

Oct. 16, 1962

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3,058,573

AUTOMATIC BELT TRAINING IDLER ASSEMBLY

Filed Oct. 8, 1959

2 Sheets-Sheet 1

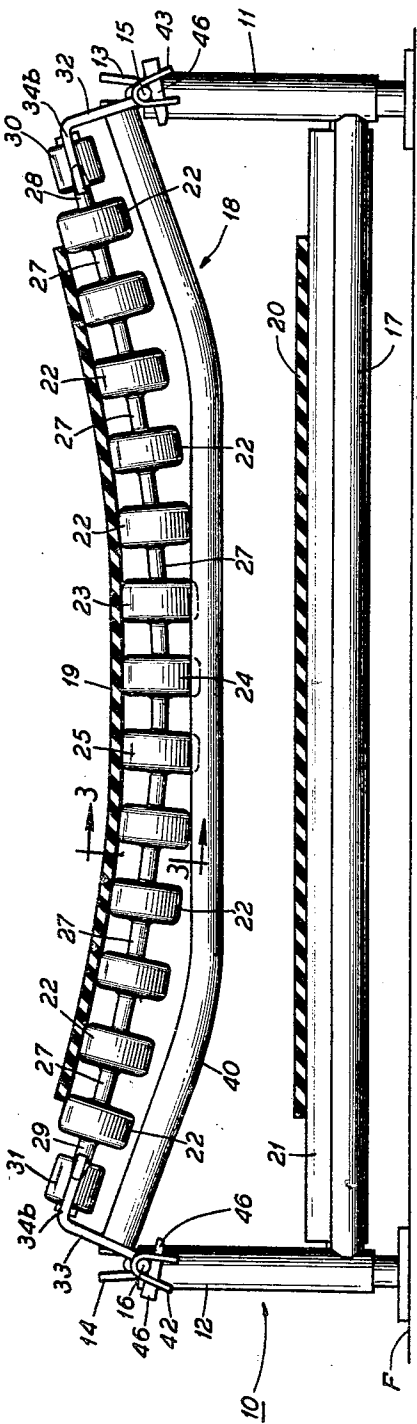


Fig. 1

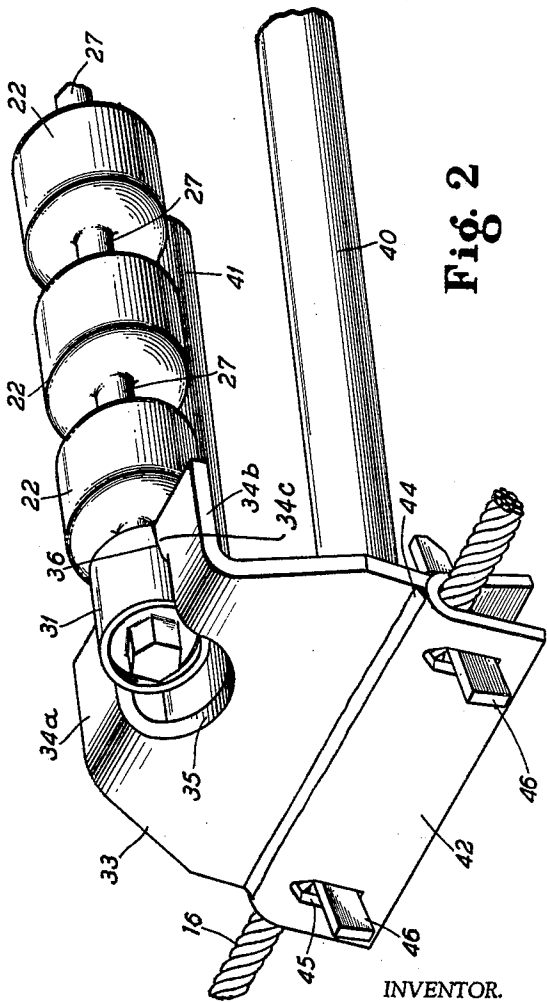


Fig. 2

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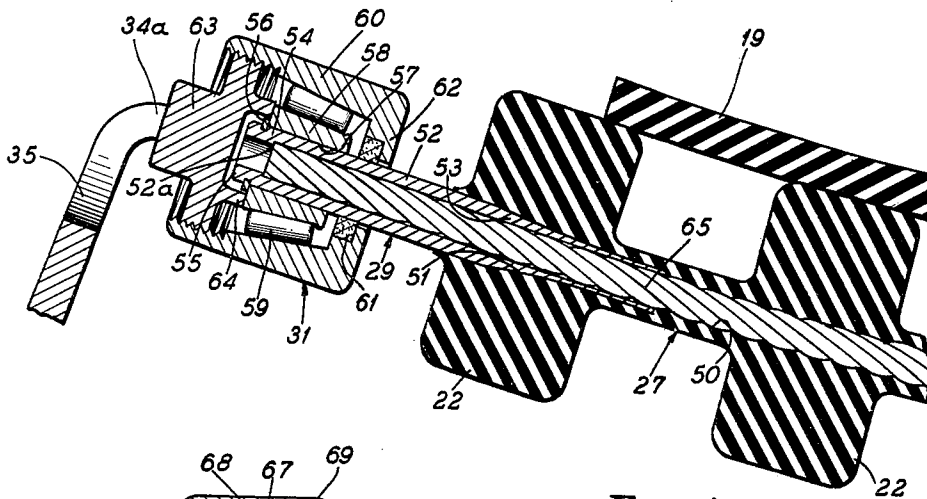


Fig. 4

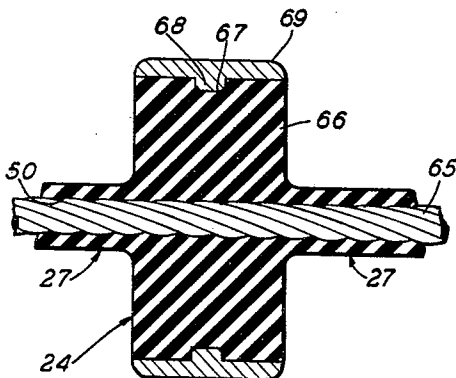


Fig. 5

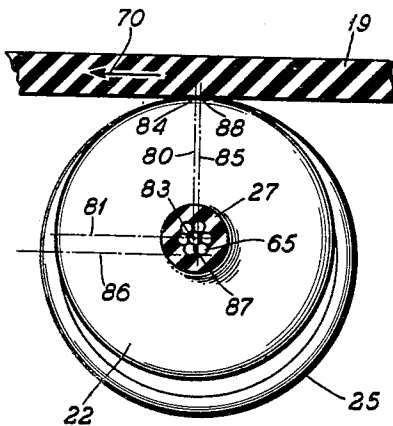


Fig. 3

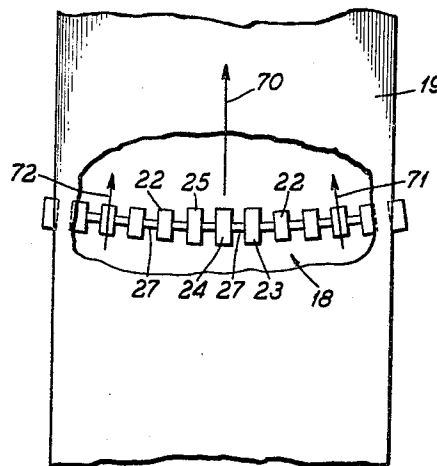


Fig. 6

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AUTOMATIC BELT TRAINING IDLER ASSEMBLY
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Filed Oct. 8, 1959, Ser. No. 845,164

4 Claims. (Cl. 198-202)

This invention relates, in general, to troughing idler assemblies for flexible belt conveyors, and, in particular, to a troughing idler assembly for automatically training a flexible conveyor belt which passes over it.

