

[Title of the Invention] **BRANCHING DEVICE**

【Technical field】

[0001]

The present invention relates to a branching device for branching an objects from a main conveyance line into two or more directions, and more particularly to a branching device capable of branching mainly in the horizontal direction.

【Background technology】

[0002]

As a conventionally known horizontal branching device, for example, there is one described in Patent Document 1. As shown in FIG. 7 (corresponding to FIG. 1 of Patent Document 1) and FIG. 8 (corresponding to FIG. 2 of Patent Document 1), there has been disclosed a technical idea of a branching device having: an endless belt formed with a conveying conveyor unit for sorting conveyed objects; a driving pulley for causing the endless belt to travel on an wound endless belt; two return members which return the endless belt wound around the drive pulley on the upstream side of the transport conveyor in the transport direction of the transport object so that the transport conveyor is positioned on the upper surface; a tail pulley around which the endless belt after being folded back by two folding members is wound; a main supporting frame on which a drive pulley is rotatably mounted; a sub supporting frame on which the tail pulley is rotatably mounted; and a switching mechanism that switches the transport direction of the transported object in the transport conveyor unit by rotating the main supporting frame and the sub supporting frame in the opposite direction by a predetermined amount.

[0003]

According to this branching device, a high-speed and reliable branching device can be realized, the occurrence of the meandering of the endless belt cannot be suppressed, and therefore, it is necessary to provide the endless belt with thick edges in the both ends in the width direction over the entire length and to provide additional wheels.

【Prior Art Literature】

[Patent Document]

[0004]

[Patent Document 1] Japanese Laid-Open Patent Application Publication No. 2009-29620

SUMMARY OF THE INVENTION

[Problems to be solved by the invention]

[0005]

However, the meandering prevention mechanism disclosed in the above-mentioned Patent Document 1 has problems that the device becomes complicated, that the member cost becomes expensive, and that the effect is limited.

[0006]

In addition, as the operation of the switching mechanism at the time of branching becomes faster, centrifugal force from the rotation center of the switching mechanism acts on the transported object during switching, and the transported object slides on the belt, and the load form deterioration such as skewing and deviation of branch timing occur, and these may cause branching errors.

[0007]

Therefore, an object of the present invention is to provide a branching device capable of realizing a object branch conveying state, such as reducing the meandering of the belt in the branching device and maintaining the posture of the conveyed product at the time of branching.

[Means for Solving the Problems]

[0008]

In order to solve such problems, a branching device according to one aspect of the present invention comprises: a pair of end pulleys pivotable in mutually opposite directions about a common axis; an endless belt stretched between said a pair of end pulleys; and a pair of intermediate free rollers disposed between said a pair of end pulleys and folding back said endless belt so that the direction of travel of said endless belt is perpendicular to each axis of rotation of said a pair of end pulleys, wherein a distance between an axis of the intermediate free roller and a common axis which is a rotation center of said a pair of end pulleys is determined such that a stretching angle of said endless belt and a winding angle of said endless belt are substantially equal.

[0009]

Specifically, the distance between said axis of the intermediate free roller and said common axis is approximately $\pi R / 2$, where R is the radius of the intermediate roller adding half of the belt thickness and π is the ratio of the circumference of a circle to its diameter.

[0010]

In this case, since the stretching angle and the winding angle of the belt are equal to each other,

the traveling of the belt is stabilized, and the occurrence of meandering and positional deviation can be reduced.

[0011]

Patent Document 1 also discloses a drawing having a distance between the axis of the intermediate free roller and the rotation center (FIG. 3 and the like), but this doesn't provide significance or theory which contribute to the improvement of the running condition such as the meandering prevention. The present invention is different from the Patent Document 1 in term of the technical idea.

[0012]

Further, intermediate free roller can be a roller having a friction reducing means in the branching device having a before-mentioned composition.

[0013]

As this intermediate free roller, one in which a plurality of omnidirectional wheels, commonly called omni wheels, are coaxially arranged is preferable. An omnidirectional wheel comprises two wheel arrangements, each wheel arrangement comprises a disc-shaped roller frame and a plurality of barrel-shaped rollers mounted on the outer periphery of the roller frame. In this case, the friction reducing means is the barrel roller. Also, the plurality of omnidirectional wheels may be rotatably mounted on one shaft.

