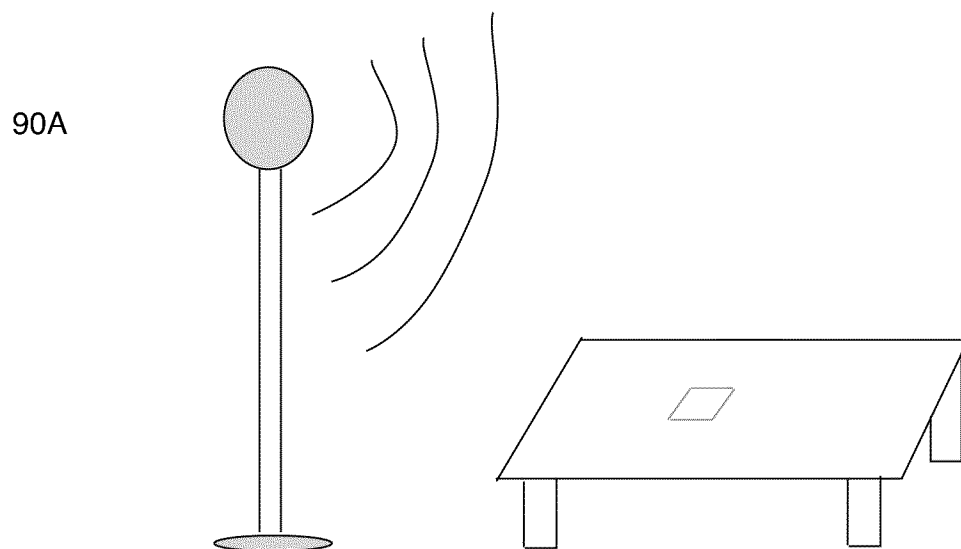


Figure 10

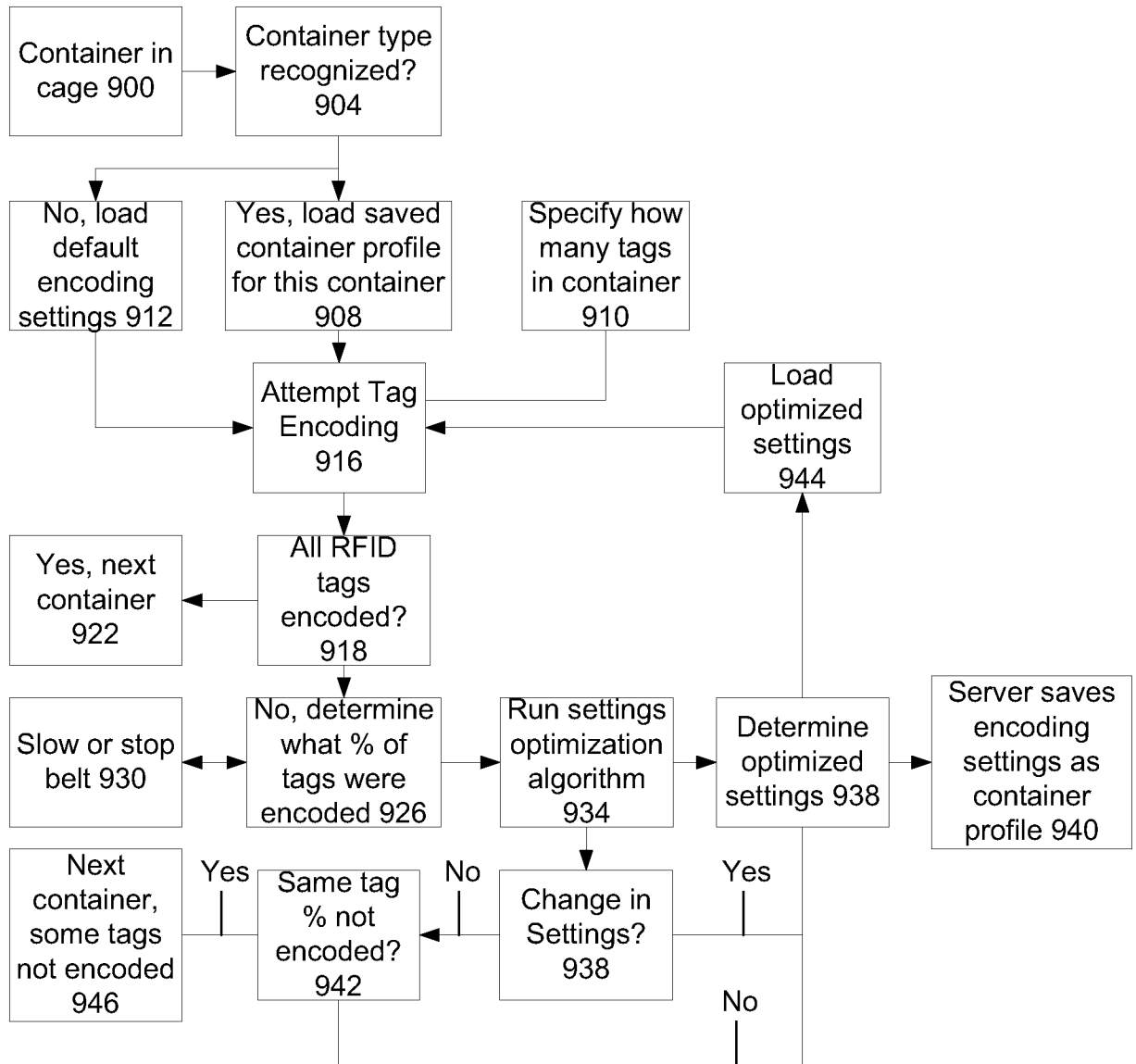