A great deal of development work has been done in recent years in the flexible belt conveyor field. One of the most important recent advances has been the development of troughing roller assemblies which are serially interconnected to form a flexible support for a conveyor belt. The rollers may be either axially aligned or offset with respect to one another, and they may be connected directly one to the other or maintained in position by an extraneous supporting structure. In any event, the troughing idler assembly is installable as a unit into flexible belt conveyors of both the rigid and flexible side frame types.

These troughing idler assemblies have many inherent desirable features including a high carrying capacity, due primarily to their ability to conform to the load being carried thereon, low initial cost, and ease of installation and replacement.

The construction of these troughing idler assemblies varies widely. In one type, a plurality of generally metallic rollers whose length is usually substantially greater than its diameter are employed. In another, a plurality of individual idlers or rollers whose axial length is generally on the order of or slightly smaller than the diameter of the roller, are serially linked together to rotate as a unit, with the linking means generally rotating with the rollers. In this construction the rollers are generally made of a resilient material, such as hard rubber. This type of roller can be employed either with or without a rigid supporting frame structure, and both variations can be employed in either rigid or flexible side frame conveyors.

One problem that is present in the above described unitarily rotatable roller structure is that of belt training.

It is well known that as a flexible belt passes over a troughing idler assembly, the assembly exerts an affect on the belt which can either cause the belt to run true, or train, down the center of the assembly, or run "wild," i.e. detrain, to one side or the other. As a general rule, the training effect exerted by a troughing idler assembly roller on a belt passing over it is directed substantially perpendicularly to the longitudinal axis of the roller.

The individual rollers in the unitarily rotatable troughing idler assemblies generally hang free, even if the ends of the idler assembly are substantially fixed with respect to one another. This is true because, as a practical matter, it is rather difficult and expensive to independently support each individual idler roller.

As a belt passes over a free-hanging unitarily rotatable troughing idler assembly, it tends to drag the entire assembly downstream with it due to the friction between the surface of the rollers and the underside of the belt. This dragging or friction effect tends to bow out the troughing idler assembly into a contour which is convex downstream. As a result, the training effect exerted by the middle rollers will be directed substantially in the direction of belt travel, whereas the training effect exerted by the wing or flanking rollers will be exerted in outward directions, or in a detraining direction, with respect to belt travel.

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If a belt should detraining when the troughing idler assembly is in this position due to improper loading, an obstruction along the conveying course, or improper placement of the components of the conveyor system, the detraining condition will be aggravated. Since the amount of training exerted on the belt is roughly proportional to the amount of contact between the belt and the rollers, an imbalance of contact between the flanking rollers will aggravate the running wild condition. For purposes of further description, when the troughing idler assembly assumes the convex downstream position, it is in a condition of unstable equilibrium.

Another problem common to most if not all such unitarily rotatable troughing idler assemblies is that of roller edge wear. Since the individual rollers are generally composed of a relatively soft material, such as hard rubber, the edges of the roller tend to wear down due to the constant shifting in the angle the belt makes with the surface of the roller as it veers from side to side. This "hunting" effect is most pronounced when the troughing idler assembly is in the unstable equilibrium condition described above.

Accordingly, a primary object of this invention is to provide a unitarily rotatable troughing idler assembly for a flexible belt conveyor which will automatically train the flexible belt as the belt passes thereover.

Another object is to provide an automatic belt training unitarily rotatable troughing idler assembly which may be utilized in both rigid and flexible side frame conveyors.

Yet a further object is to provide an automatic belt training unitarily rotatable troughing idler assembly which reduces wear of the individual rollers.

Yet a further object is to provide an automatic belt training unitarily rotatable troughing idler assembly having a series of interconnected rollers, a plurality of the rollers in a series being of a larger, composite construction, the exterior of the composite rollers having an extremely hard, wear-resistant surface.

