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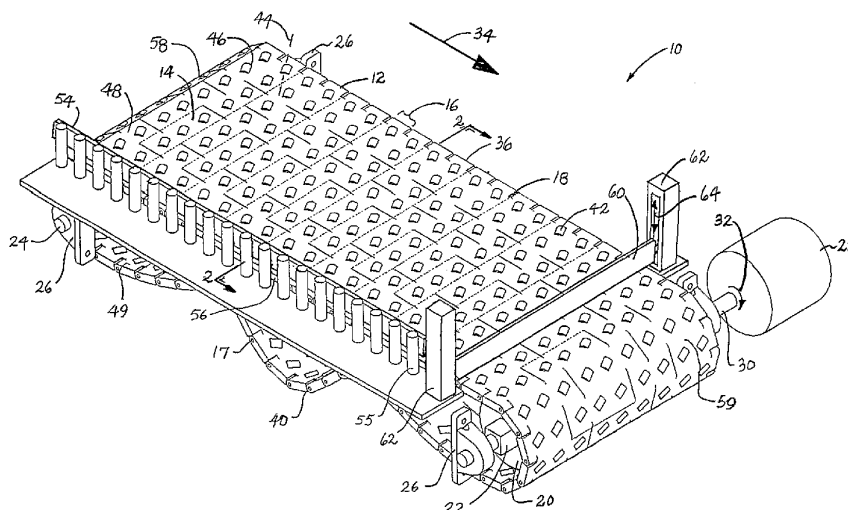
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Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
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[Continued on next page]

(54) Title: ROLLER-BELT CONVEYOR FOR ACCUMULATING AND MOVING ARTICLES Laterally Across the Conveyor



(57) Abstract: A conveyor (10) using a roller belt (12) with rollers (42) arranged to rotate on oblique axes (44) to urge articles toward a side guide (54). The conveyor includes an oblique-roller belt (12) supported on a carryway (38). Rollers (42) extend above an outer conveying surface of the belt without contacting the carryway. Each roller rotates on an axis (44) oblique to the direction of belt travel and intersects the side guide (54) downstream of the roller. A retractable stop (60) is movable to and from a blocking position along the carryway. In the blocking position, the stop blocks the conveyed articles from advancing in the direction of belt travel. The rollers underlying the blocked articles rotate as the belt runs by contact with the articles. The rotating rollers provide a force to the blocked articles directed toward the side guide (54) to push the articles against the side guide or other articles as they accumulate upstream of the stop.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

ROLLER-BELT CONVEYOR FOR ACCUMULATING AND MOVING ARTICLES LATERALLY ACROSS THE CONVEYOR

BACKGROUND

5 The invention relates to power-driven conveyors and, more particularly, to a conveyor using a conveyor belt with obliquely oriented rollers to accumulate and move articles laterally across the conveyor.

10 Many material-handling applications require that conveyed articles be accumulated and aligned single file or arranged in groups for downstream processing or inspection. One way to arrange articles single file against a side of the conveyor is with a conveyor belt having rollers with salient portions that extend beyond top and bottom surfaces of the belt. The rollers roll on supporting bearing surfaces beneath the bottom surface of the belt as it advances in a direction of belt travel. The rollers are arranged to rotate on axles oblique to the direction of belt travel. The rotation of the rollers on their oblique axles provides a sidewise component of force
15 directing conveyed articles atop the rollers toward a side guide flanking the belt. But, because contact between the rollers and the bearing surface is not frictionless, roller wear accelerates and belt tension increases. Furthermore, because the rotation of the oblique rollers pushes the articles forward as well, accumulated articles would experience high back line pressure. Consequently, such a conveyor has shortcomings in applications requiring accumulation of
20 articles in a single file or side by side.

A reference herein to a patent document or other matter which is given as prior art is not to be taken as an admission that that document or matter was known or that the information it contains was part of the common general knowledge as at the priority date of any of the claims.

SUMMARY

25 According to an aspect of the present invention, there is provided a conveyor for translating conveyed articles toward a side guide, the conveyor comprising: a carryway extending from an upstream end to a downstream end in a direction of belt travel and having a
30 first side and an opposite second side across the width of the conveyor; a conveyor belt supported on the carryway for running in the direction of belt travel, the conveyor belt including: an outer conveying surface; a plurality of rollers extending above the outer conveying surface at individual roller positions without contact with the carryway to support conveyed articles, each roller arranged to rotate on an axis oblique to the direction of belt

travel and intersecting the first side of the carryway downstream of the roller's position; a retractable stop movable to and from a blocking position along the carryway blocking the advance of conveyed articles in the direction of belt travel and causing the rollers underlying the blocked articles to rotate as the belt runs and thereby provide a component of force to the blocked articles directed toward the first side of the carryway.

According to another aspect of the present invention, there is provided a conveyor comprising: a carryway extending from an upstream end to a downstream end in a direction of belt travel and having a first side and an opposite second side and providing a support surface; a modular conveyor belt including a series of rows of belt modules connected together by hing pins at hinges between successive rows into an endless belt loop, the conveyor belt further having an outer surface and an inner surface and including: a plurality of rollers disposed across the rows and arranged in laterally spaced longitudinal lanes parallel to the direction of belt travel with portions of the rollers extending past the outer surface of the belt loop, each roller arranged to rotate on an axis oblique to the direction of belt travel and intersecting the first side of the carryway downstream of the roller; wherein a portion of the conveyor belt loop, along which articles are conveyed atop the rollers, is supported on the support surface of the carryway; a stop blocking the advance of conveyed articles along the carryway in the direction of belt travel; wherein the stop causes the rollers in contact with the blocked articles to rotate on their axes opposite to the direction of belt travel as the rollers advance with the belt and thereby provide a component of force to the blocked articles directed to push the blocked articles toward the first side of the carryway.

