

CONVEYOR CHAIN

BACKGROUND OF THE INVENTION

5 The present invention relates to a conveyor chain used in a conveying device.

 Hitherto, in many industrial fields, conveying devices have been used to convey materials, parts, products or the
10 like for the purpose of improving labor saving and productivity. For example, in a manufacturing plant of palm oil that is in high demand as vegetable oil, the conveying devices have been used to convey empty fruit bunches of the oil palms from which oil palms, fruits or the like as raw
15 materials have been removed.

 Fig. 6 illustrates an example of a conveying device 100 used in a manufacturing plant in which palm oil is produced. As illustrated in Fig. 6, the conveying device 100 is
20 provided with a base 101 on which the oil palms and empty fruit bunches P are supported, and rails 102 located on both side edges of the base 101. Furthermore, the conveying device 100 is provided with a pair of conveyor chains 103 moving on the rails 102 and metallic rods, which are referred
25 to as scrapers 104. The scrapers 104 are fixed to both conveyor chains 103 so that an axis thereof is directed to the width direction of the base 101. Furthermore, the scrapers 104 are located in a longitudinal direction of the base 101 at regular intervals.

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 The respective conveyor chains 103 are provided with an internal link 106 including a pair of internal link plates 105, an external link 108 including a pair of external link plates 107, a connecting pin 110 configured to connect the
35 internal links 106 and the external links 108, and a roller

111. The roller 111 is rotatably attached to an outer peripheral surface of the connecting pin 110 via a bushing 112.

5 The conveyor chain 103 is formed in a substantially annular shape over the entire length of the conveying device 100 in the state of being wound around a driving sprocket and a driven sprocket (not illustrated). When pulled by the driving sprocket, the conveyor chain 103 runs at a constant
10 speed while allowing the roller 111 to roll on the rail 102. With the running of the conveyor chain 103, the conveying articles on the base 101 are conveyed to a work place in which the next process is performed, while being pushed by the plurality of scrapers 104.

15 However, in particular, when the conveying articles are empty fruit bunches P of oil palms, there have been the following problems. As illustrated in Fig. 6, the empty fruit bunches P contain a lot of elongated whisker-like
20 fibers Q growing on outer skin surfaces of the oil palms. Therefore, in some cases, during conveying of the empty fruit bunches P, the fibers Q of the oil palms may enter and adhere between the roller 111 and the internal link plate 105, thereby causing the rotation failure of the roller 111. In
25 this case, as indicated by a shaded portion of Fig. 7, since only a part of the outer peripheral surface of the roller 111 is worn and the roller 111 is transformed into a polygon, there has been a problem in that the conveying performance is degraded or required power increases. Furthermore, since the
30 transformation of the roller 111 into a polygon causes damage to the rail 102, there has been a problem in that the work of an operator is increased due to replacement of the rail 102 or productivity is degraded.

35 In addition, Japanese Laid-Open Patent Publication No.

2006-103884, Japanese Laid-Open Patent Publication No. 10-250818, Japanese Laid-Open Patent Publication No. 6-227632, Japanese examined utility model application publication No. 6-11404, and Japanese Patent No. 4553952 disclose a conveyor chain or a conveying device provided with the convey chain. However, the conveyor chains disclosed in all the documents do not have a configuration for solving the above-described problems.

SUMMARY OF THE INVENTION

An object of the invention is to provide a conveyor chain capable of suppressing wastes from entering and adhering between a roller and an internal link plate during conveying.

A first aspect of the present invention is a conveyor chain that is provided with an internal link including a pair of internal link plates, an external link including a pair of external link plates, a connecting pin configured to connect the internal link and the external link, and a roller that is attached to the connecting pin and is rotatable around an axis of the connecting pin on the inside of the internal link plates, wherein the internal link and the external link are alternately connected by the connecting pins, and the conveyor chain runs on a runway surface of the conveyor chain while allowing the roller to roll. The rollers have a rolling surface rolling on the runway surface, and a pair of end surfaces facing each of the pair of internal link plates. The roller is made of engineering plastic and has a recess on each of the pair of end surfaces.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a partial side view of a conveyor chain

according to the invention;

Fig. 2 is a partial top view of the conveyor chain;

Fig. 3 is a side view illustrating the entire structure of the roller;

5 Fig. 4 is a cross-sectional view taken along a line 4-4 of Fig. 3;

Fig. 5 is an enlarged partial cross-sectional view illustrating the vicinity of the roller of the conveyor chain;

10 Fig. 6 is a partial top view schematically illustrating a conveying device provided with a conveyor chain; and

Fig. 7 is a partial perspective view illustrating a roller in which a part of the outer peripheral surface is worn.

