

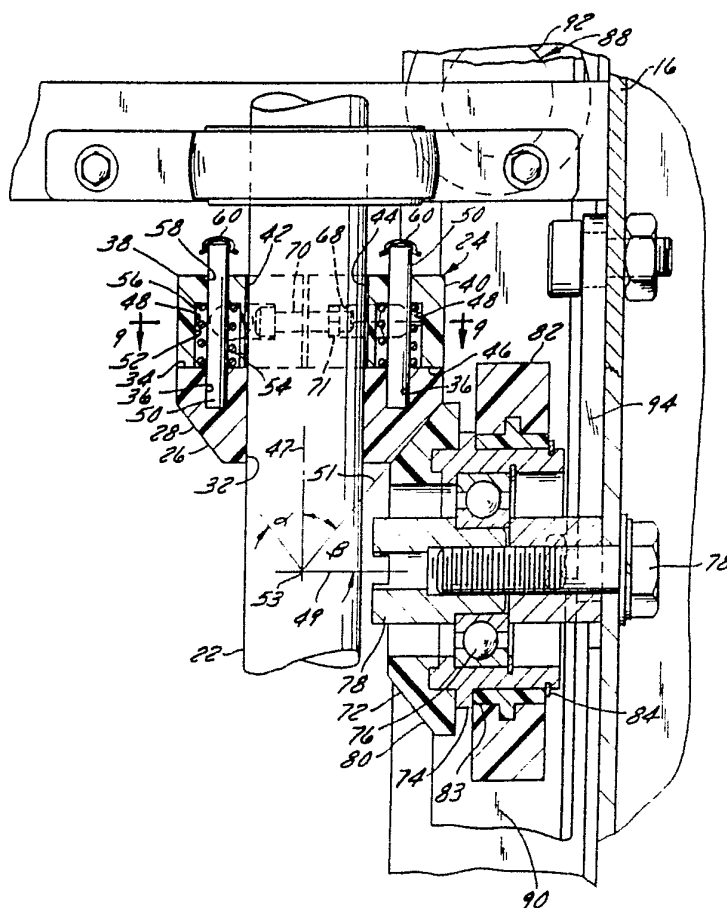


INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁵ : B65G 47/26, 13/071, 13/073	A1	(11) International Publication Number: WO 92/04261 (43) International Publication Date: 19 March 1992 (19.03.92)
(21) International Application Number: PCT/US91/05706 (22) International Filing Date: 12 August 1991 (12.08.91) (30) Priority data: 578.426 5 September 1990 (05.09.90) US (71) Applicant (for all designated States except US): THE INTERLAKE COMPANIES, INC. [US/US]; 550 Warrenville Road, Lisle, IL 60532-4387 (US). (72) Inventors; and (75) Inventors/Applicants (for US only) : COLLINS, Ellsworth, H. [US/US]; 500 Twelve Oaks Drive, Mt. Washington, KY 40074 (US). MATTINGLY, James, F. [US/US]; 5001 Bowcester Drive, Louisville, KY 40299 (US).		(74) Agent: CAMORIANO, Theresa, Fritz; 109 Daventry Lane, Suite 101, P.O. Box 43610, Louisville, KY 40253-0610 (US). (81) Designated States: AT (European patent), BE (European patent), CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), LU (European patent), NL (European patent), SE (European patent), US. Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>

(54) Title: HIGH-SPEED ROLLER-WAY**(57) Abstract**

A conveyor designed for high-speed operations includes a drive shaft, a first friction wheel having a bevelled end and mounted on the drive shaft, a second friction wheel mounted on the conveyor frame and having a bevelled end which mates with the bevelled end of the first friction wheel, and means for driving the conveyor rollers from the second friction wheel in the form of a drive wheel, itself frictional driven by the second friction wheel, which can be braked or disengaged from the second friction wheel.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	ES	Spain	MG	Madagascar
AU	Australia	FI	Finland	ML	Mali
BB	Barbados	FR	France	MN	Mongolia
BE	Belgium	GA	Gabon	MR	Mauritania
BF	Burkina Faso	GB	United Kingdom	MW	Malawi
BG	Bulgaria	GN	Guinea	NL	Netherlands
BJ	Benin	GR	Greece	NO	Norway
BR	Brazil	HU	Hungary	PL	Poland
CA	Canada	IT	Italy	RO	Romania
CF	Central African Republic	JP	Japan	SD	Sudan
CG	Congo	KP	Democratic People's Republic of Korea	SE	Sweden
CH	Switzerland	KR	Republic of Korea	SN	Senegal
CI	Côte d'Ivoire	LI	Liechtenstein	SU ⁺	Soviet Union
CM	Cameroon	LK	Sri Lanka	TD	Chad
CS	Czechoslovakia	LU	Luxembourg	TG	Togo
DE*	Germany	MC	Monaco	US	United States of America
DK	Denmark				

⁺ Any designation of "SU" has effect in the Russian Federation. It is not yet known whether any such designation has effect in other States of the former Soviet Union.

HIGH-SPEED ROLLER-WAY

BACKGROUND OF THE INVENTION

5 The present invention relates to a line shaft conveyor which is particularly suited to high speed applications.

10 In the past, most high speed conveyors were made using flat belts or chains to drive the conveyor rollers. These conveyors generally cannot run at rates above 240 feet per minute, due to the limitation in chain speed, bearing limitations, or chain or belt vibrations. These chain and belt drives also had to be broken into sections with separate drives for long conveyors, due to the limited capacity of the chains or belts used to drive the conveyor.

15 Twisted belt line shaft conveyors are also known in the art. These conveyors do not have to be broken into sections for a long drive as do the belt-driven or chain-driven conveyors, but they cannot be driven at high speeds, because the twisted belts which wrap around the drive shaft and the conveyor rollers have very little surface area contact for driving, and they will slip and fail at high speeds.

20 Conveyors are known which use a bevel gear or worm gear drive between the line shaft and the conveyor rollers, but these are expensive to manufacture, difficult to maintain, due to the requirements of lubrication, and not suitable for high speed applications for several reasons. For example, the gear sets require precise location for proper drive on the pitch line to reduce noise and wear. High speed gear sets need an enclosed housing to provide lubrication, which adds expense to the conveyor. Also, it is not possible to compensate for the wear of the gears, so gears would have to be replaced frequently in a high speed application.

Thus, it would be very impractical to drive a high speed conveyor by means of gears.

Some line shaft conveyors are known to use friction wheels to transmit drive from the drive shaft to the conveyor roller, but these conveyors have not been commercially successful. The friction wheel drives typically have at least one wheel which has very little contact surface for driving (i.e., point contact), so the wheels wear out quickly and slip at high speeds. These designs attempt to mimic the twisted belt line shaft conveyors, which, as mentioned above, are not at all suited to high speed applications.

SUMMARY OF THE INVENTION

The present invention provides a high speed conveyor which can operate at much higher speeds than prior art conveyors. It can operate at speeds of 450 feet per minute or higher, as compared with the highest speed of approximately 240 feet per minute in the prior art.

The present invention takes advantage of a line shaft type of drive, so it is not necessary to break the conveyor into pieces with separate drives when the conveyor becomes long.

The present invention provides a smooth, simple drive, which is easy to maintain and is quiet, eliminating the noise and maintenance problems of prior art drives.

The present invention provides for good surface contact of the driving members and provides a spring force which keeps the driving members in contact with each other and which compensates for wear.

