

PATENT SPECIFICATION

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(54) CONVEYOR FOR TRANSPORTING OBJECTS

(71) We, SHUTTLEWORTH INC., a Corporation organised and existing under the Laws of the State of Indiana, United States of America, of 10 Commercial Road, Huntingdon, Indiana 46750, United States of America, do hereby declare the invention for which we pray that a Patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a conveyor for transporting moving objects supported thereon.

Conveyors are used to move objects along different paths such as the path required in a case packing machine. Continuous belts are generally used to convey the objects along the given path. Other conveyors use rotatably mounted rollers which either depend on the force of gravity on the objects to move the objects down the conveyor line or which are positively driven by a motor. Another type of conveyor which employs positive driven rollers is disclosed in the United States Letters Patent Specification No. 3,610,404 and another known conveyor has rollers individually driven by belts from slippable spools mounted on a common drive shaft.

A problem with the prior art conveyors is that they require a relatively large amount of gearing and space such as that found in the continuous belt type of conveyor. The structure typically becomes complex and bulky in the event that the objects are to be driven at different speeds along the length of the conveyor. Moreover, if some of the objects conveyed are halted due to jamming the remaining objects cannot be conveyed. Usually transfer plates are employed between the prior art conveyors. These transfer plates fill the gap between the end of one conveyor and the start of another conveyor. The transfer plates pro-

vide dead spots in the conveyors thereby increasing the friction as the objects pass thereacross.

The main object of the present invention is to provide a conveyor for objects in which these disadvantages are reduced. Preferably the conveyor is quiet in operation, will permit the objects to be conveyed at different speeds along the lengths thereof, and has low line pressure for moving objects with enlarged tops in a stable manner.

According to the present invention a conveyor for transporting objects supported thereon, comprises a frame, a plurality of parallel cylindrical shafts rotatably mounted on the frame, a plurality of rollers disposed in side-by-side relationship on each shaft and having internal diameters greater than the shaft diameter so as to be loosely received on the shaft, the rollers on one shaft being spaced from the rollers on adjacent shafts and forming with them a non-vertical discontinuous object supporting surface, and drive means to impart rotation to the shafts, the arrangement being such that rotation of the shafts imparts rotation of the rollers to transport the objects along the conveyor but when supported objects are stopped exteriorly the rollers supporting the objects cease to rotate and the remaining rollers continue to rotate.

In order that the invention may be more fully understood an embodiment in accordance therewith will now be described by way of example with reference to the accompanying drawings, in which:

Fig. 1 is a fragmentary cross sectional side view of a case packer;

Fig. 2 is an enlarged fragmentary top view of the right portion of the packer shown in Fig. 1 looking in the direction of arrows 2-2;

Fig. 3 is an enlarged fragmentary cross section of two conveyor rollers;

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Fig. 4 is an enlarged fragmentary cross section of the roller pan shown in Fig. 1 taken along the line 5-5 looking in the direction of the arrows;

- 5 Fig. 5 is an enlarged cross section taken along the line 6-6 of Fig. 4 looking in the direction of the arrows;

Fig. 6 is a view of a container positioned atop the rollers of the case packer; and

- 10 Fig. 7 is an enlarged fragmentary perspective view of the rollers immediately beneath bearing 73 of Fig. 2.

In the drawings the same references are used to designate the same or similar parts.

- 15 Referring now to Fig. 1 this shows a case packer 30, which includes a frame 31. Mounted upon frame 31 is a box conveyor 32 and conveying means 33. Boxes are placed on the box conveyor 32 and move
- 20 inwardly to a position beneath the conveying means 33. The boxes are moved until they reach a position beneath a vertically moveable vacuum head 34. The vacuum head 34 functions to lift a pattern of objects from roller pan 35 after the
- 25 objects have moved from means 33 to pan 35. Vacuum head 34 lifts a pattern of objects from pan 35 which then moves horizontally to dashed line
- 30 position 35'. Head 34 then moves the objects downwardly into a respective box positioned on the box conveyor 32. Fig. 1 corresponds to Fig. 4 of United States Letters Patent Specification No. 3,386,224
- 35 with the major exception that a plurality of rollers are used in means 33 and pan 35 in lieu of the conveyor belt shown in the said Specification. The case packer 30 is fully described in No. 3,386,224 and although
- 40 the conveyor of this invention can be incorporated onto the case packer 30, of No. 3,386,224 it is to be understood that the conveyor of the present invention can be used in any suitable manner for other
- 45 purposes or in other apparatus.

