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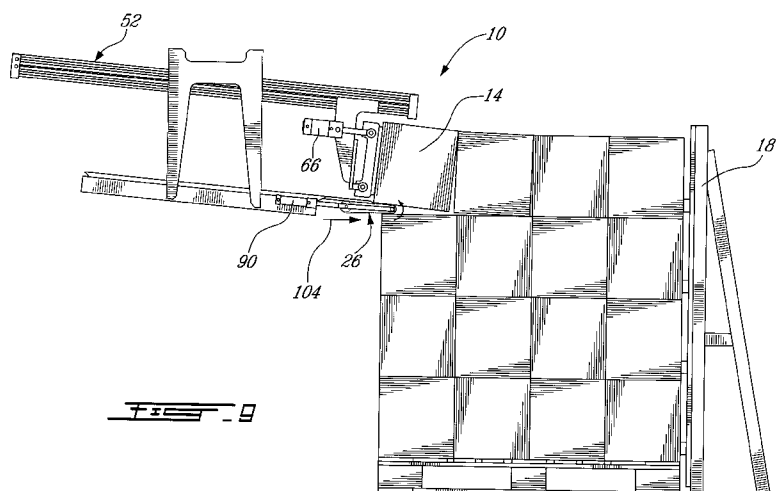
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(54) Title: LAYER DEPALLETIZING TOOL



(57) Abstract: The invention concerns a depalletizing tool for depalletizing a layer of products on a pallet. The tool is mounted to a robot via a frame, the robot allowing for movements of the tool relatively the pallet. The tool includes a platform mounted to the frame and provided with a motorized conveyor at the distal end thereof for inserting at least partially the platform under the layer of products and for raising the products onto the platform while the tool is moved towards the distal end of the layer by the robot. According to a specific embodiment, the tool includes a pusher also mounted to the frame over the platform for selectively applying pressure onto the products while the platform is inserted under the layer of products.

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**TITLE****LAYER DEPALLETIZING TOOL****FIELD**

**[0001]** The present invention generally concerns palletizing. More specifically, the present invention concerns a layer depalletizing tool.

**BACKGROUND**

**[0002]** Many types of depalletizing tools are known in the art. According to a first type of depalletizing tools, a mechanism is provided which allows picking products one at a time on a pallet.

**[0003]** Tools allowing to simultaneously depalletize a full layer are also known. They usually involve complex mechanisms including stackers and/or multi-layer conveyors wherein a movable arm is used to pull the layer onto the conveyor. Since these complex mechanisms are fixed, they require moving the pallets at their proximity. This can be seen as a further drawback since it has the direct consequence that the resulting general floor plan configuration is limited.

**[0004]** Another tool is known to depalletize a full layer, which includes a platform mounted to a robot via a mounting assembly and which is provided with motorized rollers at the distal end of the platform that act as friction elements which allow for the insertion of the platform under the layer to depalletize.

**[0005]** A problem with such a depalletizing tool from the prior art is that the motorized rollers are less effective when the products that form the

layer to pick are heavier than a certain weight. Indeed, the platform moving forward towards such a heavy load faces too much resistance from the products, which results in the platform causing damage thereto.

### **BRIEF DESCRIPTION OF THE DRAWINGS**

**[0006]** Figure 1 is a left perspective view of a layer depalletizing tool according to a first illustrative embodiment of the present invention; the tool being illustrated mounted to a robot and adjacent a pallet full of products;

**[0007]** Figure 2 is a front perspective isolated view of the tool from Figure 1;

**[0008]** Figure 3 is a left perspective view of the friction belt assembly of the tool from Figure 1;

**[0009]** Figures 4 is a side elevation of the tool from Figure 1, illustrated without the robot; and

**[0010]** Figure 5 to 11 are partially schematic side elevations of the tool from Figure 1, illustrating the operation thereof to depalletize a full layer of a pallet.

**[0011]** While the invention will be described in conjunction with illustrated embodiments, it will be understood that it is not intended to limit the scope of the invention to such embodiments.

### **DETAILED DESCRIPTION**

**[0012]** Generally stated, according to illustrative embodiments of the present invention there is provided a depalletizing tool for depalletizing a layer of products on a pallet. The tool is mounted to a robot via a frame, the robot allowing movements of the tool relatively to the pallet. The tool includes a platform secured to the frame and provided with a motorized conveyor at the distal end thereof for inserting at least partially the platform under the layer of products and for raising the products onto the platform while the tool is moved towards the distal end of the layer by the robot. The tool may include a pusher also mounted to the frame over the platform for selectively applying selected pressure onto the products while the platform is inserted under the layer of products.

**[0013]** More specifically, in accordance with a first aspect of the present invention, there is provided a tool for depalletizing a layer of products on a pallet, the layer having a proximate end and a distal end, the tool comprising:

**[0014]** a frame to be mounted to a robot;

**[0015]** a platform mounted to the frame and having proximate and distal ends for insertion, from the proximate end thereof, under the layer of products, and for receiving the layer of products between the proximate and distal ends of the platform;

**[0016]** a conveyor mounted to the platform at the proximate end thereof so that the conveyor and the platform generally lie in a same plane i) for inserting at least partially the platform under the layer of products from the proximate end of the layer and ii) for raising the products onto the platform while the tool is moved towards the distal end of the layer by the robot; and

**[0017]** a pusher slidably mounted to the frame over the platform for movement along a first axis generally parallel to the platform; the pusher being for selectively applying pressure onto the products while the platform is inserted at least partially under the layer of products.

**[0018]** According to a second aspect of the present invention, there is provided a tool for depalletizing a layer of products, the layer having a proximate end and a distal end, the tool comprising:

**[0019]** a frame to be mounted to a robot;

**[0020]** a platform mounted to the frame and having proximate and distal ends; the platform being for insertion, from the proximate end thereof, under the layer of products, and for receiving the layer of products between the proximate and distal ends of the platform;

**[0021]** a friction belt assembly mounted to the platform at the proximate end thereof so that the friction belt assembly and the platform generally lie in a same plane i) for inserting at least partially the platform under the layer of products from the proximate end of the layer and ii) for raising the products onto the platform while the tool is moved towards the distal end of the layer by the robot.

**[0022]** Other objects, advantages and features of the present invention will become more apparent upon reading the following non restrictive description of illustrated embodiments thereof, given by way of example only with reference to the accompanying drawings.

**[0023]** In the following description, similar features in the drawings have been given similar reference numerals, and in order not to weigh down the figures, some elements are not referred to in some figures if they were already identified in a precedent figure.

**[0024]** A tool 10 for depalletizing a layer 12 of products 14 on a pallet 16 according to a first illustrative embodiment of the present invention will now be described with reference to Figures 1 and 2.

**[0025]** The pallet is positioned next to a fixed stopper 18 and separated by spacers 20, the reason of which will be described hereinbelow.

**[0026]** The tool 10 comprises a mounting frame 22, a platform 24 mounted to the frame 22, a pusher 25 slidably and pivotably mounted to the frame 22 for selectively applying pressure onto the products 14 of the first layer 12, and a friction belt assembly 26 secured at the distal end 28 of the platform 30. Each of these components of the tool 10 will now be described in more detail.

**[0027]** The platform 24 includes a series of parallel rods 32 defining a proximate end 34 and a distal end 36 for the platform 24 and being assembled by a semi-rectangular frame 38 on three sides and by the friction belt assembly 26 on the side of the platform 24 defined by its distal end 36. As will become more apparent upon reading the following description, the semi-rectangular frame 38 can be seen as being part of the mounting frame 22.

**[0028]** Each rod 32 includes a generally flat side which is so mounted to the frame 38 so that the rods 32 define together a generally even product receiving surface 40.

**[0029]** The distal end 36 of each rod 32 includes a tapered tip 42 for facilitating the insertion of the platform under the first layer 12 of products 34 as will be described hereinbelow in more detail.

**[0030]** The frame 22 allows mounting the platform 24 and more generally the tool 10 to a robot 44 for their displacement relative to the pallet 16. The frame 22 is generally arc-shaped and includes a central top portion 46, including a generally centered robot coupling portion 48, and two side arm portions 50, each extending perpendicularly from the central portion 46 on opposite sides thereof. The platform 24 is fixedly mounted to the frame 22 via its frame 38 to both side arm portions 50 therebetween so as to define a small angle with the central top portion 46. This angle defines a pitch angle  $\alpha$  of the platform. The pitch angle  $\alpha$  can for example be five (5) degrees. A person skilled in the art would however appreciate that such a pitch angle may vary, for example, relatively to the pitch angle of the robot 44. Indeed, a pitch angle of zero degree can be provided between the platform 24 and the central portion 46 of the frame 22 while the robot 44 will be operated so as to yield a resulting pitch angle between the platform 24 and the layer 12. According to a still further illustrative embodiment, the resulting pitch angle, in operation, between the platform 24 and first layer 12, can be null.