[0014]

In such a configuration, even if the belt tries to move on the intermediate free roller in a direction parallel to the rotation axis, the belt slips on the intermediate free roller by the friction reducing means. As a result, the traveling direction of the belt is maintained, and movement in the direction perpendicular to the traveling direction is suppressed.

[0015]

The branching device according to one aspect of the present invention may be further characterized in that the coefficient of friction of the outer surface of the endless belt is equal to or higher than the coefficient of friction of the inner surface.

[0016]

Here, the inner side of the belt is the side wound around the end pulley and the free roller, and the outer side is the side on which the conveyed product is placed and transported.

[0017]

As described above, it is desirable that the inner surface of the belt has a low coefficient of friction from the viewpoint of preventing meandering. On the other hand, the outer surface of the belt is desirable that it has a high coefficient of friction so that the posture of the conveyed product is not deteriorated due to the slip between the conveyed product and the belt surface when the placed conveyed product is subjected to centrifugal force at the time of rotation.

[0018]

As a result, it is possible to realize a branching device in which the meandering of the endless belt is small and the posture of the conveyed product is not lost.

【Effect of the invention】

[0019]

According to the branching apparatus of the present invention, high speed and reliable branching can be performed in the horizontal direction, and meandering of the belt can be prevented without requiring an additional mechanism, and furthermore, the posture of the conveyed object is prevented to be broken even at high speed branching. In addition, the present invention has a great effect of being able to realize a object transport state.

Brief Description of the Drawings

[0020]

FIG. 1 is a plan view of an embodiment of a branching apparatus of the present invention.

FIG. 2 is an elevational view of an embodiment of the branching device of the present invention.

FIG. 3 is an explanatory view of dimension calculation of an embodiment of the branching apparatus of the present invention.

FIG. 4 is a perspective view of an intermediate free roller of an embodiment of the branching apparatus of the present invention.

FIG. 5 is a perspective view of another intermediate free roller of one embodiment of the branching device of the present invention.

FIG. 6 is a perspective view of still another intermediate free roller of an embodiment of the branching apparatus of the present invention.

FIG. 7 is a plan view of the conventional branching device (at the time of non-branching).

FIG. 8 is a plan view of a conventional branching device (at the time of branching).

FIG. 9 is a cross-sectional view of an endless belt of an embodiment of the branching device of the present invention.

MODE FOR CARRYING OUT THE INVENTION

[0021]

Hereinafter, a branching apparatus according to an embodiment of the present invention will be described with reference to the drawings. In the following, the range necessary for the description of achieving the object of the present invention is schematically shown, the range necessary for the description of the corresponding part of the present invention is mainly described, and the description omitted shall be based on a well-known technique.

[0022]

FIG. 1 is a plan view of an embodiment of the branching apparatus of the present invention, and FIG. 2 is an elevation view of an embodiment of the branching apparatus of the present invention.

[0023]

The branching unit 10 includes a base 60, a mainframe 62, and a subframe 64.

[0024]

The main frame 62 is connected to the base 60 via a connecting rod 66 so as to be rotatable in the horizontal direction with respect to the base 60. The end pulley 12 is attached to the end of the main frame 62, and the drive pulley 13 and the auxiliary pulley 15 are supported by main frame 62 so that their rotational axes are parallel to each other.

[0025]

A drive motor 22 for rotationally driving the drive pulley 13 is attached to one side surface of the main frame 62 to which the pulleys 12, 13, 15 are attached.

[0026]

A traveling carriage 68 is attached to the lower surface of the main frame 62, whereby the main frame 62 can be stably rotated about the connecting rod 66 in the horizontal direction.

[0027]

Similar to the main frame 62, the sub frame 64 is also attached via the connecting rod 70 so as to be rotatable in the horizontal direction to the base 60. The connecting rod 70 and the connecting rod 66 of the main frame 62 are on the same vertical axis Q. Therefore, the sub frame 64 and the main frame 62 can be rotated about the same axis Q.

