

A MACHINE FOR CONVEYING BULK MATERIAL COMPLETELY
ENCLOSED WITHIN A FLEXIBLE TUBULAR ENDLESS BELT

BACKGROUND OF THE INVENTION

The present invention relates to a machine for
5 conveying and elevating bulk material completely enclosed
within a flexible tubular endless belt.

A flat or troughed belt conveyor has been used for
conveying bulk material such as powder, granule,
pulverized solid, a mixture thereof. However, a
10 conventional belt conveyor cannot climb steep slopes of
even moderate length without slippage of the material to
be conveyed. It cannot be used at a slope angle steeper
than 30 degrees, even if it is troughed and is provided
with nonskid cleats mounted across the inner surface of
15 the belt to prevent the slide down of the material during
operation. The conventional belt conveyor cannot be used
in a curved line continuously.

Further, when the conventional belt conveyor is used
outdoors, the material to be conveyed is wetted in the
20 rain, in case of powder, it is blown off by a wind, and
it is often contaminated by dust. The material is often
spilt over the belt by shocks or vibrations.

In order to overcome these disadvantages, a tubular belt conveyer comprising a flexible tubular endless belt which is provided with a zipper device along its entire length may be used. In this case, however, the zipper device is often broken by the material enclosed within the belt, which is attached to the zipper. Further, the opening and closing of the zipper device is not always operated smoothly and readily.

SUMMARY OF THE INVENTION

10 It is an object of the present invention to provide a machine for conveying bulk material completely enclosed within a flexible tubular endless belt free from the aforementioned disadvantages.

15 A further object of the present invention to provide a machine for conveying bulk material in any direction and any height.

20 According to the present invention there is provided a machine for conveying bulk material completely enclosed within a flexible tubular endless belt, comprising: a flexible tubular endless belt having a normally tubular form which is formed by its own rolling up tendency around its axis, its side ends being overlapped one on another along its length; two rollers, spaced apart, on

which the belt is opened out; spaced support frames for supporting the tubular belt enclosing the bulk material; at least one support frame comprising first and second chambers through which respective conveying and return tubular belt portions pass, the support frame having support rollers disposed radially round each portion of the belt, each chamber having one support roller adapted to contact and press on the belt at its overlapping ends; and a feeder for feeding the bulk material onto the opened belt.

BRIEF DESCRIPTION OF THE DRAWINGS

Other and more specific objects, features and advantages of the present invention will appear from the following detailed description of preferred embodiments thereof with reference to the accompanying drawings, in which:

Fig. 1 is a schematic side view of a machine according to the present invention;

Fig. 2 is an enlarged longitudinal fragmentary cross-section of the loading portion of the machine in Fig. 1;

Fig. 3 is a plan view of Fig. 2;

Fig. 4 is an enlarged longitudinal fragmentary side view of the discharge portion of the machine in Fig. 1;

Fig. 5 is an enlarged cross-section, taken along the line V - V in Fig. 1;

5 Fig. 6 is a schematic side view of another machine according to the present invention;

Fig. 7 is an enlarged fragmentary underneath view of Fig. 6;

10 Fig. 8 is a schematic plan view of still another machine according to the present invention;

Fig. 9 is an enlarged cross-section of a partition plate for preventing the slippage of the material to be conveyed, mounted inside a tubular endless belt;

15 Fig. 10 is an enlarged cross-section of partition fins for preventing the slippage of the material to be conveyed, fixed inside a tubular endless belt;

Fig. 11 is an enlarged transverse cross-section of another tubular endless belt applied to the machine of the present invention;

Fig. 12 is an enlarged transverse cross-section of still another tubular endless belt applied to the machine of the present invention; and

Fig. 13 is an enlarged transverse cross-section of further tubular endless belt applied to the machine of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings, there is shown in Figs. 1 - 8 preferred embodiments of a tubular belt conveyer according to the present invention, comprising a tubular endless belt 1 which is made of a flexible or elastic material such as rubber, somewhat soft plastic material, or the like. The flexible tubular endless belt 1 is normally biased in the tubular form by its own rolling up tendency around its axis, and its inner and outer side ends 1a and 1b overlap one on another along its length.

Such a flexible tubular endless belt can be obtained by cooling only one surface of a belt by a coolant such as water before it cures completely. It can also be obtained

by joining together a plurality of layers having different elasticities.

5 The side ends 1a and 1b of the belt 1 are preferably somewhat soft and adherent so as to contact or interlock one another properly. The thickness of the free side ends of the belt are preferably decreased moderately so as not to increase excessively while they overlap, as shown in Fig. 5.