**[0031]** A robot such as model RB7600 400 kg from ABB, with a 2.5 m reach, can be used. Other robot type can also be used providing for the functionalities described herein. The model and type of robot used may vary, for example, depending on the application.

**[0032]** It is to be noted that the frame 22 can have other configurations than the illustrated arc-shaped configuration to allow operatively mounting the platform 24 and pusher 25 to the robot 44.

**[0033]** The pusher 25 is in the form of a plate slidably mounted to the top portion 46 of the frame 22 via a first actuator 52 and pivotably to the first actuator via an actuator sub-assembly 54 (which can be better seen in Figure 4 and following). The face of the pusher 25 is provided with friction elements, in the form of rubber foams 56, secured to the plate using fasteners or adhesive.

**[0034]** The first actuator 52 is in the form of a pneumatic rodless cylinder, including an elongated beam 58 provided with first longitudinal sliding elements 60 on both lateral sides thereof and second complementary sliding elements 62 mounted also on both sides. The elongated beam 58 is so fixedly mounted to the central top portion 46 of the frame 22 via L-brackets 64-64' that the beam 58 is in a parallel relationship with the platform 24. Since a pneumatic rodless cylinder is believed to be well known in the art, it will not be described furtherin.

**[0035]** The actuator sub-assembly 54 includes a second pneumatic cylinder 66 slidably mounted to the first actuator 52 in parallel relationship therewith via two mounting plates 68 secured to the second sliding elements 62. The plate 25 is mounted to a rectangular frame 70 (see Figure 4), which is pivotably mounted to the bottom portion of the mounting plates 68 via a pivot 72 and slidably secured to the moving end 74 of the second actuator 66.

**[0036]** The actuator sub-assembly 54 renders the top portion of the plate 25 tiltable relatively to its bottom.

**[0037]** The pneumatic rodless actuator 52 allows reciprocating movement of the actuator sub-assembly 54 along the beam 58, and therefore of the pusher 25 along the platform 24. The plate 25 is mounted to actuator 52 via the sub-assembly 54 so that it is movable along the length of the platform 24 thereover.

**[0038]** It is to be noted that the plate 25 is so sized as to extend laterally generally along the width of the platform 24 and has a height which covers substantially the distance between the actuator 52 and the platform 24.

**[0039]** It is to be noted that the distance between the pneumatic actuator 52 and the fixed platform 24 is at least greater than the height of the layer 12 to pick.

**[0040]** The friction belt assembly 26 will now be described in more detail with reference to Figure 3.

**[0041]** The friction belt assembly 26 includes a beam 76, a plurality of idler rolls 78 mounted thereto along its length on one side thereof, a rod 80 rotatably mounted to the beam 76 in parallel relationship therewith and including sprocket wheels 82 registered with the idler rolls 78 to receive endless belts 84 therewith. The friction belt assembly 26 is powered by a motor 86, which is secured to the beam 76.

**[0042]** Returning to Figure 2, the friction belt assembly 26 is mounted to the platform 24, at the distal end 36 thereof, and more specifically to the semi-rectangular frame 38, via sliding elements 88. The friction belt assembly 26 is made movable from a retracted position to an extended position by a pneumatic actuator 90 also secured to the frame 38.

**[0043]** The friction belt assembly 26 is positioned relative to the platform 24 so that the endless belts 84 are interposed between the rods 32. While in the retracted position (see for example in Figure 2), the distal ends of the belts 84 are aligned with the tips 42 of the rods 32. In the extended position (see for example Figure 5), the endless belts 84 are moved beyond the tips 42.

**[0044]** The friction belt assembly 26 is not limited to the illustrated embodiment of Figure 3. For example, other mechanisms can be provided to motorize the endless belts 84.

**[0045]** Other characteristics and features of the tool 10 will become more apparent upon reading the following description of the operation thereof with reference to Figures 5 to 11.

**[0046]** As illustrated in Figures 5 and 6, the tool 10 is first approached adjacent to the pallet 16 by the robot 44 (see arrow 92). The friction belt assembly 26 is put in its retracted position using the cylinder 90 (see arrow 93), and pressure is applied to the cylinders 52 and 66 (see arrows 94 and 96). The pusher 25 is then positioned by the actuator sub-assembly 54 beyond the tips 42 of the rods 32.

**[0047]** Then, as can be seen in Figure 7, the tool 10 is moved forward by the robot 44 (see arrow 92) until the pusher 25 touches the front row of products 14 of the layer 12 and then it slightly goes back. The detection of the contact of the pusher 25 with the products 14 is achieved, for example, by a read switch (not shown) on the actuator 66.

**[0048]** It is to be noted that pressure is still applied in the cylinders 52 and 66. The stopper 18 then allows preventing the layer 12 from falling on the ground.

**[0049]** With reference now to Figure 8, the tool 10 is then elevated by the robot 44 (see arrow 100) so as to raise one side of the first row of products 14 using the friction of the pusher 25. This creates a gap 102 to insert the belt assembly 26. It is to be noted that pressure is still applied on the

cylinders 52 and 66. The motor 86 of the belt assembly 26 is then energized. Of course, the motor 86 of the friction belt assembly 26 could have been energized before but with no effects.

**[0050]** The belt assembly 26 is moved forward towards the stopper 18, using cylinder 90, until it reaches the end of its stroke (see arrow 104 on Figure 9). This causes the friction belt assembly 26 to go under the first row of products 14, while pressure is still applied on the cylinders 52 and 66 (see Figure 9).

**[0051]** It is to be noted that the use of the pusher 25 allows lifting the first row of products 14 during the insertion of the friction belt assembly 26 thereunder. This eases the insertion of the friction belt assembly 26 under the products 14, further preventing the friction belt assembly 26 from damaging the products 14 during this step. These advantages of the use of the pusher 25 are more important for heavier products.

**[0052]** As illustrated in Figure 10, the tool 10 advances (see arrow 92) to insert the friction belt assembly 26 and the platform 24 under the first layer 12 of products 14. Pressure is removed on the cylinder 66 so that force is transferred at the lowest point of the pusher 25.

**[0053]** The pusher 25 then moves back under the product constraint, while the actuator 52 still applies pressure. This pressure is however gradually lowered while the products 14 are moved inside onto the platform 24 to avoid excessive pressure between the last product row and the stopper 18. The pressure on the actuator 52 is also lowered so as to allow movement of the sub-assembly 54 away from the distal end of the platform 24 as the tool 10 is moved towards the distal end of the layer 12 by the robot 44. The rotation of the belts 84 raises any product along the way so as to avoid any jamming.

**[0054]** It is to be noted that the cylinder 90 of the friction belt assembly 26 acts as a spring. Indeed, when one or more boxes 14 are raised on the belts 84, the boxes 14 are moved back towards the proximate end 34 of the platform 24 under the cylinder pressure. This prevents slowing the forward movement of the robot 44.

**[0055]** Finally, with reference to Figure 11, the tool 10 advances (see arrow 92) until the tip 42 of the friction belt assembly 26 reaches the stopper 18.

**[0056]** The belt assembly 26 is moved from its extended position to its retracted position after reaching the stopper 10 so as to allow the products 14 to go further on the platform 24.

**[0057]** The motorized belts 84 of the friction belt assembly 26 stop and the actuator 52 also stops to apply pressure on the product layer 12.

**[0058]** The product layer 12 is then raised, with the tool 10, by the robot 44.

**[0059]** According to a more specific illustrative embodiment of the present invention, a safety feature is added to the tool 10 so as to further prevent any damage to the products 14 during its depalletization by the tool 10.

**[0060]** According to this safety feature, the pressure is monitored on the actuators 52, 66 and 90. The tool 10, through its controller (not shown) verifies if a first pressure beyond a specified threshold is detected. If such is the case, the forward movement of the robot 44 is slowed while such abnormal

pressure remains. If a further abnormal pressure is detected, then the robot 44 stops and an alarm is triggered, calling for a manual intervention.

**[0061]** The unloading of the layer 12 from the platform of the tool 10 will now be briefly described.

**[0062]** The platform 24 is first positioned adjacent another pallet (not shown), a conveyor (not shown) or to any structure configured and chosen to received the layer 12 of products 14 from the platform 24. The tool 10 is then positioned by the robot 44 so that the platform 24 is slightly inclined.

**[0063]** Then the actuator 52 is energized so as to move the pusher 25 from the proximate end 34 of the platform 24 to the distal end 36 thereof so as to force the products 14 out of the platform 24 along the same path. In the mean time, the friction belts 84 are energized so that they rotate in the opposite direction than described hereinabove, thereby contributing to forcing the products 14 out of the platform 24. These two simultaneous operations are done until the platform 24 is empty.