[0028]

The axis which is the rotational center of the main frame 62 and the sub frame 64, that is, the central axis Q of the connecting rods 66 and 70 is disposed at a predetermined distance described later from the axis of the intermediate free roller 18.

[0029]

An end pulley 14 is rotatably attached to the end of the sub frame 64. A traveling carriage 72 is attached also to the lower surface of the sub-frame 64 in order to stabilize horizontal rotation, but the shape of the traveling carriage 72 is a shape that does not interfere with the belt 16 which is stretched over the pulleys 12, 13, 15 of the main frame 62 is, for example, a U-shape.

[0030]

Two intermediate free rollers 18, 20 are attached to the base 60 in parallel with each other at a constant interval in the vertical direction. These intermediate free rollers 18, 20 are composed of an omni wheel 28.

[0031]

The omni wheel 28 is conventionally known, as disclosed in, for example, Japanese Patent Laid-Open Application No. 2-249769 and Japanese Utility Patent Publication No. 63-39164. As shown in FIG 4, the omni wheel 28 is composed of two wheel assemblies 34 to be fixed to each other with the phases of the rollers 32 shifted relative to each other in which three barrel-shaped rollers 32 are rotatably provided in the circumferential direction of roller frame 30 to form one wheel assembly 34.

[0032]

More specifically, the roller frame 30 has a substantially disc shape, and a center hole is formed at the center thereof. The barrel-shaped roller 32 is mounted onto the roller frame 30 such that its rotation axis is disposed on the outer periphery of the roller frame 30, and that its rotation axis is disposed in a plane orthogonal to the central axis of the central hole of the roller frame 30.

[0033]

Further, the three rollers 32 are arranged at equal intervals in the circumferential direction. Further, the two wheel components 34 are arranged 60 degrees out of phase with respect to the central axis of the central hole of the roller frame 30 and fixed to each other, thereby constituting one omni wheel 28.

[0034]

When the omni wheel 28 is viewed in the direction of the central axis of the central hole, the outer periphery of the entire omni wheel 28 defined by the outer shape of the barrel-shaped roller 32 is circular. The number of rollers attached to each roller frame 30 may be four or more.

[0035]

A plurality of such omni wheels 28 are arranged coaxially. Then, these omni wheels 28 are integrated by passing a single shaft 36 through the center hole of the roller frame 30 to form intermediate free rollers 18 and 20. The roller frame 30 is rotatable relative to the shaft 36 so that the intermediate free rollers 18, 20 rotate about the shaft 36 in the same manner as a conventional free roller. On the other hand, since the roller 32 on the roller frame 30 is rotatable about an axis extending in the tangential direction of the circle drawn by the roller frame 30, the object that makes to contact the surface of the intermediate free rollers 18 and 20 becomes movable in a direction parallel to the central axes of the intermediate free rollers 18 and 20.

[0036]

An endless belt 16, which is wound around the pulleys 12, 13, 15, 14, the intermediate free rollers 18, 20, extends from the upper side of the end pulley 12 of the main frame 62 to the upper intermediate free roller 18, where it changes traveling direction, and it extends from under this intermediate free roller 18 towards the end pulley 14 of the sub-frame 64. Then, the belt 16 reverses the traveling direction by the end pulley 14 and returns to the end pulley 12 from the lower intermediate free roller 20 through the driving pulley 13 and the auxiliary pulley 15. In such an arrangement, it is understood from Fig.2 that the sub-frame 64 is located between the belt 16 passing through the top of the main frame 62 and the belt 16 passing through the bottom, and can be moved horizontally.

[0037]

Next, FIG. 9 is a cross-sectional view of the endless belt 16 of one embodiment of the branching device of the present invention. The endless belt 16 has a two-layer structure and is composed of an inner portion 161 and an outer portion 162. Here, the inner side of the endless belt 16 is the side wound around the end pulleys 12 and 14 and the intermediate free rollers 18 and 20, and the outer side is the side on which the conveyed product is placed on the surface and conveyed.