Figure 11

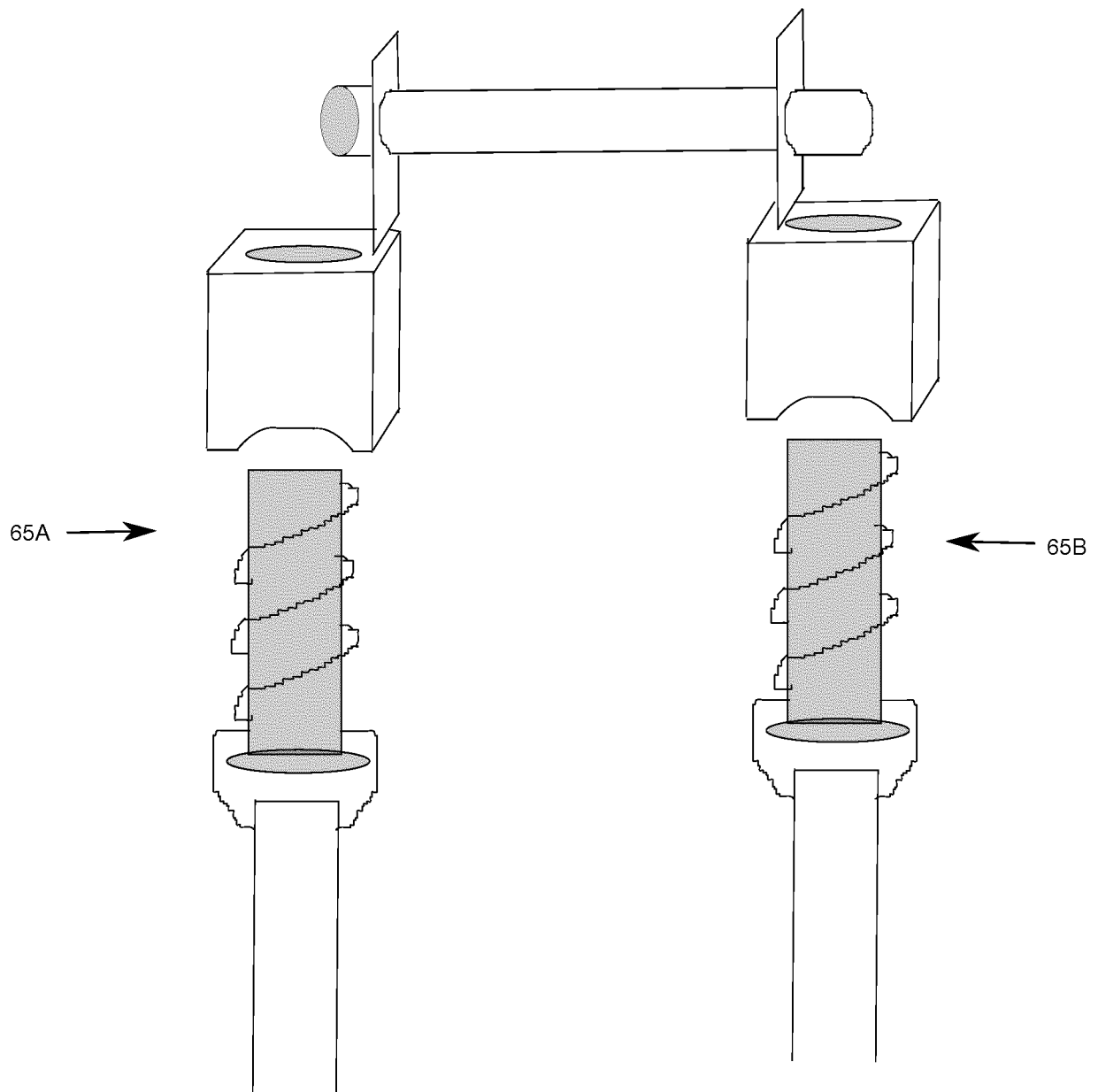
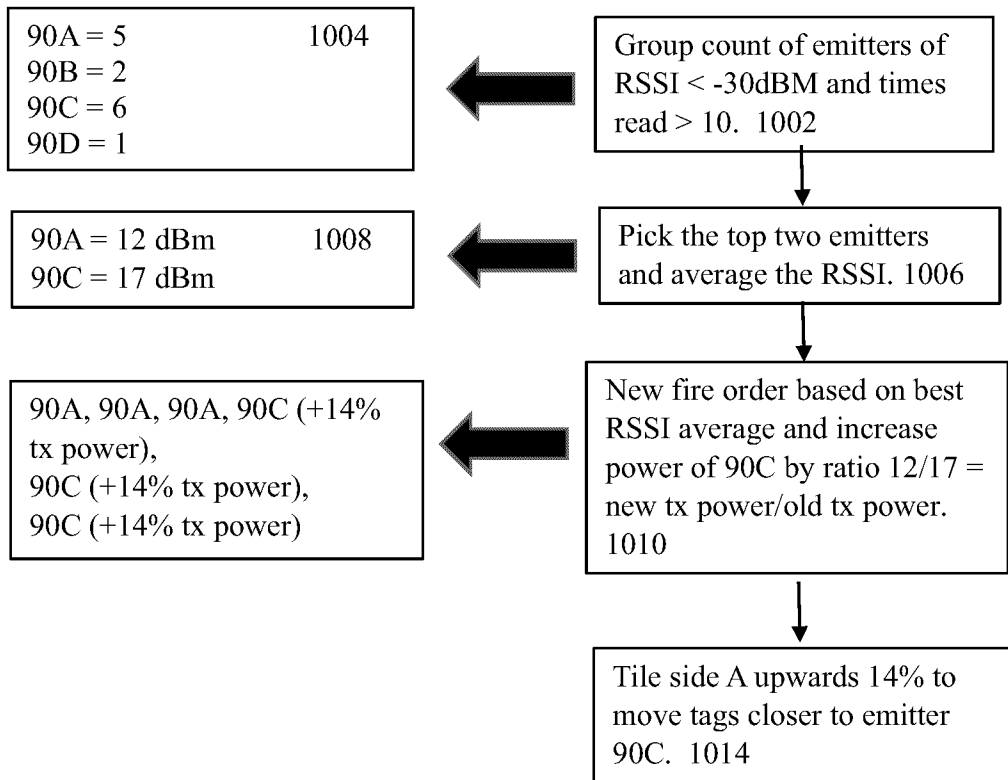