**[0064]** Of course, the first layer 12 being relative, the tool 10 can be used to depalletize further layers of the pallet after the top layers thereof have been removed.

**[0065]** According to a second illustrative embodiment of the present invention (not shown), the friction belt assembly 26 is replaced by motorized rollers assembled to the platform 24 and motorized similarly to the sprocket wheels 82 described herein. These rollers can be covered or made, for example, of any well-known friction material such as polymeric resin.

**[0066]** More generally, any conveyor assembly (not shown) , motorized or not, can be provided at the distal end of the platform to contribute to the insertion of the platform at least partially under the layer of products from the proximate end of the layer and for raising the products onto the platform while the tool is moved towards the distal end of the layer by the robot.

**[0067]** It is to be noted that many modifications could be made to the depalletizing tool 10 described hereinabove for example:

**[0068]** – the platform 24 and pusher 25 can be operatively mounted to a gantry type robot (not shown);

**[0069]** - even though the tool 10 has been described as being equipped with pneumatic cylinders, other type of actuators can also be used; and

**[0070]** – the pusher can be omitted, for example in application where the products are light and/or heavy-duty.

**[0071]** Even though the present invention has been described with reference to products being rectangular boxes 14, a depalletizing tool according to the present invention can be used to depalletize any types of stackable products, including uneven layers including layers provided with holes in the pallet layer, open boxes, open can trays, stretch wrap trays, etc.

**[0072]** It is to be understood that the invention is not limited in its application to the details of construction and parts illustrated in the accompanying drawings and described hereinabove. The invention is capable of other embodiments and of being practiced in various ways. It is also to be

understood that the phraseology or terminology used herein is for the purpose of description and not limitation. Hence, although the present invention has been described hereinabove by way of illustrative embodiments thereof, it can be modified, without departing from the spirit, scope and nature of the subject invention as defined in the appended claims.

**WHAT IS CLAIMED IS:**

1. A tool for depalletizing a layer of products on a pallet, the layer having a proximate end and a distal end, the tool comprising:

a frame to be mounted to a robot;

a platform mounted to the frame and having proximate and distal ends for insertion, from the proximate end thereof, under the layer of products, and for receiving the layer of products between the proximate and distal ends of the platform;

a conveyor mounted to the platform at the proximate end thereof so that the conveyor and the platform generally lie in a same plane i) for inserting at least partially the platform under the layer of products from the proximate end of the layer and ii) for raising the products onto the platform while the tool is moved towards the distal end of the layer by the robot; and

a pusher slidably mounted to the frame over the platform for movement along a first axis generally parallel to the platform; the pusher being for selectively applying pressure onto a first row of the layer of products while the platform is inserted at least partially under the layer of products.

2. A tool as recited in claim 1, wherein the platform includes a series of parallel rods extending from the proximate to the distal ends thereof.

3. A tool as recited in claim 2, wherein the conveyor includes a series of friction elements interposed between the parallel rods of the platform.

4. A tool as recited in claim 3, wherein the series of friction elements are friction belts.

5. A tool as recited in claim 3, wherein the series of friction elements have a proximate end and a distal end; the conveyor is slidably mounted to the platform for reciprocating between a retracted position, wherein

the distal end of the friction elements is generally aligned with the distal end of the platform, to an extended position, wherein the distal end of the friction elements extends beyond the platform.

6. A tool as recited in claim 5, wherein the pallet is positioned next to a fixed stopper; the conveyor being slidably mounted to the platform via an actuator; the actuator being further used to detect when the distal end of the friction elements contacts the fixed stopper.

7. A tool as recited in claim 2, wherein each of the parallel rods include a tapered tip at the distal end of the platform.

8. A tool as recited in claim 1, wherein the pusher is slidably mounted to the frame via a first actuator.

9. A tool as recited in claim 8, wherein the first actuator is further for applying pressure onto the pusher while the platform is inserted at least partially under the layer of products.

10. A tool as recited in claim 9, wherein the pressure is gradually released on the first actuator as the platform is inserted under the layer of products.

11. A tool as recited in claim 10, wherein pressure exerted onto the first actuator by the products is monitored so as to trigger an alarm when a resistance is detected by the first actuator beyond a predetermined threshold onto the first actuator.

12. A tool as recited in claim 8, wherein the pusher is slidably mounted to the frame via an actuator sub-assembly which includes a second actuator for pivotably mounting the pusher to the first actuator and for causing the pusher to selectively applying pressure onto a top portion of the first row of products.

13. A tool as recited in claim 12, wherein pressure exerted onto the second actuator by the products is monitored so as to trigger the alarm when a resistance is detected by the second actuator beyond a predetermined threshold onto the second actuator.

14. A tool as recited in claim 12, wherein the pusher is mounted over the platform so as to be generally perpendicular therefrom; the second actuator having a moving portion secured to a top portion of the pusher and a fixed portion secured to the first actuator via at least one mounting plate.

15. A tool as recited in claim 1, wherein the frame includes a top portion for mounting the tool to the robot and two side arms for mounting the platform to the top portion so that the platform and the top portion together define an angle.

16. A tool as recited in claim 1, wherein the conveyor is motorized.

17. A tool for depalletizing a layer of products, the layer having a proximate end and a distal end, the tool comprising:

- a frame to be mounted to a robot;

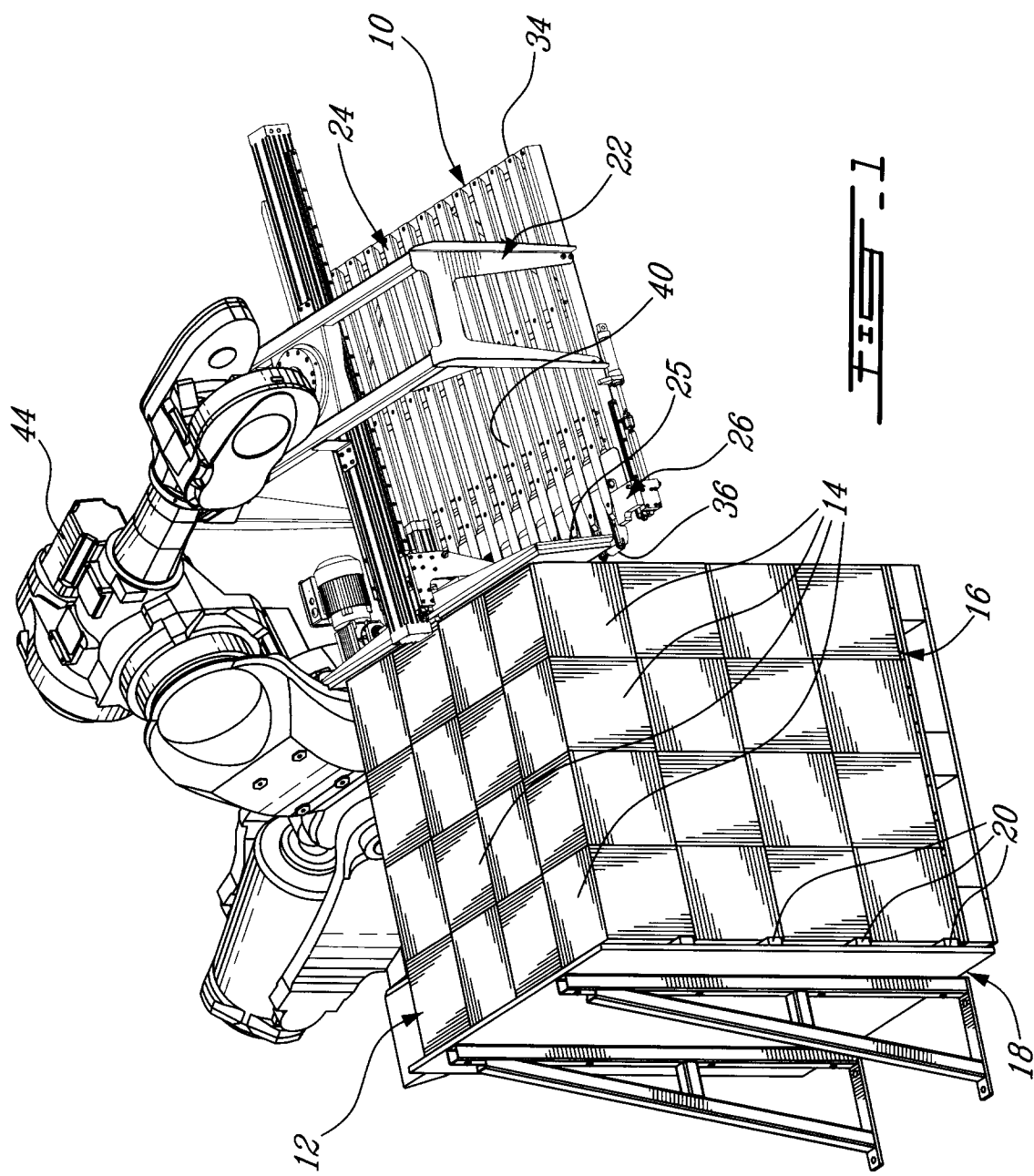
- a platform mounted to the frame and having proximate and distal ends; the platform being for insertion, from the proximate end thereof, under the layer of products, and for receiving the layer of products between the proximate and distal ends of the platform;

- a friction belt assembly mounted to the platform at the proximate end thereof so that the friction belt assembly and the platform generally lie in a same plane i) for inserting at least partially the platform under the layer of products from the proximate end of the layer and ii) for raising the products onto the platform while the tool is moved towards the distal end of the layer by the robot.

