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- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

Published:

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(54) Title: CONVEYOR EMPLOYING A VACUUM

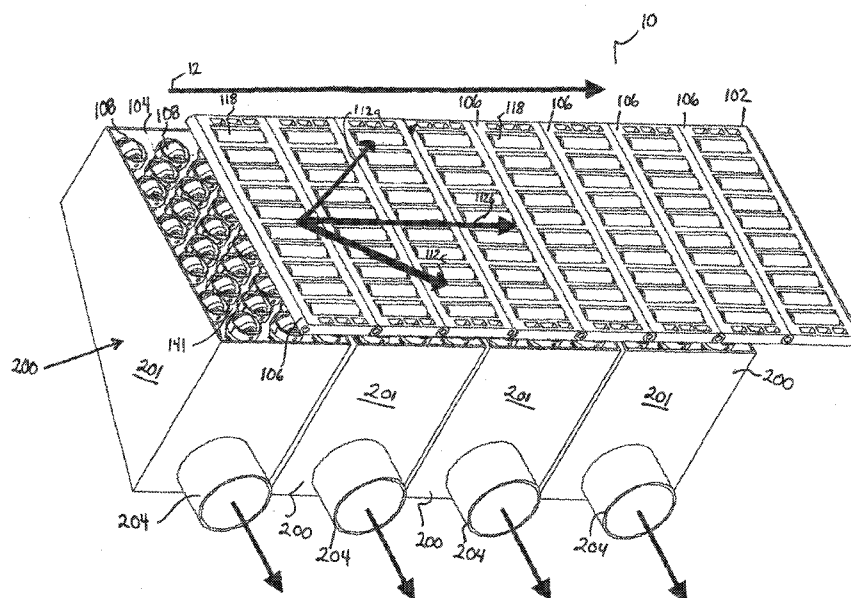


FIG. 1

(57) Abstract: A sorting conveyor employs suction to stabilize products on a conveyor belt. The sorting conveyor comprises a conveyor belt including a plurality of embedded rollers for moving conveyed objects relative to the conveyor belt. A vacuum chamber below the conveyor belt houses activators for the rollers and selectively creates a vacuum zone above the conveyor belt for pulling objects on the conveyor belt.

CONVEYOR EMPLOYING A VACUUM

BACKGROUND

The invention relates generally to power-driven conveyors and, more particularly, to
5 a conveyor that employs a vacuum to facilitate conveyance.

Conveyor belts may sometimes include article-supporting rollers to propel conveyed
objects in a desired direction as the conveyor belt advances. Conveyor belts with article-
supporting rollers may be used for accelerating, diverting, sorting, merging, switching or
otherwise moving objects in a selected direction relative to a moving conveyor belt. The
10 rollers are arranged to rotate in line with or perpendicular or oblique to the direction of belt
travel. Examples of conveyors using belts of this kind are described in, for example, U.S. Pat.
Nos. 6,494,312; 6,968,941; 7,461,739; and 7,971,701.

Conveyed objects may be unsteady on conveyor belts, particularly due to the use of
embedded rollers, which may cause the objects to shift or fall.

SUMMARY

A sorting conveyor employs suction to stabilize products on a conveyor belt
employing article-supporting rollers. The sorting conveyor includes at least one vacuum
chamber housing activators for the rollers in the conveyor belt. Each vacuum chamber is
20 coupled to a vacuum generator, which selectively generates a vacuum in the associated
vacuum chamber to pull articles being conveyed against the conveyor belt. A control system
may be used to selectively operate a selected vacuum generator when a product is in an
associated vacuum zone.

According to one aspect, a sorting conveyor comprises a conveyor belt having a
25 plurality of rollers, a vacuum chamber disposed below the conveyor belt, the vacuum
chamber connected to a vacuum generator to create a vacuum zone in a select area above the
conveyor belt and a controller for selectively operating the vacuum generator when a
conveyed object is in the vacuum zone.

In another aspect, a sorting conveyor comprises an array of vacuum chambers, each
30 vacuum chamber connected to a vacuum generator, an array of activators for selectively
activating one or more rollers in a conveyor belt, each vacuum chamber housing a set of

activators and a conveyor belt traveling over the series of vacuum chambers. The conveyor belt comprises a plurality of rollers, with at least one roller in contact with an activator.

According to another aspect, a method of conveying objects using a conveyor comprises the steps of conveying an object on a conveyor belt through a plurality of vacuum
5 zones, the conveyor belt comprising an array of rollers, and generating a vacuum in a selected vacuum zone when the object enters the selected vacuum zone.