10 In Fig. 1 is shown the first embodiment of a tubular belt conveyer comprising the flexible tubular endless belt 1 stretched between an upper drive roller 2 and a lower roller 3 on which the endless belt is opened in its width direction, at a standard slope angle.

15 Between the two rollers 2 and 3, the tubular belt 1 is properly supported by a plurality of support frames 4 which are arranged at a certain interval along the travelling path of the endless belt 1. The support frame 4 comprises
20 upper and lower chambers 4a and 4b through which the going or conveying path 1A and the return path 1B of the endless belt 1 are passed, as shown in Fig. 5. In each chamber 4a or 4b of the support frame 4 support rollers 5 are disposed radially around and in contact with the tubular belt 1. The support
25 roller 5 hold and maintain the belt of the tubular form.

The belt opened on the lower roller 3 is closed

28

gradually in a tubular form by its own rolling up force while guide rollers 6 support the bottom and both the sides of the belt 1, as shown in Figs. 2 and 3. In this process, the bulk material such as powder, granule, pulverized solid, a mixture thereof, is fed onto the belt 1 opened from a hopper 7 situated above the lower roller 3.

The tubular belt 1 now enclosing the bulk material completely, while the side ends 1a and 1b of the belt 1 overlap one on another, is passed through the upper chambers 4a of the support frames 4 along the going path 1A of the belt 1, while the tubular belt 1 is supported by the support rollers 5 in the upper chambers 4a, as described above. In this process, the side ends 1a and 1b overlapped are situated in the top of the belt along the going path while the material is enclosed in the belt, and hence there is no danger that the material enclosed in the tubular belt completely is spilt over the belt.

Then, the tubular belt 1 is opened gradually near the upper drive roller 2, and its lower part is supported by guide rollers 8. The opened belt is turned around the upper drive roller 2, while the bulk material conveyed is discharged from the belt 1 to a receiver 9 in which the belt 1 is opened, as shown in Fig. 4.

25

Then, the belt 1 is moved downwards along the return path 1B of the belt. The belt 1 opened is gradually rounded again

into the tubular form by its own rolling up tendency after
through a guide roller 10. The empty tubular belt 1 is
passed through the lower chambers 4b of the support frames 4
while it is supported by the support rollers 5 in the lower
5 chambers 4b, as described above.

The tubular belt 1 is then gradually opened again after
passing another guide roller 10. The opened belt 1 is
returned to the lower roller 3.

10

In Fig. 6, there is shown the second embodiment of a
tubular belt conveyer according to the present invention.

In this embodiment, the endless belt 1 first runs a
15 horizontal path, climbs a steep slope, and then, again, runs
a horizontal path. The travelling path of the tubular belt 1
is curved twice, but it can move smoothly without any trouble.
The maximum slope angle of the tubular belt conveyer is some-
what different depending on the conditions of the material
20 to be conveyed, such as shape, quality, water content, and so
forth. According to the present invention, when dray powder,
granule, or a mixture thereof, is conveyed, the tubular belt
conveyer can be used approximately at a slope angle 60 degrees.

25

In this case, in the return path 1B of the belt 1, the
empty tubular belt 1 is apt to be collapsed, and accordingly
the tubular belt 1 is once opened at a turning point where

the belt opened is turned around a guide roller 10a, as clearly shown in Fig. 7.

In Fig. 8 is shown the third embodiment of a tubular belt conveyer according to the present invention.

The endless belt 1 runs around an obstruction 11 such as a house, i.e. first runs horizontally in a curved line, and then climbs a slope. In the return path 1B of the endless belt 1, it is opened horizontally by a horizontal guide roller 10a at a vertical turning point, and is then opened vertically by a vertical guide roller 12 at horizontal turning point.

It is readily understood from the abovedescription, that the tubular form of the endless belt is held by its own rolling up force, while its side ends overlap, without using any interlocking means such as a zipper device of a conventional tubular belt conveyer, and hence it can be operated quite smoothly and readily, that since the material to be conveyed is completely enclosed within the tubular belt, the flexible tubular belt can be conveniently used in a steep slope, and that the flexible tubular endless belt can run continuously in a curved line, according to the present invention.

There is shown in Fig. 9 a partition plate 13 for stopping the slappage of the material enclosed in the tubular

belt 1, which is particularly effective in a steep slope.