The present invention provides a high speed drive arrangement which can be driven as easily in the backward direction as in the forward direction and therefore can be reversed as needed, without any problems involving chain or belt tensioning.

The present invention also provides a means for stopping the driving of the conveyor rollers, creating an accumulating conveyor.

DESCRIPTION OF THE DRAWINGS

5 Figure 1 is a schematic top view of a conveyor made in accordance with the present invention;

 Figure 2 is a side view thereof;

 Figure 3 is a view taken along the section 3-3 of Figure 1;

10 Figure 4 is a view taken along the section 4-4 of Figure 3;

 Figure 5 is an exploded perspective view of the first friction wheel, which is shown in Figures 1-4;

15 Figure 6 is a view taken along the section 6-6 of Figure 1;

 Figure 7 is the same view as Figure 6 but with the brake applied to stop the zone of rollers;

 Figure 8 is a broken-away perspective view of the braking arrangement shown in Figures 6 and 7;

20 Figure 9 is a sectional view through the semi-cylindrical portions of the first friction wheel;

 Figure 10 is a top view of a portion of the conveyor, showing a second embodiment of the invention, with the side rail, the second friction wheel, and the drive wheel shown in section;

25 Figure 11 is a view taken along the section 11-11 of Figure 10; and

 Figure 12 is the same view as Figure 10, except that the drive wheel has disengaged from the second friction wheel.

30

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The conveyor 10 of the present invention has two embodiments. The first embodiment is shown in Figures 1-9, and the second embodiment is shown in Figures 10-12.

The first embodiment of the conveyor is made up of a conveyor frame 12, with a left side rail 14 and a right side rail 16 and a plurality of conveyor rollers 18 having shafts 20 whose left and right ends are mounted in the left and right side rails, respectively. The axes of rotation of the conveyor rollers 18 are substantially perpendicular to the left and right side rails 14, 16 and to the direction of travel of articles carried by the conveyor 10, as indicated by the arrows in Figures 1, 2, and 6.

A motor (not shown) drives a drive shaft 22. The drive shaft 22 lies below the conveyor rollers 18 and has an axis which is substantially parallel to the direction of travel. On the drive shaft 22 at regular intervals are mounted first friction wheels 24. As shown in this embodiment, there is one first friction wheel 24 for every two conveyor rollers 18. The first friction wheels 24 are coaxial with the drive shaft 22. Each first friction wheel 24 has a beveled end 26, which is beveled at an angle alpha from the axis of the drive shaft 22. In this embodiment, the angle alpha is 40 degrees. The first friction wheel 24 is preferably made of a hard material such as steel or nylon.

The first friction wheels are preferably made in three pieces -- the first piece 28 is substantially cylindrical and includes the beveled end 26. This first piece 28 will be referred to as the beveled piece. The beveled piece 28 has a central bore 32, which is slightly larger than the diameter of the drive shaft 22. It has a flat back surface 34, which lies in a plane that is perpendicular to the axis of the central bore 32. The back surface 34 defines two cylindrical recesses 36. The second piece 38 and third piece 40 of each first friction wheel 24 are identical to each other. Each of those pieces 38, 40 defines a semi-cylindrical inner surface 42, so that, when the second and third pieces 38, 40 are

brought together, they define a cylindrical central bore 44. The semi-cylindrical pieces 38, 40 actually are each slightly less than half a cylinder, so that they can be clamped together to apply force to grip the shaft 22.

5 Each of the semi-cylindrical pieces 38, 40 also defines a flat front surface 46, which is intended to abut the flat back surface 34 of the beveled piece 28, and each of the flat front surfaces 46 defines a bore 48, which can be aligned with the cylindrical recesses 36 in the bevel
10 piece 28 to receive pins 50. The cylindrical recesses 36 in the bevel piece 28 receive the pin 50 with a press fit, so the pins 50 are retained on the bevel pieces 28. The cylindrical bores 48 in the semi-cylindrical pieces 38, 40 have an enlarged entrance portion 52, which
15 permits a spring 54 to be mounted around each pin 50. The springs 54 apply a force which tends to push the bevel piece 28 away from the semi-cylindrical pieces 38, 40. This spring force keeps the bevel piece 28 in driving contact with a second friction wheel, which will
20 be described later. Inside the enlarged entrance openings 52, the cylindrical bores 48 have a reduced diameter, which provides a shoulder 56 for the spring to push against. The reduced diameter portion 58 of the cylindrical bores 48 is large enough to permit the pin 50
25 to slide relative to the semi-cylindrical pieces 38, 40. Caps 60 are press fit onto the ends of the pins 50 to prevent the pins from sliding out of the semi-cylindrical pieces 38, 40.

Each of the semi-cylindrical pieces 38, 40 also has
30 two radial recesses 62, which receive an insert 64. Each insert 64 is slightly longer than its radial recess 62, so that the insert projects slightly from the semi-cylindrical inner surface 42 of its respective piece 38, 40.

35 Each of the semi-cylindrical pieces 38, 40 also has a cylindrical bolt-receiving bore 66, which is

substantially perpendicular to the axis of the central bore 44, and a hexagonal bore 68, which can be aligned with the bolt-receiving bore 66 of the other semi-circular piece 38, 40. When the bolt-receiving bore 66 of each piece 38, 40 is aligned with the hexagonal bore 68 of the opposite piece 40, 38, bolts 70 and hexagonal nuts 71 are inserted into their respective bolt-receiving bores 66 and hexagonal bores 68 and are threaded together to clamp the pieces 38, 40 onto the shaft 22. (The nuts 71 may be molded as an integral part of the bores 68 as an alternative to the embodiment shown here.) As the bolts 70 are tightened, the inserts 64 contact the drive shaft 22 and press against it. The inserts 64 are preferably made of polyurethane, so that, when the bolts 70 are tightened, the inserts apply a force to the drive shaft 22 which causes the semi-cylindrical pieces 38, 40 to be fixed to the drive shaft 22. The pins 50 cause the beveled piece 28 of the first wheel 24 to rotate with the semi-circular pieces 38, 40, which are fixed to and rotate with the drive shaft. The springs 54 cause the beveled piece 28 of the first friction wheel 24 to be biased in the direction of the beveled end 26.

On the right side rail 16 of the conveyor 10 is mounted a plurality of second friction wheels 72, one for every first friction wheel 22. These second friction wheels 72 are molded onto a hub 74, which is mounted on a bearing 76, which, in turn, is mounted on a stub shaft 78 that is bolted to the right side rail 16. In this manner, the second friction wheel 72 is free to rotate about the axis of the stub shaft 78, which is substantially perpendicular to the right side rail, but the second friction wheel 72 is otherwise in a fixed position relative to the conveyor frame 12, in that it cannot move toward or away from the side rail 16 or up or down relative to the side rail 16. The second friction wheel 72 has a beveled end 80, which lies at an angle

beta relative to its axis of rotation. In this embodiment, the angle beta is 50 degrees. As is shown in the drawings, the beveled ends 26, 80 of the first and second friction wheels 24, 72, respectively, have a frustro-conical shape.