[0038]

Here, the coefficient of friction of the surface of the outer portion 162 is set equal to or higher than the coefficient of friction of the surface of the inner portion 161. It is desirable that the inner portion

of the belt 16 has a lower coefficient of friction from the viewpoint of preventing meandering, while the outer periphery of the belt 16 has a higher coefficient of friction subjected to a centrifugal force during rotation when a transported object is placed. This is because it is desirable that the coefficient of friction be high so that the posture of the conveyed product is not deteriorated due to the slippage between the conveyed product and the belt surface.

[0039]

Here, these two coefficients of friction are compared to the same object (for example, iron) with same surface state.

[0040]

As a material of such a two-layered belt, the inner portion 161 is often made of canvas such as polyester, polyamide, nylon or the like incorporating a core 163 for securing strength.

[0041]

In order to maintain the posture of transporting objects, the outer portion 162, which is also referred to as a cover rubber, is required to have a higher coefficient of friction such as polyvinyl chloride, polyurethane, polyolefin, etc, rather than to have strength.

[0042]

The material and the structure (the number of layers, the presence or absence of a core, etc.) of these belts are only an example, and the present invention is not limited to these, and any materials may be used as long as they are used as a conveying belt.

[0043]

In addition, angle α between the central axis C1 of the belt 16 between the end pulley 12 of the main frame 62 and the vertical plane to which the central axes of the intermediate free roller 18 including the central axis of the connecting rods 66 and 70 are positioned perpendicular is always set to be opposite with the same value to the angle β between the vertical axis V and the central axis C2 of the belt 16 between the end pulley 14 of the sub-frame 64 and the lower intermediate free roller 20. In the situation shown by the dashed-two dotted line in FIG. 1, the central axes C1 and C2 are on the same vertical plane, and α and β are 0 degree.

[0044]

In order to turn the main frame 62 and the sub frame 64 while maintaining this positional relationship, the branch apparatus 10 is provided with a turning mechanism. There are various

types of pivoting mechanisms, and although not shown in the drawings, for example, a mechanism that uses a linear actuator to push and pull the main frame 62 and the sub frame 64 by the same amount in opposite directions, a mechanism or the like that moves the main frame 62 and the sub frame 64 by the same amount in opposite directions by the rotational force of the drive motor using a pinion rack can be used.

[0045]

Next, the operation of such a branching device is described. The bifurcating device 1 can move the endless belt 16 between a position shown by a solid line in FIG. 1 and a position shown by a dashed-two dotted line, whereby objects can be directed either one of the two downstream conveyors.

[0046]

Here, the method of calculating the distance between the central axis (rotational axis) Q of the connecting rod and the axis of the intermediate free roller 18 described above is described with reference to FIG.3.

[0047]

For example, assuming that the distance from the central axis of the intermediate free roller 18 to the rotation axis Q is X, it is assumed that the main frame 62 and the sub frame 64 rotate in opposite directions about the rotation axis Q by an angle α .

[0048]

In that case, in a plan view (FIG. 3 (1)) in which the conveyance surface of the belt 16 is displayed horizontally, the central axis C1 of the belt 16 contacts the roller almost immediately above the central axis of the intermediate free roller 18. The extension angle of the belt in this situation, that is, the rotation angle of the belt center line is α , and the distance between the contact points on the plan view is twice of $X \tan \alpha$.

[0049]

On the other hand, the belt comes in contact with the roller and is then wound around the roller, and it makes a half turn around the roller and comes off in the opposite direction directed to the central axis C2 direction. The angle γ in the developed view (FIG. 3 (2)) is $\tan \gamma = 2 \times \tan \alpha / \pi R$, because the developed length of the half circumference is πR , where R is the radius of the roller obtained by adding half of the belt thickness.

[0050]

Here, in order to achieve $\alpha = \gamma$, the relation $X = \pi R / 2$ is satisfactory. In this way, the stretching angle α and the winding angle γ of the belt become equal, the traveling of the belt becomes stable, and the occurrence of meandering is able to be reduced. If X is larger or smaller than this, the stretching angle α and the winding angle γ of the belt are not equal leading to a occurrence of a movement to align the angles during belt travelling, which results in a belt meanders and/or misalignment of traveling position.