18. A tool as recited in claim 17, wherein the friction belt assembly includes a beam mounted to the frame at the distal end thereof, at least one first roll mounted to the beam so as to be in parallel relationship with the platform, at least one second roll mounted to the beam so as to be registered with the at least one first roll, and an endless belt received onto the at least one first and second rolls.

19. A tool as recited in claim 18, wherein at least one first and second rolls is motorized.

20. A tool as recited in claim 17, wherein the friction belt assembly has a proximate end and a distal end; the friction belt assembly being slidably mounted to the platform for reciprocating between a retracted position, wherein the distal end of the friction belt assembly is generally aligned with the distal end of the platform, to an extended position, wherein the distal end of the friction belt assembly extends beyond the platform.



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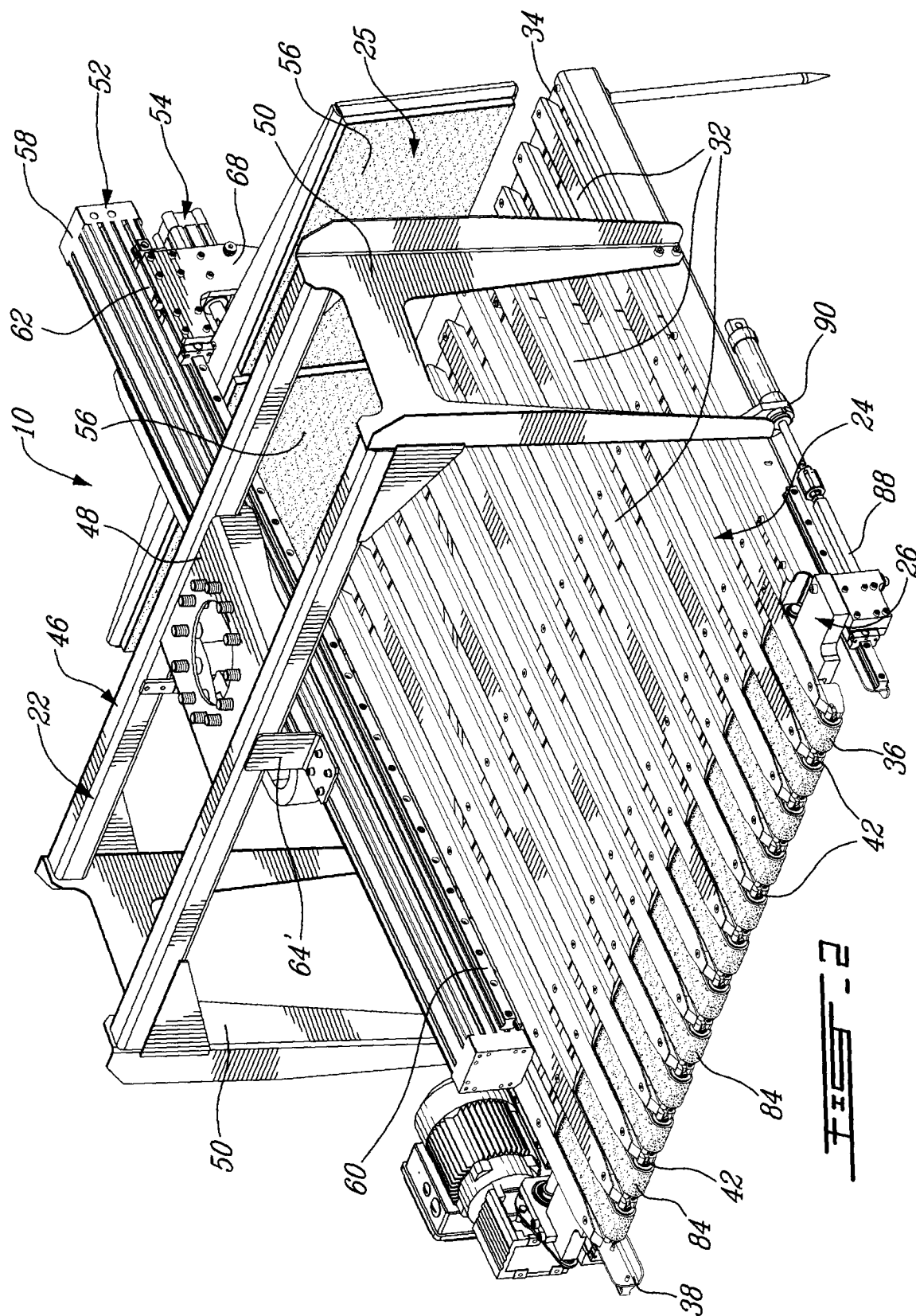
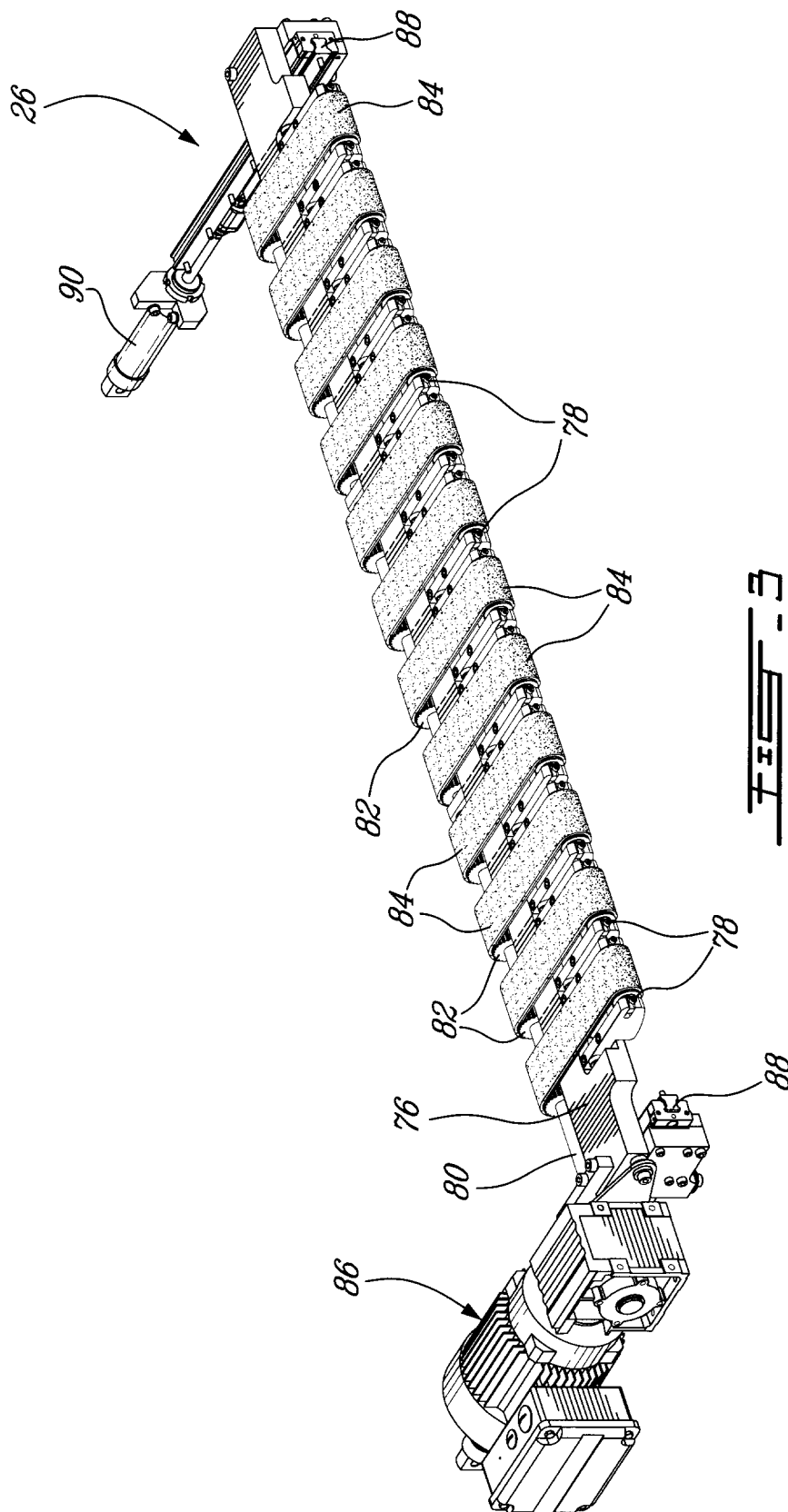