The sum of the angles alpha and beta, which are the angles of the bevels on the first and second friction wheels 24, 72, is equal to the angle between the axes of the first and second friction wheels. Also, the beveled surfaces define a line of contact 51, which, when extended, intersects the point of intersection of the axes 47, 49 of the first and second friction wheels, respectively, as shown at the point 53 in Figure 4. In this embodiment, the axes 47 and 49 of the drive shaft 22 and the stub shaft 78, respectively, intersect at an angle of 90 degrees, and the angles alpha (40 degrees) and beta (50 degrees) are complementary angles, the sum of which is 90 degrees. It is important that the sum of the angles alpha and beta be equal to the angle between the axes of the first and second friction wheels 24, 72, so that the beveled ends 26, 80 mate with at least line contact between them. This provides true rolling contact between the first and second friction wheels and avoids the problems of slippage and failure encountered in prior art designs which have less than line contact. Without this good surface area of contact between the two friction wheels, this conveyor could not operate at such high speeds.

It is also important that the first friction wheel 24 has a spring force biasing it in the direction of the second friction wheel 72, so that, as the beveled faces wear, there will still be good contact between the first and second friction wheels over a large surface area.

A third friction wheel 82 is mounted on the hub 74 between a shoulder 83 on the hub 74 and a snap ring 84 which snaps into a recess in the hub 74. The third

friction wheel 82 (or drive wheel) has a clearance fit with the hub 74 and is centered below two of the conveyor rollers 18, contacting both of those conveyor rollers 18, with line contact between the cylindrical outer surface of the third friction wheel 82 and the cylindrical outer surface of each of those conveyor rollers 18.

The shafts 20 of the conveyor rollers 18 ride in vertical slots 86 in the left and right side rails 14, 16 (shown in Figure 6), and generally do not reach the bottom of the slots 86, so that the weight of each roller 18 is carried on its respective third friction wheel 82. Of course, the weight of any product that is being carried on the conveyor roller 18 will also be supported by the third friction wheel 82. Since the amount of friction between the third friction wheel 82 and the hub 74 and the amount of friction between the conveyor roller 18 and the third friction wheel 82 increases as the weight of the conveyor roller increases, the amount of friction available to drive the rollers 18 increases as the load increases. This mounting arrangement ensures that there will always be enough friction to drive the conveyor rollers 18, even when they are under heavy loads.

To summarize the drive arrangement in this conveyor: A motor (not shown) drives the drive shaft 22. The rotating drive shaft drives the first friction wheels 24, which are biased toward the second friction wheels 72, and which have contact with the second friction wheels 72 along a line, giving them good surface area contact for driving the second friction wheels 72. The second friction wheels 72 drive their respective hubs 74, which, in turn, drive the third friction wheels 82, and the third friction wheels 82 drive the conveyor rollers 18. The drawings shown here have the drive shaft always rotating in one direction and the articles on the conveyor always moving from left to right. However, the

direction of rotation of the drive shaft 22 could readily be reversed, thereby reversing the direction of travel of the articles on the conveyor. Such a simple reversal of direction of drive is not available on prior art drive arrangements.

In many cases, it will be advantageous to operate this high speed conveyor as an accumulating conveyor. In this situation, means can be provided for stopping the conveyor rollers 18 in order to accumulate products on the conveyor. If this conveyor is to operate as an accumulating conveyor, it will preferably include a brake mechanism 88 for stopping the rotation of the third friction wheels 82, which will also cause the conveyor rollers 18 which contact the stopped friction wheels 82 to stop.

The brake mechanism is shown in Figures 3, 6, 7, and 8. Each brake mechanism 88 in the embodiment shown here is designed to stop two of the third friction wheels (or drive wheels) 82, which stops four of the conveyor rollers 18. The four conveyor rollers controlled by the brake 88 are then said to be a zone. The brake 88 includes a flat friction bar 90, mounted on a piston-cylinder arrangement 92 (or on some other type of actuator). There are two arms 94 (shown in Figures 6-8) which are bolted to the conveyor frame 12 and to the friction bar 90. The arms 94 are mounted so as to pivot relative to the conveyor frame 12 and relative to the friction bar 90, and the distance between the pivot points on each of the arms 94 is the same. As the arms pivot from a lowered, non-braking position, as shown in Figure 6, to an upper, braking position, as shown in Figure 7, the equal-length arms 94 provide a parallelogram effect, so that, as the friction bar 90 is pushed upward by the piston 92, the friction bar 90 remains parallel to the third friction wheels 82.

There are sensors (not shown) located at intervals along the conveyor 10, as is known in the art for accumulation conveyors. When the sensors sense a back-up of products, they begin to cause fluid to enter the cylinders 92 in the zones in which products are to accumulate, causing the friction bars 90 for those zones of the conveyor 10 to move upward until they contact their respective drive wheels 82, causing those drive wheels 82 to stop rotating. These drawings show each friction bar 90 contacting two drive wheels 82, but it would be possible for each friction bar to contact any desired number of drive wheels 82, depending upon the desired length of the zone. The clearance fit between the third friction wheels 82 and their hubs 74 facilitates this process, permitting the hubs 74 to continue rotating freely even when the brake is applied, so as not to interfere with the driving of the other parts of the conveyor 10.

Figures 10-12 show a second embodiment of the invention, in which a different type of second friction wheel and drive wheel are mounted on the support shafts. The rest of the conveyor, including the drive shaft, the first friction wheels, and the conveyor rollers remain the same as in the first embodiment, except that the conveyor rollers 18 ride at the bottom of the slots 86. As in the first embodiment, this embodiment contemplates a number of drive wheels, with each of the drive wheels located so as to contact and drive two conveyor rollers. In this second embodiment, the support shaft (second friction wheel shaft) 200 has a threaded end 202, which terminates at a shoulder 204, which is larger than the opening in the side rail 16 through which the support shaft 200 is mounted. The support shaft is mounted on the side rail 16 by means of a nut 206 and lock washer 208, which push the shoulder 204 against the side rail 16.

Beyond the shoulder 204 is a portion of the support shaft which has a D-shaped cross-section 210, and the right half 212 of a thrust bearing 214 is mounted on that D-shaped portion of the support shaft and has a corresponding D-shaped cross-section, so as to prevent rotation of the right half 212 of the thrust bearing 214 relative to the support shaft 200. The left half 218 of the thrust bearing 214 has a cylindrical cross-section and is mounted on a portion of the support shaft 200 which is cylindrical and has the same diameter as the D-shaped portion of the shaft 200. Balls 215 are located between the left and right portions of the thrust bearing 214 and permit the left portion to rotate relative to the right portion without excessive friction or wear. A C-cup (not shown) may be added to surround the thrust bearing to keep out dust particles. A spring 216 is mounted on the support shaft 200 between the side rail 16 and the right half 212 of the thrust bearing. If the spring 216 provides enough friction force on the right side of the thrust bearing to prevent it from rotating, the D-shaped cut on the shaft and thrust bearing can be eliminated, making the pieces cylindrical instead. The primary function of the spring 216 is to bias the drive wheel into engagement with the second friction wheel, as will be explained later.

The next element mounted on the support shaft is a ring 220, which is preferably made of steel. The ring 220 has a cylindrical inside diameter, which is about 0.001 inches (.025 mm) larger in diameter than the cylindrical portion of the support shaft 200, and an outside diameter which is large enough to have good surface contact with the right side of the drive wheel 222. The drive wheel 222 has a cylindrical outer surface, which is in friction contact with two of the conveyor rollers, as in the first embodiment. It has a beveled (frustro-conical) inner surface 224, which is

beveled at an angle of approximately 45 degrees to the axis of the support shaft. The drive wheel 222 is preferably made of two materials which are molded together to form a single piece. The inner piece 226, which contacts the second friction wheel 250 and the ring 220, is preferably made of Delrin, and the outer piece 228, which contacts the conveyor rollers, is preferably made of polyurethane. The inner piece 226 defines an annular shoulder 227 with a tapered inner surface which fits around the outside diameter of the ring 220.