Other objects and advantages of the invention will become obvious in the course of the following specification and claims.

The invention is illustrated more or less diagrammatically in the accompanying drawings wherein:

FIGURE 1 is a sectional view through a flexible side frame conveyor;

FIGURE 2 is a perspective view illustrating the end construction of the automatic belt training troughing idler assembly of FIGURE 1;

FIGURE 3 is a view taken substantially on the line 3-3 of FIGURE 1;

FIGURE 4 is a partial sectional view through the end of the troughing idler assembly illustrated in FIGURES 1 and 2;

FIGURE 5 is a detail sectional view of one of the center rollers in the roller series; and

FIGURE 6 is a diagrammatic top plan view illustrating the contour the troughing idler assembly assumes when a belt passes thereover.

Like reference numerals will be used to refer to like parts throughout the following specification and drawings.

In FIGURE 1, a flexible strand conveyor is indicated generally at 10. It consists essentially of a plurality of telescoping support stands 11 and 12 resting on the floor F. Each of the stands carries, in this instance, U-shaped saddle members 13 and 14 at its upper end which receive flexible strands 15 and 16. A rigid cross strut 17 maintains the stands and thus the gauge of ropes, a fixed distance apart, and the level of the strand seats may be adjusted to lie in a common horizontal plane by suitable adjusting means, not shown.

A troughing idler assembly, indicated generally at 18, forms a support for the conveying reach 19 of a flexible

conveyor belt. The return reach 20 of the belt is supported by a return roller 21 connected to the flexible strands or other supporting structure by suitable means, not here shown.

The troughing idler assembly includes, in this instance, a series of individual troughing idler rollers 22, 23, 24 and 25. The individual rollers are serially joined by linking means 27, illustrated best in FIGURES 4 and 5, the end portions 28 and 29 of which are secured in end bearings 30 and 31. The end bearings in turn are supported by a pair of end plates 32 and 33. Each end plate consists of a pair of inwardly directed flange portions 34a and 34b which form a groove 35 to receive the end bearings. The flanges 34a, 34b retain the bearings 31 and 32 as at 36. The bearings may be merely wedged in position between the inwardly directed wedge portions 34c as shown best in FIGURE 2, or the cylindrical bearing wall may be apertured to receive the wedge portions 34c. In this latter case, the wedge portions 34a would act as abutment members. The particular mode of suspension of the idler assembly is not an essential feature of the invention, it is only important that the assembly be easily removable for inspection and replacement.

A pair of slightly concave upwardly elongated tubular members 40 and 41 extend beneath the level of the troughing idler rollers and are welded at their ends to the inside faces of the end plates 32 and 33. Frame members 40, 41 and end plates 32, 33 form, in effect, a frame assembly which carries the series of rollers. The roller frame assembly is connected to the flexible strands by a pair of inverted U-shaped plates 42 and 43 which are welded to the end plates as at 44. A plurality of aligned apertures 45 in each leg of the connecting plates 42 and 43 receive drift pins 46 which force the flexible strand into tight engagement in the seat formed in the bight of the connecting plates.

Although a two-point support for the frame assembly has been illustrated in FIGURE 2, it should be understood that one, or three or more point supports are within the scope of the invention. Similarly, although a pair of elongated frame members 40 and 41 have been illustrated, a single member may suffice in some environments. Likewise, although the connecting means 42 and 43 are shown as welded to the end plates 32 and 33, they could be connected directly to the elongated frame members.

The diameter of the individual troughing idler rollers is not equal along the length of the roller series as shown in FIGURE 1. Thus the ten wing rollers 22 flanking the three center rollers 23, 24 and 25 are all of substantially smaller diameter than the center rollers. In this instance, the flanking, or wing rollers 22 are of equal diameter. The three center rollers are likewise of equal diameter, one to the other.