FIG. 2

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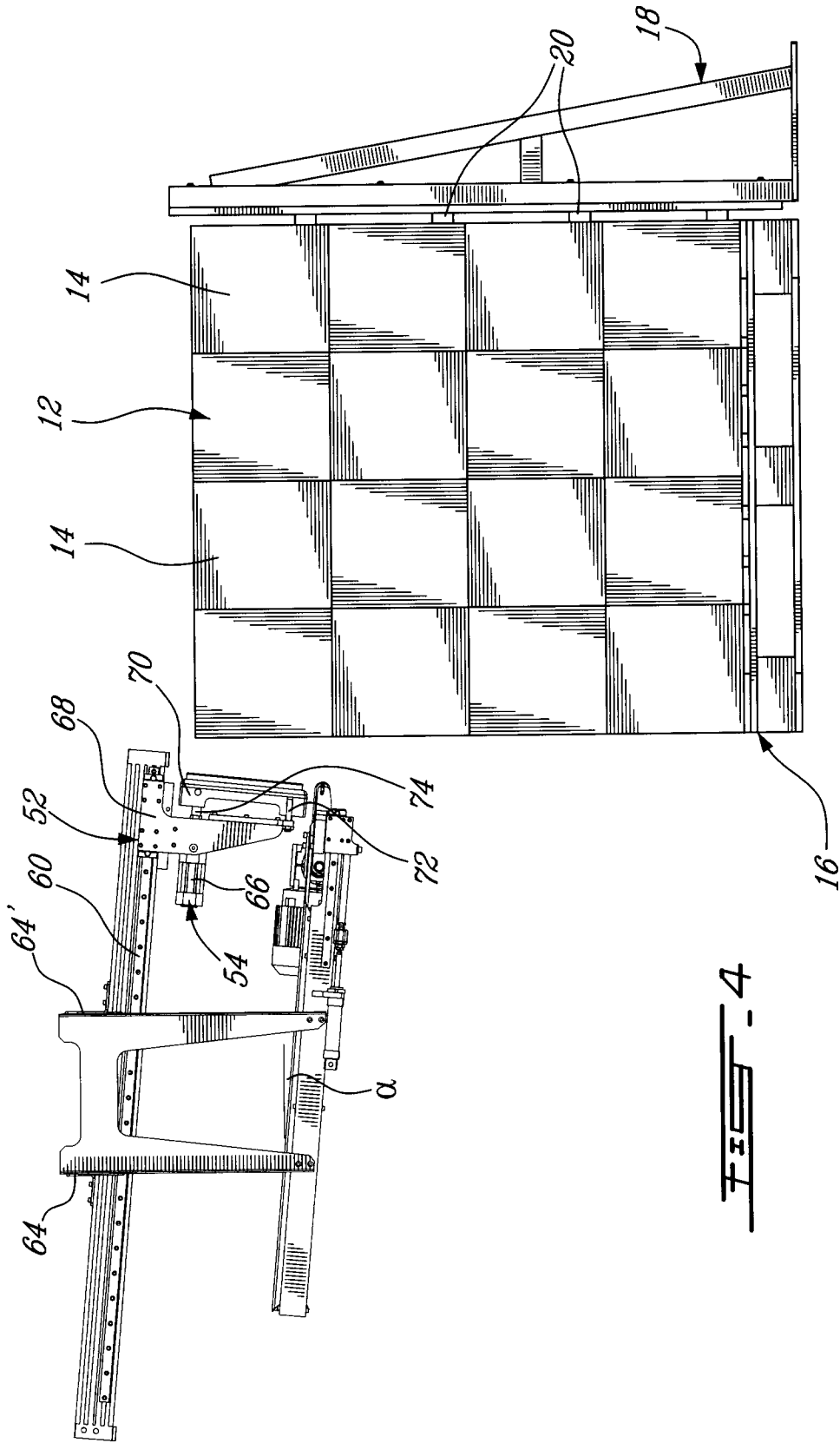


FIG. 4

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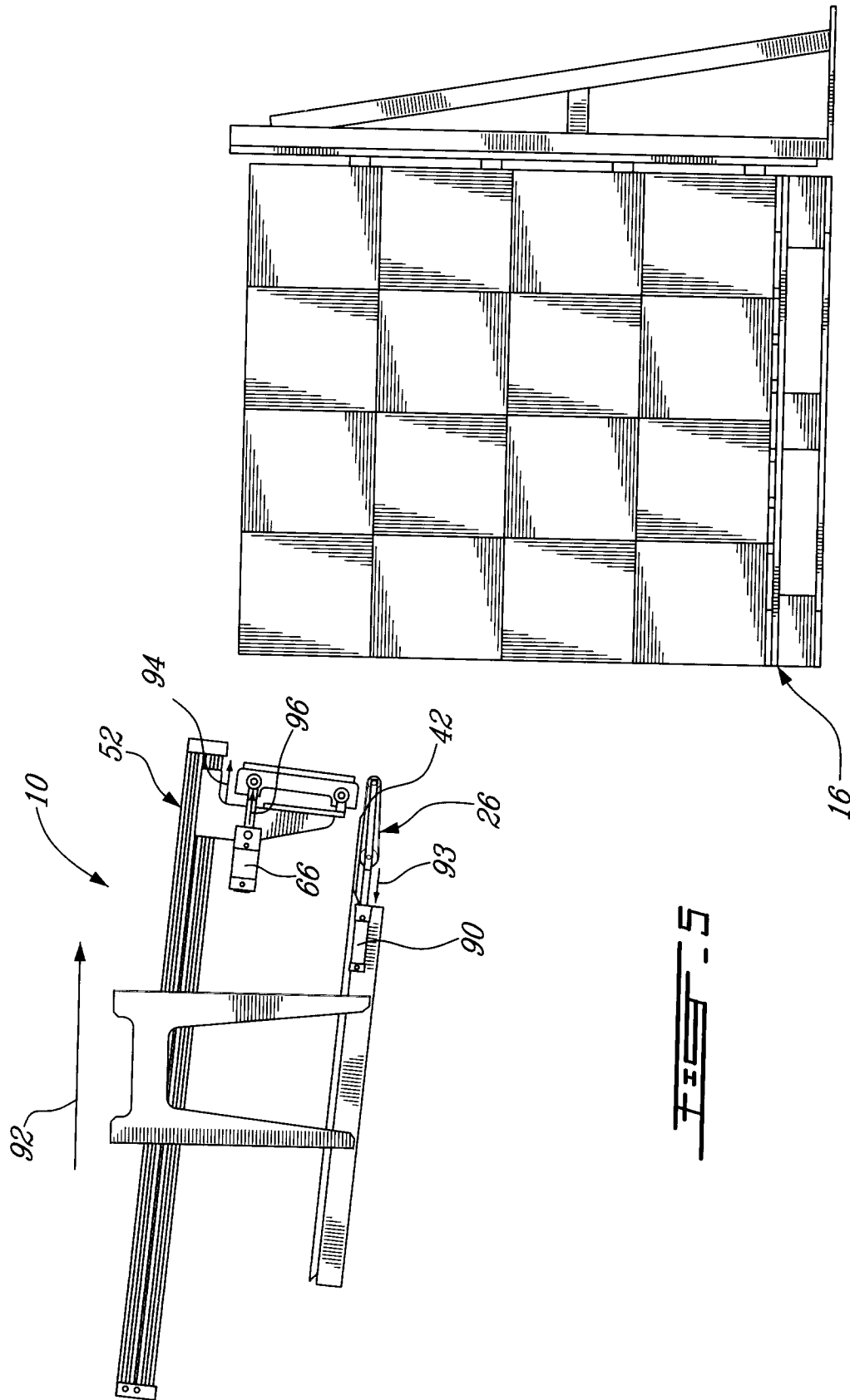
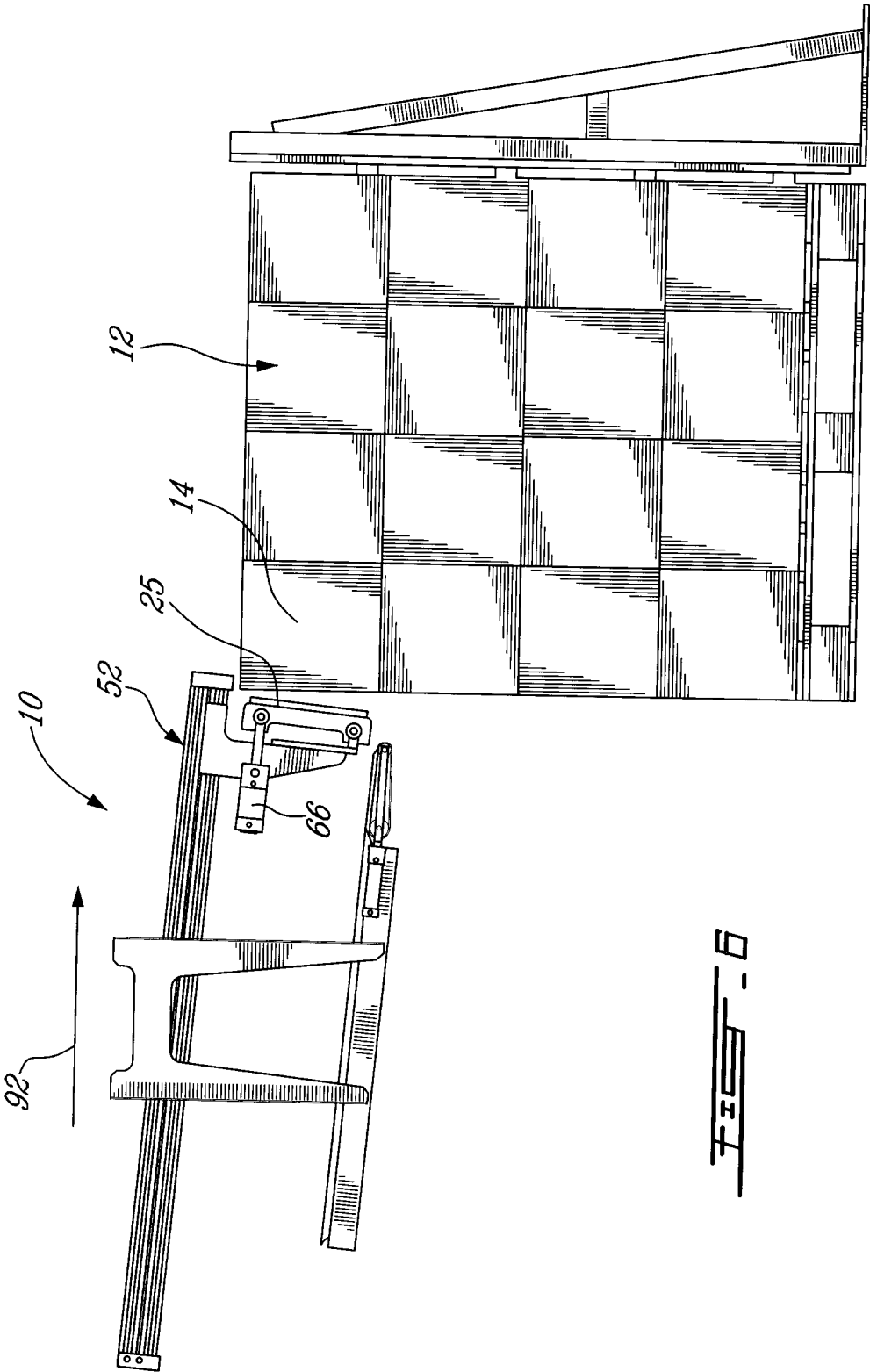