The next element mounted on the support shaft 200 is an air pressure ring 230, which has a small inside diameter portion 232 which mounts on the same portion of the support shaft 200 as the ring 220, and a large inside diameter portion 234, to the left of the small inside diameter portion, which mounts on a large diameter portion 236 of the support shaft 200. Both the small inside diameter portion 232 and the large inside diameter portion 234 of the pressure ring member 230 seal against their respective portions of the support shaft 200 by means of O-ring seals 238, 240, respectively. An annular chamber 242 is formed between the small seal 238 and the large seal 240. The left and inner walls of the chamber are formed by the support shaft 200, and the right and outer walls of the chamber 242 are formed by the pressure ring 230. The chamber 242 is in fluid communication with an air inlet 244 at the end of the support shaft 200 through a conduit 246 in the support shaft 200.

To the left of the pressure ring member 230 is a bearing 248, on which is mounted the second friction wheel 250. The outer race of the bearing 248 is mounted between a snap ring 252 and a shoulder 254 on the inside of the second friction wheel 250, and the inner race of the bearing is mounted between a shoulder 256 and a snap ring 258 on the large-diameter portion of the outer surface of the support shaft 200.

The second friction wheel 250 has a beveled (frustro-conical) left end surface 260, as in the first embodiment, and a beveled (frustro-conical) right surface or outer surface 262, which lies at a 45 degree angle to the axis of the support shaft 200 (the same angle as the inner surface of the drive wheel 222), and which mates with the inner tapered surface of the drive wheel 222 along a large surface area. The second friction wheel 250 is preferably also molded of two different materials. The right portion 270, which has friction contact with the drive wheel 222, is preferably made of steel or Delrin, and the left portion 272, which is in friction contact with the first friction wheel, is preferably made of polyurethane.

Operation of the second embodiment is as follows: The drive shaft 22 rotates, causing the first friction wheel 24 to rotate, as in the first embodiment. The second friction wheel 250 is in friction contact with the first friction wheel, so the second friction wheel also rotates. Under normal driving conditions, the spring 216 pushes against the side rail 16 and against the thrust bearing 214, causing the thrust bearing 214 to push against the ring 220, which, in turn, pushes against the right surface of the drive wheel 222, forcing the drive wheel 222 into friction engagement with the second friction wheel 250 and with the conveyor rollers, thereby causing the drive wheel to rotate and drive the conveyor rollers. The drive wheel 222 also causes the ring 220 and the left side 218 of the thrust bearing 214 to rotate.

When pressurized air is forced into the air inlet 244 of the support shaft 200, it travels through the conduit 246 and into the chamber 242. The pressurized air pushes against the walls of the chamber 242, causing the pressure ring 230 to shift about 1/8 inch 3.175 mm to the right, pushing against the ring 220 and overcoming

the force of the spring 216 so as to permit the drive wheel 222 to move to the right, as shown in Figure 12. As the drive wheel 222 shifts to the right, it moves down slightly, out of contact with the conveyor rollers. The drive wheel 222 then contacts the second friction wheel only at the uppermost point (not shown), and there is a gap between the drive wheel 222 and the second friction wheel 250 around the rest of their beveled surfaces. Because there is no load on the drive wheel 222, it can be driven in a freewheeling mode by the small amount of friction from the point contact with the second friction wheel 250. However, there is not sufficient friction between the second friction wheel 250 and the drive wheel 222 to transfer a driving force to the conveyor rollers, even if the drive wheel 222 did contact the conveyor rollers. Thus, when the pressure ring 230 overcomes the spring bias and shifts to the right, it disconnects the train of driving elements, so the conveyor rollers driven by the drive wheel 222 stop rotating and begin to accumulate. When the controller wishes to resume driving that section of the conveyor, the air pressure is vented from the chamber 242, through the conduit 246 and the inlet 244, and the spring force again shifts the drive wheel to the left and upward, causing the drive wheel 222 to engage the second friction wheel 250 and the conveyor rollers, so the drive wheel again drives the conveyor rollers. If the conveyor is not intended to be used to accumulate products, the air pressure ring 230 can be eliminated. Then, after the conveyor is installed, it can readily be converted to serve as an accumulating conveyor simply by inserting the pressure ring 230 or by replacing the complete support shaft assembly.

It will be obvious to those skilled in the art that modifications may be made to the embodiments described above without departing from the scope of the present invention.

WHAT IS CLAIMED IS:

1. A conveyor, comprising:
 - a drive shaft;
 - a conveyor frame;
 - 5 a conveyor roller mounted on the conveyor frame and having an axis which is substantially perpendicular to the drive shaft;
 - a first friction wheel mounted on the drive shaft and having an axis which is coaxial with the drive shaft, said first friction wheel having a first beveled end which is beveled at a first angle to the axis of the first friction wheel;
 - 10 mounting means for mounting the first friction wheel on the drive shaft so that the first friction wheel rotates with the drive shaft, including means for biasing said first friction wheel in the direction of the beveled end;
 - a second friction wheel shaft, mounted on the conveyor frame and extending substantially parallel to the axis of said conveyor roller;
 - 20 a second friction wheel, mounted on said second friction wheel shaft, said second friction wheel having an axis and a second beveled end which is beveled at a second angle to the axis of the second friction wheel, with the sum of the angles of the bevels on the first and second friction wheels being equal to the angle between the axes of the first and second friction wheels, so that the beveled ends of the first and second friction wheels mate with at least line contact between them; and
 - 30 means for driving the conveyor roller from the second friction wheel, including a drive wheel mounted on said second friction wheel shaft by a mounting means which puts said drive wheel in friction driving contact with said conveyor roller, wherein said mounting means causes said drive wheel to rotate with said second friction wheel, so as to drive said conveyor roller, and
 - 35

permits said drive wheel to be selectively stopped while said second friction wheel is rotating, so as to stop the rotation of said conveyor roller.

2. A conveyor as recited in Claim 1, wherein said
5 mounting means comprises:

a hub, mounted on said second friction wheel shaft and supporting the second friction wheel such that, when the second friction wheel rotates, the hub rotates; and

10 wherein said drive wheel is mounted on said hub with a clearance fit.

3. A conveyor as recited in Claim 1, wherein said first friction wheel has a fixed axis of rotation and is limited in motion to rotation about its axis and to
15 sliding along its axis, and wherein the second friction wheel is limited in motion to rotation about its axis.

4. A conveyor, comprising:

a drive shaft;

a conveyor frame;

20 a conveyor roller mounted on the conveyor frame and having an axis which is substantially perpendicular to the drive shaft;

a first friction wheel, mounted on the drive shaft and having an axis which is coaxial with the drive shaft, said first friction wheel having a beveled end which is beveled at a first angle to the axis of the first friction wheel;

25 mounting means for mounting the first friction wheel on the drive shaft so that the first friction wheel rotates with the drive shaft, including
30 means for biasing said first friction wheel in the direction of the beveled end;

a hub mounted on the conveyor frame;

a second friction wheel, mounted on the hub such that, when the second friction wheel rotates, said hub rotates, said second friction wheel having an axis and a beveled end which is beveled at a second angle to the axis of the second friction wheel, with the sum of the angles of the bevels on the first and second friction wheels being equal to the angle between the axes of the first and second friction wheels, so that the beveled ends of the first and second friction wheels mate with at least line contact between them; and

means for driving the conveyor roller from the second friction wheel, including a drive wheel mounted on said hub, said drive wheel having an outer surface which has friction contact with said conveyor roller; and

further comprising braking means for selectively stopping the rotation of the drive wheel while said hub is rotating.