In yet another aspect of the present invention, there is provided a conveyor comprising: an upstream conveyor section extending from a first end of the conveyor toward a second end of the conveyor; and a downstream conveyor section receiving conveyed articles from the upstream conveyor section and extending to the second end of the conveyor; at least one conveyor belt advancing in a direction of belt travel from the first end to the second end along the upstream and downstream conveyor sections and having rollers arranged to rotate on axes oblique to the direction of belt travel with salient portions of the rollers extending past outer and inner surfaces of the conveyor belt; opposite first and second side guides flanking at least portions of the upstream and downstream conveyor sections; wherein the upstream conveyor section includes roller bearing surfaces underlying the conveyor belt and contacting the salient portions of the rollers extending past the inner surface of the conveyor belt in rolling contact to rotate the rollers as the conveyor belt advances to push articles supported atop the salient portions of the rollers toward the second side guide; a movable stop positionable across the

downstream conveyor section to block conveyed articles from passing the stop as the belt advances along the downstream conveyor section; wherein the downstream conveyor section includes a belt-supporting surface underlying the conveyor belt out of contact with the salient portions of the rollers extending past the inner surface of the conveyor belt to allow the rollers in the downstream conveyor section in contact with a blocked article to rotate opposite to the rotation of the rollers in the upstream conveyor section to push the blocked articles in the downstream conveyor section toward the first side guide with reduced back line pressure.

In still another aspect of the present invention, there is provided a conveyor having opposite first and second sides comprising: rollers embedded in at least one conveyor belt advancing in a direction of belt travel through an upstream conveyor section and a downstream conveyor section, the rollers arranged to rotate on generally parallel axes oblique to the direction of belt travel; bearing surfaces underlying the rollers in the upstream conveyor section in rolling contact to rotate the rollers in a first direction as the conveyor belt advances along the upstream portion to push conveyed articles toward the second side of the conveyor; a belt-supporting surface supporting the belt in the downstream conveyor section without contacting the rollers; a stop extending laterally across the downstream conveyor section between the first and second sides of the conveyor to block conveyed articles from advancing with the belt past the stop; wherein the rollers in the downstream conveyor section rotate in a second direction opposite to the first direction by contact with blocked articles to push the blocked articles toward the first side of the conveyor.

BRIEF DESCRIPTION OF THE DRAWINGS

These features and aspects, as well as advantages, of the invention are better understood by referring to the following description, appended claims, and accompanying drawings, in which:

FIG. 1 is an isometric view of a conveyor embodying features of the invention;

FIG. 2 is a cross section of a portion of the conveyor of FIG. 1 taken along lines 2-2 of FIG. 1;

FIGS. 3A-3E are top views of the conveyor of FIG. 1 illustrating its operation;

FIGS. 4A-4F are top views of the conveyor of FIG. 1 illustrating its operation when configured as a palletizer;

FIGS. 5A-5B are side elevation schematic views of the conveyor of FIG. 1 operating as a palletizer as in FIGS. 4A-4F;

FIG. 6 is a cross section of the conveyor of FIG. 4A taken along lines 6–6 of FIG. 4A; and

FIG. 7 is a side elevation view of another version of a portion of a conveyor as in FIG. 1 operating as a palletizer.

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DETAILED DESCRIPTION

FIG. 1 shows a conveyor 10 embodying features of the invention including a conveyor belt 12, such as a modular roller-top conveyor belt. The conveyor belt shown is a modular conveyor belt made up of belt modules 14 arranged in a series of rows 16. The rows are connected together by hinge pins 17 at hinge joints 18 that allow the belt to articulate about drive and idler sprockets 20 at each end of the conveyor. The belt forms an endless loop trained around a drive shaft 22 and an idler shaft 24. The shafts are supported at their ends in bearing blocks 26 mounted on a conveyor frame (not shown for simplicity). A motor 28 is coupled to the drive shaft 22 to drive the belt. As the motor's output shaft 30 rotates as shown by arrow 32, the belt advances in a direction of belt travel 34.

A portion of the belt loop, in particular the upper, article-conveying portion 36 in FIG. 1, is supported on a carryway 38 (FIG. 2). The belt returns from the drive sprockets via a returnway 40 beneath the carryway. Shoes, drums, or rollers may be used in the returnway to reduce sag in the belt.

20 The belt includes a plurality of rollers 42, preferably arranged in longitudinal lanes parallel to the direction of belt travel. The rollers are arranged to rotate on axes 44 oblique to the direction of belt travel. For example, the axes may be 30°, 45°, or 60° from the direction of belt travel. In the examples shown, the rollers are mounted in cavities 46 that open onto an outer, article-conveying surface 48 and an opposite inner surface 49 of the belt loop. One suitable belt is the Series 400 Angled Roller™ belt manufactured and sold by Intralox, L.L.C. of Harahan, Louisiana, U.S.A. The Intralox belt is made of a thermoplastic polymer such as polypropylene, polyethylene, acetal, or composite materials in an injection-molding process. The rollers 42, as shown in FIG. 2, are generally cylindrical in shape and mounted in the cavities on axles 50. Bores 52 through the rollers receive the axles. The rollers are free to rotate on the axles, which define axes of rotation for the rollers. The ends of the axles are embedded in the body of the belt module 14.

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As shown in FIG. 1, a side guide 54, mounted on supports 55, bounds one side 56 of the belt along the carryway 38. The carryway extends in the direction of belt travel 34 from

an upstream end 58, at which articles are fed onto the conveyor, to a downstream end 59, from which articles are transferred off the conveyor. A stop 60 at the downstream end of the conveyor is movable from a first position blocking conveyed articles, as shown in FIG. 1, to a second unblocking position allowing arranged articles to pass. An elevator 62 is shown in this example for raising and lowering opposite ends of a stop barrier, as indicated by double-headed arrow 64. In the raised, unblocking position, the stop barrier is elevated high enough above the outer belt surface along the carryway to avoid articles passing below. The stop could be realized in other ways. One example is a gate that swings from a blocking position across the carryway to an unblocking position alongside the carryway.

