

SPECIFICATION

Continuous Conveyance System

This invention relates to a conveyance system whereby a large volume of bulk load supplied continuously from a belt conveyor or other means can be conveyed continuously to a transfer section at any elevation.

As means for conveying loose bulk to an elevated position, there are known typically a bucket conveyor system comprising a series of buckets adapted to an endless chain or chains passed round a pair of upper and lower chain wheels and a belt conveyor system disposed with a gentle inclination. However, according to the conventional bucket conveyor system, the loose bulk accumulated at a low place is immediately raised up by the buckets to an elevated position, so that it is impossible with this system to continuously receive and convey to an elevated location the bulk supplied continuously from a belt conveyor or such. On the other hand, in case that the loose bulk is to be conveyed to an elevated position with the aid of the belt conveyor system, nobody can apply higher inclination than that as previously specified for installing any belt conveyor and this makes the whole conveyance system excessively elongated in the longitudinal direction. It therefore is pointed out with the hitherto known belt conveyor system that the same occupies a large area for installation thereof. In view of these facts the present invention is intended to eliminate the drawbacks and disadvantages inherent to the hitherto known conveyance system for loose bulk materials.

The primary objects of this invention is to provide a conveyance system which is capable of continuously conveying the continuously supplied loose bulk vertically or straight up and down to any elevated or low location and which requires merely a limited space for its installation.

Another object of this invention is to provide a conveyance system capable of continuously conveying the loose bulk from a bulk receiving section to a transfer section which may be at any distance from said bulk receiving section.

Still another object of this invention is to provide a conveyance system whereby the loose bulk can be conveyed to any elevated or low location at any distance by suitably combining both horizontal and vertical transport lines.

Yet another object of this invention is to provide a conveyance system in which the conveyance containers can be moved while maintaining their horizontal posture through the course of transport from the bulk receiving section to the transfer section.

A further object of this invention is to provide a conveyance system which suffers little drop-out of the bulk from the conveyance containers in the course of conveyance.

Still another object of this invention is to provide a conveyance system according to which the loose bulk in any conveyance container won't

be left over in the container but is entirely dropped out of the container.

65 An additional object of this invention is to provide a conveyance system which allows smooth, quiet and secure conveyance of loose bulk.

70 According to the invention there is provided a continuous conveyance system for continuously conveying a loose volume of bulk load, characterized in that the system comprises a series of boat shaped conveyance containers (E) for receiving, conveying and discharging loose bulk material, the body (15) of each container (E) being constructed of flexible plates, two pairs of endless chains (1, 1') joined to the front and rear portion of each said container (E) to carry it, said two pairs of endless chains (1, 1') consisting of a pair of inner endless chains (1, 1) for carrying the front portion of each said container (E) and a pair of outer endless chains (1', 1') for carrying the rear portion of each said container (E), chain wheels (2, 2') around which said endless chains (1, 1') are passed, said chain wheels (2, 2') comprising inner chain wheels (2, 2) around which said inner endless chains (1, 1) are passed and outer chain wheels (2', 2') around which said outer endless chains (1', 1') are passed, said both inner and outer wheels (2, 2') being secured to a common shaft (4) at the rotatory section (C) where bulk is supplied into each container (E), the rotatory section (D) where bulk is discharged and the rotatory sections (C', C'') where the direction of movement of the return run of the endless chains (1, 1') is changed by 90°, said both inner and outer chain wheels (2, 2') being arranged with their rotational axes horizontal while suitably spaced-apart from each other at the rotatory sections (A, B) where movement of each conveyance container (E) is changed from generally horizontal movement into movement with a substantial vertical component while maintaining a horizontal container orientation and the rotatory sections (A', B') where the vertical component movement thereof is changed into horizontal movement, and a bulk discharge promotion device (13) provided at the rotatory section (D) where bulk is discharged out of the containers (E) and arranged for local co-operative engagement with the body (15) of a container (E) whereby to resiliently deform the floor thereof and promote the discharge of the contents thereof.