- Fig. 2 is a fragmentary enlarged top view of conveying means 33 mounted atop frame 31. The objects on the conveying means 33 move in the direction of the arrow 36 into
- 50 six separate and parallel rows 37-42. The six rows are formed by a plurality of dividing walls 43 which are suspendedly mounted by fasteners 44 to pairs 45 of parallel bars 46 and 47 mounted atop posts 48 and 49
- 55 secured to the frame 31. The fasteners 44 may be loosened to allow adjustment of the divider walls depending upon the size of the moving objects and the number of rows desired.

- 60 The conveying means 33 includes a plurality of rollers arranged in two groups 33A and 33B. Only some of the rollers have been shown in the drawings for sake of clarity. The dividers 43 extend above but
- 65 do not contact the rollers in group 33B.

Group 33A feeds the objects to group 33B and rows 37-42. The rollers 50 in group 33B rotate at a speed less than the rollers 51 in group 33A. The rollers 50, 51 are identical except that the rollers 50 rotate at a speed less than the rollers 51. The rollers 51 will now be described it being understood that an identical description applies to rollers 50. A cross sectional enlarged view of two rollers 51 is shown in Fig. 3. Each roller 51 is rotatably mounted on a metal drive shaft 52 and includes an outer sleeve 53 made from a material such as rubber fixedly mounted onto an inner sleeve 54 made from a plastics material. The inside diameter of the sleeve 54 is oversized with respect to the outside diameter of the shaft 52 thereby allowing the roller to rotate freely on the shaft. In one embodiment, the shaft 52 is produced from stainless steel having an outside diameter of $\frac{1}{4}$ inch, while the inner sleeve 54 has an inside diameter of approximately $\frac{17}{64}$ inch and is made from a material such as a form of nylon e.g. that as sold under the trade mark "NYLON-90 TRON". In another embodiment, a stainless steel outer coating is provided on the sleeve 53, which is mounted on the sleeve 54 so that relative motion therebetween is prevented. At least a portion of the interior surface of the sleeve 54 contacts the outer surface of the drive shaft 52 so rotation of the drive shafts imparts rotation to the rollers. Rotation of the drive shaft 52 results in rotation of the outer sleeve 53 thereby conveying an object such as a bottle or can. An increase of downward pressure on the rollers will result in the torque output increasing until eventually the rollers will slip on the drive shafts. Thus, if the moving bottles or objects become jammed, then the rollers 51 will stop even though the drive shafts 52 continue to rotate. The length of each roller along its axis of rotation is approximately $\frac{7}{16}$ inch. The shafts 52 are bearingly mounted on bars which are fixed atop the frame 31. Fixedly mounted at one end to each drive shaft is a pulley (not shown, which is drivingly connected to a shaft 59 by a belt 60. A pulley 61 is fixedly mounted on the shaft 59 and is drivingly connected to a larger diametered pulley 62 on a shaft 63 by a belt 64. Another pulley 65 mounted on the shaft 63 is drivingly connected by a belt 66 to the rotatable output shaft of a motor 67 mounted atop the frame 31. The drive shaft of each row of rollers is provided with a pulley for engaging one of the belts 60 which extend over the drive shaft 59 as shown in Fig. 2. The drive shafts 52 are perpendicular to the shaft 59 and thus the belts 60 are toroidal belts with a separate belt provided for each shaft 52. Other types of drivers may be used in lieu of the belts and pulleys.

An apparatus not shown is provided to distribute sequentially and evenly the moving objects into the rows 37 through 42. Such an apparatus is shown in United States Patent No. 3,342,303. Typically an apparatus is utilized which forms a single row of objects moving over the rollers 51 and then distributes a predetermined number of units from the single row sequentially into the rows 37, 38 and 39. Likewise, a similar apparatus forming a single line of objects moving over the rollers 51 distributes predetermined numbers of units sequentially into the rows 40 through 42. Thus since the objects moving over the rollers in group 33B are moving in a number of rows, such as six, whereas the objects moving in groups 33A are moving only in one or two rows, it is necessary to drive the rollers 50 of group 33B at a speed slower than the rollers 51 of group 33A. Thus a second shaft 68 (Fig. 2) is provided with belts 69 which drivingly engage the pulleys mounted to the drive shafts of the rollers 50. A pulley 70 is mounted on the shaft 68 and is drivingly connected by a belt 71 to a smaller diametered pulley 72 mounted on the shaft 63. The pulley 62 is of relatively large diameter whereas the pulley 61 mounted on the shaft 59 is of relatively small diameter. On the other hand the pulley 72 is of relatively small diameter whereas the pulley 70 mounted on the shaft 68 is of relatively large diameter. As a result the drive shaft 59 is rotated at a faster speed than the drive shaft 68 even though the shaft 63 is rotated at a constant speed. The shaft 68 is rotatably mounted by bearings 73 secured by brackets 74 to the posts 49. Likewise the shaft 59 is rotatably mounted by the bearings 73 secured by the brackets 74 mounted onto posts 75 secured to the frame 31. The shaft 63 is mounted in similar bearings 76 mounted atop the frame 31.