As shown in FIG. 2, the belt is supported in the carryway on support surfaces, such as metal rails or plastic wearstrips 66, mounted on a conveyor pan 68 or other structure. The wearstrips, which are preferably made of a wear-resistant, low-friction material, such as UHMW (ultra-high molecular weight) plastic, are laid out along the carryway longitudinally in the direction of belt travel and spaced laterally across spaces 70 between consecutive wearstrips. (Spaces may also exist between the lateral outermost wearstrips and the sides of the belt.) The inner surface 49 of the belt rides on bearing surfaces 72 on the wearstrips. Salient portions 74 of the rollers extend from the belt cavities past the outer and inner surfaces of the belt. Articles are conveyed along the carryway atop the salient portions of the rollers extending past the outer, conveying surface. The salient portions of the rollers extending past the inner surface of the belt are positioned in the spaces 70 between adjacent wearstrips. In this way, the rollers do not contact any conveyor structure under the belt along the carryway and are free to rotate or remain stationary.

The operation of the conveyor is illustrated step by step in FIGS. 3A–3E with the stop 60 in the blocking position. The carryway extends in the direction of belt travel 34 from the upstream end 58 to the downstream end 59. The rollers 42 rotate on oblique axes 44, each of which intersects the side guide 54 at a point 76 downstream of the roller's position 78. In FIG. 3A, articles A, B, and C are being conveyed along the carryway in the direction of belt travel atop the rollers. The rollers, which do not contact the carryway or its wearstrips, are not rotating significantly, and the articles travel with the belt. In FIG. 3B, lead article A meets the stop 60 blocking its further passage along the carryway. Trailing articles B and C continue to advance with the running belt toward article A. With article A blocked, the rollers beneath it rotate as they encounter the article's bottom surface. Because article A is prevented from advancing in the direction of belt travel, it causes the rollers beneath it to rotate in the

direction indicated by arrow 80. The direction 80 is perpendicular to the roller axis and has a first component opposite the direction of belt travel and a second component directed toward the side guide. The component opposite the direction of belt travel generally matches the speed of the belt and allows articles to accumulate with low backline pressure against each other and the stop. The component directed toward the side pushes article A against the side guide 54, as shown in FIG. 3C. As article B catches up to blocked article A and is, in turn, blocked by it, the rollers start to rotate under article B as they pass beneath it. The rotation of the rollers under article B urges it toward the side guide, too, as article C is still being conveyed along. Eventually, as shown in FIG. 3D, article C bumps into leading article B.

Prevented from advancing in the direction of belt travel, article C causes the rollers to rotate as they pass below, which applies a component of force toward the side guide. As shown in FIG. 3E, articles A, B, and C are registered against the side guide and accumulated under low pressure against the stop. Once the stop is moved to its unblocking position, the articles will advance in the direction of belt travel along the side of the conveyor.

The accumulation and registration capabilities of the conveyor make it especially suitable for grouping articles before palletizing. As shown in FIG. 4A, the accumulation and registration conveyor 10 receives a conveyed article D from an upstream conveyor belt 82 across a gap 84, which may be partly filled by a transfer plate. The upstream conveyor belt could be, as shown in FIG. 4A, identical in construction to the belt 14 in the downstream conveyor. But the upstream belt is operated differently from the downstream belt. As shown in FIG. 6, the rollers 42 in the upstream belt 82 extend past its inner surface 49 and its outer surface 48 and ride on supporting bearing surfaces 86, such as UHMW wearstrips, in rolling contact. As the belt advances, the rollers rotate on the bearing surfaces and propel articles toward the left side against a left side guide 88, as indicated by the arrow in FIG. 4A. Article D continues along the left side of the downstream conveyor along the extended side guide. When article D hits the stop 60, its forward progress is stopped, which causes the free rollers under it to rotate opposite to the direction of rotation of the rollers in the upstream conveyors and push article D laterally along the stop in the direction of the arrow in FIG. 4B toward the right side guide. Eventually article D registers against the right side rail and the stop, as shown in FIG. 4C. Subsequent articles, such as article E in FIG. 4D, are moved toward the left side guide by the upstream conveyor and, once blocked, are moved toward the right on the downstream conveyor. Article E follows the same general path as article D, but comes to a full stop beside article D. FIG. 4E shows the formation of a packed group of articles in two

rows. Because the final article in the leading row, article F, does not leave enough room between itself and the left side guide, the following article, article G, is pushed by the rollers across the belt to the right side guide along the rear of the leading row of articles. The process continues until a group 89 of articles of a predetermined size and shape is formed. Then the stop is retracted from its blocking position to an unblocking position, and the group is advanced by the downstream conveyor, as shown in FIG. 4F onto a palletizer table 90, for example. As also shown in FIG. 4F, each row could be arranged with articles in different orientations by an upstream process that presents the articles in the correct orientation to the conveyor.

FIGS. 5A–5B illustrate the formation of a pallet of articles on the palletizer table 90. As soon as the group of products for the bottom layer of the pallet to be formed is transferred completely from the conveyor 10 to the table, the table is lowered, as indicated by arrow 92 in FIG. 5B, to level at which the tops of the article in the bottom layer 89 are generally level with the outer surface of the conveyor belt. Then a second layer 89' is formed and transferred onto the top of the first layer, and the table is lowered again for a third layer, and so on, until a pallet of predetermined size is formed. After the pallet is removed, the table is elevated to its original position to receive the next bottom layer, as indicated by two-headed arrow 93 in FIG. 5A.

The palletizing conveyor shown in the example of FIGS. 4A–4F uses an upstream conveyor belt 82 and a separately driven downstream conveyor belt 12. But, as shown in FIG. 7, the two-belt system can be replaced by a single oblique-roller belt 94 with retractable roller bearing surfaces 96. The bearing surfaces may be vertically raised and lowered into and out of contact with the rollers as indicated by arrows 98. Individually actuated roller bearing surface selectively positioned along the carryway under the belt can program the belt to have different characteristics along its length. For example, with the bearing surfaces in a raised position engaging the rollers, conveyed articles are urged toward one side of the belt in that section. With the bearing surfaces in a lowered, non-engaging position and a stop 60 in place at the end of that section, blocked articles can be pushed toward the other side of the belt. To complement the programmability of the belt along its length, the stop may translate along the belt as indicated by arrow 99 to accumulate articles at various positions along the length of the carryway.