115 In order to ensure smooth, quiet and positive movement of said series of conveyance containers while carried by the endless chains, it is desirable that the inner and outer endless chains are passed round the respective chain wheels with a half-pitch offset from each other. Alternatively, the chains may be arranged without any such pitch offset.

120 As said above, the inner and outer chain wheels are spaced-apart horizontally from each other at the rotatory section where the horizontal conveyance of the containers is shifted to vertical conveyance while maintaining the horizontal posture of the containers and at the rotatory

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section where vertical conveyance is shifted to horizontal conveyance, and in this case, the distance between the horizontally spaced-apart inner and outer chain wheels is so set that it is equal to the distance between a protuberance pivotally secured to the front end of the container and another protuberance secured fixedly to the rear end of the container.

In order to prevent the loose bulk from dropping out of the containers during supply of the bulk into the containers or during movement of the containers, it is preferred that the flexible engaging plates are mounted to the front or rear end or to both ends of each said container.

For allowing positive transfer of bulk cargo in the containers at the bulk transfer section, it is desirable that a bulk discharge promoting device composed of a spindle-shaped roller is mounted on the shaft of said section and that a means for giving vibrations to the container body is also provided in said discharge promoting device.

Other objects and advantageous features of this invention will become apparent from the following detailed description of the invention and the appended claims.

The characteristic features and other peculiarities of this invention will be easily understood from the following description of the invention when taken in conjunction with the accompanying drawings in which like reference numerals are used throughout to designate like parts.

Figure 1 is a side elevational view illustrating conventionally the structural mechanism of the continuous conveyance system according to this invention;

Figure 2 is a top plan view of the conveyance system shown in Fig. 1;

Figure 3 is front view showing the structural arrangements of the rotatory sections A, B, C and D, with the endless chains being removed;

Figure 4 is a plane view of a conveyance container used in the system of this invention;

Figure 5 is a sectional view of the container of Fig. 4 taken on a plane along a length thereof;

Figure 6 is a cross-sectional view of the container of Fig. 4, showing a condition where the bottom portion of the container is raised up by the bulk cargo discharge promoting device;

Figure 7 is a plane view showing connection of the container with the inner and outer endless chains;

Figure 8 is a side view showing the assembly of a series of containers and endless chains shown in Fig. 7;

Figure 9 is a front view showing the mode of connection between container and endless chain on an enlarged scale;

Figure 10 is an enlarged side view showing the chain wheel and its associated elements at the rotatory section C', and

Figure 11 is a side view showing the mechanism at and around the rotatory section D.

Fig. 1 is a side elevational view

diagrammatically illustrating the conveyance

mechanism of the continuous conveyance system according to this invention, and Fig. 2 is a plane view thereof. The rotatory section C positioned beneath a belt conveyor F is composed of a shaft 4 and a pair of inner chain wheels 2, 2 and a pair of outer chain wheels 2', 2' mounted toward both ends of said shaft 4 as shown in Fig. 3, and both ends of said shaft 4 are supported by bearings 3, 3 secured to the casing 14.

The rotatory section C' is of the same mechanism as the section C. The rotatory section C'' is also the same in mechanism as the section C, but in this section C'', as shown in Fig. 10, cutouts 12 are provided suitably between the teeth of the inner chain wheel so that the connecting element 5' connecting the outer endless chain 1' and the conveyance container E (as further described later) will not interfere with the teeth of the inner chain wheel when said element 5' passes said section C'.

The rotatory section D is also substantially same in structural mechanism as the section C, but in this section, a driving chain wheel 2'' is secured to one end of the shaft 4 and connected to a motor M through reduction gearing (not shown). Also, a cargo discharge promoting device 13 is secured to the central part of said shaft 4, said device being arranged to abut against the bottom of the container E to give impact force thereto or to push up the button of the container to discharge out the material (bulk) therein.