5. A conveyor as recited in Claim 4, wherein there is a plurality of said conveyor rollers mounted on said conveyor frame, and a plurality of said drive wheels, and wherein each of said drive wheels contacts and drives two of said conveyor rollers.

6. A conveyor as recited in Claim 5, wherein there is a braking means for stopping each of said drive wheels.

7. A conveyor as recited in Claim 2, wherein said conveyor frame has first and second conveyor side rails which define slots, and said conveyor roller has a shaft which rides in said slots, such that the weight of said conveyor roller is supported on said drive wheel, reducing the clearance and causing the friction force

between the drive wheel and the hub to increase as the weight of the articles on the conveyor roller increases.

8. A conveyor, comprising:

a drive shaft;

5 a conveyor frame;

a conveyor roller mounted on the conveyor frame and having an axis which is substantially perpendicular to the drive shaft;

10 a first friction wheel, mounted on the drive shaft, including:

a. a substantially cylindrical member which includes a first beveled end and defines a central bore, which receives said drive shaft with a sliding fit;

15 b. first and second semi-cylindrical members, which are identical to each other and which are clamped together around said drive shaft, applying a gripping force to said drive shaft so as to be fixed to said drive shaft; and

20 c. at least one spring mounted between the cylindrical member and the clamped-together first and second semi-cylindrical members so as to bias the cylindrical member and said first beveled end away from the clamped-together first and second semi-cylindrical members;

25 a second friction wheel shaft fixed to the conveyor frame;

30 a second friction wheel, mounted on said second friction wheel shaft, said second friction wheel having a second beveled end, which is in friction contact with said first beveled end; and

a drive wheel, mounted on said second friction wheel shaft, said drive wheel having friction contact with said conveyor roller.

9. A conveyor as recited in Claim 1, wherein said first friction wheel includes:

5 a. a substantially cylindrical member which includes said first beveled end and defines a central bore, which receives said drive shaft with a sliding fit;

10 b. first and second semi-cylindrical members, which are identical to each other and which are clamped together around said drive shaft, applying a gripping force to said drive shaft so as to be fixed to said drive shaft; and

15 c. at least one spring mounted between the cylindrical member and the clamped-together first and second semi-cylindrical members so as to bias the cylindrical member and said first beveled end away from the clamped-together first and second semi-cylindrical members and toward said second beveled end.

10. A conveyor, comprising:

20 a drive shaft;
a conveyor frame;
a conveyor roller mounted on the conveyor frame and having an axis which is substantially perpendicular to the drive shaft;

25 a first friction wheel mounted on the drive shaft;

a second friction wheel shaft, fixed to the conveyor frame;

30 a second friction wheel mounted on said second friction wheel shaft, said second friction wheel being in friction contact with said first friction wheel;

a drive wheel mounted on said second friction wheel shaft by a mounting means which causes said drive wheel to rotate with said second friction wheel and which permits said drive wheel to be
35 selectively stopped while said second friction wheel is

rotating, said drive wheel also having friction contact with said conveyor roller.

11. A conveyor as recited in Claim 10, wherein said mounting means includes a hub, mounted on said second friction wheel shaft, wherein said second friction wheel is mounted on said hub such that, when said second friction wheel rotates said hub rotates, and wherein said drive wheel is loosely mounted on said hub such that said drive wheel can rotate with said hub and can selectively be stopped while said hub is rotating.

12. A conveyor as recited in Claim 1, wherein said second friction wheel defines a drive-wheel-engaging surface and said drive wheel defines a second-friction-wheel-engaging surface which engages the drive-wheel-engaging surface of said second friction wheel; and further comprising:

a drive wheel biasing means located between said conveyor frame and said drive wheel to bias the engaging surface of the drive wheel into driving engagement with the corresponding engaging surface of the second friction wheel.

13. A conveyor as recited in Claim 12, and further comprising means for opposing said drive wheel biasing means so as to disengage said drive wheel from driving engagement.

14. A conveyor, comprising:
a drive shaft;
a conveyor frame;
a conveyor roller mounted on the conveyor frame and having an axis which is substantially perpendicular to the drive shaft;

a first friction wheel mounted on the drive shaft and having an axis which is coaxial with the drive shaft, said first friction wheel having a first beveled end;

5 mounting means for mounting the first friction wheel on the drive shaft so that the first friction wheel rotates with the drive shaft, including means for biasing said first friction wheel in the direction of the beveled end;

10 a second friction wheel shaft, mounted on the conveyor frame and extending substantially parallel to the axis of said conveyor roller;

a second friction wheel, mounted on said second friction wheel shaft, said second friction wheel having
15 an axis and a second beveled end so that the beveled ends of the first and second friction wheels mate with at least line contact between them;

a drive wheel mounted on said second friction wheel shaft, wherein said drive wheel and said second
20 friction wheel have mating surfaces which engage each other; and

drive wheel biasing means for pushing said drive wheel into driving engagement with said second friction wheel so that said second friction wheel drives
25 said drive wheel, and said drive wheel drives the conveyor roller.