Although the invention has been described in detail with reference to preferred versions, other versions are possible. For example, the belt shown has rollers that extend from

5 cavities through the belt's thickness past the outer and inner belt surfaces. But it would be possible to use a belt in which the rollers do not extend past the inner surface of the belt. With such a belt, different carryway bearing configurations could be used. Instead of linear wearstrips, chevron wearstrips or a continuous carryway pan would be possible. Another oblique-roller belt that could be used with almost any carryway configuration would be one in which the rollers are mounted completely above the outer belt surface. Alternatively, the rollers could pop up out of the belt cavities to engage conveyed articles along the carryway. In all these versions, the rollers could, instead of rotating about fixed axles, include integral stubs that define axes of rotation. The ends of the stubs could be rotatably received in belt recesses that would allow the rollers to rotate. A yet another example, the roller bearing surfaces underlying rollers could be static surfaces, such as on wearstrips or wearsheets, or rotatable surfaces, such as provided by rollers rotatable on axes in the direction of belt travel. So, as these few examples suggest, the scope of the claims is not meant to be limited to the versions described in detail.

15 Where the terms "comprise", "comprises", "comprised" or "comprising" are used in this specification (including the claims) they are to be interpreted as specifying the presence of the stated features, integers, steps of components, but not precluding the presence of one or more other features, integers, steps or components, or group thereof.

THE CLAIMS DEFINING THE PRESENT INVENTION ARE AS FOLLOWS:

1. A conveyor for translating conveyed articles toward a side guide, the conveyor comprising:
 - 5 a carryway extending from an upstream end to a downstream end in a direction of belt travel and having a first side and an opposite second side across the width of the conveyor;
 - a conveyor belt supported on the carryway for running in the direction of belt travel, the conveyor belt including:
 - 10 an outer conveying surface;
 - a plurality of rollers extending above the outer conveying surface at individual roller positions without contact with the carryway to support conveyed articles, each roller arranged to rotate on an axis oblique to the direction of belt travel and intersecting the first side of the carryway downstream of the roller's position;
 - 15 a retractable stop movable to and from a blocking position along the carryway blocking the advance of conveyed articles in the direction of belt travel and causing the rollers underlying the blocked articles to rotate as the belt runs and thereby provide a component of force to the blocked articles directed toward the first side of the carryway.
- 20 2. A conveyor as in claim 1 wherein the retractable stop is further movable along the carryway in the direction of belt travel.
3. A conveyor as in claim 1 or 2 further comprising a first side guide at the first side and a second side guide at the second side of the conveyor and an infeed conveyor feeding articles onto the conveyor belt at the upstream end of the carryway along the second side
 - 25 guide.
4. A conveyor comprising:
 - a carryway extending from an upstream end to a downstream end in a direction of belt travel and having a first side and an opposite second side and providing a support surface;
 - 30 a modular conveyor belt including a series of rows of belt modules connected together by hinge pins at hinges between successive rows into an endless belt loop, the conveyor belt further having an outer surface and an inner surface and including:
 - a plurality of rollers disposed across the rows and arranged in laterally spaced longitudinal lanes parallel to the direction of belt travel with portions of the rollers extending past

the outer surface of the belt loop, each roller arranged to rotate on an axis oblique to the direction of belt travel and intersecting the first side of the carryway downstream of the roller;

wherein a portion of the conveyor belt loop, along which articles are conveyed atop the rollers, is supported on the support surface of the carryway;

a stop blocking the advance of conveyed articles along the carryway in the direction of belt travel;

wherein the stop causes the rollers in contact with the blocked articles to rotate on their axes opposite to the direction of belt travel as the rollers advance with the belt and thereby provide a component of force to the blocked articles directed to push the blocked articles toward the first side of the carryway.

5. A conveyor as in claim 4 wherein the stop is movable between a first position blocking the advance of conveyed articles along the carryway in the direction of belt travel and a second position allowing articles to advance with the belt in the direction of belt travel and is further movable along the carryway in the direction of belt travel.

6. A conveyor as in claim 4 or 5 further comprising a first side guide at the first side and a second side guide at the second side of the carryway and an infeed conveyor feeding articles onto the conveyor belt at the upstream end of the carryway along the second side guide.

7. A conveyor comprising:

an upstream conveyor section extending from a first end of the conveyor toward a second end of the conveyor; and

a downstream conveyor section receiving conveyed articles from the upstream conveyor section and extending to the second end of the conveyor;

at least one conveyor belt advancing in a direction of belt travel from the first end to the second end along the upstream and downstream conveyor sections and having rollers arranged to rotate on axes oblique to the direction of belt travel with salient portions of the rollers extending past outer and inner surfaces of the conveyor belt;

opposite first and second side guides flanking at least portions of the upstream and downstream conveyor sections;

wherein the upstream conveyor section includes roller bearing surfaces underlying the conveyor belt and contacting the salient portions of the rollers extending past the inner surface of the conveyor belt in rolling contact to rotate the rollers as the conveyor belt

advances to push articles supported atop the salient portions of the rollers toward the second side guide;

a movable stop positionable across the downstream conveyor section to block conveyed articles from passing the stop as the belt advances along the downstream conveyor section;

wherein the downstream conveyor section includes a belt-supporting surface underlying the conveyor belt out of contact with the salient portions of the rollers extending past the inner surface of the conveyor belt to allow the rollers in the downstream conveyor section in contact with a blocked article to rotate opposite to the rotation of the rollers in the upstream conveyor section to push the blocked articles in the downstream conveyor section toward the first side guide with reduced back line pressure.