15 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Hereinafter, an embodiment in which a conveyor chain of the invention is embodied will be described with reference to Figs. 1 to 5.

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As illustrated in Figs. 1 and 2, a conveyor chain 10 is provided with internal links 20 including a pair of internal link plates 12, external links 30 including a pair of external link plates 13, connecting pins 14 configured to connect the internal links 20 and the external links 30, and rollers 15. The internal links 20 and the external links 30 are alternately connected by the connecting pins 14. The rollers 15 are attached to the connecting pins 14 configured to connect the internal links 20 and the external links 30.

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The roller 15 is rotatably supported by an outer peripheral surface of the connecting pin 14 via a bushing 16. The roller 15 has an outer peripheral surface 50 as a rolling surface rolling on a runway surface 1 of the conveyor chain 10, a pair of end surfaces 51 facing the inside of the

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internal link plate 12, and an insertion hole 52 through which the connecting pin 14 is inserted. The roller 15 rolls on the runway surface 1, while both end surfaces 51 make sliding contact with the internal link plate 12.

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The roller 15 is made of resin. The roller 15 is made of engineering plastic with excellent heat resistance and mechanical strength and having self-lubricating characteristics. As the engineering plastic, for example,
10 polyacetal (POM), polyamide (PA), polycarbonate (PC), modified polyphenylene ether (m-PPE), polybutylene terephthalate (PBT), amorphous polyarylate (PAR), polysulfone (PSF), polyether sulfone (PES), polyphenylene sulfide (PPS), polyetheretherketone (PEEK), polyimide (PI), polyetherimide
15 (PEI), fluorine resin, liquid crystal polymer and the like are adopted.

Next, a shape of the roller 15 will be described with reference to Figs. 3 to 5.

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As illustrated in Figs. 3 and 4, the roller 15 is formed in a ring shape having a predetermined thickness. The roller 15 is divided into a boss portion 53 fitted to the outer peripheral surface of the connecting pin 14, an outer
25 peripheral portion 54 including an outer peripheral surface, and an intermediate portion 55 located between the boss portion 53 and the outer peripheral portion 54. Each of the boss portion 53, the outer peripheral portion 54, and the intermediate portion 55 has widths W_3 , W_4 , and W_5 along a
30 radial direction of the roller 15. The radial width W_5 of the intermediate portion 55 is set to be larger than the radial width W_3 of the boss portion 53 and to be larger than the radial width W_4 of the outer peripheral portion 54. The radial width W_3 of the boss portion 53 is set to be equal to
35 the radial width W_4 of the outer peripheral portion 54.

The roller 15 has a recess 56 in each of the end surfaces 51. The recess 56 is formed in a substantially trapezoidal cross-sectional shape. The recess 56 includes an annular groove around a rotational center O of the roller 15. From a side view of the roller 15, the recess 56 is formed between an internal peripheral end 55a and an outer peripheral end 55b of the intermediate portion 55. Furthermore, the recess 56 is located at an intermediate position between an internal peripheral surface of the insertion hole 52 and an outer peripheral surface 50. Specifically, the recess 56 is located so that a central position thereof in the radial direction matches with a central position between the internal peripheral surface of the insertion hole 52 and the outer peripheral surface 50. A corner portion in which both end surfaces 51 of the roller 15 intersect with the outer peripheral surface 50 and a corner portion in which both end surfaces 51 of the roller 15 intersect with the insertion hole 52 are both chamfered. For this reason, the two corner portions are formed with a C surface 57.