BRIEF DESCRIPTION OF THE DRAWINGS

The disclosed systems and methods can be understood with reference to the
10 following drawings. The components in the drawings are not necessarily to scale.

FIG. 1 is a perspective view of a section of a sorting conveyor employing a vacuum according to an illustrative embodiment of the invention;

FIG. 2 is a detailed, cross-sectional view of an actuator and conveyor belt module of the sorting conveyor of FIG. 1; and

15 FIG. 3 is a block diagram showing the relationship between a sensor, tracker, vacuum generator and controller for the vacuum generator according to one embodiment of the invention.

DETAILED DESCRIPTION

20 A sorting conveyor employs the use of a vacuum to stabilize conveyed objects. The invention will be described below relative to certain illustrative embodiments, though the invention is not limited to the illustrative embodiments.

FIG. 1 illustrates a sorting conveyor 10 according to an illustrative embodiment of the invention. The sorting conveyor 10 comprises a conveyor belt 102 traveling in a travel
25 direction indicated by arrow 12. The conveyor belt includes embedded rollers 118, which are longitudinally oriented in the illustrative embodiment. The conveyor belt may comprise a plurality of conveyor belt modules 106 hingedly connected together. An array of activators, illustrated as field 104 of angularly adjustable drive roller modules 106 is disposed below the conveyor belt a sorting region. Each roller module 108 may comprise a free-spinning drive
30 roller 125 mounted in a cartridge 130. The cartridge 130 may include teeth 136, shown in FIG. 2, used to orient the activator. The conveyor belt and activators may be same or similar

to the system described in US Patent Number 7,971,701, the contents of which are incorporated herein by reference.

The activators 106 may be selectively oriented and actuated to move product in a selected direction, indicated by arrows 112a, 112b and 112c, relative to the conveyor belt.

5 Each module includes spaces 109 between the rollers 118 and the module body 106. The module may include other openings extending from the top surface of the module to the bottom surface, as well.

The array of activators 104 may include spaces 141 between the cartridges 108 and spaces 142 between the cartridges 130 and driver rollers 125.

10 The sorting conveyor 10 employs a vacuum to stabilize conveyed articles on the conveyor belt 102. In one embodiment, the sorting conveyor 10 includes one or more vacuum chambers 200 housing the activators 104 and arranged in series. Each vacuum chamber is a sealed box comprising side walls 201 and an open top. A set of activators 104 is housed within the side walls 201 of each vacuum chamber 200. The conveyor belt 102 rides
15 over the open tops of the vacuum chambers. Each vacuum chamber further includes a connector 204 in a side wall for connecting the vacuum chamber 200 to a vacuum generator. A vacuum generator (not shown) is connected to each vacuum chamber 200 to create a vacuum zone above each vacuum chamber. Each vacuum zone may be segregated from the other vacuum zones.

20 The vacuum generated by the vacuum generator may pull articles being conveyed against the belt 102 to provide stability. The vacuum may be applied to the conveyed articles during straight conveyance, switching, sorting, and/or transitions on and off of the conveyor belt 102.

In one embodiment, the vacuum is a continuous air flow. In another embodiment,
25 the vacuum may be controlled in different regions. For example, each vacuum chamber may be selectively actuated to create a vacuum in a selected vacuum zone.

Referring to FIG. 3, to perform selective actuation of a vacuum zone, the sorting conveyor 10 may include a sensor 230 for sensing of an article of conveyance. The sensor 230 may be a photoelectric sensor or any other suitable sensor known in the art. The sensor may
30 sense the initial positioning of the product. A tracker 240, such as an encoder, may track the location of the conveyed article along the conveying surface.

Information from the sensor 230 and tracker 240 is fed to a controller 250 for a vacuum generator 260. Based on the information, the controller may selectively activate a vacuum generator for each vacuum zone. The vacuum generator may generate a vacuum only when a conveyed object is in the vacuum zone and turn the vacuum off when the
5 article exits the vacuum zone. The selective operation of the vacuum conserves energy and resources.

Alternatively, the controller 250 may use information regarding the location of a conveyed object to selectively connect a vacuum chamber 200 to a vacuum generator when it is desirable to create a vacuum in the vacuum zone above the vacuum chamber, and
10 disconnect the vacuum chamber from the vacuum generator when suction is not necessary or desirable in the vacuum zone.

What is claimed is:

1. A sorting conveyor, comprising:

a conveyor belt comprising a plurality of rollers;

5 a vacuum chamber disposed below the conveyor belt, the vacuum chamber connected to a vacuum generator to create a vacuum zone in a select area above the conveyor belt; and

a controller for selectively operating the vacuum generator when a conveyed object is in the vacuum zone.