8. A conveyor as in claim 7 wherein the movable stop is movable along the carryway in the direction of belt travel.

9. A conveyor as in claim 7 or 8 wherein the at least one conveyor belt comprises a first belt in the upstream conveyor section and a second belt in the downstream conveyor section.

10. A conveyor as in claim 7 or 8 wherein the at least one conveyor belt comprises a single belt advancing through both the upstream and downstream conveyor sections.

11. A conveyor as in any one of claims 7 to 10 wherein the roller bearing surfaces are movable from a first position contacting the rollers to a second position out of contact with the rollers.

12. A conveyor as in any one of claims 7 to 10 further comprising roller bearing surfaces in the downstream conveyor section movable into and out of contact with rollers in the downstream conveyor section.

13. A conveyor having opposite first and second sides comprising:

rollers embedded in at least one conveyor belt advancing in a direction of belt travel through an upstream conveyor section and a downstream conveyor section, the rollers arranged to rotate on generally parallel axes oblique to the direction of belt travel;

bearing surfaces underlying the rollers in the upstream conveyor section in rolling contact to rotate the rollers in a first direction as the conveyor belt advances along the upstream portion to push conveyed articles toward the second side of the conveyor;

a belt-supporting surface supporting the belt in the downstream conveyor section without contacting the rollers;

a stop extending laterally across the downstream conveyor section between the first and second sides of the conveyor to block conveyed articles from advancing with the belt past the stop;

wherein the rollers in the downstream conveyor section rotate in a second direction opposite to the first direction by contact with blocked articles to push the blocked articles toward the first side of the conveyor.

14. A conveyor as in claim 13 wherein the stop is movable along the carryway in the direction of belt travel.
15. A conveyor as in claim 13 or 14 wherein the at least one conveyor belt comprises a first belt in the upstream conveyor section and a second belt in the downstream conveyor section.
16. A conveyor as in claim 13 or 14 wherein the at least one conveyor belt comprises a single belt advancing through both the upstream and downstream conveyor sections.
17. A conveyor as in any one of claims 13 to 16 wherein the bearing surfaces are movable from a first position contacting the rollers to a second position out of contact with the rollers.
18. A conveyor as in any one of claims 13 to 17 further comprising bearing surfaces in the downstream conveyor section movable into and out of contact with rollers in the downstream conveyor section.
19. A conveyor substantially as herein described with reference to the accompanying drawings.

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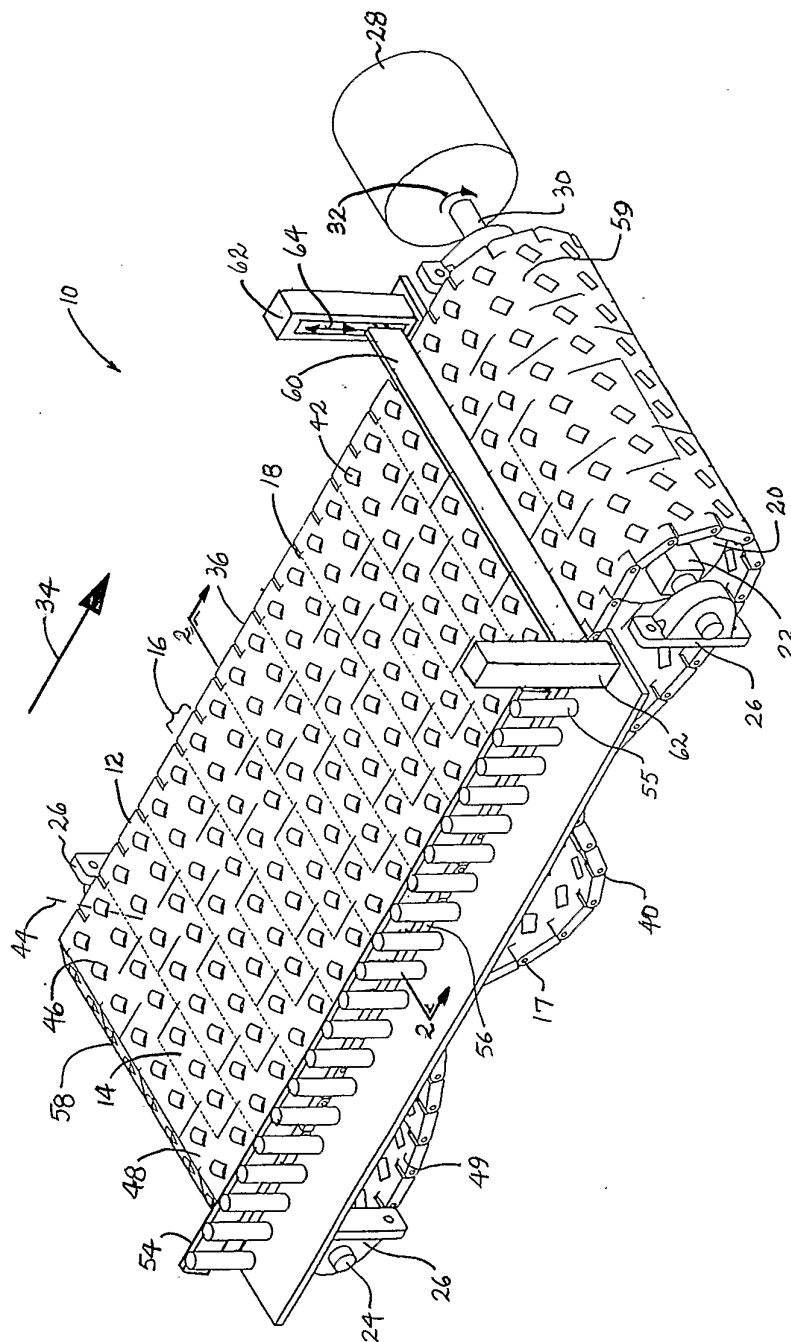


