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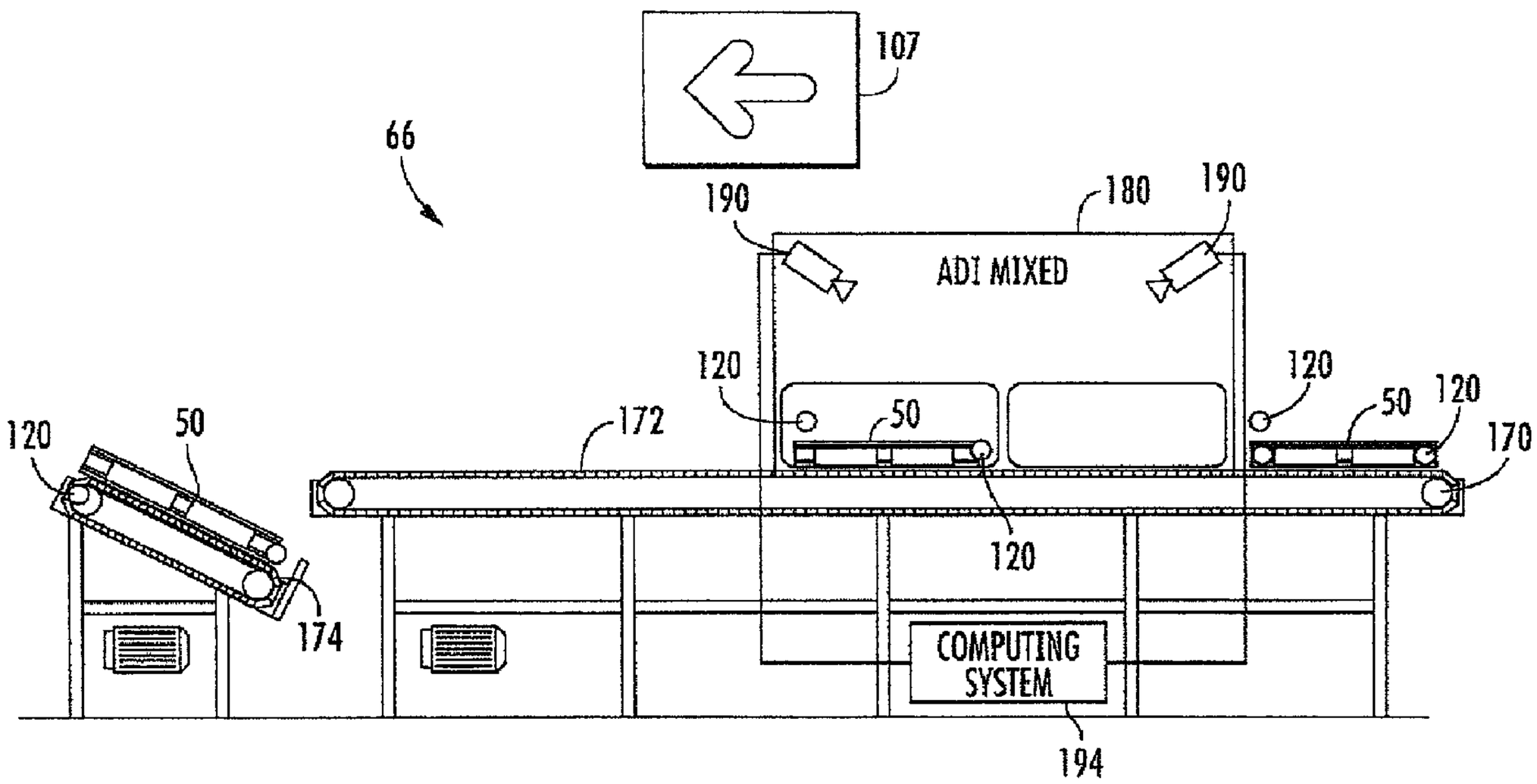
(54) Titre : SYSTEME D'EXAMEN VISUEL ET DE REPARATION DES PALETTES, ET METHODES ASSOCIEES
(54) Title: PALLET INSPECTION AND REPAIR SYSTEM AND ASSOCIATED METHODS



(57) Abrégé/Abstract:
A pallet inspection and repair system includes a pallet in-feed for receiving pallets for inspection, and an automated pallet inspection system for inspecting the pallets. A processor cooperates with the automated pallet inspection system to generate a repair recipe for each pallet based on the inspecting, and compares the repair recipes to determine at least one performance repair parameter for the pallets. The at least one performance repair parameter corresponds to a type of repair to be made to the pallets.

PALLET INSPECTION AND REPAIR SYSTEM AND ASSOCIATED METHODS

Abstract of the Disclosure

A pallet inspection and repair system includes a pallet in-feed for receiving pallets for inspection, and an automated pallet inspection system for inspecting the pallets. A processor cooperates with the automated pallet inspection system to generate a repair recipe for each pallet based on the inspecting, and compares the repair recipes to determine at least one performance repair parameter for the pallets. The at least one performance repair parameter corresponds to a type of repair to be made to the pallets.

PALLET INSPECTION AND REPAIR SYSTEM AND ASSOCIATED METHODS

Field of the Invention

[0001] The present invention relates to pallet inspection and repair systems, and more particularly, to the processing of data obtained from a pallet inspection and repair system.

Background of the Invention

[0002] Wooden pallets are used to transport a variety of bulk goods and equipment as required in manufacturing and warehousing operations. In high volume industries, pallet pools provide a lower total industry cost than one-way pallets. The current assignee of the present invention recognizes the benefits of pooled pallets, and currently has over several hundred million pallets that are pooled each year.

[0003] After the bulk goods and equipment are off loaded from the pooled pallets, the pallets are returned to pallet inspection and repair facilities for inspection, and if necessary, repair, before the pallets are returned to service.

[0004] As one might expect, wooden pallets are subject to damage in use that occurs from handling with forklifts or other like equipment. Since wooden pallets are in wide use, a large number of damaged and

unusable pallets need to be repaired or discarded daily during the pallet inspection and repair process. Repair of damaged pallets has become an increasingly sound alternative to disposal due to the sheer volume of pallets that require repair each day.

[0005] Pallet inspection and repair traditionally requires manual handling and inspection by an operator, with mechanized systems available for moving pallets to and from the human operator who completes the repair of the pallets. An automated pallet inspection and repair system is advantageous because it does not rely on a human operator to perform the inspection and repair.

[0006] U.S. published patent application no. 2006/0242820 discloses an automated pallet inspection and repair system, which is assigned to the current assignee of the present invention and is incorporated herein by reference in its entirety. The automated pallet inspection and repair system discloses an automatic pallet inspection cell comprising multi-axis robot arms that terminate in either internal or exterior pallet grippers. A robot may be used to transport a gripped pallet through an automated pallet inspection station that generates a three-dimensional data map of a pallet surface. A processor interprets the map and generates a corresponding repair recipe. One or more repair stations may conduct pallet repair operations that are specified by the repair recipe. These repairs may be automatically made by one or processor-controlled pallet repair devices, or manually by a human.

[0007] While automated pallet inspection and repair systems are advantageous for inspecting and repairing pallets, there is still a need to improve how the

inspection data is processed and analyzed.

Summary of the Invention

[0008] In view of the foregoing background, it is therefore an object of the present invention to further process and analyze pallet inspection data.

[0009] This and other objects, features, and advantages in accordance with the present invention are provided by a method for inspecting and repairing pallets comprising receiving a plurality of pallets for inspection, inspecting each pallet using an automated pallet inspection system, generating a repair recipe for each pallet based on the inspecting, and comparing the repair recipes to determine at least one performance repair parameter for the pallets.

[0010] The at least one performance repair parameter may correspond to at least one type of repair to be made to the pallets. The method may further comprise determining repair trends based on the types of repairs to be made to the pallets. This advantageously allows material usage and the amount of time for repairing the pallets to be estimated or determined, which in turn allows the throughput of the pallet inspection and repair system to be monitored so that lumber and personnel can be accurately forecasted.

[0011] The automated pallet inspection system may inspect the pallets based on a plurality of inspection parameters each having a tolerance associated therewith. The method may further comprise adjusting at least one of the tolerances based on the at least one performance repair parameter. If one or more of the inspection tolerances are set to stringent, for example, this may cause unnecessary repairs to be made

to the pallets. By relaxing the inspection tolerances with the pallets still meeting customer demands, less repairs would be made. Alternatively, different customers may have different tolerance requirements.

[0012] The plurality of pallets to be inspected may be received from a customer, and the method may further comprise collecting customer data with respect to the received pallets, tracking the customer data with the at least one performance repair parameter, and analyzing the at least one type of repair to be made to the pallets provided by the customer. This advantageously allows feedback to be provided to the customer. The feedback would allow corrective action to be taken by the customer to reduce certain types of repairs being made to the pallets provided by that customer.

[0013] The method may further comprise repairing damaged pallets based on the respective repair recipes using at least one processor-controller pallet repair device. Alternatively, the repairs may be made by human operators.

[0014] Another aspect of the present invention is directed to a pallet inspection and repair system comprising a pallet in-feed for receiving a plurality of pallets for inspection, and an automated pallet inspection system for receiving the plurality of pallets from the pallet in-feed for inspecting. At least one processor may cooperate with the automated pallet inspection system for generating a repair recipe for each pallet based on the inspecting, and comparing the repair recipes to determine at least one performance repair parameter for the pallets.

Brief Description of the Drawings

[0010] FIG. 1 is a top-level block diagram of a pallet inspection and repair system in accordance with the present invention.

[0011] FIG. 2 illustrates a forklift removing pallets from a truck prior to inspection in accordance with the present invention.

[0012] FIG. 3 is a schematic diagram of the stack in-feed illustrated in FIG. 1.

[0013] FIG. 4 is a schematic diagram of the tipper/accumulator illustrated in FIG. 1.

[0014] FIG. 5 is a schematic diagram of the preparation screening line illustrated in FIG. 1.

[0015] FIGS. 6 and 7 are schematic diagrams of the automated digital inspection (ADI) station illustrated in FIG. 1.

[0016] FIGS. 8 and 9 respectively illustrate a pallet repair summary table and an element repair summary table generated by the ADI station in accordance with the present invention.

[0017] FIGS. 10, 11 and 12 respectively illustrate different configurations of the top deck boards of a pallet as well as element ID and indexing of the boards in accordance with the present invention.

[0018] FIG. 13 illustrates the bottom deck baseboards of a pallet as well as element ID and indexing of the boards in accordance with the present invention.