FIG. 5



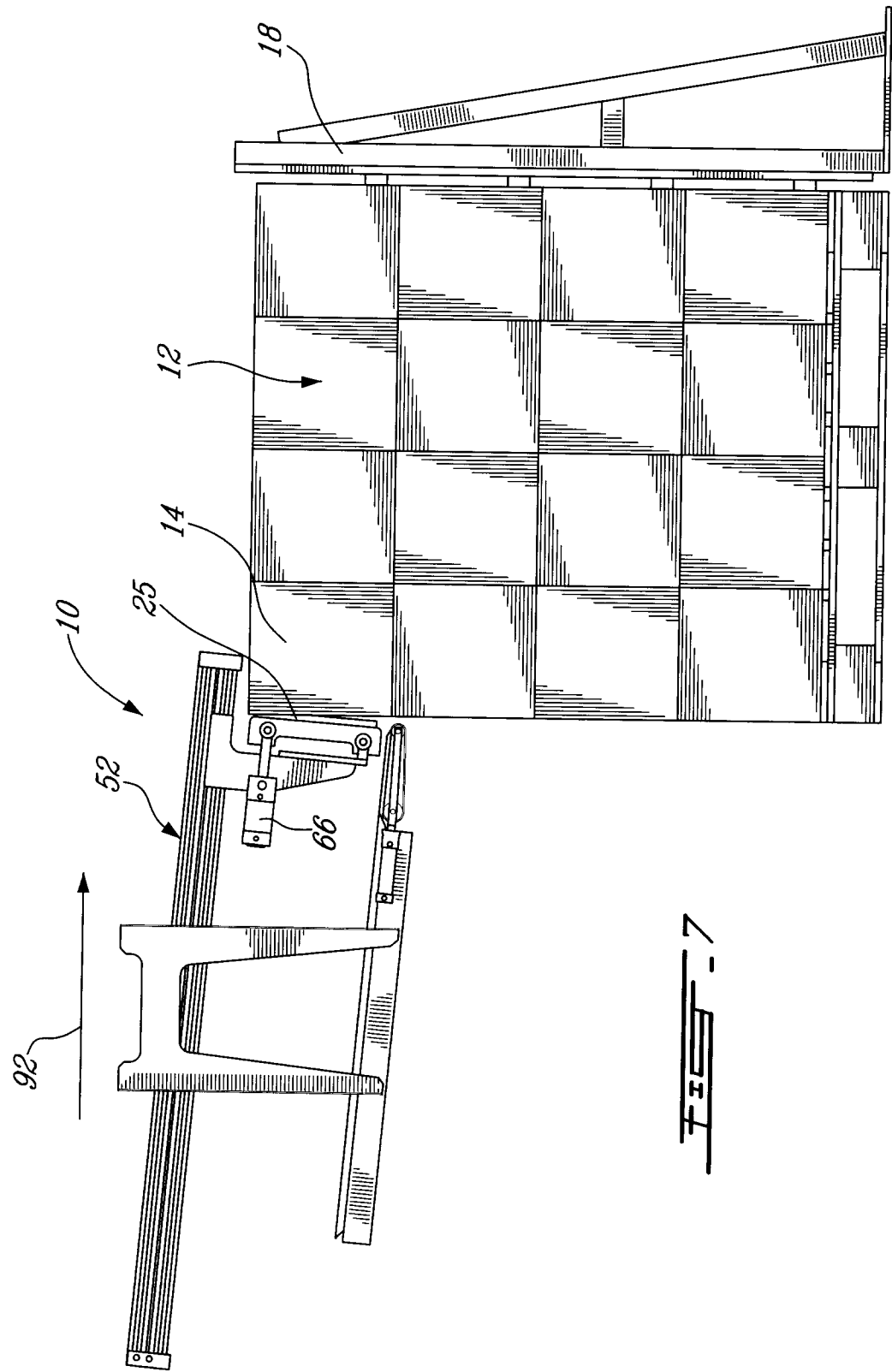
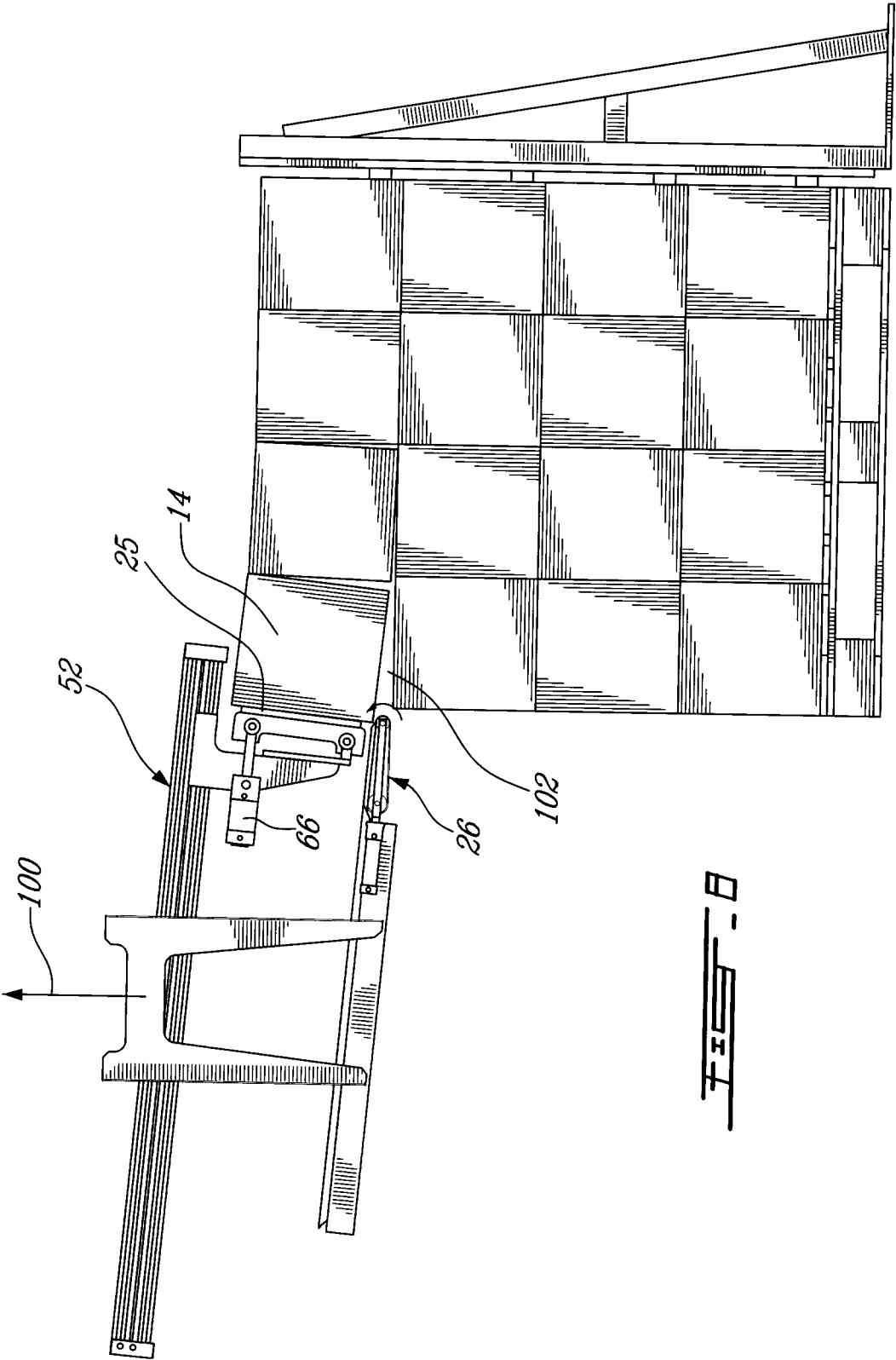