FIG. 1

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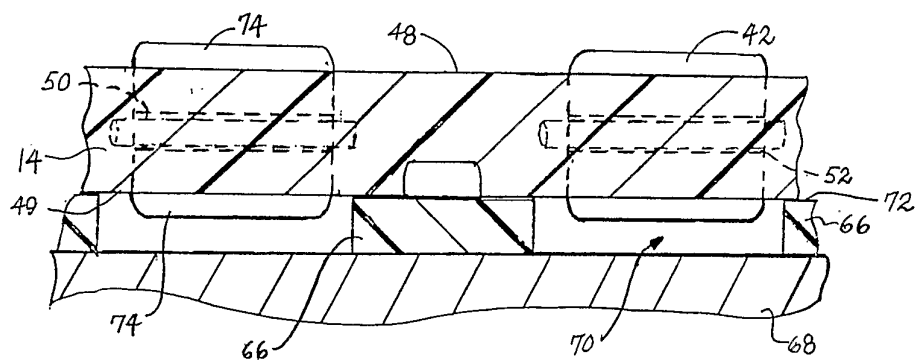


FIG. 2

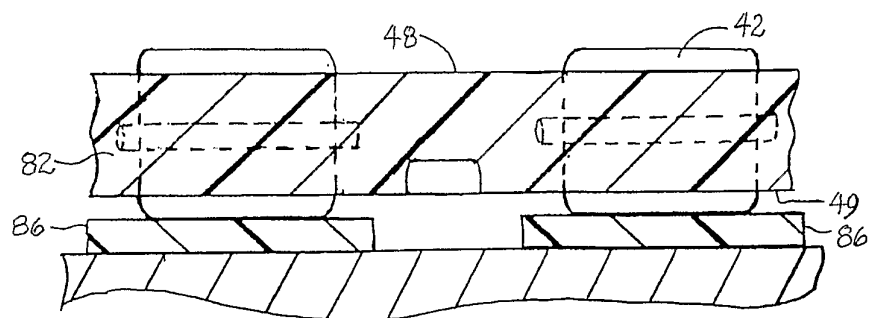


FIG. 6

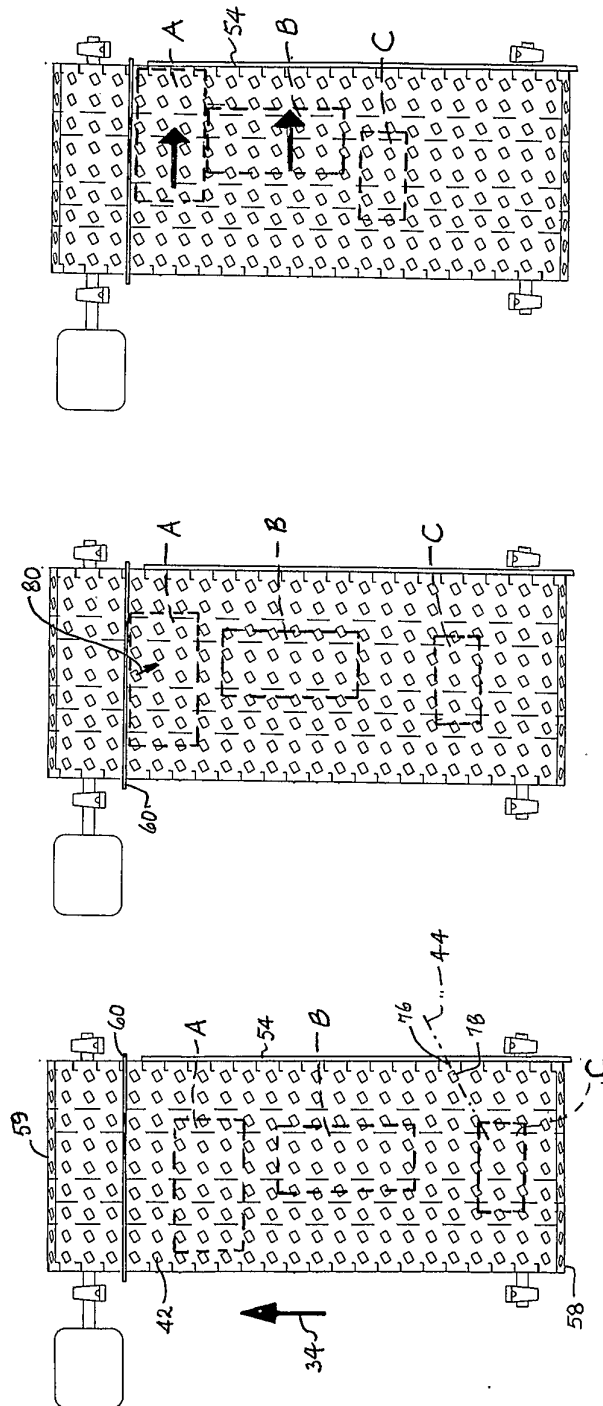


FIG. 3C

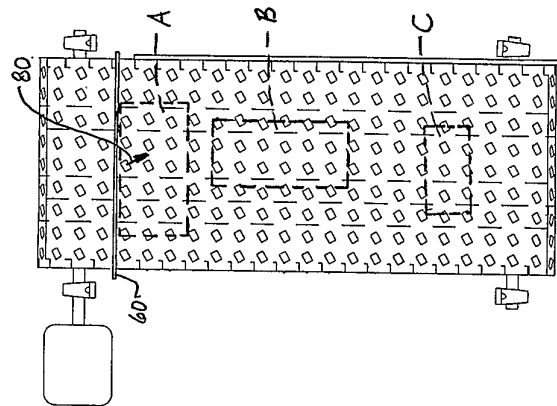