[0019] FIG. 14 illustrates the stringers of a pallet as well as element ID and indexing of the boards in accordance with the present invention.

[0020] FIG. 15 is a schematic diagram of the classification divert line illustrated in FIG. 1.

[0021] FIG. 16 is a more detailed block diagram of the different repair machines/repair devices associated with the repair line illustrated in FIG. 1.

Detailed Description of the Preferred Embodiments

[0022] The present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout.

[0023] A top-level overview of the pallet inspection and repair system **40** will initially be discussed with reference to FIG. 1. Pooled pallets **50** from different customers are returned to a pallet pooling company for inspection, and if necessary, repair, before the pallets are returned to service **51**. As the pallets **50** are received, customer data is collected and recorded. Customer data includes the customer providing the pallets, along with how many pallets are being returned. Customer data may also include other pertinent information about the customer, as readily appreciated by those skilled in the art.

[0024] Prior to inspection, the pallets **50** are provided to a stack in-feed **52**. As the pallets **50** are placed in the stack in-feed **52**, customer data **70** associated with the pallets are provided to at least one processor, referred to herein as a factory management system (FMS) server **56**. As each pallet **50** is

individually tracked through the pallet inspection and repair system **40** by an automated controller **60**, the FMS server **56** keeps track of the corresponding customer data **70** to be associated therewith.

[0025] The stack in-feed **52** squares each stack of pallets before being passed to a tipper/accumulator **62**. The tipper/accumulator **62** provides a steady stream of spaced apart pallets **50** for inspection by the automated digital inspection (ADI) station **66**. As the pallets **50** leave the tipper/accumulator **62**, they pass through a preparation screening line **64**.

[0026] In the preparation screening line **64**, each pallet **50** is visually inspected by a human operator to remove any loose debris or trash that may affect the ADI station **66**. If necessary, the human operator will also make minor repairs. Each pallet **50** is individually tracked through the preparation screening line **64** by the automated controller **60**. In some cases, a pallet **50** may be discarded during the preparation screening line **64** if it is damaged too badly, as indicated by block **65**.

[0027] From the preparation screening line **64**, each pallet **50** is inspected by the ADI station **66**. The ADI station **66** may be configured as one or two inspection booths. As part of the inspection, image data **72** is generated for the pallet **50**. The ADI station **66** compares the generated image data **72** to an expected profile **74**. The generated image data **72** may also be referred to as measurement data, and the expected profile **74** may also be referred to as pallet classification. Based on the comparison, a damage report **76** is generated. As will be discussed in greater detail below, the damage report **76** comprises a

pallet repair summary and an element repair summary.

[0028] The damage report **76** is sent to the FMS server **56**. The FMS server **56** generates a repair recipe **78** for the inspected pallet **50** based on the damage report **76**. During the pallet inspection and repair process, the information in the FMS server **56** (i.e., repair recipes **78**) is queried. The inspected pallet **50** travels from the ADI station **66** to a classification divert line **68**.

[0029] The classification divert line **68** may also be referred to as a sort line, and queries the FMS server **56** to determine if the inspected pallet is good or bad. If the inspected pallet **50** is bad, this means that the pallet requires repair (via repair line **80**) or is to be discarded (via discard line **84**). If the inspected pallet **50** is good, then the pallet **50** is sent to the paint booth **82** prior to being returned to service **51**.

[0030] Prior to being sent to the repair line **80**, the classification divert line **68** may position which way the pallets are to face for the repairs to be made. The repair line **80** includes a series of processor-controlled repair machines/repair devices available for repairing each pallet **50** based on the corresponding repair recipe **78**, as will be discussed in greater detail below. Depending on how extensive the pallet **50** is damaged, the number of repair machines/repair devices involved in the repair can vary from one to more than one. In addition, certain repairs may be manually made by a human, as readily appreciated by those skilled in the art.

[0031] As illustrated in FIG. 1, the automated controller **60** controls the tipper/accumulator **62**, the preparation screening line **64**, the ADI station **66** and

the classification divert line **68**. In this portion of the pallet inspection and repair system **40**, the pallets **50** are moved on a conveyor system, for example. A series of detectors, such as photocells, for example, are positioned along the conveyor system for tracking position and movement of each pallet. The automated controller **60** is a computer-based controller that tracks the position and movement of each pallet **50** via the sensors, and coordinates with the ADI system **66** on when the image data **72** of each pallet **50** is to be generated.

[0032] For each pallet **50**, the corresponding customer data **70** and repair recipe **78** are provided from the FMS server **56** to another processor, which is referred to herein a data analysis server **58**. The data analysis server **58** is illustrated as being separate from the FMS server **56**. Alternatively, the FMS server **56** and the data analysis server **58** could be configured as a single server or processing system, as readily appreciated by those skilled in the art.

[0033] The data analysis server **58** performs post-analysis processing for the inspected pallets **50**. This involves comparing the repair recipes **78** to determine performance repair parameters **90** for the pallets **50**. The performance repair parameters **90** correspond to the different types of repairs to be made to the pallets.

[0034] As a result of analyzing the types of repairs being made to the pallets **50**, statistical data can be collected including how many pallets are being repaired, how much time and lumber is being consumed or is expected to be consumed in repairing the pallets, as well as tracking what repairs are being made. This advantageously allows the throughput of the pallet

inspection and repair system **40** to be monitored so that lumber and personnel can be accurately forecasted.

[0035] By determining certain repair trends, changes may be made to the pallet inspection and repair system **40** to more efficiently make the repairs. This may involve modifying one or more of the processor-controlled repair devices, or even the addition of a processor-controlled repair device if the repair was initially being manually made by a human operator.

[0036] Moreover, the repair trends may cause an examination of the inspection tolerances associated with the ADI station **66**, for example. If one or more of the inspection tolerances are set to stringent, this may cause unnecessary repairs to be made to the pallets **50**. By relaxing the inspection tolerances, less repairs would be made with the pallets **50** still meeting customer demands.

[0037] The performance repair parameters **90** may also be tracked with the customer data so that feedback can advantageously be provided to the customer. The feedback would allow corrective action to be taken by the customer to reduce certain types of repairs being made to the pallets provided by that customer.

[0038] By analyzing the types of repairs being made to the pallets for a particular customer, certain trends may be noted. For example, the customer may be damaging the supports blocks on the pallets more often than other customers, or the top deck boards are being replaced more often than other customers. Corrective action may be for the customer to instruct their forklift operators to reduce impacting the forklift tines with the support blocks, and to not stack loaded pallets too high on top of one another, for example.

If the customer ignores the feedback, then the customer may be charged a higher rate on their pooled pallets.

[0039] The pallet inspection and repair system **40** will now be discussed in greater detail. Referring now to FIG. 2, a forklift **100** is used to unload wooden pallets **50** from a tractor-trailer truck **102**. A standard tractor-trailer truck **102** holds about 500 pallets **50**, for example. As the pallets **50** are unloaded, a vehicle mount terminal (VMT) **104** on the forklift **100** records the customer data **70**. The customer data **70** includes the truck number, the customer providing the pallets **50**, and how many pallets are being unloaded for inspection. The customer data **70** is entered into the VMT **104** by the operator of the forklift **100**. This process is repeated each time pallets **50** are unloaded from a truck **102** or any other delivery vehicle.

[0040] At the stack in-feed **52**, the forklift **100** places the wooden pallets **50** against a backboard **124**, as illustrated in FIG. 3. As the pallets **50** are stacked, the VMT **104** communicates with the FMS server **56**. The FMS server **56** may also be referred to as a logistics database, for example.

[0041] The stack in-feed **52** comprises a series of conveyors **110**, **112**, **114** and **116**, which are controlled by electrical motors **119**. The illustrated arrow **107** indicates the flow direction of the pallets **50**. Each conveyor has one or more detectors **120** for determining the position of a stack of pallets **122** as it moves along the conveyors **110**, **112**, **114** and **116**. The detectors **120** may be photoelectric sensors, or photoeyes, for example. A photoelectric sensor is used to detect the presence of a stack of pallets **122** by using a light transmitter, often infrared, and a

photoelectric receiver. Other types and forms of detectors **120** may be used, as readily appreciated by those skilled in the art.

[0042] The pallets **50** are initially stacked on a conveyor **110** against the backboard **124** to form a stack of pallets **122**. Each illustrated stack of pallets **122** is 20 pallets high. After a stack of pallets **122** has been formed, the stack moves from conveyor **110** to a stack squarer **126** via conveyor **112**. The stack squarer **126** squares each stack of pallets **122**. After being squared, the conveyor **114** associated with the stack squarer **126** moves the stack of pallets **122** to an adjacent conveyor **116**. This conveyor **116** then moves the stack of pallets **122** toward the tipper/accumulator **62**.

[0043] The tipper/accumulator **62** comprises a tipper **130** and an accumulator **140**, as the name implies, as illustrated in FIG. 4. The illustrated arrow **107** indicates the flow direction of the pallets **50**. The tipper **130** includes an L-shaped member that is tilted from a first position in which the long side **132** of the L-shaped member is upright and the short side **134** is horizontal, to a second position in which the long side **132** is near horizontal and the short side **134** is near vertical (as in FIG. 4). When the short side **134** of the L-shaped member is in the horizontal position, the stack of pallets **122** is loaded onto the tipper **140**. After loading, the tipper **140** moves the L-shaped member to the second position in which the long side **132** of the tipper is nearly horizontally disposed so that the pallets **50** held on the L-shaped member can be moved off the tipper **130** to the accumulator **140**.

[0044] The accumulator **140** provides an intermediate stage between the stack of pallets **122** and the

preparation screening line **64**. The tipper **130** delivers and transfers the stack of pallets **122** to the accumulator **140** which then holds and delivers the pallets **50** one at a time to the preparation screening line **64**. This is while the tipper **130** returns to receive another stack of pallets **122**.

[0045] At the output of the accumulator **140**, the pallets **50** are passed to another series of conveyors **150, 152, 154, 156, 158** and **160** defining the preparation screening line **64**, as illustrated in FIG. 5. The illustrated preparation screening line **64** is one example, and others variations are readily applicable. The illustrated arrow **107** indicates the flow direction of the pallets **50**. Detectors **120** are spaced along the conveyors **150-160** for tracking the position of each pallet **50**. The pallets **50** from the accumulator **140** are placed with the top deck facing up on conveyor **150**. The top deck of each pallet **50** is visually inspected by a human operator to insure that any loose debris or trash is removed from the pallet **50** before reaching the ADI station **66**. Also, any loose boards on the top deck that can be easily repaired may also be nailed down at this time. If the human operator determines that the pallet **50** is too damaged to be repaired, then the pallet is discarded at this point.