[0051]

As can be understood here, since the distance X from the central axis of the intermediate free roller to the rotation axis Q does not depend on the rotation angle α , a object traveling state can be obtained at any angle. Therefore, the branching direction is not limited to one side, and is also applicable to branching to two or more sides with different branching angles.

[0052]

Note that the value obtained by this formula is a theoretical value. In an actual installation, however, the value may not be optimal in some cases due to various manufacturing errors etc. The proximity values are also included in the scope of the present invention. Therefore, in the claims, the word "general" is used.

[0053]

Here, in the case where the intermediate free rollers 18 and 20 are configured with the omni wheel 28 in FIG. 4 as in the present embodiment, the belt 16 is less likely to be displaced and travels stably in comparison to the case where a simple cylindrical roller is used in traveling after rotation.

[0054]

Also, when the main frame 62 and the sub frame 64 are rotated, the belt 16 tends to exert a large force on the intermediate free rollers 18 and 20. In this case, unnecessary power is able to be absorbed with the use of the intermediate free roller 18, 20 consisting of the omni wheel 28. Therefore, the load acting on the belt 16, the intermediate free rollers 18 and 20, and the other pulleys are small, and the life of the entire branching apparatus 10 is extended.

[0055]

Furthermore, the roller is not limited to the one composed of an omni wheel as shown in FIG. 4. Any form may be used as long as it is movable in the same direction to that of the rotation axis with a reduced friction of the strip or sheet on the surface of the roller against the roller.

[0056]

For example, one having a large number of barrel-shaped rollers 52 rotatably embedded in a cylindrical body 50 as schematically shown in FIG. 5 or one having a large number of balls 54 rotatably embedded as schematically shown in FIG.5 are also within the scope of the present invention. Also, although not shown, the same effect can be achieved by a free roller in which the surface of a cylindrical body is subjected to surface treatment such as fluorine resin processing or diamond like carbon processing to reduce friction.

[0057]

Also, the endless belt 16 has a coefficient of friction of its outer surface 162 equal to or higher than the coefficient of friction of the inner surface 161. This prevents a mistake in branching due to skewing and a shift in the branch timing caused by objects' sliding on the endless belt 16 by centrifugal force generated when the rods 66 and 70 rotate around the central axis Q of the rod during branch traveling.

[0058]

The branching device of the present invention has a capability to be used as a merging device for merging objects transported from two or more upstream directions into one direction. In that case, the running direction of the belt is reversed to that of the embodiment of the present invention.

[Description of the code]

[0059]

10 branch device
12, 14 end pulley
16 belts
161 Inner part of the belt
162 Outer part of the belt
18, 20 Intermediate free roller
22 Drive unit
24 main transport line
26 Guide frame
28 Omni Wheel
30 roller frame
32 Barrel roller (friction reduction means)
34 wheel assembly
36 shaft

50 cylinder
52 Barrel-shaped roller (friction reduction means)
54 Ball (friction reduction means)
60 base
62 mainframe
64 subframes
66, 70 connecting rods

【Document Name】 Claims

[Claim 1]

A branching device, comprising:

A pair of end pulleys pivotable in mutually opposite directions about a common axis;

An endless belt stretched between said a pair of end pulleys; and

A pair of intermediate free rollers disposed between said a pair of end pulleys and folding back said endless belt so that the direction of travel of said endless belt is perpendicular to each axis of rotation of said a pair of end pulleys,

wherein

A distance between an axis of the intermediate free roller and a common axis which is a rotation center of said a pair of end pulleys is determined such that a stretching angle of said endless belt and a winding angle of said endless belt are substantially equal.

[Claim 2]

The branching apparatus according to claim 1, wherein the distance between said axis of the intermediate free roller and said common axis which is a rotation center of said end pulley is approximately $\pi R / 2$, where R is the radius of the intermediate roller adding half of the belt thickness and π is the ratio of the circumference of a circle to its diameter.

[Claim 3]

The branching device according to claim 1, wherein said intermediate free roller is a roller having a friction reducing means.

[Claim 4]

The apparatus according to claim 1, wherein the friction coefficient of the outer surface of said endless belt is equal to or higher than the friction coefficient of the inner surface.