10

2. The sorting conveyor of claim 1, further comprising:

an array of activators for activating the rollers, the array of activators housed within the vacuum chamber.

15 3. The sorting conveyor of claim 1, further comprising an array of vacuum chambers below the conveyor belt, each vacuum chamber connected to a separate vacuum generator.

4. The sorting conveyor of claim 1, wherein the vacuum chamber comprises a sealed box having side walls and an open top.

20

5. The sorting conveyor of claim 1, further comprising a sensor for sensing the location of a conveyed object, wherein the controller selectively operates the vacuum generator based on information from the sensor.

25 6. The sorting conveyor of claim 5, further comprising a tracker for tracking a conveyed object sensed by the sensor, wherein the controller uses the information from the tracker to selectively operate the vacuum generator.

7. A sorting conveyor, comprising:

30 an array of vacuum chambers, each vacuum chamber connected to a vacuum generator;

an array of activators for selectively activating one or more rollers in a conveyor belt, each vacuum chamber housing a set of activators; and

a conveyor belt traveling over the series of vacuum chambers, the conveyor belt comprising a plurality of rollers, with at least one roller in contact with an activator.

5

8. The sorting conveyor of claim 7, wherein the vacuum chambers are arranged in series along a conveying direction of the conveyor belt.

9. The sorting conveyor of claim 7, further comprising a sensor for sensing a conveyed
10 object on the conveyor belt.

10. The sorting conveyor of claim 9, further comprising a tracker for tracking the conveyed object on the conveyor belt.

11. The sorting conveyor of claim 10, further comprising a controller for selectively
15 operating a vacuum generator associated with a vacuum chamber when a conveyed object is determined to be in a vacuum zone above the vacuum chamber based on information from the sensor and tracker.

12. A method of conveying objects using a conveyor, comprising the steps of:
20 conveying an object on a conveyor belt through a plurality of vacuum zones, the conveyor belt comprising an array of rollers; and
generating a vacuum in a selected vacuum zone when the object enters the selected vacuum zone.

25

13. The method of claim 12, wherein each vacuum zone is formed by a vacuum chamber below the conveyor belt housing an array of activators for activating select rollers in the conveyor belt.

14. The method of claim 12, further comprising the step of stopping the vacuum when
30 the object leaves the selected vacuum zone.

15. The method of claim 12, further comprising the step of generating a vacuum in a second vacuum zone when the object enters the second vacuum zone.