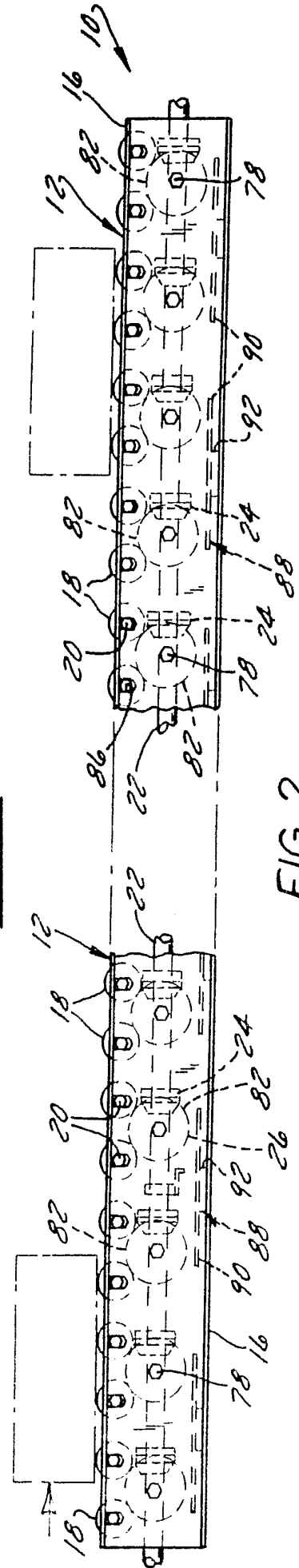
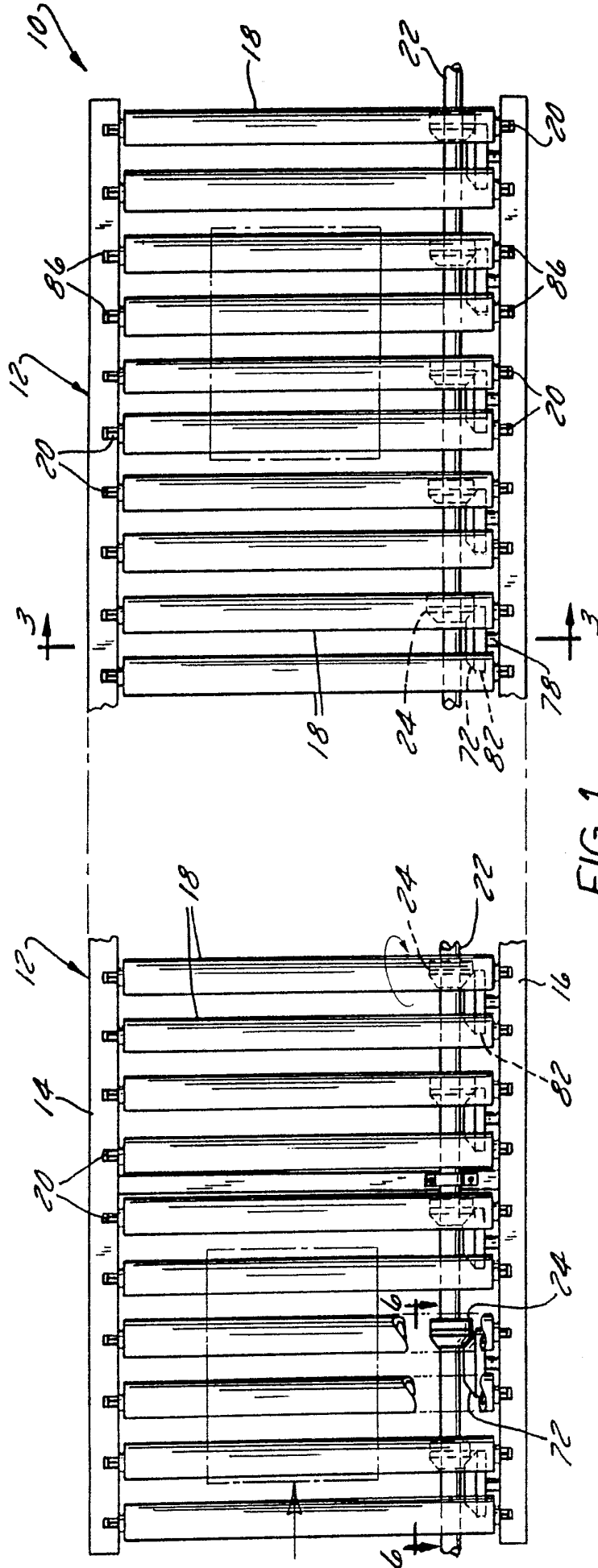
15. A conveyor as recited in Claim 14, wherein the mating surfaces of said second friction wheel and said drive wheel have a frustro-conical shape, both of said
30 mating surfaces being bevelled at substantially the same angle relative to the axis of the second friction wheel shaft, with the mating surface of said second friction wheel facing outwardly, and the mating surface of said drive wheel facing inwardly.

16. A conveyor as recited in Claim 15, wherein said drive wheel biasing means includes a spring and a thrust bearing located between said conveyor frame and said drive wheel.

5 17. A conveyor as recited in Claim 14, including means for disengaging said drive wheel, including a pressure ring member mounted on said second friction wheel shaft, said pressure ring member being sealed around said second friction wheel shaft at first and
10 second seals, so as to define a chamber between the seals; wherein said chamber is in fluid communication with a fluid inlet port on the second friction wheel shaft; so that applying pressurized fluid to said inlet port pressurizes the chamber and causes said pressure
15 ring to push against the drive wheel biasing means.

 18. A conveyor as recited in Claim 17, wherein said second friction wheel shaft defines a large diameter portion and a small diameter portion, and said pressure ring member has a large diameter portion and a small
20 diameter portion, with said first seal sealing between the large diameter portions of said pressure ring member and shaft, and said second seal sealing between the small diameter portions of said pressure ring member and shaft, so that said chamber has a left wall and an inner wall
25 defined by said shaft and a right wall and inner wall defined by said pressure ring member.

 19. A conveyor as recited in Claim 18, wherein said drive wheel biasing means includes a spring, a thrust bearing, and a ring located between said conveyor frame
30 and said drive wheel.