The partition plates 13 may be mounted across the inner surface of the belt 1 at a certain interval in a conventional manner.

5 There is shown in Fig. 10 partition fins 14 which have the same function as the partition plate 13, and may be mounted across the inner surface of the belt 1 at a certain interval. The partition fins 14 may be made of the same material as the belt at the same time as the belt 1 is manufactured.

10 In Fig. 11, there is shown another embodiment of a flexible tubular endless belt 21. In this embodiment, the inner surface of the outer side end 21a and the outer surface of the inner side end 21b of the belt 21 are provided with
15 fine projections and complementary recesses/^{22a; 22b}which are overlapped one another, and thus the side ends are connected stronger than the first embodiment.

20 In Fig. 12, there is shown still another embodiment of a flexible tubular endless belt 31 having mechanical adhesive tape fasteners 32a and 32b in the inner surface of the outer side end 31a and the outer surface of the inner side end 31b. The tape fasteners 32a and 32b are interconnected each other. The same functions and effects are obtained as the one of
25 Fig. 11.

In Fig. 13, there is shown further embodiment of a

flexible tubular endless belt 41 which is the same as the first embodiment except that the central portion of the belt is thicker than the side ends along its entire length, and the thickness of the belt is decreased moderately from the center to the side ends. In this embodiment, it is convenient to impart the widthways rolling up tendency to the belt during manufacture, and to make the central portion of the belt, which is usually given a strong tension by the drive roller, stronger than that in the embodiments described above.

Although the present invention has been shown and described in terms of preferred embodiments thereof, however, various changes and modifications can be made by those skilled in the art without departing from the scope of the present invention.



1. A machine for conveying bulk material completely enclosed within a flexible tubular endless belt, comprising:

5 a flexible tubular endless belt having a normally tubular form which is formed by its own rolling up tendency around its axis, its side ends being overlapped one on another along its length;

10 two rollers, spaced apart on which the belt is opened out;

spaced support frames for supporting the tubular belt enclosing the bulk material;

at least one support frame comprising first and second chambers through which respective conveying and return
15 tubular belt portions pass, the support frame having support rollers disposed radially round each portion of the belt, each chamber having one support roller adapted to contact and press on the belt at its overlapping ends; and

20 a feeder for feeding the bulk material onto the opened belt.



2. A machine according to claim 1, wherein the inner surface of the outer side end and the outer surface of the inner side end of the belt are provided with projections and complementary recesses which engage one another.
5
3. A machine according to claim 1, wherein the inner surface of the outer side end and the outer surface of the inner side end of the belt are provided with mechanical adhesive tape fasteners which contact each other.
10
4. A machine according to any of claims 1 - 3, wherein the belt is provided with spaced partition plates mounted across its inner surface.
5. A machine according to any of claims 1 - 3, wherein the belt is provided with spaced partition fins fixed across its inner surface.
15
6. A machine according to claim 4 or claim 5, wherein the central portion of the belt is thicker than its side ends along its entire length.
7. A machine for conveying bulk material substantially as described herein with reference to and as illustrated in Figures 1 to 5 of the accompanying drawings.
20



8. A machine for conveying bulk material substantially as described herein with reference to and as illustrated in Figures 6 and 7 of the accompanying drawings.

5 9. A machine for conveying bulk material substantially as described herein with reference to and as illustrated in Figure 8 of the accompanying drawings.

10 10. A machine for conveying bulk material as claimed in any of claims 7 to 9, and incorporating a partition plate substantially as described herein with reference to and as illustrated in Figure 9 of the accompanying drawings.

11. A machine for conveying bulk material as claimed in any of claims 7 to 9, and incorporating partitioning substantially as described herein with reference to and as illustrated in Figure 10 of the accompanying drawings.

15 12. A machine for conveying bulk material as claimed in any of claims 7 to 9, and incorporating a tubular endless belt substantially as described herein with reference to and as illustrated in Figure 11 of the accompanying drawings.

20 13. A machine for conveying bulk material as claimed in any of claims 7 to 9, and incorporating a tubular endless belt substantially as described herein with reference to



and as illustrated in Figure 12 of the accompanying drawings.

14. A machine for conveying bulk material as claimed in any of claims 7 to 9, and incorporating a tubular endless
 5 belt substantially as described herein with reference to and as illustrated in Figure 13 of the accompanying drawings.

The text of the specification has been reproduced by photocopying the applicants original typescript. It may contain a few amendments which are difficult to read. The original typescript containing these amendments may be inspected on the premises of the Patent Office