The rotatory section A consists of a pair of shafts 4', 4' and a pair of outer chain wheels 2', 2' mounted on said respective shafts 4', 4' which are supported at their ends by the respective bearings 3, 3. The rotatory section B also comprises a pair of shafts 4'', 4'' on which the inner chain wheels 2, 2 are mounted, respectively, said shafts being supported at their ends by the respective bearings 3, 3. The rotatory section A' is of the same mechanism as the section A, and the rotatory section B' has the same mechanism as the section B. It will be easily understood from the accompanying drawings that the distance between the sections A and B and between the sections A' and B' is equal to the distance between the shafts 10 and 10' passed horizontally across the container E.

In the conveyance system according to this invention, said rotatory sections C, A, B, A', B', D, C'' and C' are disposed at the predetermined positions shown in Fig. 1, and the inner endless chains 1 are passed round said sections C, B, B', D, C'' and C' while the outer endless chains 1' are passed round the sections C, A, A', D, C'' and C'. Also, both sides of the front end of each conveyance container E are joined to two lines of inner endless chains 1, 1 through the connecting elements 5, while both sides of the rear end of the container are joined to two lines of outer endless chains 1', 1' through the connecting elements 5', thereby arranging a plurality of containers like a train between the parallel lines of endless chains. Because of the above-described arrangement of the respective rotatory sections with the endless

chains passed therearound, the conveyance containers E arranged in train are allowed to move horizontally at each horizontal transport section and to rise up vertically while

equidistantly spaced-apart from each other and maintaining a normal horizontal posture at each vertical transport section.

In the rotatory section C'', each container E passes in a turned-over condition as so is the connecting element 5' which connects said container E to the outer endless chains 1'. In this case, therefore, there is a possibility that said connecting element 5' might interfere with the chain wheel 2 between the teeth thereof. In order to avoid such interference, cutouts 12 are suitably provided between the teeth of each chain wheel 2.

Also, in order to ensure smooth and secure movement of the endless chains, the inner and outer chain wheels are arranged such that their corresponding teeth are shifted by a half-pitch from each other at each rotatory section, and hence the inner and outer chain wheels are engaged alternately with the endless chains.

It is to be noted, however, that the both inner and outer chain wheels may be arranged parallel to each other without any pitch offset therebetween.

Figs. 4 to 9 diagrammatically illustrate the connection of the conveyance container E with the inner and outer endless chains 1, 1'. The container E comprises a flexible rubber-made intermediate plate 15 extending between both side walls, with both edges of said plate being securely held by the bent portions 16, 16 at the lower ends of both side walls and presser plates 17, 17, so that the body portion 9 of the container E is ship-shaped. At the upper parts of both side wall portions of the container E are provided the front protuberances 8 which are pivotally secured by bolts 18. The rear protuberances 8' are fixed by welding to the container side walls. In the drawings numerals 7, 7' indicate bolt holes formed in the respective protuberances 8, 8', and 6 is a rubber-made engaging member secured to the front portion of the container body 9 by adhesive, bolting or other means. This engaging member 6 has the role of filling up the space produced between this container and the adjoining one.

It will be noted that the front portion of the container E is connected to the inner endless chains 1 by means of the shaft 10 passed through said round holes 7 and connecting elements 5, while the rear portion is connected to the outer endless chains 1' by means of the shaft 10' passed through said round holes 7' and connecting members 5'.

Now, the operation of the conveyance system according to this invention is described with particular reference to Fig. 1. When the motor is started to let the inner and outer endless chains 1, 1' move in the direction of arrows, the containers E arranged in train move horizontally in the direction of arrow at the lower horizontal

transport section. At the vertical transport section, since the inner endless chains 1 are passed round the inner chain wheels 2 at the rotatory sections B, B' and the outer endless chains 1' are passed round the outer chain wheels 2' at the rotatory sections A, A', the containers E rise up vertically while spaced-apart from each other vertically and maintaining the horizontal posture, and upon reaching the top of the ascending line, each container E is turned 90° at the rotatory sections A', B' and move forward horizontally in the direction of arrow. Then each container E is inverted at the rotatory section D to move horizontally in an inverted state and is further turned 90° at the rotatory section C'' to move downwardly in a posture shown in the drawing, and upon reaching the rotatory section C', each container is further turned 90° to move toward rotatory section C.