FIG. 3B

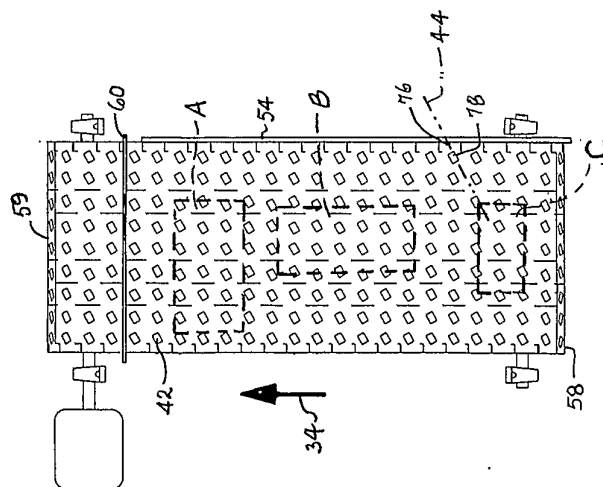


FIG. 3A

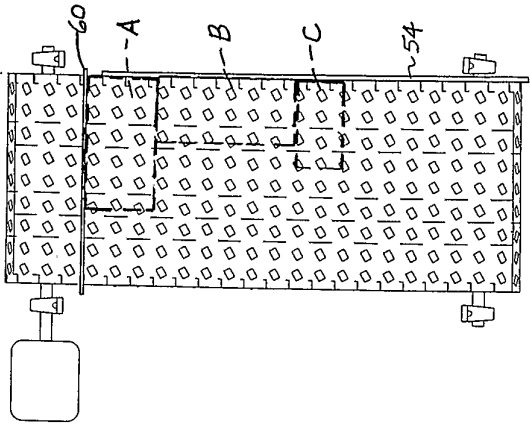


FIG. 3E

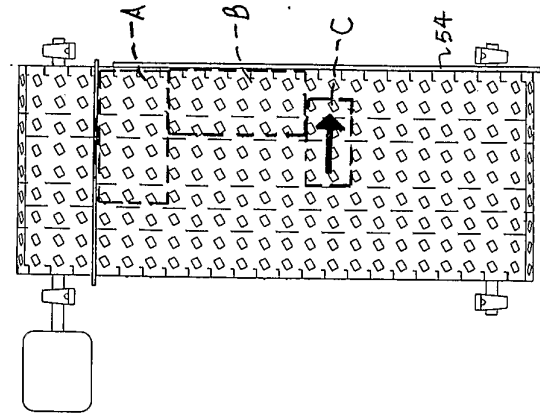


FIG. 3D

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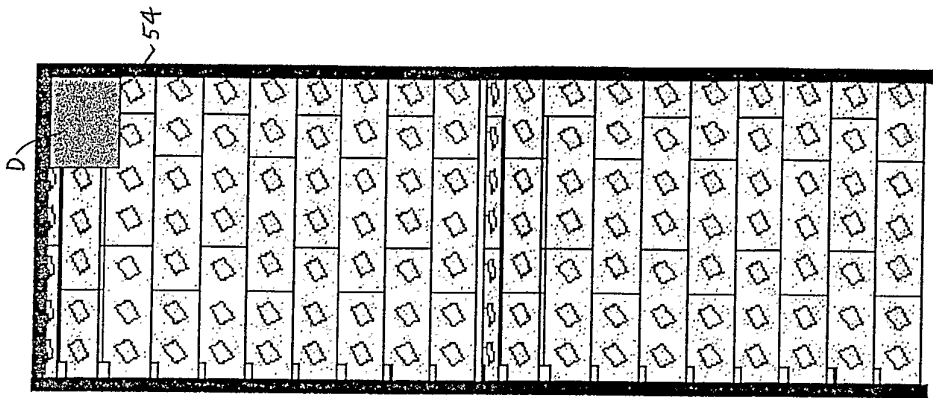