[0046] The pallets **50** travel along conveyor **152** and are then flipped because of the transition with conveyor **154** so that the bottom deck is now facing up. Likewise, the bottom deck of each pallet **50** is visually inspected by a human operator to insure that any loose debris or trash is removed from the pallets before reaching the ADI station **66**. As with the top deck, any loose boards on the bottom deck that can be easily

repaired may also be nailed down at this time. Again, if the human operator determines that the pallet **50** is too damaged to be repaired, then the pallet is discarded at this point.

[0047] The pallets **50** travel along conveyor **156** and are then flipped over at conveyor **158** so that the top deck is again facing up. This is so the ADI station **66** first inspects the top deck of each pallet **50**. The pallets **50** continue moving on conveyor **160** toward the ADI station **66**.

[0048] The next step in the pallet inspection and repair system **40** is to inspect the pallets **50**, as illustrated in FIGS. 6 and 7. The illustrated embodiment for the ADI station **66** shown in FIG. 1 comprises a pair of ADI inspection stations **180, 182.** The illustrated arrow **107** indicates the flow direction of the pallets **50**.

[0049] During the inspection process, the top and bottom decks of each pallet **50** are inspected in separate ADI inspection stations **180, 182.** Conveyor **170** receives a pallet **50** from conveyor **160** in the preparation screening line **64.** The top deck of the pallet **50** is inspected in ADI inspection station **180.** Detectors **120** are used to track movement of the pallet **50** prior to entering the ADI station **180**, as well as tracking movement within the ADI station.

[0050] The ADI station **180** inspects the top deck of the pallet **50** using pallet feature sensing heads **190** placed above the pallet. Each pallet feature sensing head **190** may comprise a series of sensors in a line (linear array) to detect the presence or absence of timber (or other pallet material), as discussed in the above-referenced patent application that is

incorporated herein by reference. This type of sensing head is positioned adjacent to the moving pallet **50** so that it scans the pallet surface passing near it for generating an image **72** of the pallet.

[0051] In another embodiment, the pallet feature sensing head **190** may comprise a laser and camera system to capture individual profiles (cross-sections) of the pallet **50** (i.e., the camera records the location of a projected laser line and triangulates its position to give height and coordinate data). The laser beam that is projected onto the pallet **50** may be fan shaped, or it may be scanned across the pallet surface using, for example, moving mirrors. Such a system will generate a three-dimensional digital data map on the pallet **50** and can be used for detecting gaps or protrusions such as nails, hanging wood, etc.

[0052] Alternatively, similar three-dimensional maps of pallet features, dimensions and topography may be created using a system of cameras, which may be stereoscopic or monocular in location and action. These can be mathematically manipulated to give data on each element that can then be analyzed for damage as in other pallet feature sensing head arrangements.

[0053] The ADI station **180** has at least one computing system **194** cooperating with the pallet feature sensing heads **190** for generating an image of the top deck of the pallet **50** being inspected. Likewise, the other ADI station **182** has at least one computing system **194** cooperating with the pallet feature sensing heads **190** for generating an image of the bottom deck of the pallet **50**.

[0054] Between the ADI stations **180** and **182**, conveyor **172** moves the pallet **50** to conveyor **174**,

wherein the transition between the two conveyors causes the pallet to flip over so that the bottom deck is facing up. The pallet **50** then moves on conveyors **176** and **178** to the ADI station **182** for inspecting the upper facing bottom deck.

[0055] Although not illustrated, the two computing systems **194** and **204** are coupled together for generating a damage report **76** on the pallet **50**. The computing system **194** compares the generated image data **72** for the top and bottom decks of the pallet **50** with expected profiles **74** for generating the damage report **76**.

[0056] The damage report **76** comprises a pallet repair summary and an element repair summary. The pallet repair summary and the element repair summary may be configured as tables, as illustrated in FIGS. 8 and 9. The element repair summary corresponds to the elements making up the pallet **50**. For example, the top deck of the pallet **50** could be formed with 5, 6 or 7 boards as illustrated in FIGS. 10, 11 and 12. Accordingly, when a pallet **50** is to be inspected, the pallet needs to be classified as a 5, 6 or 7 board pallet. The corresponding element ID **206** and element index **208** for each type of pallet are also provided.

[0057] Once the pallet **50** has been classified, then the expected profile can be selected by the computing systems **194, 204**. Similarly, the elements making up the bottom deck of the pallet **50**, and the elements making up the stringer boards of the pallets are illustrated in FIGS. 13 and 14. The corresponding element ID **206** and element index **208** for the pallet are also provided.

[0058] As an alternative to separate ADI stations **180** and **182**, a single ADI station may be used when

pallet feature sensing heads **190** are positioned below the conveyor. In this embodiment, the pallet **50** does not have to be flipped over so that the bottom deck is facing up during inspection. In addition, a single computing system **194** may be used.

[0059] As illustrated in FIG. 1, the damage report is provided to the FMS server **56**. Since the damage report **76** includes the pallet repair summary table and the element repair summary table as illustrated in FIGS. 8 and 9, the FMS server **56** generates a repair recipe **78** for the pallet **50**.

[0060] The repair recipe **78** determines how the pallet **50** is to be repaired if it is damaged. The repair recipe **78** takes into account the inspection results, the complexity of the repair and the repair machines available and the paths available (with respect to the repair machines) in the pallet inspection and repair system **40**. The repair recipe **78** also takes into consideration what repair operations get priority if multiple repairs have to be made to the pallet **50**. The FMS server **56** thus creates a relational database scheme for handling the very large number of repair variables that are possible when repairing pallets **50**.

[0061] Conveyor **180** moves the pallet **50** from the second ADI station **182** to the classification divert line **68**, as illustrated in FIG. 15. The classification divert line **68** includes a conveyor **185** for receiving the pallet **50** from the second ADI station **182**. Conveyor **210** operates as a control gate for directing the pallet **50** to conveyor **212** or to conveyor **208**. Conveyor **212** provides the pallet **50** to conveyor **214** which directs the pallet to the repair line **80**.

Conveyor **208** provides the pallet **50** to the paint booth **82**. Although not illustrated, the classification divert line **68** also directs the pallet to the discard line **84** if the pallet **50** is too damaged to be repaired. The classification divert line **68** thus operates based on the repair recipe **78**.

[0062] In the repair line **80**, a number of different processor-controlled repair devices and repair machines are available to support a complete repair of a pallet **50**. The repair line **80** includes the following: a de-stubbing device **240**, a lead board adjustment machine **242**, a nailing machine **244** for the lead board adjustment machine, an any board removal machine **246**, a board placing/nailing machine **248**, a lead board removal machine **250** and a nail presser for proud nails **252**. In addition, some repairs may be manually made by a human, either directly or with the human operating a repair machine, as indicated by reference **254**. The order in which a pallet **50** is repaired in the repair line **80** is based on the generated repair recipe **78**.

[0063] The repair recipe **78** may be provided to the repair line **80** in a number of different ways. For example, the position of each pallet **50** is still being tracked so that the repair recipe **78** "travels" with each pallet. Alternatively, each pallet **50** may be physically marked with their repair recipe **78** before leaving the classification divert line **68**. This may be in the form of a bar code, or as a set of written instructions. Once the pallet **50** arrives at the repair line **80**, the repair recipe **78** is read. The repair recipe **78** may be read by a processor or by a human operator.

[0064] As part of the repair line **80**, one or more

robot cells may be used to position each pallet **50** among the different repair devices/machines based on the repair recipe **78**. Alternatively, conveyors with switch gates may be used for providing the pallets **50** to the appropriate repair devices/machines based on the repair recipe **78**.

[0065] After a pallet **50** has been repaired, or for a pallet that did not need repair, the pallet may be sent to the paint booth **82** before being returned to service. In one embodiment, several pallets **50** are placed in the paint booth **82** at one time. The paint booth **82** is enclosed, and the pallets **50** spin as edges or sides of the pallets are sprayed with paint. Next, a stencil may be used to mark the pallets with indicia, such as the company logo. In one embodiment, a robot is used for dipping its paint guns into a pit of paint for marking at least two pallets at a time. An alternative design is to use an inkjet type paint sprayer to spray in a dot matrix format the indicia.

[0066] In the discard line **84**, the pallets **50** are dismantled. A robot, for example, may be programmed to dismantle the pallets **50**.

Claims:

1. A method for inspecting and repairing pallets comprising:

receiving a plurality of pallets for inspection, with at least a portion of the pallets being received from a customer, and for the pallets received from the customer comprising collecting customer data with respect to the received pallets;

inspecting each pallet using an automated pallet inspection system;

generating a repair recipe for each pallet based on the inspecting;

comparing the repair recipes to determine at least one performance repair parameter for the pallets, the at least one performance repair parameter corresponding to at least one type of repair to be made to the pallets, and tracking the customer data with the at least one performance repair parameter;

analyzing the at least one type of repair to be made to the pallets so as to collect statistical data, and for the pallets received from the customer, providing feedback to the customer so corrective action can be taken by the customer; and

repairing damaged pallets based on the respective repair recipes.

2. The method according to Claim 1, wherein the analyzing comprises determining at least one repair trend.

3. The method according to Claim 1, wherein the analyzing comprises determining material usage for repairing the pallets.

4. The method according to Claim 1, wherein the analyzing comprises estimating an amount of time for repairing the pallets.

5. The method according to Claim 1, wherein the automated pallet inspection system inspects the pallets based on a plurality of inspection parameters each having a tolerance associated therewith; and wherein the analyzing comprises adjusting at least one of the tolerances so that inspection of new pallets by the automated pallet inspection system is based on at least one adjusted tolerance.

6. The method according to Claim 1 wherein inspecting each pallet using the automated pallet inspection system comprises:

generating image data for each pallet; and

comparing the generated image data with an expected profile of the pallet, with the repair recipe being generated based on the comparing.

7. The method according to Claim 1, wherein the customer data comprises identification of the customer, and how many pallets are received from the customer.

8. The method according to Claim 1, further comprising using at least one processor-controller pallet repair device to repair the damaged pallets.

9. A pallet inspection and repair system comprising:

a pallet in-feed for receiving a plurality of pallets for inspection;

an automated pallet inspection system for receiving the plurality of pallets from said pallet in-feed for inspecting and generating image data for each pallet; and

at least one processor cooperating with said automated pallet inspection system for

comparing the generated image data with an expected profile of each respective pallet,

generating a repair recipe for each pallet based on the comparing,

comparing the repair recipes to determine at least one performance repair parameter for the pallets, the at least one performance repair parameter corresponding to at least one type of repair to be made to the pallets; and

analyzing the at least one type of repair to be made to the pallets so as to collect statistical data; and

a repair line to receive repair recipes to repair the inspected pallets.