As illustrated in Fig. 5, the recess 56 has a bottom surface 56a and a pair of opening surfaces 56b and 56c on both sides of the bottom surface 56a, respectively. The bottom surface 56a of the recess 56 is parallel to the end surface 51 of the roller 15. A boundary portion between the bottom surface 56a of the recess 56 and the respective opening surfaces 56b and 56c includes an arcuate surface 59. The pair of opening surfaces 56b and 56c obliquely intersects with the end surface 51 of the roller 15, respectively.

The boss portion 53 and the outer peripheral portion 54 each have axial thicknesses T3 and T4 along the axis C1 of the roller 15. The axial thickness T3 of the boss portion 53

is set to be larger than the axial thickness T4 of the outer peripheral portion 54. Therefore, the opening surface 56b of the pair of opening surfaces 56b and 56c close to the boss portion 53 is wider than the opening surface 56c close to the
5 outer peripheral portion 54.

The roller 15 is attached to the bushing 16 and the connecting pin 14 so that only the boss portion 53 is brought into sliding contact with the internal link plate 12.
10 Furthermore, from a side view of the roller 15, a leading end of the internal link plate 12 is located at approximately the same radial position as the center of the recess 56. Therefore, a gap 60 is formed between the outer peripheral portion 54 of the roller 15 and the leading end of the
15 internal link plate 12. That is, the recess 56 is opened in the vicinity of the leading end of the internal link plate 12.

Next, the operation of the conveyor chain 10 will be described with reference to Fig. 5.

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As illustrated in Fig. 5, the recesses 56 are provided on both end surfaces 51 of the roller 15, respectively. Waste generated from the conveyed articles during running of the conveyor chain 10 are captured in the recess 56 from the
25 gap 60 between the outer peripheral portion 54 of the roller 15 and the leading end of the internal link plate 12. After being captured in the recess 56, the waste remains there or is discharged to the outside from the above-described gap 60. Furthermore, since the axial thickness T3 of the boss portion
30 53 is larger than the axial thickness T4 of the outer peripheral portion 54, after being captured in the recess 56, the waste does not enter the gap between the roller 15 and the internal link plate 12 beyond the boss portion 53.

35 Furthermore, the roller 15 is formed of engineering

plastic having self-lubricating characteristics. Therefore, the waste will not easily adhere to the surface of the roller 15. Therefore, after being captured in the recess 56, the waste continues to slide on the surface of the roller 15 with the rotation of the roller 15 or is discharged to the outside from the gap 60 through the opening surface 56b of the roller 15 and the inner surface of the internal link plate 12. Therefore, by a synergistic effect between the recess 56 formed on both end surfaces 51 of the roller 15 and the self-lubricating characteristics as material characteristics of the roller 15, the waste is prevented from entering and adhering between the roller 15 and the internal link plate 12.

As described above, according to this exemplary embodiment, it is possible to obtain the following effects.

(1) The roller 15 is formed of engineering plastic with excellent heat resistance and mechanical strength and having self-lubricating characteristics. The roller 15 has recesses 56 on each of both end surfaces 51. With this configuration, when the conveyor chain 10 runs and the roller 15 rotates, since the waste remains captured in the recess 56, the waste hardly enters the gap between the roller 15 and the internal link plate 12. Furthermore, since the roller 15 has self-lubricating characteristics, it is difficult for the waste to adhere between the roller 15 and the internal link plate 12. Therefore, it is possible to prevent the waste from entering and adhering between the roller 15 and the internal link plate 12, by the synergistic effect between the self-lubricating characteristics of the roller 15 and the recess 56. Furthermore, by forming the roller 15 from the engineering plastic, the weight of the roller 15 can be reduced. Thus, in the conveying device provided with the conveyor chain 10, damage to the runway surface 1 is reduced, and the required power is reduced.

(2) The recess 56 forms an annular groove around the rotational center O of the roller 15. With this configuration, since the waste continues to move in a circumferential direction while sliding in the recess 56, which serves as an annular groove, with the rotation of the roller 15, it is difficult for the waste to enter the gap between the roller 15 and the internal link plate 12. Furthermore, in this case, since the waste always moves in the recess 56, it is possible to further limit the waste from entering and adhering between the roller 15 and the internal link plate 12.