Figure 12



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2013/042241

<b>A. CLASSIFICATION OF SUBJECT MATTER</b> IPC(8) - G06K 19/07 (2013.01) USPC - 340/572.1 According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b> Minimum documentation searched (classification system followed by classification symbols) IPC(8) - G06K 7/00, 19/06, 19/07; H04Q 5/22 (2013.01) USPC - 235/375, 492; 340/10.51, 572.1, 572.4, 572.7, 572.8 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched CPC - G06K 7/0008, 7/0095, 19/07718, 19/07749 (2013.01) Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) PatBase, Google Patents		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 7,073,712 B2 (JUSAS et al) 11 July 2006 (11.07.2006) entire document	1-9, 14, 17-25, 28, 29
Y	US 3,211,277 A (KNAPP et al) 12 October 1965 (12.10.1965) entire document	1-9
Y	US 2006/0022826 A1 (HIGHAM) 02 February 2006 (02.02.2006) entire document	1-9, 14, 17-25, 28, 29
Y	US 2003/0052167 A1 (HILTON et al) 20 March 2003 (20.03.2003) entire document	2
Y	US 6,109,428 A (HARM) 29 August 2000 (29.08.2000) entire document	3
A	US 2012/0212327 A1 (TORABI) 23 August 2012 (23.08.2012) entire document	1-29
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/>		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 23 July 2013		Date of mailing of the international search report <b>30 JUL 2013</b>
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201		Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774