In the event that a large load is placed on the rollers, the drive shafts upon which the rollers are mounted will bend downwardly. To prevent the drive shafts from becoming permanently deformed, a plurality of support bars 176 (Fig. 3) are mounted atop the frame 31 having top surfaces spaced approximately $\frac{3}{32}$ inch and not greater than $\frac{1}{4}$ inch from the bottom of a roller. The bars 176 extend the length of the frame beneath the rollers 50 and 51 and will contact some of the rollers as the drive shafts are bent downwardly. The rollers which contact the bars 176 will stop; however, those rollers not contacting the bars 176 will continue to rotate thereby moving the objects through the device.

It has been determined that the object being moved on the rollers should be supported at all times by at least three rollers

to prevent tilting of the objects. A typical object to be moved is shown in Fig. 7 as a bottle 77. It will be noted that the length of the flat bottom surface 78 of the bottle 77 is denoted by dimension 79. It is very desirable that the spacing from the centre of one row of rollers to the centre of the adjacent row of rollers does not exceed one third the distance denoted by the dimension 79 so as to provide at least three rows of rollers beneath the bottle at all times. Otherwise there may be a loss of stability of the bottle.

As set out in United States Specification No. 3,386,224 the case packer 30 includes a roller pan 35 which moves horizontally to the left as viewed in Fig. 1 of this Specification to the position indicated by the dashed line configuration 35'. The roller pan moves to the left after the objects thereon have been lifted by the vacuum head 34 to allow the vacuum head to pass downwardly to the case.

Fig. 4 is a fragmentary top cross sectional view taken along the line 5-5 of Fig. 1 and viewed in the direction of the arrows showing the roller pan 35 which is provided with rows of rollers 80 identical to the rollers 50 and 51. The rollers 80 are mounted to drive shafts 84 identical to the drive shafts 52. The drive shafts having rollers 80 mounted thereon are bearingly received by bars 81, 82 and 83 fixedly mounted atop the roller pan 35. Likewise, drive shafts 84 are provided with pulleys at their outer ends which engage belts 85 which extend over a tube 86 connected to the shaft 68 and rotatable therewith. A cross section of tube 86 and the shaft 68 is shown in Fig. 5. The shaft 68 is provided with a keyway 87 which receives a key 88 mounted interiorly to and extending along the length of the tube 86. The tube 86 is rotatably mounted by bearings 87 secured to a post 88 mounted to the roller pan 35. The roller pan 35 is mounted in a manner identical to the mounting of platform or pan 205 of United Specification No. 3,386,224. A hydraulic cylinder is employed to move the roller pan 35 to the position indicated by the dashed lines as described in the patent. Tube 86 is slidably mounted on shaft 68 with a key 88 insuring that the tube and shaft rotate together. Thus as the pan 35 moves to the position 35' the tube 86 may telescopically extend on the shaft 68 allowing the roller pan to move to and from the position 35'. It is noted that the shafts 59 and 68, and the tube 86 are parallel to the rod 63 and perpendicular to the drive shafts 52.

The shafts 59 and 68 (Fig. 2) and the tube 86 (Fig. 4) are each rotatably supported in bearings. As a result, the belts for the row of rollers immediately beneath the bearings will not be able to extend

around the shaft or tube without interfering with the bearings. Fig. 7 illustrates the arrangement of belts to circumvent this problem. These show the shaft 59 rotatably supported by the bearing 73. Four rows of rollers 90-93 are adjacent or beneath the bearings 73. A double grooved pulley 94 is mounted to the end of the drive shaft of the row 90 for engaging a belt 95 mounted on the shaft 59 and for also engaging a second belt 96 which connects the pulley 94 to a pulley 97 mounted to the drive shaft of the row 91. Likewise, a pulley 98 of row 93 is provided with a pair of grooves one of which engages belts 99 with the other groove engaging belt 100 which is received by pulley 101 of row 92. All the belts in conveying means 33 are elastomeric belts.

It will be obvious from the above description that the present invention provides a conveying means which conveys the objects at different speeds along the length thereof. The conveying means allows the objects moved thereon to be stopped at one portion of the conveying means while the remaining objects located sidewardly thereof are conveyed. The rollers are especially quiet as compared with the prior art belts and rollers and in addition are of sufficiently small size so as to eliminate the need for transfer plates typically used between the end of one conveyor and the start of a second conveyor.