FIG. 7



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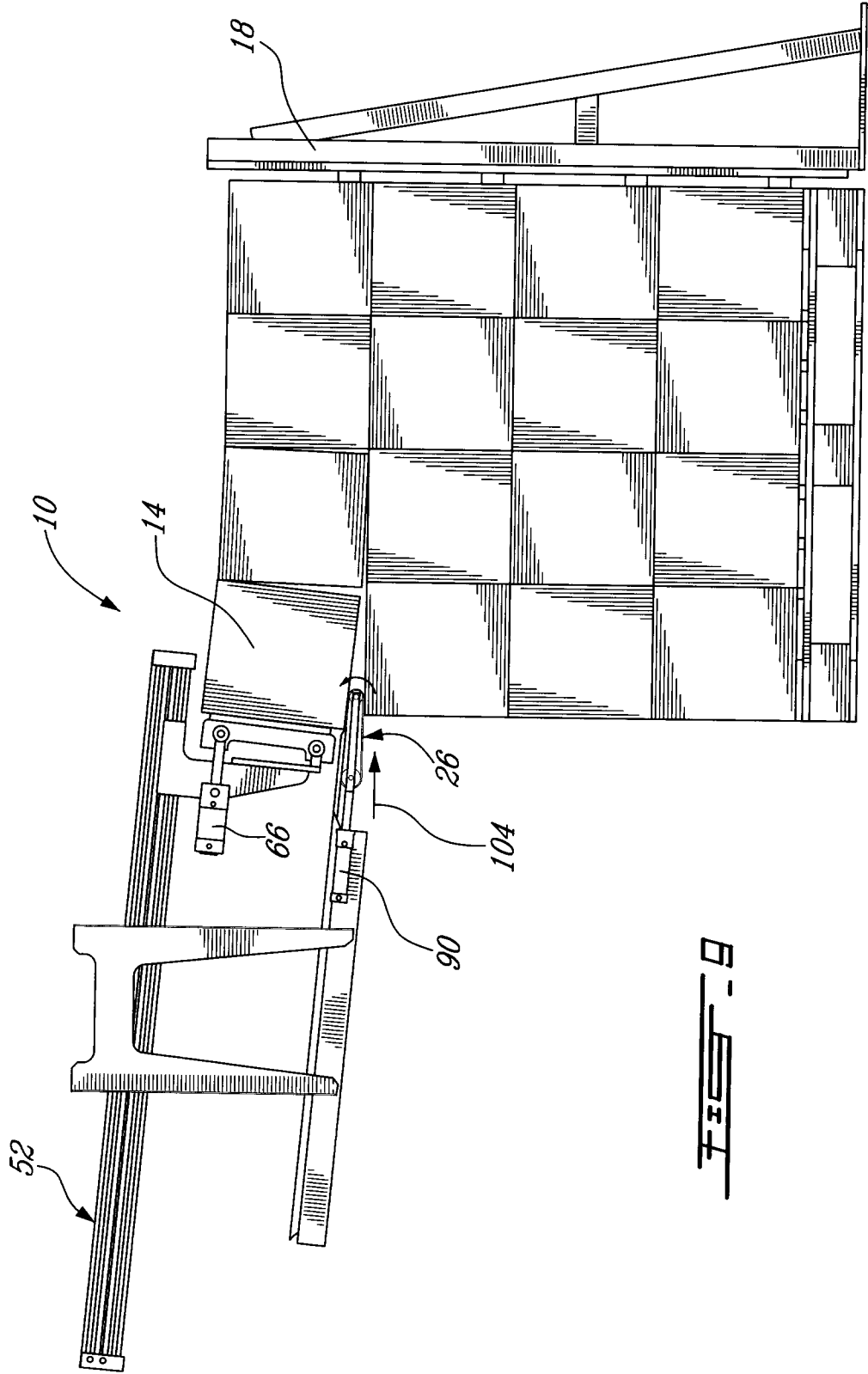
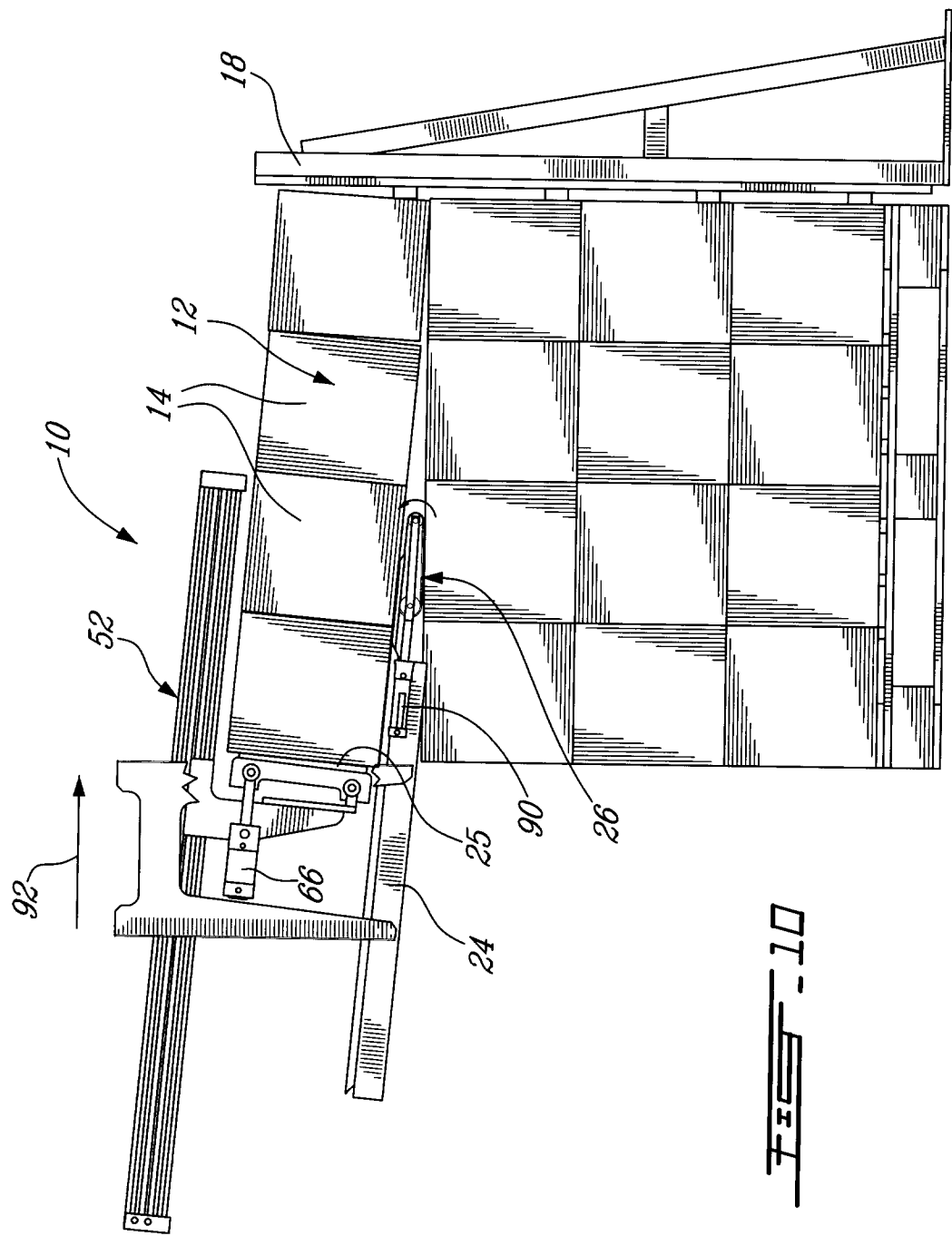