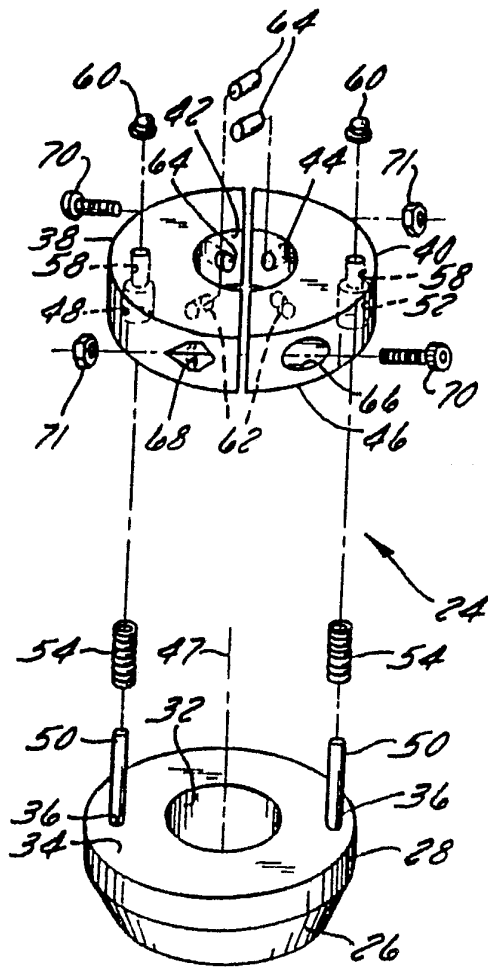


FIG. 5

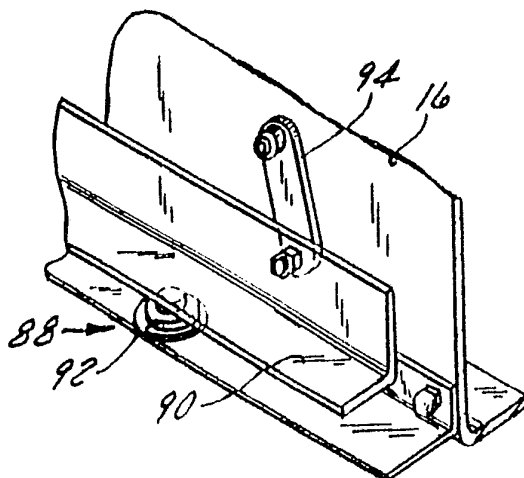


FIG. 8

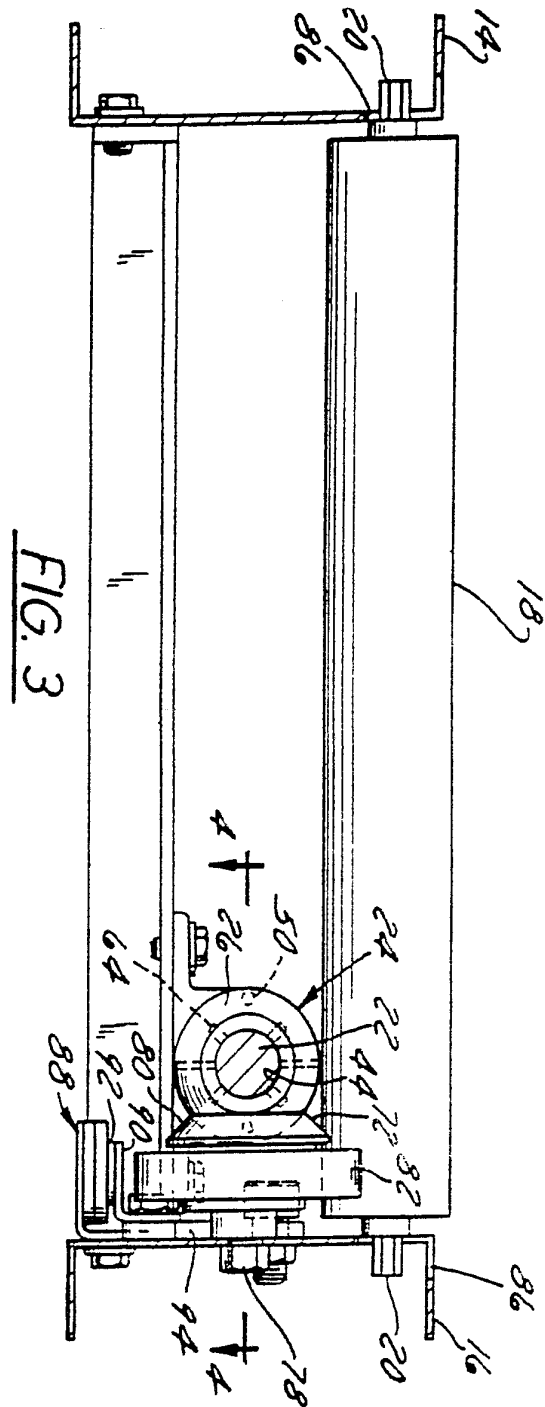
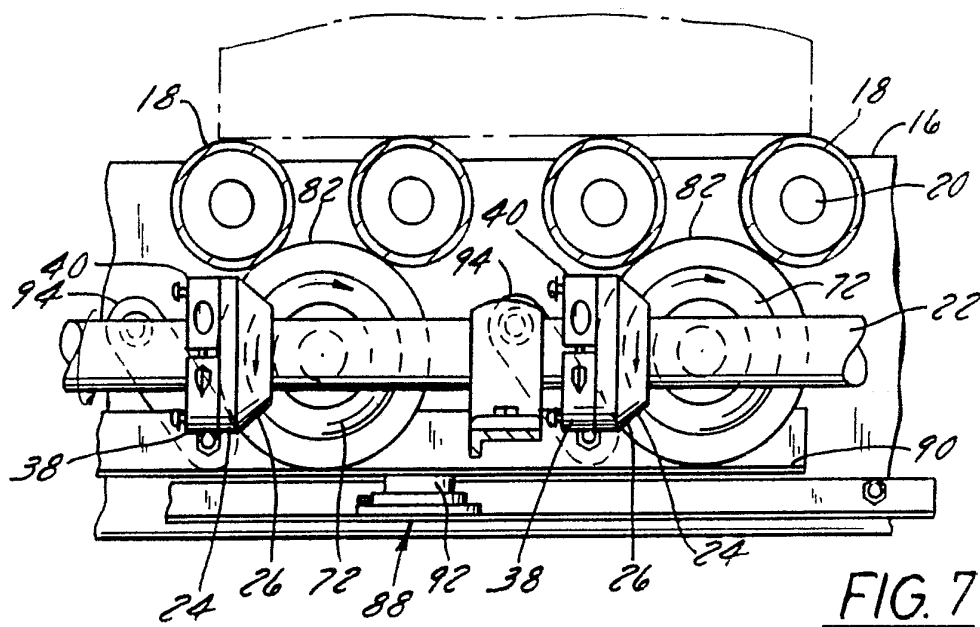
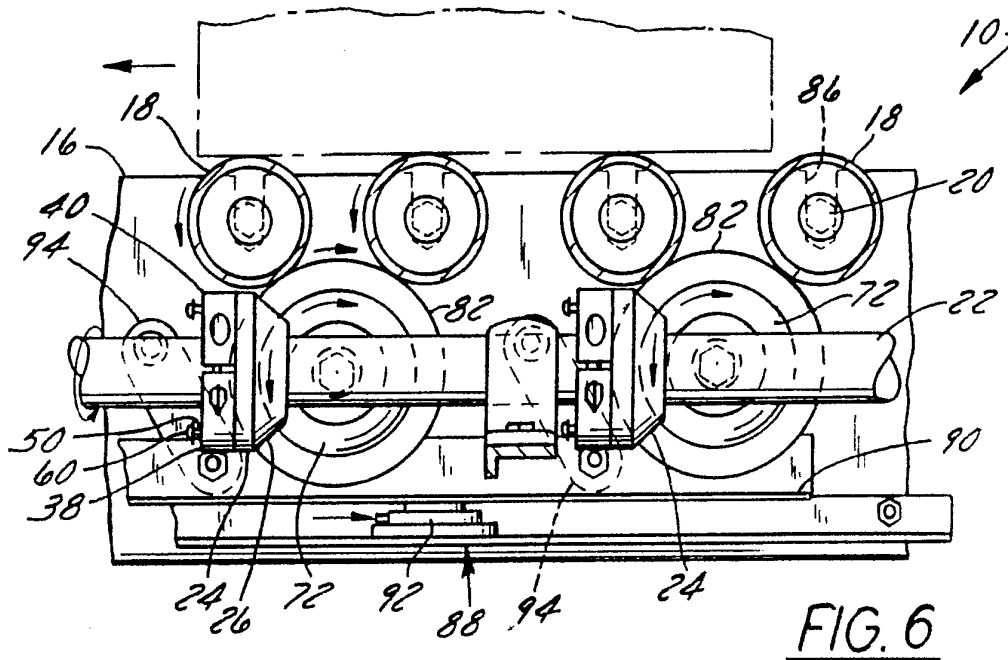


