BRAKE FOR ROLLER CONVEYORS


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ABSTRACT
A selectively operable brake for roller conveyors is described in which each roller is connected to a pulley beneath the pass line by a tensioned resilient drive belt and the pulleys are selectively stopped by interposing a sprag. The pulleys may either be positively arrested or allowed to frictionally slip for braking. Interposition of the sprag is controlled by means which permit the device to function as an accumulation conveyor while permitting accumulated objects to be released individually or in groups. The device is usable as a powered live-roller accumulation conveyor or without power as a gravity conveyor.

15 Claims, 20 Drawing Figures
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BRAKE FOR ROLLER CONVEYORS

DESCRIPTION OF THE INVENTION

This invention relates to roller conveyors used to transport individual objects on a pass line, and in its principal aspect concerns a brake for a minimum pressure accumulation roller conveyor which is effective to prevent jamming, pressure build-up and overrun of conveyed objects.

A principal object of the present invention is to provide an improved positive braking system for roller conveyors which is effective to automatically slow or stop the movement of individual conveyed objects to prevent them from running together and jamming or from building up a potentially damaging accumulation of forward pressure against a downstream stoppage. It is particularly intended to provide a positive braking means for such conveyors which will accumulate conveyed objects at predetermined spaced intervals upstream of a stoppage, while permitting the accumulated objects to be selectively released as desired.

The invention has as a further object the provision of a simple and inexpensive brake particularly adapted for live-roller conveyors in which a common drive shaft powers each individual roller through a tensioned drive belt.

It is also intended to provide such a conveyor brake which is usable both in powered and gravity accumulation conveyors, and which will permit a controlled degree of overrun of a conveyed object, if desired, when the brake is applied. Provision is made for coincidence actuation in which the detection of a conveyed object at each of two separated trigger positions is required before a given section of braked rollers will be braked.

In greater detail, it is intended to provide a control means for a roller conveyor brake which allows the braked conveyor sections to be released either singly or in multiple groups to provide for singulation or slug runout of the conveyed objects as required.

Other objects and advantages of the invention will become apparent from reading the following detailed description in conjunction with the drawings, in which:

FIG. 1 is a partial side elevation of a live-roller accumulation conveyor exemplifying one aspect of the present invention;

FIG. 2 is an enlarged section taken in the plane 2—2 of FIG. 1;

FIG. 3 is a section similar to FIG. 2 showing a gravity conveyor pulley arrangement;

FIG. 4 is an end elevation of the structure of FIG. 1;

FIG. 5 is a schematic diagram of a live-roller accumulation conveyor utilizing the structure of FIG. 1;

FIG. 6 is a live-roller accumulation conveyor incorporating a modification of the structure of FIG. 5;

FIG. 7 is a schematic diagram of a gravity accumulation roller conveyor utilizing the structure of FIG. 3;

FIG. 8 is a side elevation of a second exemplary roller conveyor;

FIG. 9 is an enlarged section taken in the plane 9—9 of FIG. 8;

FIG. 10 is a fragmentary view of an alternative embodiment of the configuration of FIG. 8;

FIG. 11 is an end elevation of the structure of FIG. 8;

FIG. 12 is a schematic diagram of a live-roller conveyor similar to that of FIG. 5 utilizing the structure of FIG. 11 and having provision for slug runout;

FIG. 13 is a schematic diagram of an accumulation roller conveyor employing a plurality of close-coupled braked roller sections;

FIG. 14 is a schematic diagram of a gravity roller conveyor utilizing the structure of FIG. 11;

FIG. 15 is a partial side elevation of a third exemplary live-roller accumulation conveyor;

FIG. 16 is an enlarged section taken in the plane 16—16 of FIG. 15;

FIG. 17 is an end elevation of the structure of FIG. 15;

FIG. 18 is a schematic diagram of a live-roller conveyor similar to that of FIG. 5 and having the structure of FIG. 15;

FIG. 19 is a schematic diagram of a roller conveyor similar to FIG. 18 having coincidence triggering; and

FIG. 20 is a gravity accumulation conveyor utilizing the structure of FIG. 15.