10. The pallet inspection and repair system according to Claim 9, wherein the analyzing by said at least one processor comprises determining at least one repair trend.

11. The pallet inspection and repair system according to Claim 9, wherein the analyzing by said at least one processor comprises determining material usage for repairing the pallets.

12. The pallet inspection and repair system according to Claim 9, wherein the analyzing by said at least one processor comprises estimating an amount of time for repairing the pallets.

13. The pallet inspection and repair system according to Claim 9, wherein said automated pallet

inspection system inspects the pallets based on a plurality of inspection parameters each having a tolerance associated therewith; and wherein the analyzing by said at least one processor comprises adjusting at least one of the tolerances based on the at least one performance repair parameter so that inspection of new pallets by the automated pallet inspection system is based on at least one adjusted tolerance.

14. The pallet inspection and repair system according to Claim 9, wherein the plurality of pallets are received from a customer; wherein said pallet in-feed collects customer data with respect to the received pallets; and wherein said at least one processor tracks the customer data with the at least one performance repair parameter, and analyzes the at least one type of repair to be made to the pallets provided by the customer.

15. The pallet inspection and repair system according to Claim 14, wherein said at least one processor further generates feedback for the customer so corrective action can be taken by the customer, and wherein the customer data comprises identification of the customer, and how many pallets are received from the customer.

16. The pallet inspection and repair system according to Claim 9, further comprising at least one processor-controller pallet repair device for repairing damaged pallets based on the respective repair recipes.

17. A pallet inspection and repair system comprising:

a pallet in-feed for receiving a plurality of pallets for inspection, with at least a portion of the

pallets being received from a customer and having customer data associated therewith;

an automated pallet inspection system for receiving the plurality of pallets from said pallet in-feed, and for generating image data for each pallet, and comparing the generated image data with an expected profile of the pallet; and

at least one processor cooperating with said automated pallet inspection system for

generating a repair recipe for each pallet based on the comparing, and

comparing the repair recipes to determine at least one performance repair parameter for the pallets, with the at least one performance repair parameter corresponding to at least one type of repair to be made to the pallets, and tracking the customer data with the at least one performance repair parameter, and

analyzing the at least one type of repair to be made to the pallets so as to collect statistical data, and for the pallets received from the customer, providing feedback to the customer so corrective action can be taken by the customer; and

a repair line to receive repair recipes to repair the inspected pallets.

18. The pallet inspection and repair system according to Claim 17, wherein said at least one processor further determines at least one repair trend based on the at least one type of repair to be made to the pallets.

19. The pallet inspection and repair system according to Claim 17, wherein said at least one processor further determines at least one of material usage and estimates an amount of time for repairing the pallets based on the at least one type of repair to be made to the pallets.

20. The pallet inspection and repair system according to Claim 17, wherein said automated pallet inspection system inspects the pallets based on a plurality of inspection parameters each having a tolerance associated therewith; and wherein said at least one processor further cooperates with said automated pallet inspection system for adjusting at least one of the tolerances based on the at least one performance repair parameter.

21. The pallet inspection and repair system according to Claim 17, further comprising at least one processor-controller pallet repair device for repairing damaged pallets based on the respective repair recipes.

22. The pallet inspection and repair system according to Claim 17, further comprising:

a plurality of spaced apart sensors for tracking movement of the pallets; and

a controller cooperating with said plurality of spaced apart sensors for controlling said automated inspection system based on movement of the pallets.

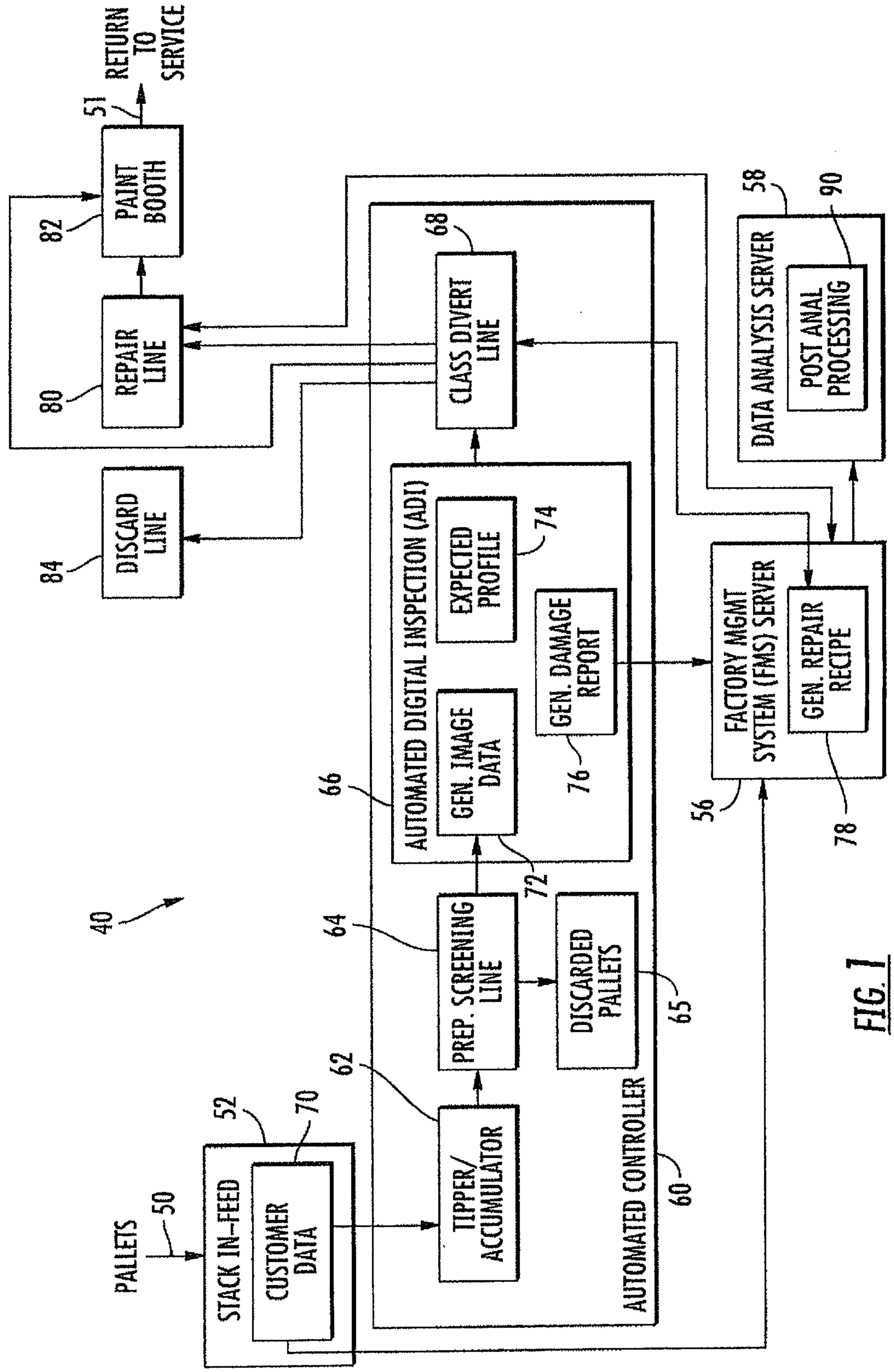

40
PALLETS
50
STACK IN-FEED
52
CUSTOMER DATA
70
62
TIPPER/ ACCUMULATOR
64
PREP. SCREENING LINE
DISCARDED PALLETS
65
AUTOMATED DIGITAL INSPECTION (ADI)
66
GEN. IMAGE DATA
72
EXPECTED PROFILE
74
GEN. DAMAGE REPORT
76
AUTOMATED CONTROLLER
60
FACTORY MGMT SYSTEM (FMS) SERVER
56
DATA ANALYSIS SERVER
58
POST ANAL PROCESSING
90
GEN. REPAIR RECIPE
78
REPAIR LINE
80
PAINT BOOTH
82
DISCARD LINE
84
RETURN TO SERVICE
51
CLASS DIVERT LINE
68