FIG. 4C

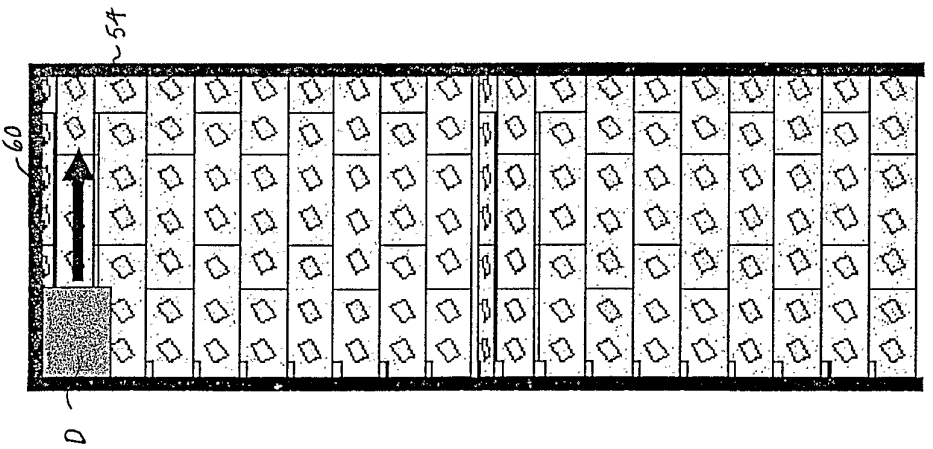


FIG. 4B

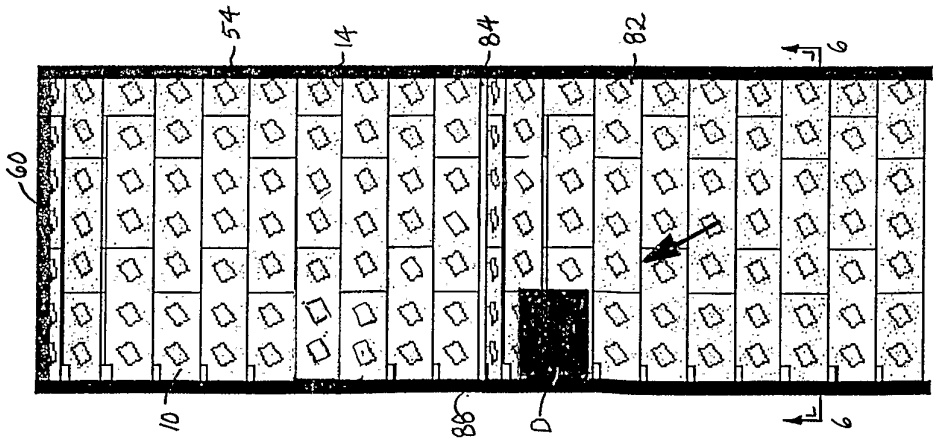


FIG. 4A

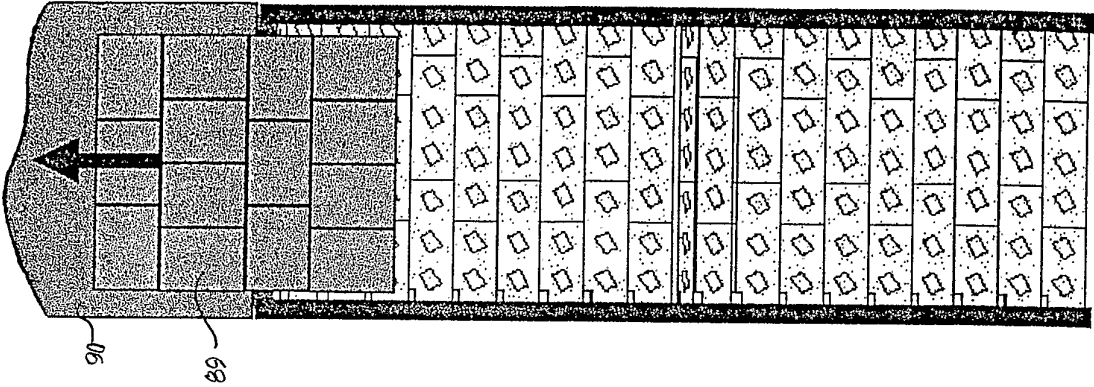


FIG. 4F

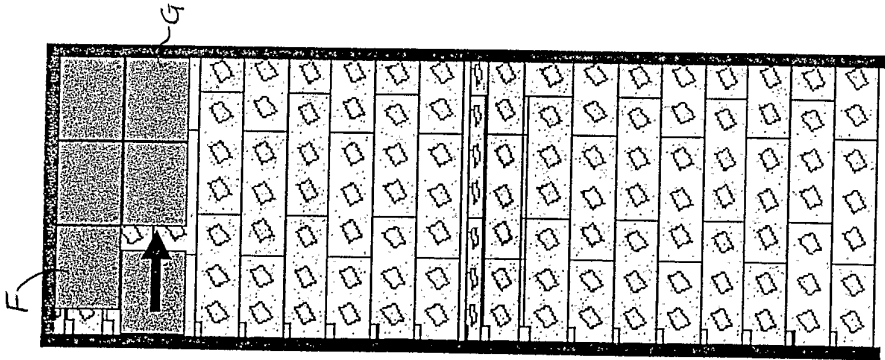


FIG. 4E

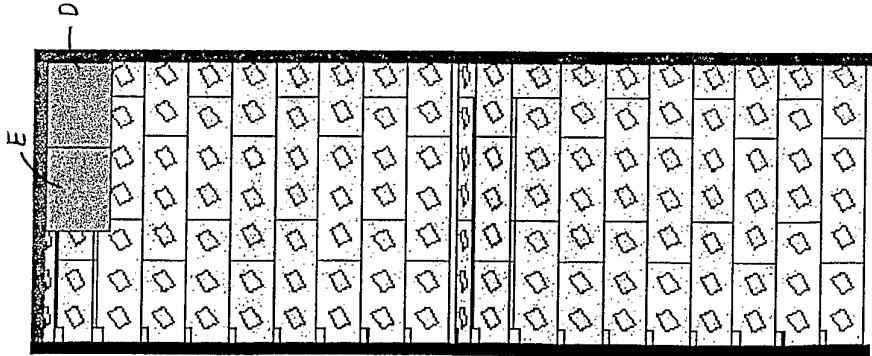


FIG. 4D

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FIG. 5A

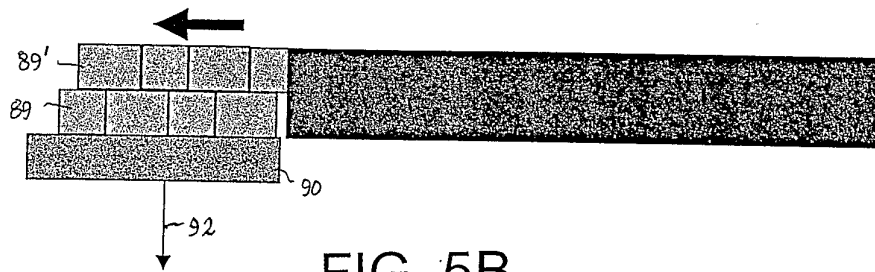


FIG. 5B

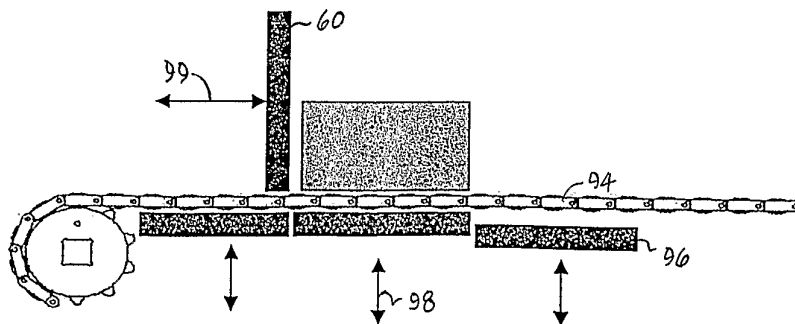


FIG. 7