Thus, according to the system of this invention, the bulk such as powder is continuously dropped from a belt conveyor F into each conveyance container E which has just reached the lower horizontal transport section, and during this operation, no drop-out of bulk is caused owing to the engaging member 6 provided to each container E to fill up the space between the adjoining containers. Each container E which has thus been loaded with bulk moves on horizontally, then rises up vertically along the ascending line at the vertical transport section and then changes into horizontal movement at the upper horizontal transport section. When the container E is inverted at the rotatory section D, the bulk in the container is perfectly discharged out, with no leftover in the container, by the action of the discharge promoting device and is successively dropped onto a belt conveyor G disposed below the rotatory section D.

It is to be added that the container E can maintain the horizontal posture during passing through the said lower rotatory sections A, B as well as the said upper rotatory sections A', B' owing to the fact that the inner and outer chains 1, 1' are arranged at a distance therebetween, which corresponds to that between the front and rear protuberances 8 and 8' or the front and rear connecting members 5 and 5'.

Further it is to be added that the container E can pass smoothly through all the rotatory sections C, C', C'' and D, because the protuberances 8 are pivotally moved so as to correct the reduced distance between the connecting members 5 and 5', the said reduced distance being caused during the passage through the rotatory sections.

The body of the container used in the transport system of this invention is preferably constituted from rubber plates, laminate plates formed by bonding a thin flexible metal plate to the underside of each rubber plate, plates made of an elastic synthetic resin with excellent releasability, or elastic plates provided with a releasing layer on the surface. Use of such container plates allows absorption of any metallic sound produced during

operation of the system. Also, owing to water repellency of said container plates, even moist bulk can be perfectly discharged out of the container without causing adhesion of bulk to the container walls. Further, bulk is urged to gather centrally in the ship-shaped container, without adhering to the container walls, during movement of the container, and when the container is inverted at the rotatory section D, bulk is perfectly discharged out without adhering to the container bottom under the action of the discharge promoting device.

The discharge promoting device, as best shown in Fig. 6, comprises a spindle-shaped roller mounted on a shaft. In order to better the discharging action, it is recommended to provide unevenness on the surface to produce a sort of vibration.

Figs. 6 and 11 show the deformed condition of the container plate at the inversion section.

Other features of the continuous bulk transport system according to this invention are as follows:

(1) A great volume of bulk can be transported with a combination of vertical and horizontal components of movement.

(2) At the horizontal transport section, no drop-out of bulk such as powder is caused because an engaging member made of a rubber plate or such is provided to each transport container such that said engaging member with engage or overlap with that of the adjoining container or directly with the adjoining container, and hence high transport efficiency is ensured.

(3) The installation area required for the system of this invention is far smaller than that required for the conventional belt conveyor owing to the fact conveyance can be effected in the vertical direction.

(4) It is possible to transport bulk from an elevated location to a lower place by performing the reverse operation.

Having the above-described features and effect, the transport system according to this invention can be applied for a variety of uses, such as for stowing and unstowing the ship's hold with bulk, conveyance of sand in underground construction work, conveyance of ores in mines, etc.

Claims

1. A continuous conveyance system for continuously conveying a loose volume of bulk load, characterized in that the system comprises a series of boat-shaped conveyance containers (E) for receiving, conveying and discharging loose bulk material, the body (15) of each container (E) being constructed of flexible plates, two pairs of endless chains (1, 1') joined to the front and rear portion of each said container (E) to carry it, said two pairs of endless chains (1, 1') consisting of a pair of inner endless chains (1, 1) for carrying the front portion of each said container (E) and a pair of outer endless chains (1', 1') for carrying the rear portion of each said container (E), chain wheels (2, 2') around which said endless chains