FIG. 1

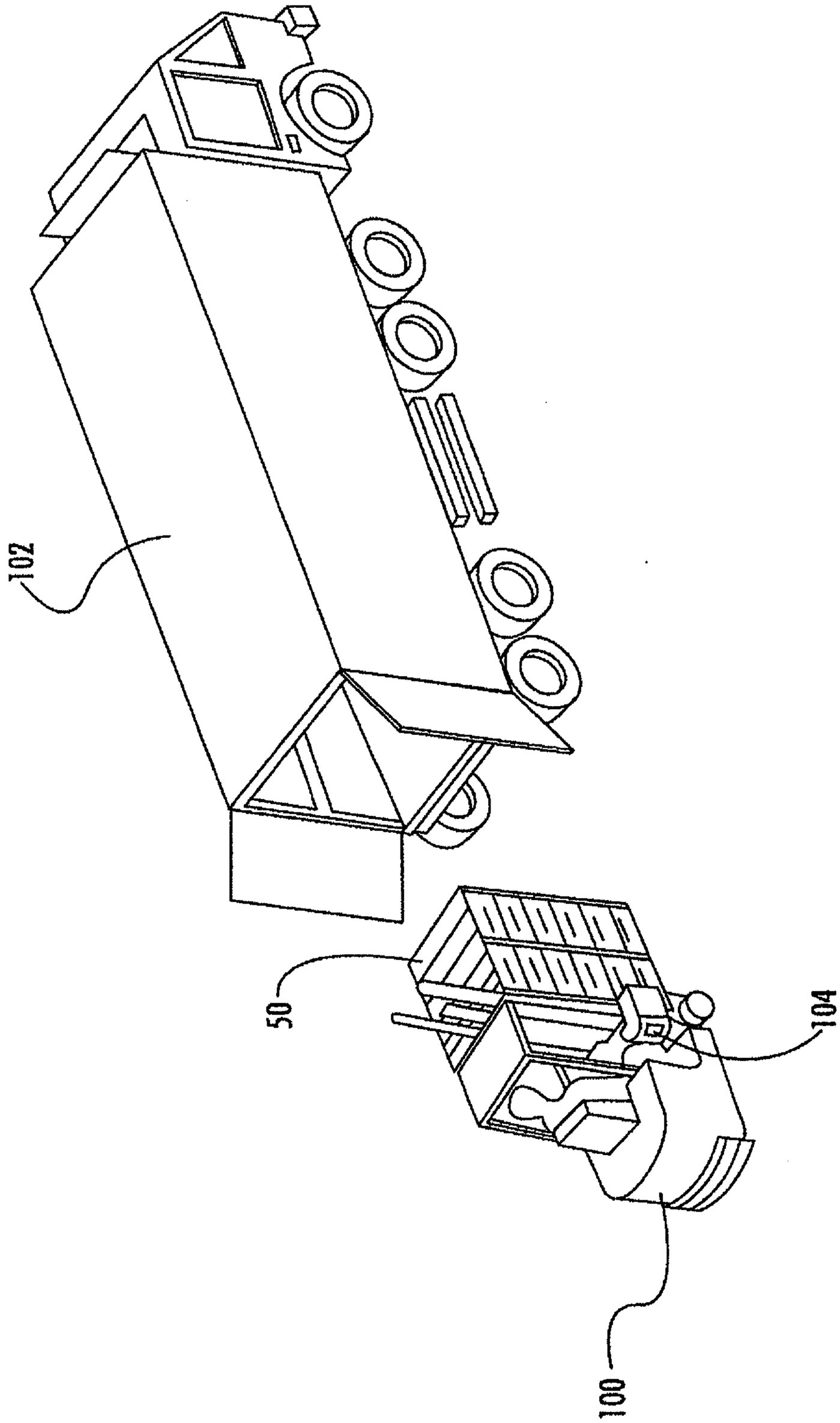


FIG. 2

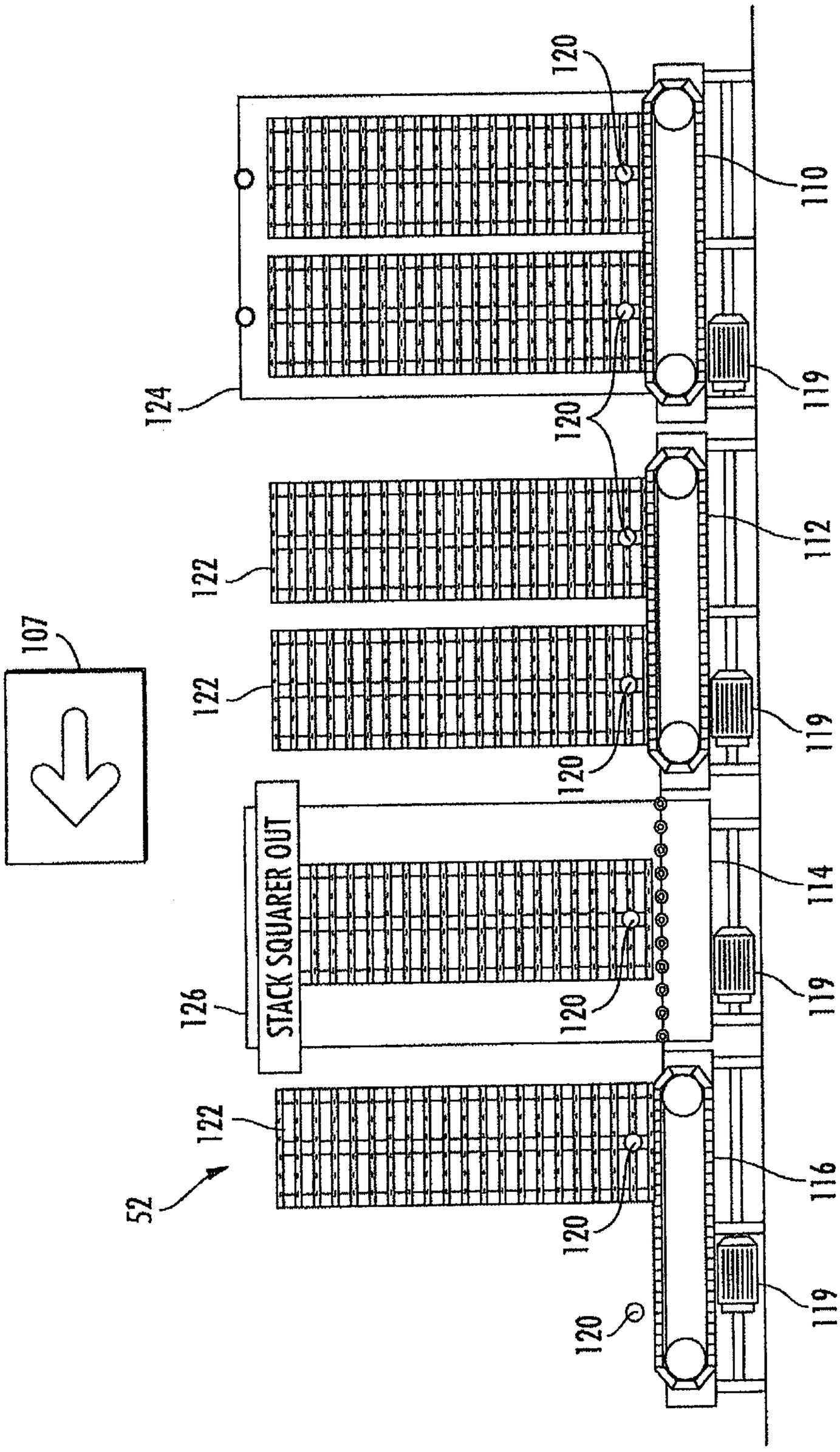


FIG. 3

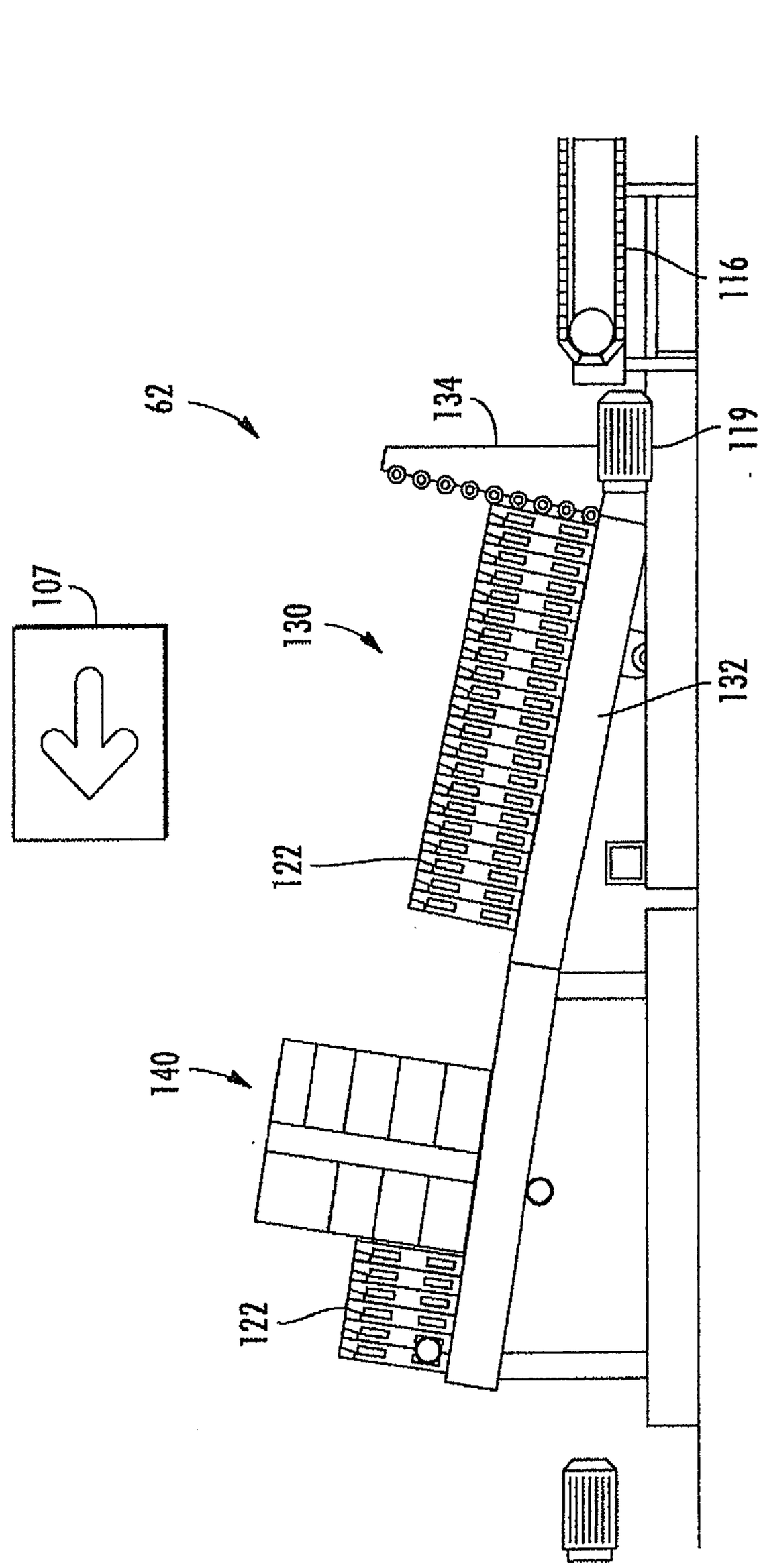
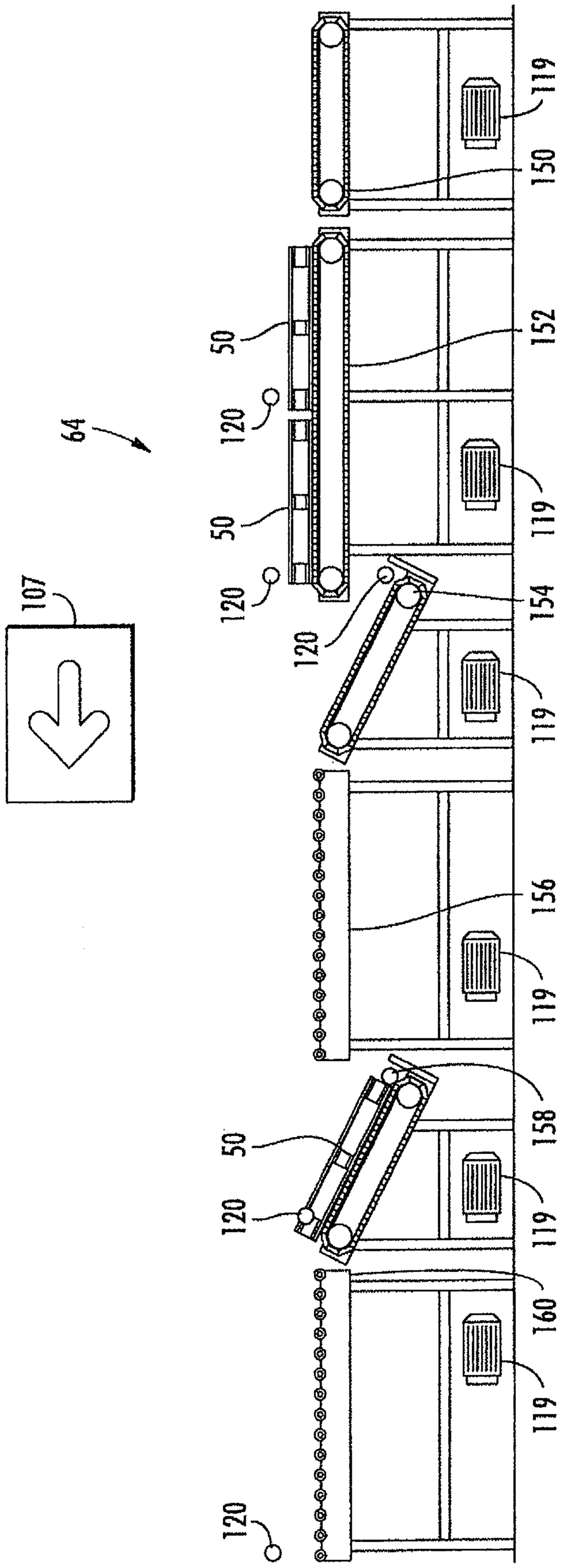