The rollers are illustrated in detail in FIGURES 4 and 5. Each of the rollers 22 is shown, in this instance, as composed of a relatively stiff, resilient material such as hard rubber. The individual rollers have been molded integrally with connecting sleeves 27 which join the rollers one to another whereby they may be rolled along a level surface as a unit. A contoured bore 50 extends the length of the roller series, passing through the connecting sleeves 27 and individual rollers. The bore expands or flares outwardly as at 51 to receive a connecting sleeve 52 having an inner tapered portion 53, complementarily received in flare 51, and an outer tubular portion 54. Outer portion 54 is necked down near its outer end 55 to receive an abutment ring 56. The sleeve passes through the bore 57 of the journal member 58 of bearing 31. Journal member 58 is tapered along its circumference and a plurality of roller bearings 59 provide rolling friction between the journal member, and race member 60 of bearing 31. Packing 61 in inner end wall 62 of bearing 31 prevents ingress of dirt to the bearing and prevents escape of lubricant out along the connecting sleeve 52. Positioning cap 63 is threadably received in the outer end of bearing 31

and has an integral flange ring 64 which bears against the outer end of journal member 58 to properly orient the journal and race members.

An elongated flexible strand 65 passes through bore 50 of the roller series and terminates in the outer portion of the connecting sleeve 52. A shoulder 52a prevents unintended endwise movement of the strand. The strand 65 may be wire, nylon, or combination nylon-Dacron rope. It acts as a reinforcing member and imparts toughness and strength to the series of interconnected rollers. The rollers may be molded about it.

One of the expanded diameter center rollers is illustrated in detail in FIGURE 5. Only roller 24 has been illustrated, since it is substantially identical to rollers 23 and 25.

Roller 24 includes a body portion 66 of substantially the same material of which the wing or flanking rollers 22 are composed. The circumference of the body portion 66 has been notched, as at 67, to receive a mating tongue 68 projecting inwardly from wear-resistant ring 69. Ring 69 may be formed of any well known wear-resistant material such as a suitable metal or a relatively hard plastic material.

The use and operation of the invention can best be understood by referring to FIGURES 3 and 6. In FIGURE 6, the direction of travel of the conveying reach 19 of the flexible belt is indicated by the arrow 70. The arrows 71, 72 indicate the direction and magnitude of the training effect exerted by the individual rollers on the belt 19.

As the belt passes over the troughing idler assembly, the linear speed of the belt and the peripheral speed of the rollers 22 will be approximately the same, because the proportion of the belt-roller contact represented by these smaller diameter rollers is substantially greater than the less numerous, larger diameter rollers 23-25. In other words, there are substantially more smaller diameter rollers than larger diameter rollers. Since all rollers rotate as a unit because of the integral connecting means 27, the peripheral speed of the large diameter rollers will be greater than the linear speed of the belt. The difference, of course, can be readily calculated from well known laws of physics, and will be proportional to the radii of the respective rollers.

Since the peripheral speed of the larger diameter rollers is greater than that of the belt and the adjacent small diameter rollers, the center rollers will crawl upstream. There will of course be some slippage between the large diameter rollers and the underside of the belt. When the large diameter rollers move upstream, they cause the entire troughing idler assembly to assume a contour which is concave downstream. As a result, the training effect exerted by the rollers on the belt is directed inwardly as represented by force vectors 71 and 72 and the belt is in a stable equilibrium condition. Should the belt detrain to one side or the other, say for example to the right, the training effect exerted by the small diameter rollers to the right of the large diameter center rollers will increase due to the increase in contact between the belt and rollers, and the contact between the belt and rollers to the left of the large diameter center rollers will decrease correspondingly. The right training force 71 will correspondingly increase over left training force 72, and, as a result of the imbalance of forces, the belt will be urged back to a centered position.

The position assumed by the rollers in a running condition is best illustrated by FIGURE 3. In this figure, quadrant lines 80 and 81 of flanking roller 22 are shown as meeting at the center 83 of the rollers. The roller contacts the belt at 84. Similarly, quadrant lines 85 and 86 meet at the center 87 of one of the large diameter center rollers 25. The roller contacts the belt at 88. As is obvious from the longitudinal distance between the points of contact 84 and 88, the center of the large

diameter center rollers are positioned upstream from the center of the wing rollers.