(1, 1') are passed, said chain wheels (2, 2') comprising inner chain wheels (2, 2) around which said inner endless chains (1, 1) are passed and outer chain wheels (2', 2') around which said outer endless chains (1', 1') are passed, said both inner and outer wheels (2, 2') being secured to a common shaft (4) at the rotatory section (C) where bulk is supplied into each container (E), the rotatory section (D) where bulk is discharged and the rotatory sections (C', C'') where the direction of movement of the return run of the endless chains (1, 1') is changed by 90°, said both inner and outer chain wheels (2, 2') being arranged with their rotational axes horizontal while suitably spaced apart from each other at the rotatory sections (A, B) where movement of each conveyance container (E) is changed from generally horizontal movement into movement with a substantial vertical component while maintaining a horizontal container orientation and the rotatory sections (A', B') where the vertical component movement thereof is changed into horizontal movement, and a bulk discharge promotion device (13) provided at the rotatory section (D) where bulk is discharged out of the container (E) and arranged for local co-operative engagement with the body (15) of a container (E) whereby to resiliently deform the floor thereof and promote the discharge of the contents thereof.

2. A conveyance system as set forth in Claim 1, characterized in that the inner and outer endless chains (1, 1') are passed round the respective chain wheel (2, 2') with a half-pitch offset from each other.

3. A conveyance system as set forth in Claim 1, characterized in that the inner and outer endless chains (1, 1') are passed around the respective chain wheel (2, 2') with no pitch offset from each other.

4. A conveyance system as set forth in Claim 1, characterized in that the inner and outer endless chains (1, 1') are driven by a motor (M) through chain wheel (2'') mounted on a shaft (4) at the rotatory section (D) where bulk is discharged out of the container (E).

5. A conveyance system as set forth in Claim 1, characterized in that the inner endless chains (1) are connected to each conveyance container (E) through the media of protuberant elements (8) pivotally secured to the front side end of each container (E), a shaft (10) passed through said protuberant elements (8) and connecting members (5) joined to said shaft (10), while the outer endless chains (1') are connected to said container (E) through the media of protuberant elements (8') fixedly secured to the rear side end of the container (E), a shaft (10') passed through said protuberant elements (8') and connecting member (5') joined to said shaft (10').

6. A conveyance system as set forth in Claim 5, characterized in that at the rotatory section (A, B) where horizontal movement of each container (E) is changed into vertical movement while maintaining the horizontal posture of the container (E) and at the rotatory section (A', B')

operation of the system. Also, owing to water repellency of said container plates, even moist bulk can be perfectly discharged out of the container without causing adhesion of bulk to the container walls. Further, bulk is urged to gather centrally in the ship-shaped container, without adhering to the container walls, during movement of the container, and when the container is inverted at the rotatory section D, bulk is perfectly discharged out without adhering to the container bottom under the action of the discharge promoting device.

The discharge promoting device, as best shown in Fig. 6, comprises a spindle-shaped roller mounted on a shaft. In order to better the discharging action, it is recommended to provide unevenness on the surface to produce a sort of vibration.

Figs. 6 and 11 show the deformed condition of the container plate at the inversion section.

Other features of the continuous bulk transport system according to this invention are as follows:

(1) A great volume of bulk can be transported with a combination of vertical and horizontal components of movement.

(2) At the horizontal transport section, no drop-out of bulk such as powder is caused because an engaging member made of a rubber plate or such is provided to each transport container such that said engaging member with engage or overlap with that of the adjoining container or directly with the adjoining container, and hence high transport efficiency is ensured.

(3) The installation area required for the system of this invention is far smaller than that required for the conventional belt conveyor owing to the fact conveyance can be effected in the vertical direction.

(4) It is possible to transport bulk from an elevated location to a lower place by performing the reverse operation.

Having the above-described features and effect, the transport system according to this invention can be applied for a variety of uses, such as for stowing and unstowing the ship's hold with bulk, conveyance of sand in underground construction work, conveyance of ores in mines, etc.