While the invention is described in connection with certain illustrative and exemplary embodiments, it will be understood that the invention is not restricted to the particular uses and applications shown and described herein, but on the contrary may be utilized in all roller conveyor applications wherein a positive and accurately controllable braking effect is required to assure proper operation.

Turning next to the drawings, there is shown in FIG. 1 an exemplary live-roller accumulation conveyor in which individually powered transverse rollers 10 are supported for rotation by a frame having longitudinal side members 11. The upper surfaces of the individual rollers 10 are disposed on a common plane and define a pass line along which conveyed objects (shown in phantom) are propelled. Certain rollers 10 are individually driven from a drive shaft 12 which, in this example, is positioned beneath the pass line and aligned in the direction of conveyor movement. A motor (not shown) drives the shaft 12 in a conventional manner.

Spaced along the length of the drive shaft 12 and rotatable thereon are a plurality of end-to-end elongate sleeves 13, one for each section of rollers 10 which will be braked as a group. Each sleeve 13 carries a plurality of spools 16, one for each roller 10. The spool sections 16 in the particular embodiment of FIG. 1 are separately carried as individual spool units by the sleeve 13.

Power is transferred from each spool 16 to its associated roller 10 through a resilient tensioned drive belt 18 such as an O-ring. The elastomeric properties of the belt 18 allow it to stretch somewhat in accommodating itself to the spacing between the roller 10 and the sleeve 13, thus applying a preload tending to pull the sleeve 13 and spools 16 to one side of the drive shaft 12 (FIG. 2). This preload provides a controlled degree of coupling friction between the shaft 12, the sleeve 13 and the spools 16. Under ordinary operating conditions the frictional coupling between these elements is sufficient to provide non-slipping power transmission to each roller 10.

Pursuant to a principal aspect of the invention, a brake is provided for individual groups of rollers 10 by which the sleeve 13 and its spools 16 are positively halted while the drive shaft 12 continues to rotate. This is accomplished by providing a key 20 on the sleeve 13 which rotates with the sleeve, but which can be positively stopped by the interposition of a sprag 21 carried on a pivot shaft 22. As seen in FIG. 1, the pivot shaft 22
is rotated in a counterclockwise direction to bring the sprag 21 into the path of the key 20 on the rotating sleeve 13. The rollers 10 of the embodiment shown in FIGS. 1 and 2 are therefore driven by a double-friction mechanism, that is, there are two points of possible frictional slippage between the drive shaft 12 and the rollers 10 so that certain desirable motion in the drive system may continue although other elements are immobilized.

Actuation of the sprag 21 is accomplished through trigger means which, in this exemplary embodiment, includes a trigger roller 23 attached to a pivot frame 24 mounted on the frame side members 11 and carrying a chain 25 or other linkage means running back to a lever 26 on the next preceding pivot shaft 22. A spring 27 is provided to retain the sprag 21 in a disengaged position and to hold the trigger roller 23 slightly above the surface of the pass line ready to engage a passing conveyed object. The trigger frame 24 is desirable constructed of two side plates with a cross member so that it is rigid and prevents cocking or skewing of the trigger roller 23.

When a conveyed object approaches the trigger roller 23, it depresses that roller and its frame 24 in a downwardly rotating motion which pulls the chain 25 to the right as seen in FIG. 1, rotating the pivot shaft 22 which brings the sprag 21 into the path of the key 20 on the rotating sleeve 13. Upon encountering the key 20, the sprag 21 holds it stationary while the drive shaft 12 continues to rotate within the sleeve 13. The frictional torque thus produced is not sufficient to cause any mechanical damage, but will cause the sleeve 13 to begin rotating again when the sprag 21 is removed. The various slippable members are desirably constructed of materials which will not cause excessive wear or galling during operation, such as metal against plastic and vice versa. Desirably, the drive shaft 12 is of metal with the sleeve 13 being of a dissimilar metal and the individual spools 16 being of plastic.

The use of individual spools 16 mounted on each sleeve 13 allows the accumulation of more conveyed objects on a given length of conveyor than would otherwise be possible. If individual spools 16 were not used with the belts 18 being driven directly by the sleeve 13, when an object was stopped at a point where a first trigger means was depressed the next oncoming object would be driven onto the braked section until the friction between the bottom of the object and the still-moving upstream rollers was equal to the downstream braked rollers. The object would therefore come to a stop before it reached the point where it could actuate the trigger roller at the front of that braked section. Further oncoming objects would strike it, nudging it gradually forward until it depressed the trigger means to brake the next section of upstream rollers to stop the nudging process (FIG. 5).