The small rollers are particularly advantageous in conveying objects having beaded top edges. It has been determined that these objects will not tilt when they are conveyed by the rollers disclosed herein due to the low force applied. Tilting typically results when the containers are jammed together whereby the top beaded edges are contacted and the lower portion of the cans are similarly contacted thereby tilting the cans. A similar problem exists with tapered bottles and is also alleviated by the present invention.

Another advantage is the smooth acceleration or deceleration of the conveyed objects when moving from one set of rollers rotating at one speed to another set of rollers rotating at another speed. For example, when the conveyed object moves from group 33A to group 33B (Fig. 2) the first rollers 50 engaged by the object will slip slightly on their drive shafts. As the object is conveyed further in group 33B, rollers 50 will slip less and less until the object is conveyed at full speed i.e. with no slip of the rollers 50.

WHAT WE CLAIM IS:—

1. A conveyor for transporting objects supported thereon, comprising a frame, a plurality of parallel cylindrical shafts rotatably mounted on the frame, a plurality of

rollers disposed in side-by-side relationship on each shaft and having internal diameters greater than the shaft diameter so as to be loosely received on the shaft, the rollers on one shaft being spaced from the rollers on adjacent shafts and forming with them a non-vertical discontinuous object supporting surface, and drive means to impart rotation to the shafts, the arrangement being such that rotation of the shafts imparts rotation of the rollers to transport the objects along the conveyor but when supported objects are stopped exteriorly the rollers supporting the object cease to rotate and the remaining rollers continue to rotate.

2. A conveyor according to claim 1 wherein each shaft has a circumferential groove at one end, the drive means includes a rotatably mounted first rod and a plurality of continuous drive belts engaged with the rod and at least some of the shaft grooves to rotate the shafts and rollers when the rod rotates.

3. A conveyor according to claim 2 wherein pulley wheels are mounted one on one end of each shaft, the circumferential shaft grooves being located on the pulley wheels.

4. A conveyor according to any of claims 1 to 3 wherein a plurality of rollers are mounted to each drive shaft.

5. A conveyor according to any of claims 1 to 4 wherein each roller has an inner plastics sleeve fixedly mounted within an outer resilient e.g. rubber cylinder.

6. A conveyor according to any of claims 1 to 5 wherein dividing means are provided on the frame dividing the supporting surface into a plurality of separate passageways each of which receives and conveys in succession a row of objects.

7. A conveyor according to claim 3 or claim 3 and any of claims 4 to 6 wherein second and third rods are rotatably mounted on the frame, a plurality of pulleys and belts connect the first and second rods to the third rod, and connect the third and second rods to some of the drive shafts, and the pulleys are of different sizes whereby the first and second rods rotate at different speeds.

8. A conveyor according to claim 7 wherein the first and second rods are parallel with the third rod and perpendicular to the drive shafts.

9. A conveyor according to any of claims 1 to 8 wherein a support beam is mounted on the frame beneath but spaced from the rollers, the beam being spaced from the outer surface of at least one roller per drive shaft by a distance of substantially $3/32$ inch but not greater than $7/8$ inch to support the roller as the drive shaft bows under a load.

10. A conveyor according to claim 2



around the shaft or tube without interfering with the bearings. Fig. 7 illustrates the arrangement of belts to circumvent this problem. These show the shaft 59 rotatably supported by the bearing 73. Four rows of rollers 90-93 are adjacent or beneath the bearings 73. A double grooved pulley 94 is mounted to the end of the drive shaft of the row 90 for engaging a belt 95 mounted on the shaft 59 and for also engaging a second belt 96 which connects the pulley 94 to a pulley 97 mounted to the drive shaft of the row 91. Likewise, a pulley 98 of row 93 is provided with a pair of grooves one of which engages belts 99 with the other groove engaging belt 100 which is received by pulley 101 of row 92. All the belts in conveying means 33 are elastomeric belts.

It will be obvious from the above description that the present invention provides a conveying means which conveys the objects at different speeds along the length thereof. The conveying means allows the objects moved thereon to be stopped at one portion of the conveying means while the remaining objects located sidewardly thereof are conveyed. The rollers are especially quiet as compared with the prior art belts and rollers and in addition are of sufficiently small size so as to eliminate the need for transfer plates typically used between the end of one conveyor and the start of a second conveyor.