Claims

1. A continuous conveyance system for continuously conveying a loose volume of bulk load, characterized in that the system comprises a series of boat-shaped conveyance containers (E) for receiving, conveying and discharging loose bulk material, the body (15) of each container (E) being constructed of flexible plates, two pairs of endless chains (1, 1') joined to the front and rear portion of each said container (E) to carry it, said two pairs of endless chains (1, 1') consisting of a pair of inner endless chains (1, 1) for carrying the front portion of each said container (E) and a pair of outer endless chains (1', 1') for carrying the rear portion of each said container (E), chain wheels (2, 2') around which said endless chains

(1, 1') are passed, said chain wheels (2, 2') comprising inner chain wheels (2, 2) around which said inner endless chains (1, 1) are passed and outer chain wheels (2', 2') around which said outer endless chains (1', 1') are passed, said both inner and outer wheels (2, 2') being secured to a common shaft (4) at the rotatory section (C) where bulk is supplied into each container (E), the rotatory section (D) where bulk is discharged and the rotatory sections (C', C'') where the direction of movement of the return run of the endless chains (1, 1') is changed by 90°, said both inner and outer chain wheels (2, 2') being arranged with their rotational axes horizontal while suitably spaced-apart from each other at the rotatory sections (A, B) where movement of each conveyance container (E) is changed from generally horizontal movement into movement with a substantial vertical component while maintaining a horizontal container orientation and the rotatory sections (A', B') where the vertical component movement thereof is changed into horizontal movement, and a bulk discharge promotion device (13) provided at the rotatory section (D) where bulk is discharged out of the container (E) and arranged for local co-operative engagement with the body (15) of a container (E) whereby to resiliently deform the floor thereof and promote the discharge of the contents thereof.

2. A conveyance system as set forth in Claim 1, characterized in that the inner and outer endless chains (1, 1') are passed round the respective chain wheel (2, 2') with a half-pitch offset from each other.

3. A conveyance system as set forth in Claim 1, characterized in that the inner and outer endless chains (1, 1') are passed around the respective chain wheel (2, 2') with no pitch offset from each other.

4. A conveyance system as set forth in Claim 1, characterized in that the inner and outer endless chains (1, 1') are driven by a motor (M) through chain wheel (2'') mounted on a shaft (4) at the rotatory section (D) where bulk is discharged out of the container (E).

5. A conveyance system as set forth in Claim 1, characterized in that the inner endless chains (1) are connected to each conveyance container (E) through the media of protuberant elements (8) pivotally secured to the front side end of each container (E), a shaft (10) passed through said protuberant elements (8) and connecting members (5) joined to said shaft (10), while the outer endless chains (1') are connected to said container (E) through the media of protuberant elements (8') fixedly secured to the rear side end of the container (E), a shaft (10') passed through said protuberant elements (8') and connecting member (5') joined to said shaft (10').

6. A conveyance system as set forth in Claim 5, characterized in that at the rotatory section (A, B) where horizontal movement of each container (E) is changed into vertical movement while maintaining the horizontal posture of the container (E) and at the rotatory section (A', B')



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- where vertical movement is changed into horizontal movement, the horizontal distance between the inner and outer wheels (2, 2') is equal to the distance between the protuberance (8) provided at the front side end of each container (E) and the corresponding protuberance (8') provided at the rear side end of said container (E).
- 5 7. A conveyance system as set forth in Claim 1,
- 10 characterized in that the conveyance container body (15) is made of a flexible and resilient plate material which is securely held at its ends by a bent portion (16) at the lower edges of the container side walls and presser plates (17).
- 15 8. A conveyance system as set forth in Claim 1, characterized in that a flexible engagement plate (6) is provided to the front or rear end or to the both front and rear ends of each conveyance container (E).
- 20 9. A conveyance system as set forth in Claim 1, characterized in that cutouts (12) are provided between the teeth of each inner chain wheel (2) at the rotatory section (C'') where the connecting member (5) for connecting each container (E) to
- 25 the endless chain (1) moves in an inverted state, so as to prevent said connecting member (5) from hitting against said chain wheel (2).
10. A conveyance system as set forth in Claim 1, characterized in that the bulk discharge promotion device (13) for promoting discharge of bulk out of the container (E) is constituted from a spindle-shaped roller mounted on a shaft (4) at the rotatory section (D) where bulk is dropped out of the container (E).
- 30 11. A conveyance system as set forth in Claim 10, characterized in that a means for giving vibration to the container body is provided in said bulk discharge device (13).
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