FIG. 4


64
107
50
120
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120
120
50
120
119
150
152
119
154
119
119
156
119
158
119
160
119

FIG. 5

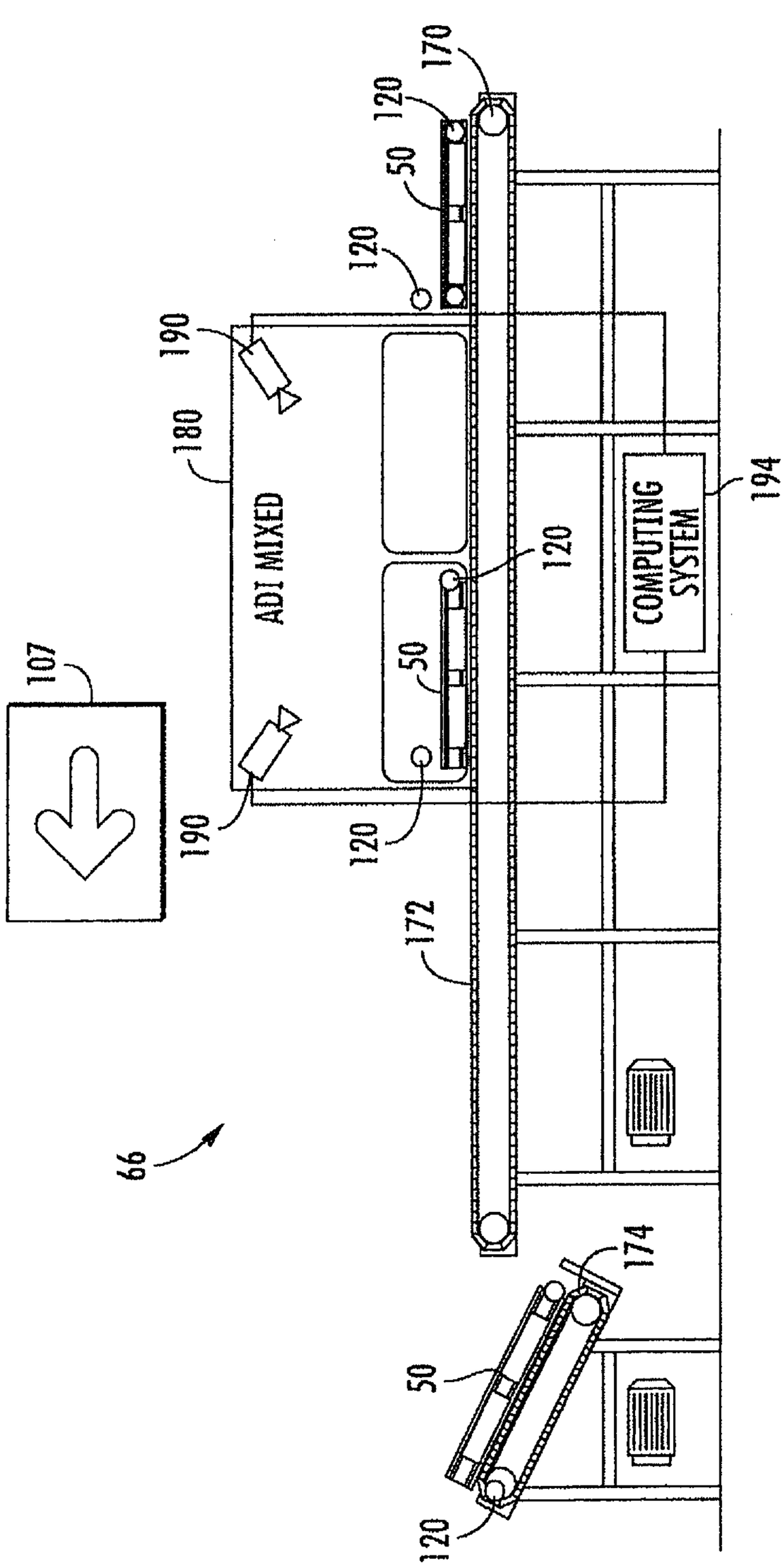

66
107
190
180
ADI MIXED
190
120
50
120
170
120
50
120
COMPUTING SYSTEM
194
172
174
50
120

FIG. 6

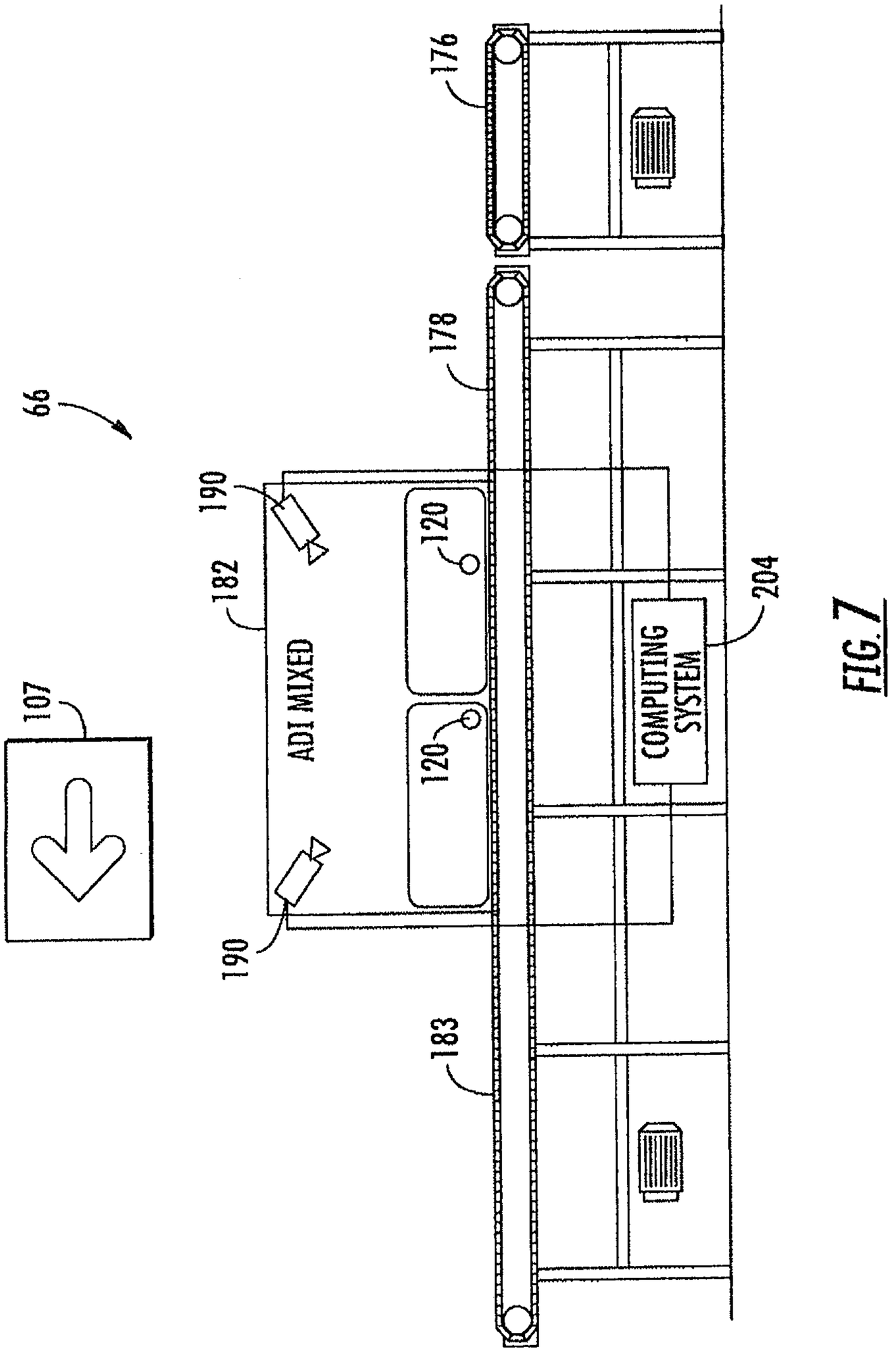

66
107
190
182
ADI MIXED
120
120
190
176
178
183
204
COMPUTING SYSTEM

FIG. 7

rpr_PALLETREPAIRSUMMARY			
CUSTOMER NAME	DATE TIME	LENGTH	ALLOW NAILS
PALLET	VALCHAR	50	
PALLET DEFECT	VALCHAR	30	
PALLET TYPE	VALCHAR	10	✓
ROW ID	INT	4	

FIG. 8

rpr_PALLETREPAIRSUMMARY			
CUSTOMER NAME	DATE TIME	LENGTH	ALLOW NAILS
PALLET	VALCHAR	4	
PALLETID	VALCHAR	30	
ELEMENTINDEX	INT	4	
DEFECT_TERMINDEX	INT	4	✓
DEFECT_DEFECTINDEX	INT	4	✓
DEFECT_MEASUREMENT	DECLINED	5	✓
ACTION_ACTIONINDEX	INT	4	✓
ROW ID	INT	4	