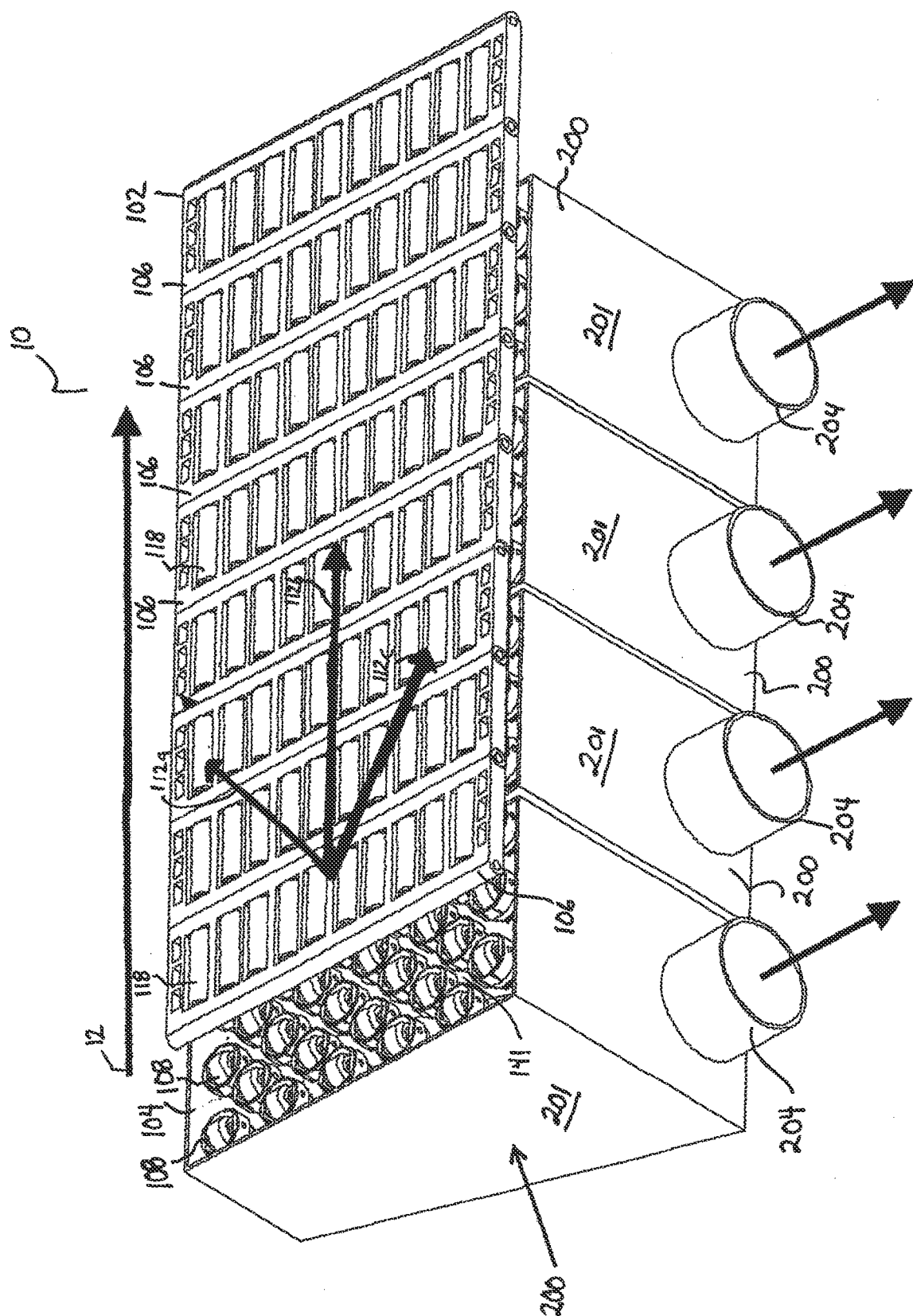


FIG. 1

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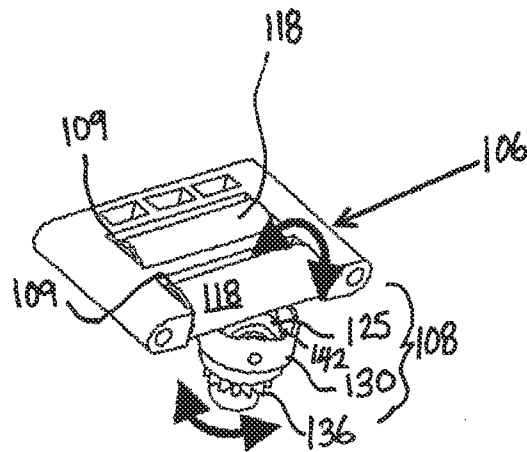


FIG. 2

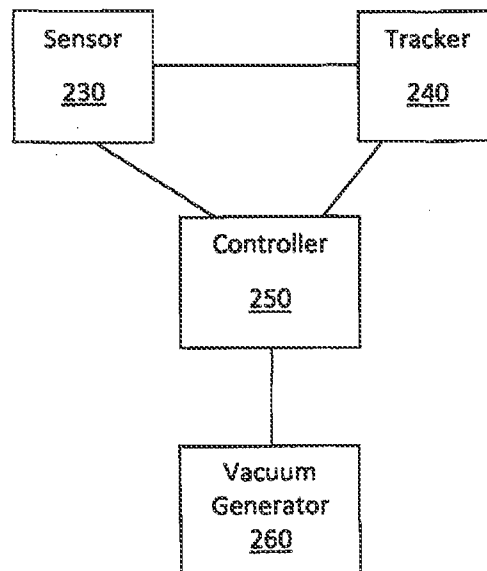


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/054016**A. CLASSIFICATION OF SUBJECT MATTER****B65G 13/00(2006.01)i, B65G 47/22(2006.01)i**

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)

B65G 13/00; B65G 47/22

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords: conveyor, belt, roller, sort, vacuum, chamber, array

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	KR 10-2010-0058148 A (SFA ENGINEERING CO., et al.) 03 June 2010 See paragraphs 38 - 78 and figures 1 - 10	1-15
Y	US 7971701 B2 (FOURNEY, MATTHEW L.) 05 July 2011 See column 3, line 49 - column 4, line 21 and figure 1	1-15
A	WO 2012-078112 A2 (SEMICONDUCTOR TECHNOLOGIES AND INSTRUMENTS PTE LTD et al.) 14 June 2012 See description and figures 1 - 6	1-15
A	US 2006-0070855 A1 (LEMM, CHRISTOPH) 06 April 2006 See description and figures 1 - 4	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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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

"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

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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Information on patent family members

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