(3) The axial thickness T3 of the boss portion 53 is larger than the axial thickness T4 of the outer peripheral portion 54. With this configuration, it is possible to ensure a height difference between the end surface of the roller 15 and the bottom surface 56a of the recess 56 by the boss portion 53. Thus, it is possible to further limit the waste from entering the gap between the roller 15 and the internal link plate 12 beyond the boss portion 53.

(4) The recess 56 is formed between the internal peripheral end 55a and the outer peripheral end 55b of the intermediate portion 55. Furthermore, the radial width W5 of the intermediate portion 55 is larger than the radial width W3 of the boss portion 53 and to be larger than the radial width W4 of the outer peripheral portion 54. With this configuration, by setting the large radial width W5 of the intermediate portion 55, it is possible to ensure a sufficient volume in the recess 56. For this reason, it is possible to increase the amount of waste that can be retained in the recess 56. Therefore, even if the amount of waste entering the conveyor chain 10 increases, it is possible to prevent the waste from entering the gap between the roller 15

and the internal link plate 12.

(5) From a side view of the roller 15, the leading end of the internal link plate 12 is located at approximately the same radial position as the center of the recess 56. With this configuration, the gap 60 is formed between the outer peripheral portion 54 of the roller 15 and the leading end of the internal link plate 12. That is, it is possible to open the recess 56 in the vicinity of the internal link plate 12 and to ensure a sufficient opening area. Thus, it is possible to easily discharge the waste captured in the recess 56 to the outside from the recess 56.

(6) The pair of opening surfaces 56b and 56c obliquely intersects with the end surface 51 of the roller 15, respectively. With this configuration, the waste is easily captured in the recess 56 through the opening surface 56c close to the outer peripheral portion 54. Moreover, after being captured in the recess 56, the waste is also easily discharged to the outside through the wall surface of the internal link plate 12 from the opening surface 56b close to the boss portion 53.

(7) A boundary portion between the bottom surface 56a of the recess 56 and the respective opening surfaces 56b and 56c includes the arcuate surface 59. With this configuration, it is possible to prevent the waste captured in the recess 56 from adhering to the boundary portion between the bottom surface 56a and the respective opening surfaces 56b and 56c. Therefore, it is possible to restrict the waste from entering and adhering between the roller 15 and the internal link plate 12 and to promote the discharge of the waste to the outside from the recess 56.

(8) The recess 56 is located at an intermediate

position between the internal peripheral surface of the insertion hole 52 and the outer peripheral surface 50. Specifically, the recess 56 is located so that the central position thereof in the radial direction matches with the
5 central position between the internal peripheral surface of the insertion hole 52 and the outer peripheral surface 50 in the radial direction. With this configuration, it is also possible to set the position of the recess 56 at a position that is away from the insertion hole 52 through which the
10 connecting pin 14 is inserted, and away from the outer peripheral surface 50 rolling on the runway surface 1 of the conveyor chain 10. Thus, it is possible to optimize the shape of the recess 56, without being subjected to a design limitation due to the other components except for the roller
15 15.

This exemplary embodiment may be modified as follows.

In this exemplary embodiment, the recess 56 was a
20 circular groove around the rotational center O of the roller 15. Alternatively, the recess 56 may be an elliptical annular groove.

In this exemplary embodiment, the axial thickness T3 of
25 the boss portion 53 was set to be larger than the axial thickness T4 of the outer peripheral portion 54. Alternatively, the axial thickness T3 of the boss portion 53 may be set to be equal to the axial thickness T4 of the outer peripheral portion 54 or to be smaller than the axial
30 thickness T4 of the outer peripheral portion 54.

In this exemplary embodiment, the radial width W5 of the intermediate portion 55 was set to be larger than the radial width W3 of the boss portion 53 and to be larger than
35 the radial width W4 of the outer peripheral portion 54.