FIG. 9

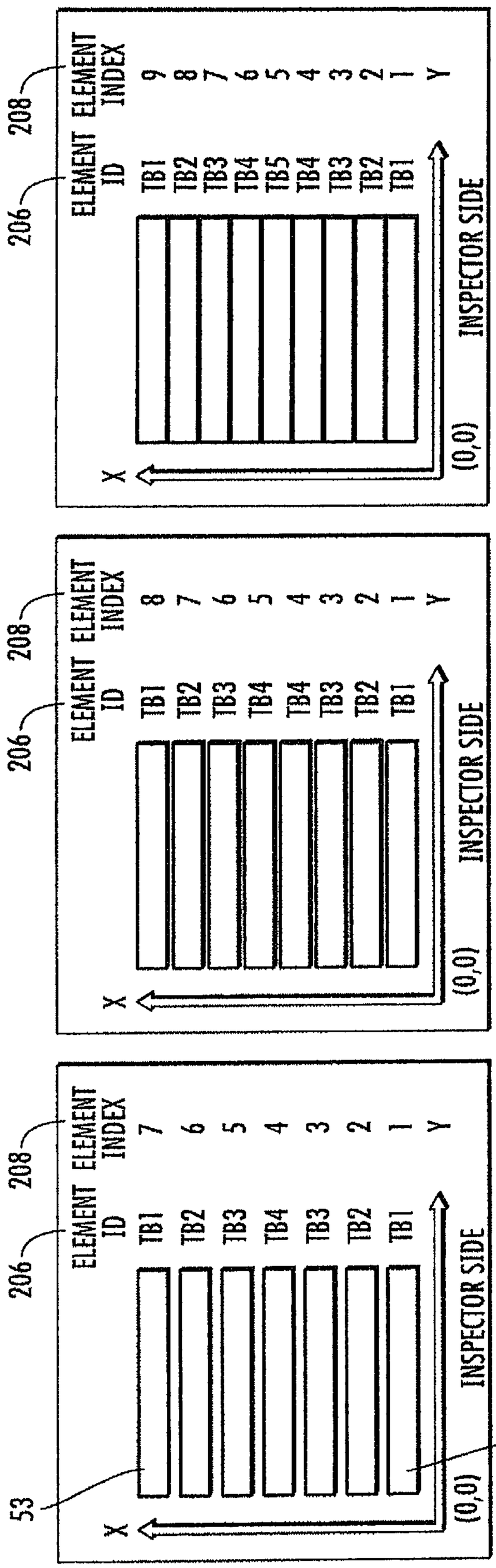


FIG. 12

FIG. 11

FIG. 10

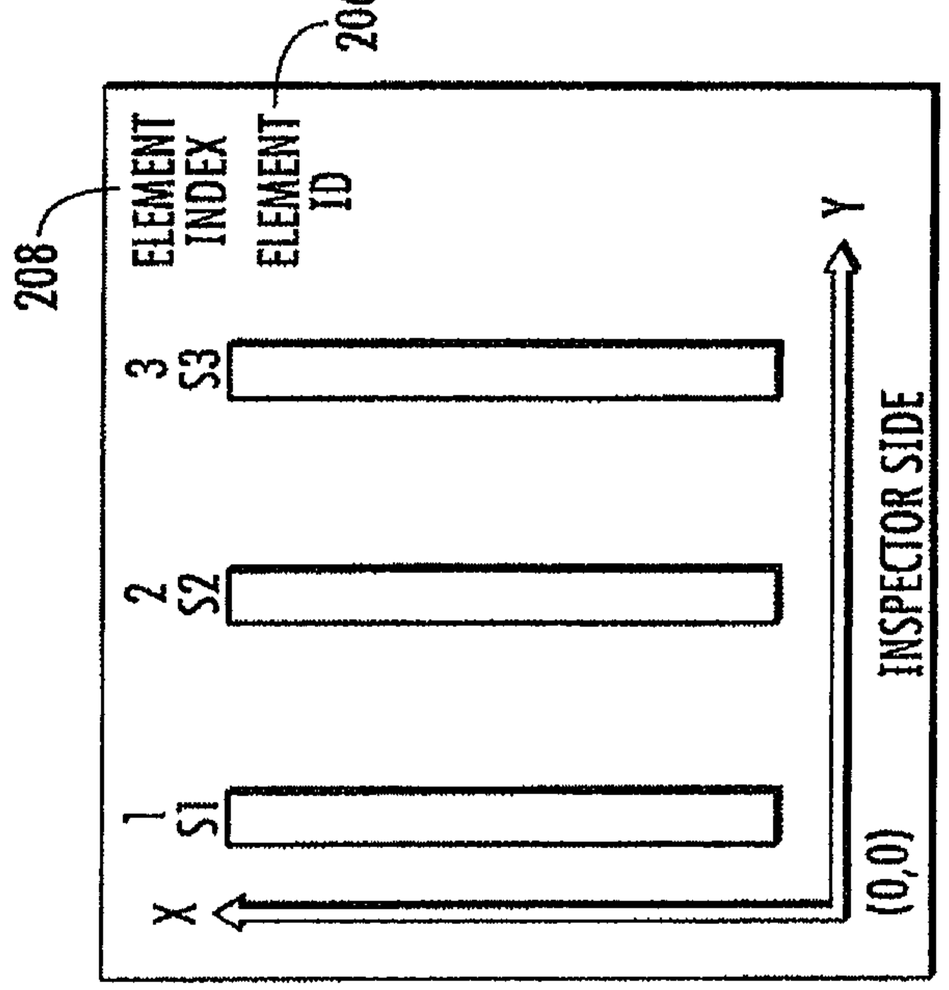

208
ELEMENT INDEX
ELEMENT ID
20
3 S3
2 S2
1 S1
X
Y
(0,0)
INSPECTOR SIDE

FIG. 14

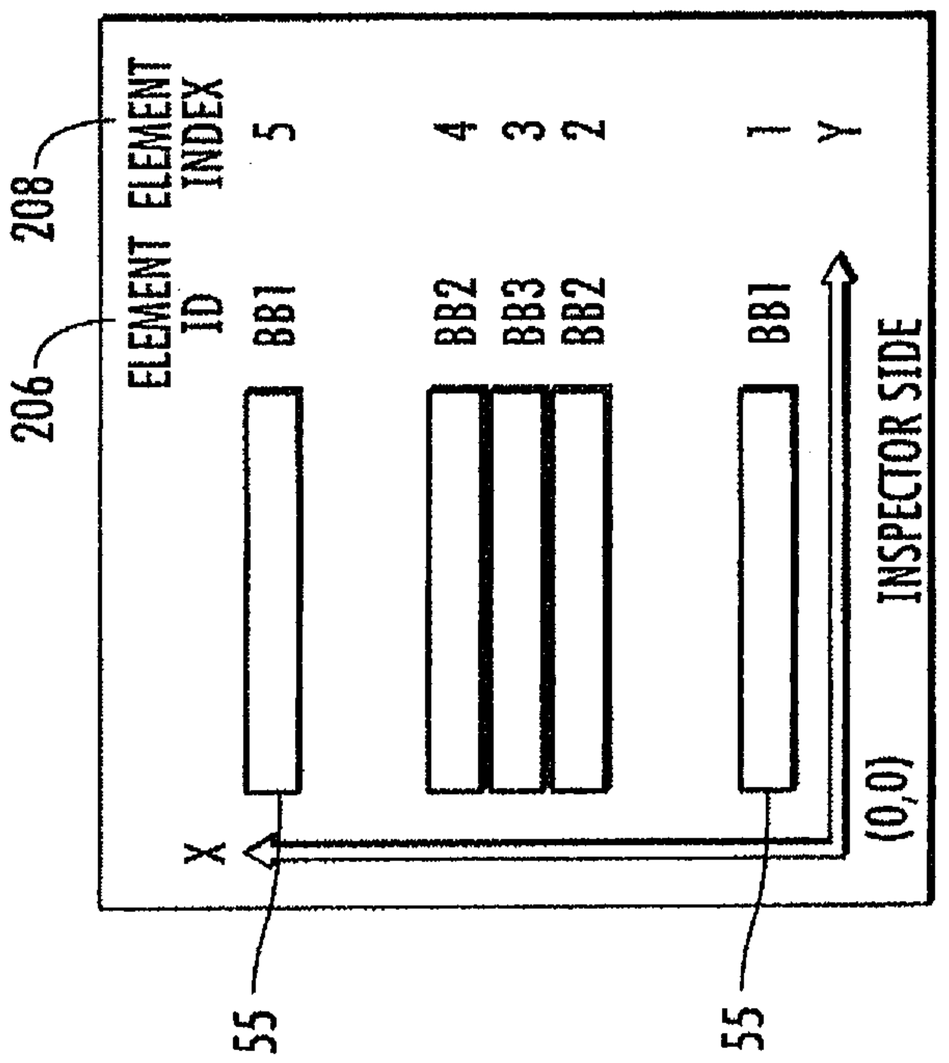

208
206
ELEMENT ID
ELEMENT INDEX
5
4
3
2
1
BB1
BB2
BB3
BB2
BB1
Y
X
(0,0)
INSPECTOR SIDE
55
55

FIG. 13

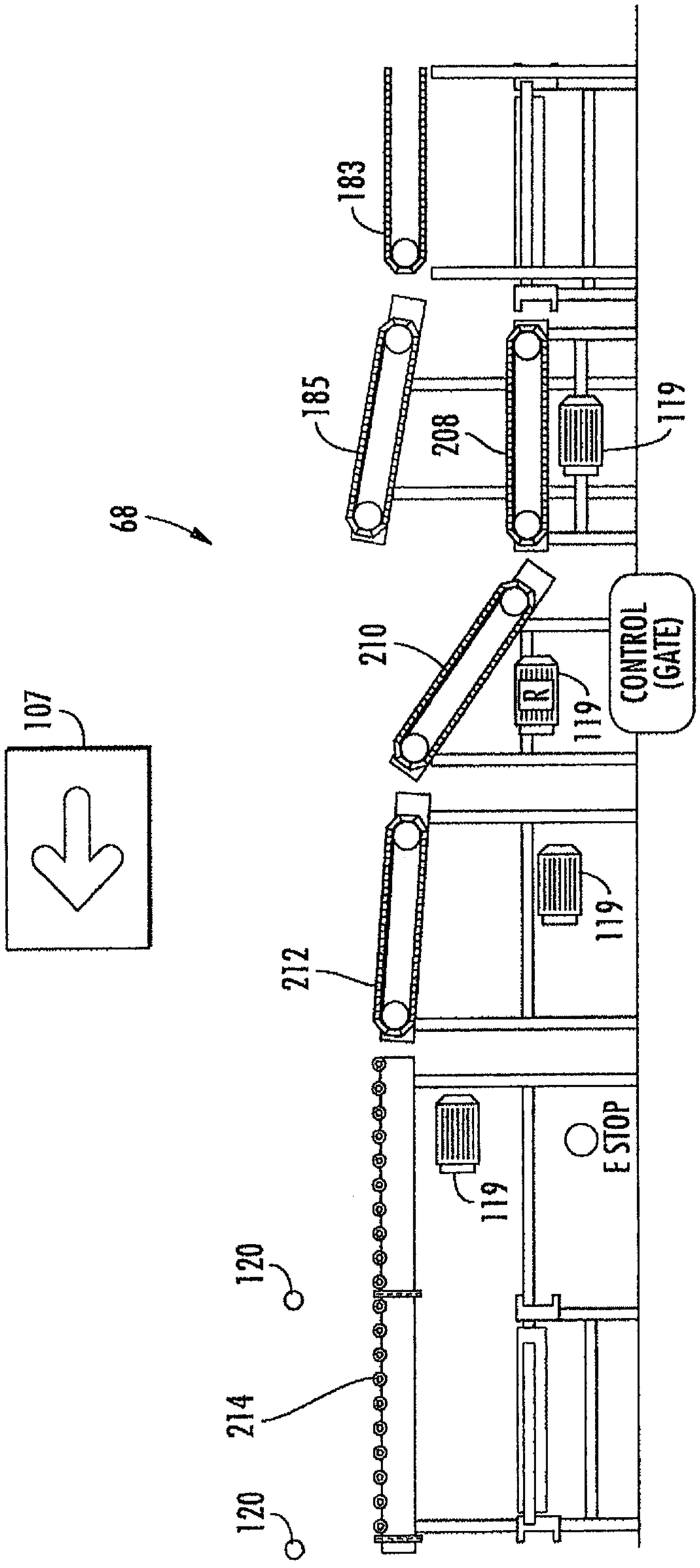

68
107
183
185
208
119
210
R
119
CONTROL
(GATE)
212
119
119
E STOP
120
214
120

FIG. 15

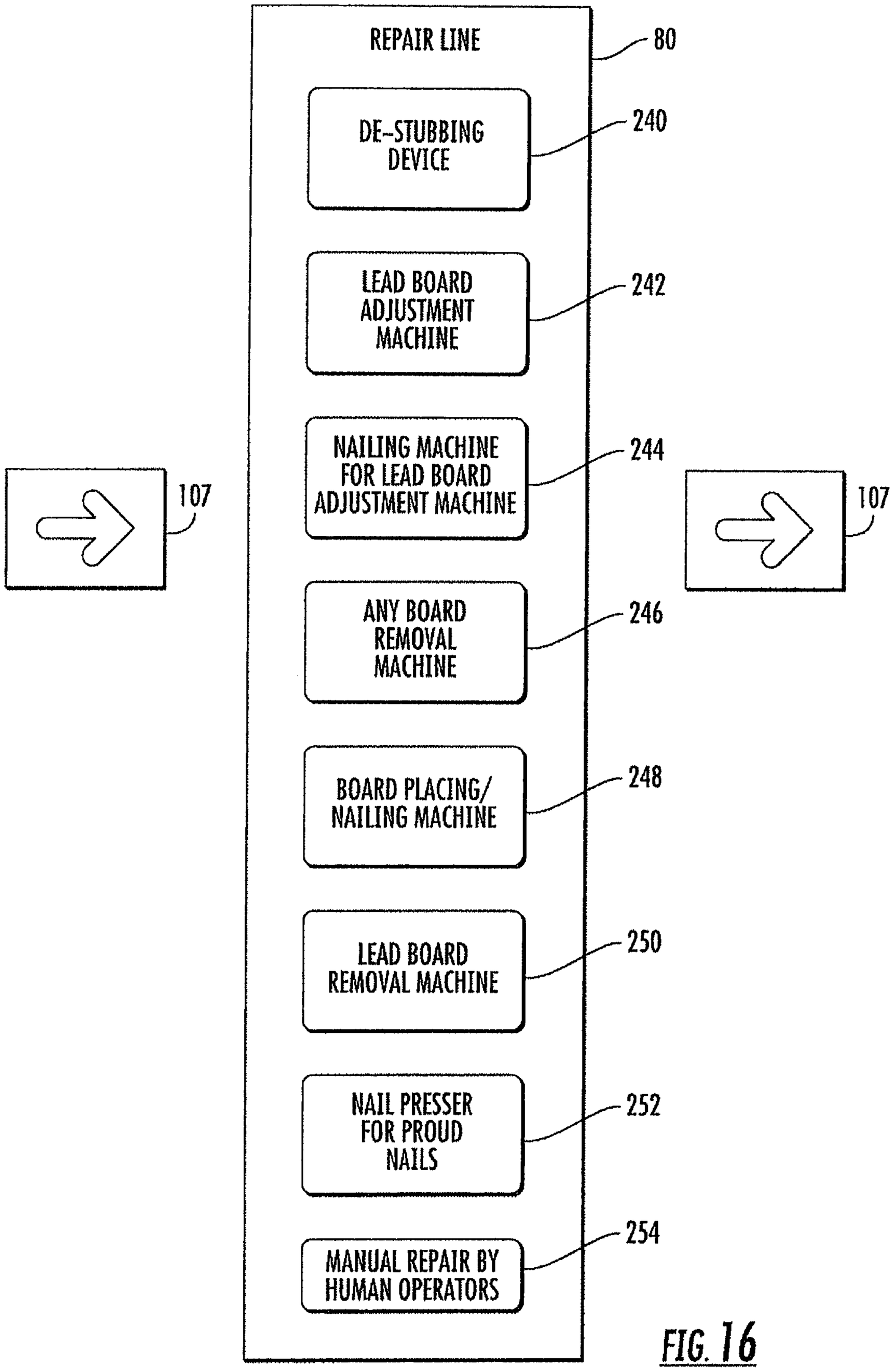
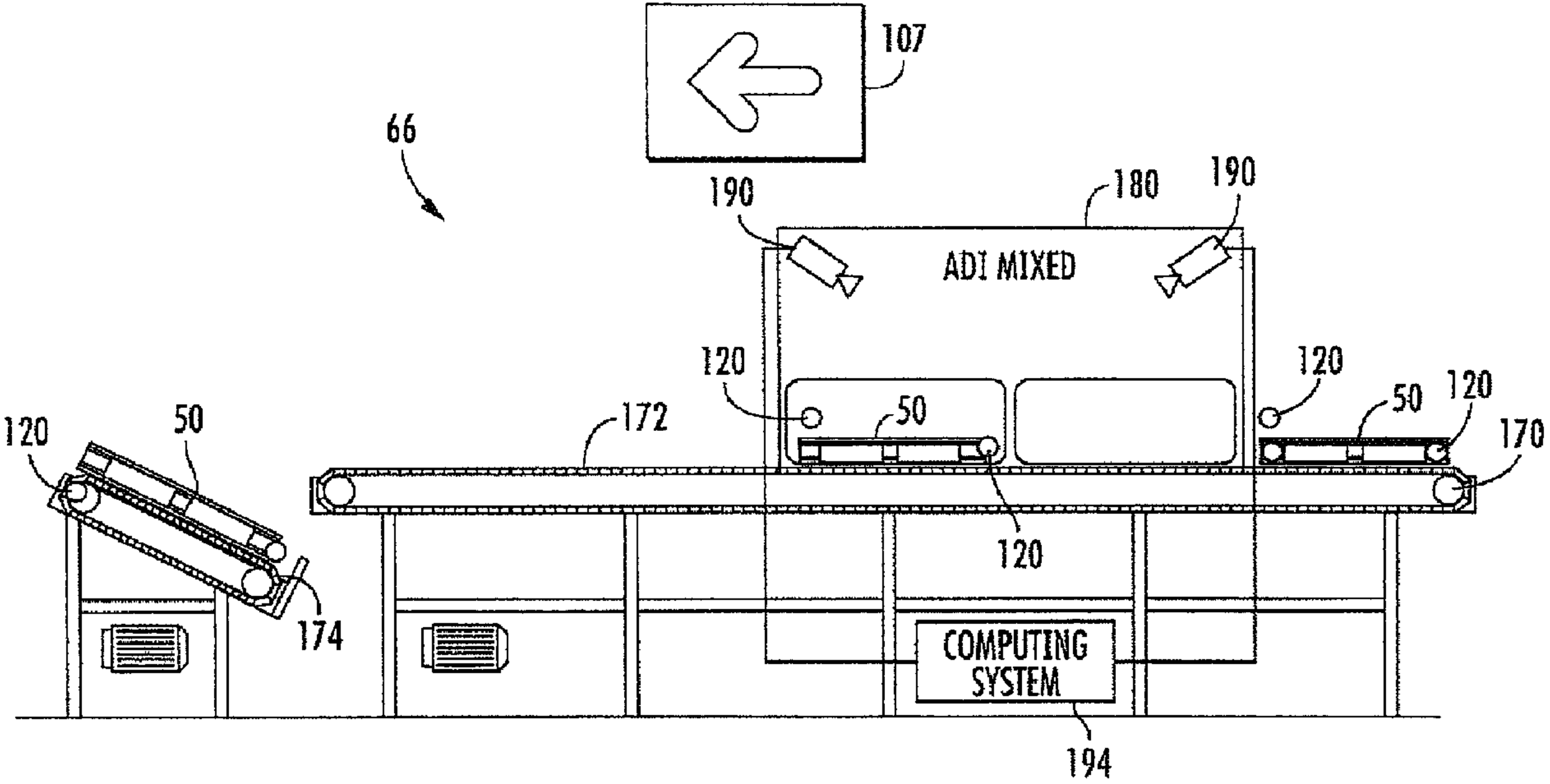

REPAIR LINE
80
DE-STUBBING DEVICE
240
LEAD BOARD ADJUSTMENT MACHINE
242
NAILING MACHINE FOR LEAD BOARD ADJUSTMENT MACHINE
244
107
107
ANY BOARD REMOVAL MACHINE
246
BOARD PLACING/ NAILING MACHINE
248
LEAD BOARD REMOVAL MACHINE
250
NAIL PRESSER FOR PROUD NAILS
252
MANUAL REPAIR BY HUMAN OPERATORS
254

FIG. 16


107
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180
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ADI MIXED
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50
120
50
120
172
170
120
174
120
COMPUTING SYSTEM
194