By contrast, with the individually frictionally retained spools 16 the next object can overrun the first few braked rollers 10 by forward inertia until the energy of inertia is dissipated by the individual spools 16 rotating against the arrested sleeve 13. The first of the braked rollers 10 thereby roll beneath the object instead of the object sliding over them. The object will therefore move forward onto the braked section of rollers 10 farther than it would otherwise, and will reach the next trigger roller 23 to stop the motion of the next preceding group of rollers sooner than would otherwise be the case. This action will lead to almost complete filling of the accumulation conveyor with little or no pressure between the objects on the conveyor because all of the braked rollers 10 are completely separated from their source of power in this particular case.

A slightly modified configuration is shown in FIG. 6 in which each trigger means is located at the midpoint of the next succeeding downstream section of braked rollers so that an object will tend to come to a stop directly over the trigger means for the next preceding group of braked rollers. The overrunning provision mentioned previously allows gaps between the products to be closed. This construction has the further advantage of allowing accurate singulation of individual products from the accumulated group after the blockage has been removed, since each product is enabled to start up smoothly when the next succeeding downstream product passes away from the trigger means on which it previously had been resting.

When used as a gravity conveyor the drive shaft 12 is omitted, resulting in the structure shown in FIG. 3. In either case the spools 16 are free to rotate on the sleeve 13 even though the sleeve may be arrested by the interposition of the sprag 21 to catch the key 20 and arrest the sleeve 13. The advantage of this structure in a gravity conveyor (FIG. 7) is that it allows a group of free rollers to carry a conveyed object onto or almost onto the next succeeding group of braked rollers. The gentle pushing action with which the objects are accumulated does not cause breakage because the spools 16 tend to resist further movement as they slip on the sleeve 13. As a result, the conveyed objects are gently accumulated in a continuous line on braked sections of the roller.

In FIG. 8 a second major embodiment of the invention is shown in which the belts 18 are directly driven by the sleeve 13 through spool-shaped depressions 28 in its outer surface. The double-friction feature of the separate spool 16 is eliminated, with the result that a conveyed object is stopped immediately upon encountering a braked section of rollers 10.

A modification of the foregoing is shown in FIGS. 10 and 11 wherein an integral separate sprag 30 is carried by the trigger frame 24 itself and engages a key 20 carried on an axial extension 31 of the sleeve 13. The sleeve extension 31 extends downstream by at least one group of braked rollers 10 so that the rollers 10 associated with the sleeve 13 are braked as before by a trigger roller 23 located downstream of the affected rollers. The sleeve extension 31 extends axially downstream of the braked rollers 10 to a point adjacent the trigger frame 24 to provide engagement with the sprag 30. In this embodiment, each sleeve extension 31 over laps the sleeve 13 preceding, and both are rotatably carried by a pivot 32 rather than the drive shaft 12. The necessary driving force is provided by a separate drive shaft 33 located parallel and adjacent to the stationary shaft 32 (FIG. 11). In this construction other frictionally driven spools 34 are employed to drive the powered rollers 10 through separate O-ring belts 18.

A further feature of the invention shown in FIGS. 9 and 11 provides a brake activation means which allows
the sprag 21 to be selectively disengaged even while its trigger roller 23 is depressed, permitting any accumulated objects to be released as a group for slug runout. For this purpose the pivot shaft 22 is slidable received on a cross shaft 36 mounted to the frame side members 11 and is positioned by means of a yoke 37 engaging a pin 38. The yoke 37 is controlled by an actuating shaft 40 running longitudinally down the conveyor. Under normal operation the sprag 30 engages the key 20 to arrest the sleeve 13 and its associated rollers 10. The drive shaft 33 of the embodiment of FIG. 11 continues to rotate within the spools 34, but slips frictionally because the rollers 10 are kept from moving by the sprag 30. When it is desired to release the rollers 10, the actuating shaft 40 is rotated in a clockwise direction as seen in FIG. 11, thereby moving the yoke 37 to the right and shifting the pivot shaft 22 with it. This moves the sprag 30 to the disengaged position as indicated in phantom in FIG. 11.