Although the spacing of the individual rollers along the reinforcing strands 65 can be varied at will, the illustrated equidistant spacing is considered to be highly practical. Similarly, the placement of the large diameter rollers can vary somewhat, but they should be close to or at the mid-portion of the roller series to obtain the best training effect.

Similarly although the troughing idler assembly has been illustrated in conjunction with a flexible strand conveyor, it will be understood that the construction may be equally well adapted for rigid frame conveyors.

While I have shown and described the preferred form of my invention, it should be understood that numerous modifications, changes, substitutions and alterations can be made without varying from the invention's fundamental theme. I, therefore, wish that the invention be unrestricted except as by the appended claims.

I claim:

1. A troughing idler assembly for a flexible belt conveyor which is operable to maintain a conveyor belt centered as it passes over the assembly solely by virtue of contact between the conveyor belt and the assembly, said assembly including, in combination,
 a roller assembly comprised of
 a yieldable roller supporting core, and
 a plurality of belt-contacting rollers carried by the core and spaced from one another along the core, said rollers being rotatable with the core, and
 connecting means for suspending the roller assembly by its ends from the side frames of a flexible belt conveyor,
 said rollers being divided into an intermediate roller series and
 a pair of flanking roller series,
 the individual rollers in the flanking roller series being of substantially the same diameter,
 the rollers in the intermediate series each being of a substantially larger diameter than the rollers in the flanking series,
 each roller in the intermediate series having a harder, more wear resistant belt contacting surface than the belt contacting surfaces in the flanking rollers whereby the roller assembly, due to the difference in diameters between the rollers, will be oriented into a belt training position in response to passage of a belt thereover.

2. The belt training troughing idler assembly of claim 1 further characterized in that each of the rollers in the intermediate series is of substantially the same diameter.

3. The belt training troughing idler assembly of claim 1 further characterized in that the flanking series rollers are composed of a resilient material having the properties of hard rubber,

and the belt contacting surfaces of the intermediate series rollers are substantially harder than the flanking rollers,

said belt contacting surfaces being composed of a

material selected from the group consisting essentially of metal and plastic.

4. A wire rope flexible belt conveyor, said conveyor including, in combination,
 a pair of wire ropes trained in generally parallel relationship to one another along a conveying course, means for supporting the wire ropes at substantially regular intervals along the course,
 a plurality of troughing idler assemblies suspended from the wire ropes for supporting the conveying reach of a flexible conveyor belt,
 a plurality of return rollers and means for supporting said rollers along the conveying course, and
 a flexible conveyor belt having its conveying reach supported by the troughing idler assemblies and its return reach supported by the return rollers, each of said troughing idler assemblies being effective to maintain the conveying reach of the belt in train as it passes thereover solely by virtue of contact between the belt and the assembly,
 said assembly further including, in combination,
 a roller assembly comprised of
 a yieldable roller supporting core, and
 a plurality of belt-contacting rollers carried by the core and spaced from one another along the core, said rollers being rotatable with the core, and being divided into
 an intermediate roller series and
 a pair of flanking roller series,
 the individual rollers in the flanking roller series being of substantially the same diameter,
 the rollers in the intermediate series each being of a substantially larger diameter than the rollers in the flanking series,
 each roller in the intermediate series having a harder, more wear resistant belt contacting surface than the belt contacting surfaces on the flanking rollers, whereby the roller assembly, due to the difference in diameters between the rollers, will be oriented into a belt training position in response to passage of a belt thereover,
 an elongated substantially rigid frame,
 means for suspending the roller assembly from points which are a substantially fixed distance apart on the frame, and
 means for connecting the frame and the roller assembly suspended thereby from the wire ropes.

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