The small rollers are particularly advantageous in conveying objects having beaded top edges. It has been determined that these objects will not tilt when they are conveyed by the rollers disclosed herein due to the low force applied. Tilting typically results when the containers are jammed together whereby the top beaded edges are contacted and the lower portion of the cans are similarly contacted thereby tilting the cans. A similar problem exists with tapered bottles and is also alleviated by the present invention.

Another advantage is the smooth acceleration or deceleration of the conveyed objects when moving from one set of rollers rotating at one speed to another set of rollers rotating at another speed. For example, when the conveyed object moves from group 33A to group 33B (Fig. 2) the first rollers 50 engaged by the object will slip slightly on their drive shafts. As the object is conveyed further in group 33B, rollers 50 will slip less and less until the object is conveyed at full speed i.e. with no slip of the rollers 50.

WHAT WE CLAIM IS:—

1. A conveyor for transporting objects supported thereon, comprising a frame, a plurality of parallel cylindrical shafts rotatably mounted on the frame, a plurality of

rollers disposed in side-by-side relationship on each shaft and having internal diameters greater than the shaft diameter so as to be loosely received on the shaft, the rollers on one shaft being spaced from the rollers on adjacent shafts and forming with them a non-vertical discontinuous object supporting surface, and drive means to impart rotation to the shafts, the arrangement being such that rotation of the shafts imparts rotation of the rollers to transport the objects along the conveyor but when supported objects are stopped exteriorly the rollers supporting the object cease to rotate and the remaining rollers continue to rotate.

2. A conveyor according to claim 1 wherein each shaft has a circumferential groove at one end, the drive means includes a rotatably mounted first rod and a plurality of continuous drive belts engaged with the rod and at least some of the shaft grooves to rotate the shafts and rollers when the rod rotates.

3. A conveyor according to claim 2 wherein pulley wheels are mounted one on one end of each shaft, the circumferential shaft grooves being located on the pulley wheels.

4. A conveyor according to any of claims 1 to 3 wherein a plurality of rollers are mounted to each drive shaft.

5. A conveyor according to any of claims 1 to 4 wherein each roller has an inner plastics sleeve fixedly mounted within an outer resilient e.g. rubber cylinder.

6. A conveyor according to any of claims 1 to 5 wherein dividing means are provided on the frame dividing the supporting surface into a plurality of separate passageways each of which receives and conveys in succession a row of objects.

7. A conveyor according to claim 3 or claim 3 and any of claims 4 to 6 wherein second and third rods are rotatably mounted on the frame, a plurality of pulleys and belts connect the first and second rods to the third rod, and connect the third and second rods to some of the drive shafts, and the pulleys are of different sizes whereby the first and second rods rotate at different speeds.

8. A conveyor according to claim 7 wherein the first and second rods are parallel with the third rod and perpendicular to the drive shafts.

9. A conveyor according to any of claims 1 to 8 wherein a support beam is mounted on the frame beneath but spaced from the rollers, the beam being spaced from the outer surface of at least one roller per drive shaft by a distance of substantially $\frac{3}{32}$ inch but not greater than $\frac{7}{8}$ inch to support the roller as the drive shaft bows under a load.

10. A conveyor according to claim 2

or claim 2 and any of claims 3 to 9 wherein some of the pulley wheels have at least two circumferential parallel grooves one of which receives one of the belts engaged with the first rod and another of which receives a belt engaged with the pulley wheel of the immediately adjacent drive shaft.

11. A conveyor according to claim 6 or claim 6 and any of claims 7 to 10 wherein a platform is moveably mounted on the frame, a second rod is rotatably mounted on the platform, the first and second rods are telescopically connected together with the second rod extendable from the first rod and horizontally moveable on the frame, the first and second rods being connected together to prevent relative rotational motion therebetween and some of the drive shafts with some of the rollers are rotatably mounted on the platform and coupled by belts to the second rod.

12. A conveyor according to claim 11 wherein the second rod is hollow and slidably receives the first rod and the first and second rods include a key and a complementary sized keyway to prevent relative rotational movement therebetween.

13. A conveyor according to claim 11 or

12 wherein the rollers engaged with the first rod are parallel with and convey objects to the rollers on the platform, a box conveyor is provided operable to carry boxes to a loading position beneath the platform, lifting means are mounted on the frame above the platform operable to lift objects off the platform and down into the boxes, and means are provided for moving the platform horizontally from a position adjacent to the rollers connected to the first rod and a removed position where it is no longer under the lifting means.

14. A conveyor for transporting objects supported thereon according to claim 1, substantially as herein described with reference to Figs. 1 to 8 of the accompanying drawings.

15. A conveyor for transporting objects supported thereon according to claim 6 substantially as herein described with reference to Figs. 1 to 7 of the accompanying drawings.

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