Application of the foregoing structure to various conveyors is shown schematically in FIGS. 12, 13 and 14. In FIG. 12 a single group 41 of contiguous braked rollers is associated with a downstream trigger means 42. This conveyor will accumulate when a first conveyed object 43 enters the trigger means 42 and halts any preceding conveyed object 44 entering upon the group 41 of braked rollers. When a group of objects has been accumulated, they may be released as a group for slug runout by disengaging an activation means 45 such as the actuating shaft 40 in FIG. 11. In the embodiment of FIG. 13, the groups 41 of braked rollers are arranged in continuous succession, each group being separated by the trigger means 42 for the next preceding group of rollers. A common actuating means 45 controls the brakes of each of the groups 41 to allow for release of all accumulated objects simultaneously. In FIG. 14, the same structure is applied to an unpowered gravity roller conveyor.

In a third major embodiment of the invention, shown in FIG. 15, the conveyor structure is substantially identical to that of FIG. 8 except that the pivot shaft 22 is carried by an extension of the adjacent trigger frame 24 instead of by the conveyor frame side members 11. With this construction the trigger frame 24 itself acts as an activation means which prevents the sprag 21 from engaging the key 20 unless the adjacent trigger roller 23 at that position is depressed. The result is a coincidence actuation system in which the trigger roller 23 at each group of contiguous rollers 10 to be braked must be depressed in addition to the next downstream trigger roller 23 normally associated with that group.

The coincidence triggering mechanism of FIG. 15 has the advantage of assuring that each object is carried freely all the way onto a section of rollers before it is braked. Otherwise, an object would tend to stop toward the upstream side of the group of braked rollers, leaving a gap until it was finally nudged down over that group of rollers to contact the trigger means at the end.

The structure of FIG. 15 may be utilized with that of FIG. 11 in a construction such as shown in FIG. 17 wherein a separate power shaft 33 and individual spools 34 are provided to drive the rollers 10, with the braking effect being supplied by a sleeve 13 carried on a separate shaft 32 and connected to the rollers 10 by its own O-ring belts 18. An activation means is provided through the use of a pivot shaft 40, yoke 37 and pin 38 as in the embodiment of FIG. 11.

As shown in FIG. 16, the pivot shaft 22 and sprag 21 of the embodiment of FIGS. 15 and 17 are shiftable both in a downward direction through movement of the trigger frame 24 and in a sideways direction through the shifting of the pivot shaft 22 by the yoke 37. This enables the brake to be released through the release of the actuation means with the additional advantage of coincidence actuation.

The use of coincidence actuation in various conveyors is illustrated in FIGS. 18, 19 and 20. In FIG. 18 a single group of braked rollers 41 is used as in the preceding example of FIG. 12. An actuation means 45 provides for slug runout, and an additional trigger means 46 supplies coincidence actuation. This has the advantage of preventing excessive wear on the mechanism when only single objects are passing down the conveyor, since one such object is incapable by itself of actuating any of the brakes since it cannot depress more than one trigger means at a time. In FIG. 19 the use of the coincidence triggering mechanism is again illustrated, showing how objects are gently accumulated in a continuous line because a given group of braked rollers 41 will not be braked unless a conveyed object 43 happens to depress the trigger means 42 immediately downstream as well as the trigger means beyond the next group of rollers 41. In FIG. 20 the same structure is applied to a gravity conveyor.

In applications such as exemplified by FIGS. 8 and 15 where the double-friction mechanism provided by the separate spools 16 is not utilized it is desirable to have a low-friction surface on the rollers 10 to allow each object to be nudged over them during accumulation. However, where the separate pulleys 16 are used, or where a single group of braked rollers is used to accumulate a long line of products as in the schematic representations of FIGS. 12 and 18, a somewhat tacky high-frictional material is desirable such as a soft plastic or rubber coating.

In the embodiments of FIGS. 12 and 18 which have braked roller sections 41 at spaced intervals, objects will be accumulated in contiguous groups, one for each section 41 of braked rollers, and with a gap separating the groups. In such cases the individual products will be singulated (individually discharged) upon removal of the blockage, although the pressure between products upstream of the braked section is greater than in those other embodiments wherein a larger number of braked sections are used. In such applications the double-friction feature of the embodiment of FIG. 1 may be employed to advantage.