FIG. 9



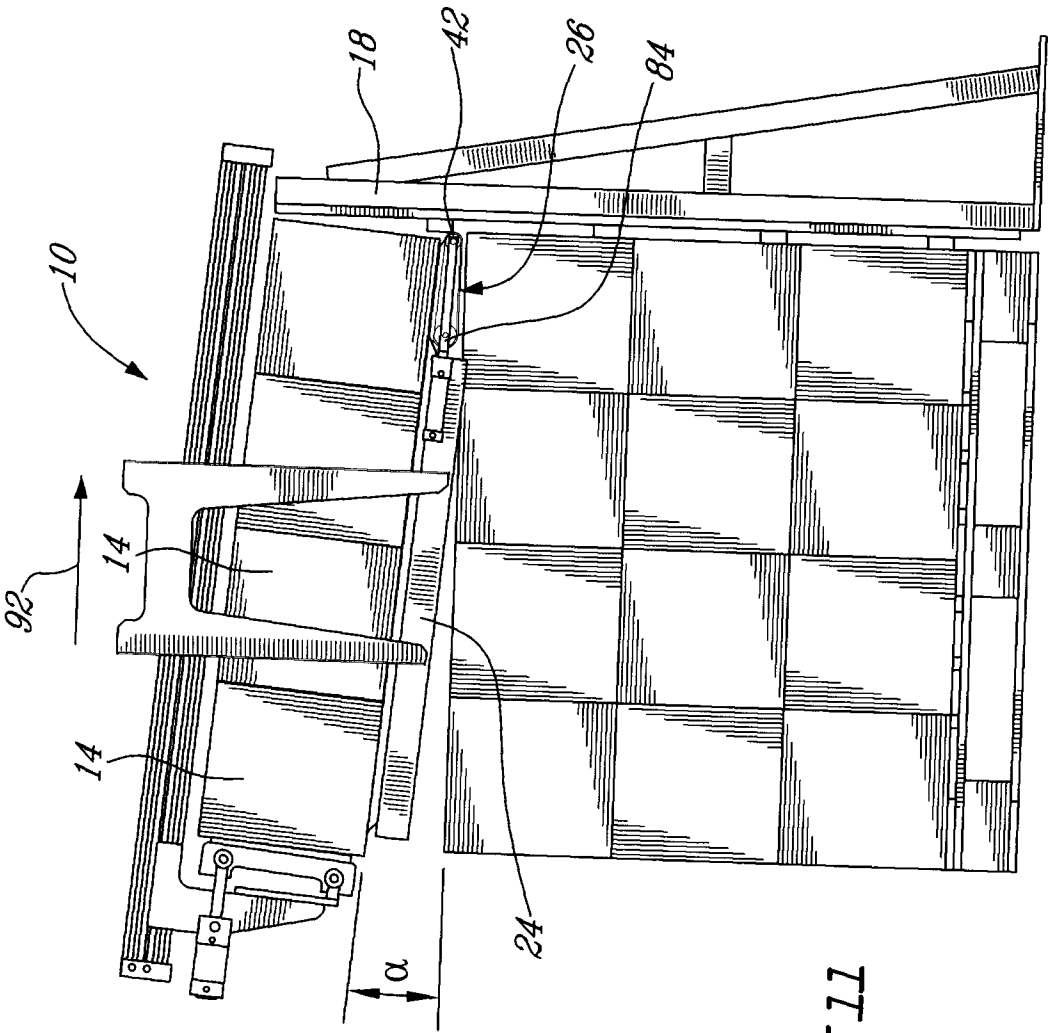


FIG. 11

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/CA2008/001731

## A. CLASSIFICATION OF SUBJECT MATTER

IPC: **B65G 59/02** (2006.01) , **B25J 5/00** (2006.01) , **B65G 47/82** (2006.01) , **B65G 61/00** (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: **B65G 59/02** (2006.01) , **B25J 5/00** (2006.01) , **B65G 47/82** (2006.01) , **B65G 61/00** (2006.01)

ECLA: B65G 59/02B; US classes: 414/788.1, 788.2, 788.4, 788.8, 790.3, 793.1, 793.5, 795.4, 796.4, 796.5, 796.9, 797.2, 797.3, 797.7, 797.9, 798.5, 798.6, 799, 198/506-509, 510.1 511-520

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)

Delphion, Espacenet, Canadian Patent Database

Keywords: pallets, depalletizing, stacking, destacking, robotic arm, belt, conveyor.

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages      | Relevant to claim No.              |
|-----------|-----------------------------------------------------------------------------------------|------------------------------------|
| X<br>Y    | US 5 524 747 (WOHLFAHRT, A. et al.) 11 June 1996 (11-06-1996)<br>the whole document     | 1, 8 to 10, 16 and 17<br>18 and 19 |
| Y         | CA 2 595 816 A1 (VAN DE KLUNDERT, M.) 24 August 2006 (24-08-2006)<br>the whole document | 18 and 19                          |
| A         | US 4 453 874 (VELDHUIZEN, H. et al.) 12 June 1984 (12-06-1984)<br>the whole document    | 1, 17 and 20                       |
| A         | US 5 683 222 (INGELHAG, A. G. P.) 4 November 1997 (4-11-1997)<br>the whole document     | 1 and 17                           |
| A, P      | WO 2008/014 532 (HANSI, R. et al.) 7 February 2008 (07-02-2008)<br>the whole document   | 1 and 17                           |
| A         | US 4 911 608 (KRAPPITZ, H. et al.) 27 March 1990 (27-03-1990)<br>the whole document     | 1 and 17                           |

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

|                                                                                                                                                                         |                                                                                                                                                                                                                                                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| * Special categories of cited documents :                                                                                                                               | "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                                              |
| "A" document defining the general state of the art which is not considered to be of particular relevance                                                                | "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                                                                     |
| "E" earlier application or patent but published on or after the international filing date                                                                               | "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 |
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| "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                                                                  |                                                                                                                                                                                                                                                  |

Date of the actual completion of the international search

28 November 2008 (28-11-2008)

Date of mailing of the international search report

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# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/CA2008/001731

| C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT |                                                                                    |                       |
|-------------------------------------------------------|------------------------------------------------------------------------------------|-----------------------|
| Category*                                             | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
| A                                                     | US T998 009 (BEVAN, R.) 2 September 1980 (02-09-1980)<br>the whole document        | 1 and 17              |
| A                                                     | US 5 222 857 (HASEGAWA, A.) 29 June 1993 (29-06-1993)<br>the whole document        | 1 and 17              |
| A                                                     | CA 933 961 (YAMASHITA, U.) 18 September 1973 (18-09-1973)<br>the whole document    | 1 and 17              |
| A                                                     | US 3 819 068 (WEIR, S. M.) 25 June 1974 (25-06-1974)<br>the whole document         | 1 and 17              |
| A                                                     | US 6 746 203 (LEBLANC, P. et al.) 8 June 2004 (08-06-2004)<br>the whole document   | 1 and 17              |

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

International application No.  
**PCT/CA2008/001731**

| Patent Document<br>Cited in Search Report | Publication<br>Date | Patent Family<br>Member(s)                                                                                                                                                                                    | Publication<br>Date                                                                                                                                                                              |
|-------------------------------------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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