Alternatively, the radial width W5 of the intermediate portion 55 may be set to be smaller than the radial width W3 of the boss portion 53 and to be smaller than the radial width W4 of the outer peripheral portion 54. Otherwise, the radial width W5 of the intermediate portion 55 may be set to be a size between the radial width W3 of the boss portion 53 and the radial width W4 of the outer peripheral portion 54.

In this exemplary embodiment, when viewed at the radial position of the roller 15, the leading end of the internal link plate 12 was located at the same position as the center of the recess 56. Alternatively, the leading end of the internal link plate 12 may be located at a position closer to the outer peripheral surface 50 of the roller 15 rather than the center of the recess 56 or at a position closer to the insertion hole 52 of the roller 15 rather than the center of the recess 56.

In this exemplary embodiment, the recess 56 was formed so that each of the pair of opening surfaces 56b and 56c obliquely intersected with the end surface 51 of the roller 15. Alternatively, the shape of the recess 56 may be modified so that each of the pair of opening surfaces 56b and 56c intersects with the end surface 51 of the roller 15 at a right angle.

In this exemplary embodiment, the boundary portion between the bottom surface 56a of the recess 56 and the respective opening surfaces 56b and 56c was the arcuate surface 59, but the boundary portion may be a polygonal surface. In addition, the bottom surface 56a of the recess 56 may be an arcuate surface.

In this exemplary embodiment, the position of the recess 56 was set so that the central position in the radial

direction of the recess 56 matched with the central position between the internal peripheral surface of the insertion hole 52 and the outer peripheral surface 50. Alternatively, the position of the recess 56 may be set so that the central
5 position in the radial direction of the recess 56 is shifted from the central position between the internal peripheral surface of the insertion hole 52 and the outer peripheral surface 50.

WHAT IS CLAIMED IS:

1. A conveyor chain comprising:

an internal link including a pair of internal link
5 plates; an external link including a pair of external link
plates; a connecting pin configured to connect the internal
link and the external link; and a roller that is attached to
the connecting pin and is rotatable around an axis of the
connecting pin on the inside of the internal link plates,
10 wherein

the internal link and the external link are alternately
connected by the connecting pin,

the conveyor chain runs on a runway surface of the
conveyor chain while allowing the roller to roll,

15 the roller has a rolling surface rolling on the runway
surface and a pair of end surfaces, and one of the end
surfaces faces each of the internal link plates, and

the roller is made of engineering plastic and has a
recess on each of the end surfaces, and

20 the recess is formed in a substantially trapezoidal
cross-sectional shape and includes an annular groove around a
rotational center of the roller.

2. The conveyor chain according to claim 1, wherein

25 the roller includes a boss portion, which is fitted to
an outer peripheral surface of the connecting pin, an outer
peripheral portion, which includes the rolling surface, and
an intermediate portion, which is located between the boss
portion and the outer peripheral portion,

30 the recess is provided in the intermediate portion of
the roller, and

the boss portion and the outer peripheral portion each
have an axial dimension, and the axial dimension of the boss
portion is larger than the axial dimension of the outer

peripheral portion.

3. The conveyor chain according to claim 2, wherein the boss portion, the outer peripheral portion, and the

5 intermediate portion each have a radial dimension, and the radial dimension of the intermediate portion is larger than the radial dimension of the boss portion and is larger than the radial dimension of the outer peripheral portion.

10 4. The conveyor chain according to any one of claims 1 to 3, wherein a leading end of the internal link plate extends radially to approximately the center of the recess.

15 5. The conveyor chain according to any one of claims 1 to 4, wherein

the recess has a bottom surface and a pair of opening surfaces on both sides of the bottom surface, and

both opening surfaces obliquely intersect with the end surfaces of the roller.

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6. The conveyor chain according to claim 5, wherein a boundary portion between the bottom surface and each of the pair of opening surfaces is constituted by an arcuate surface.

25 7. The conveyor chain according to any one of claims 1 to 6, wherein the roller has an insertion hole through which the connecting pin is inserted, and

the recess is provided at a radially intermediate position between an internal peripheral surface of the

30 insertion hole and the rolling surface.