The following is claimed as invention:

1. In a roller conveyor having a frame and a plurality of rollers carried by the frame to define a pass line, a roller brake comprising in combination, a plurality of pulleys disposed beneath the pass line and each connected to an individual one of a group of braked rollers by a tensioned resilient belt looped between each pulley and its associated roller, a rotatable sleeve drivably connected to each of the pulleys, and sprag means carried by the frame for selectively engaging the sleeve to arrest the sleeve and rollers.

2. An accumulation conveyor including apparatus as defined in claim 1 and having trigger means disposed
adjacent the conveyor pass line downstream of the braked rollers for actuating the sprag means in
response to the presence of a conveyed object.
3. Apparatus as defined in claim 2 in which the trigger means includes a trigger roller carried by a
trigger frame which is pivoted for downward movement upon encountering a conveyed object, and linkage
means connecting the trigger frame to the sprag means.
4. Apparatus as defined in claim 2 in which the trigger means includes a trigger roller carried by a
trigger frame which is pivoted for downward movement upon encountering a conveyed object, the sprag means
being carried by the trigger frame, and the rotatable sleeve extending axially downstream of the braked rol-
ers to a point adjacent the trigger frame for engagement with the sprag means.
5. Apparatus as defined in claim 2 in which the sprag means is carried by a shifting member for movement
toward and away from operating proximity to the sleeve, and having activation means for selectively
bringing the shifting member into position for engagement of the sprag means with the sleeve in response to
the trigger means.
6. Apparatus as defined in claim 5 in which the group of braked rollers and associated downstream trigger
means are disposed at the end of a series of unbraked rollers, for accumulation and selective slug runout.
7. An accumulation conveyor including a plurality of consecutively disposed apparatus as defined in claim 5
in which the activation means of each apparatus is jointly operable for effecting slug runout of a group of
accumulated conveyed objects.
8. An accumulation conveyor including a plurality of consecutively disposed apparatus as defined in claim 5
in which each activation means is responsive to a preceding upstream trigger means.
9. An accumulation conveyor including a plurality of consecutively disposed apparatus as defined in claim 5
in which each activation means includes a trigger frame which is pivoted for downward movement upon en-
countering a conveyed object, said trigger frame carrying both the trigger roller associated with one group of
contiguous braked rollers and the sprag means for the
next succeeding downstream group of contiguous braked rollers, whereby the sprag means is engageable
with the sleeve of said one group upon being triggered by the next succeeding downstream trigger roller only
upon the simultaneous depression of the trigger roller of said one group.
10. Apparatus as defined in claim 1 where each pulley is separately carried by the sleeve in slippable fric-
tional engagement, whereby the amount of driving force transmitted to each individual roller is limited by
individual pulley slippage.
11. Apparatus as defined in claim 10 in which the trigger means is disposed at the end of a next succeed-
ing downstream group of braked rollers.
12. Apparatus as defined in claim 10 in which the trigger means is disposed at the midpoint of a next suc-
ceding group of braked rollers.
13. A live-roller conveyor including apparatus as defined in claim 1 and having a powered rotating drive
shaft carried by the frame and disposed within the sleeve in slippable frictional driving engagement therewith.
14. A roller conveyor comprising a frame, a plurality of rollers rotatably mounted on said frame to define a
pass line extending along the length of said conveyor, a drive shaft spaced from said rollers and extending
transversely thereof, at least one sleeve rotatably mounted upon said drive shaft and juxtaposed to at
least some of said rollers, said sleeve being frictionally coupled to said drive shaft to limit the amount of
torque transmitted between said drive shaft and said some rollers, a pulley rotatably mounted on said sleeve,
and an endless transmission belt for each of said some rollers looped about said pulley and about the asso-
ciated one of said rollers, said pulley being frictionally coupled to limit further the amount of torque
transmitted between said drive shaft and said rollers and to permit one of said some rollers to be stopped
independently of the remainder of said some rollers.
15. The combination according to claim 14 wherein brake means are provided for engaging said sleeve to
arrest the rotation of said sleeve and said some rollers.