FIG. 3



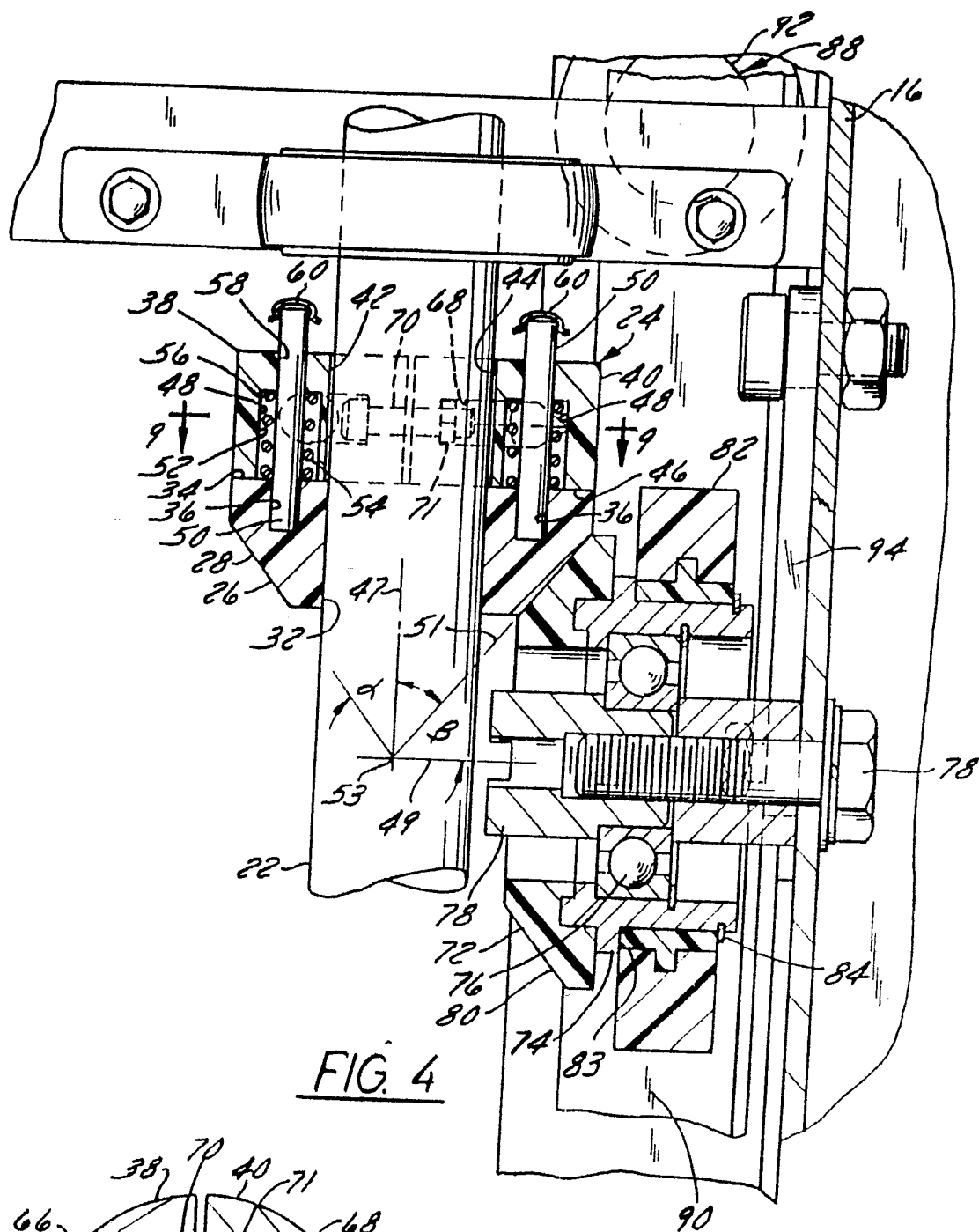


FIG. 4

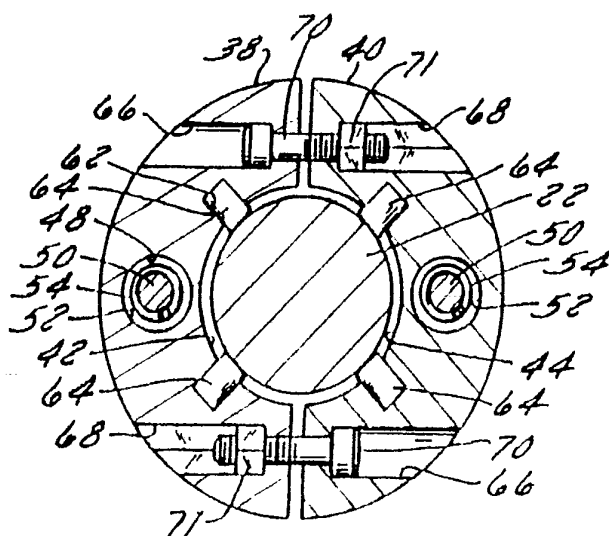
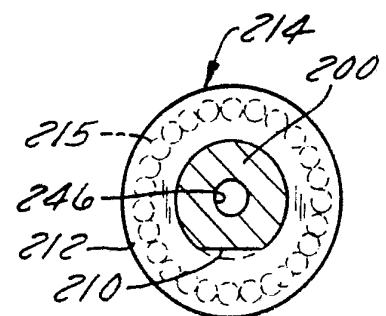
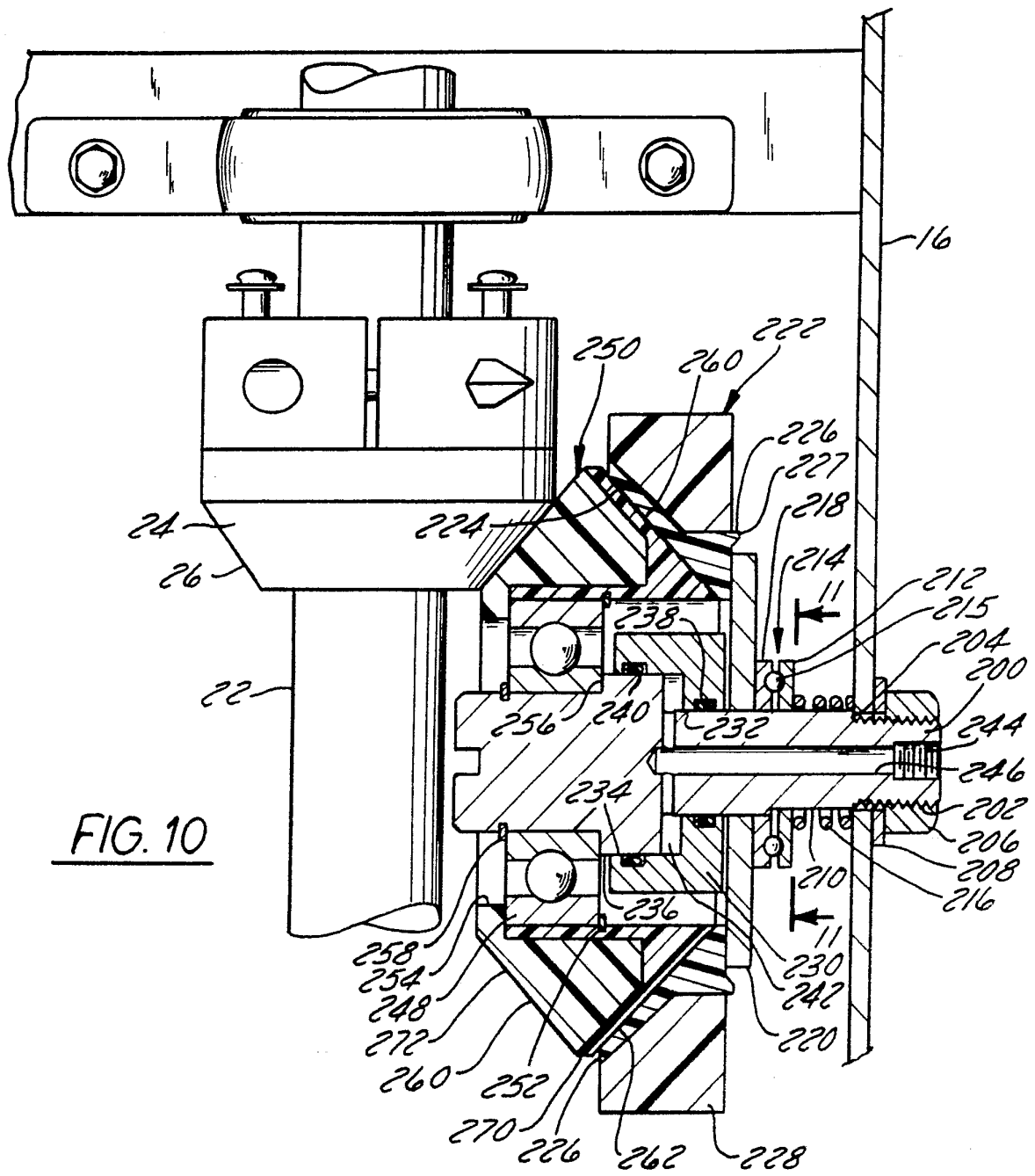
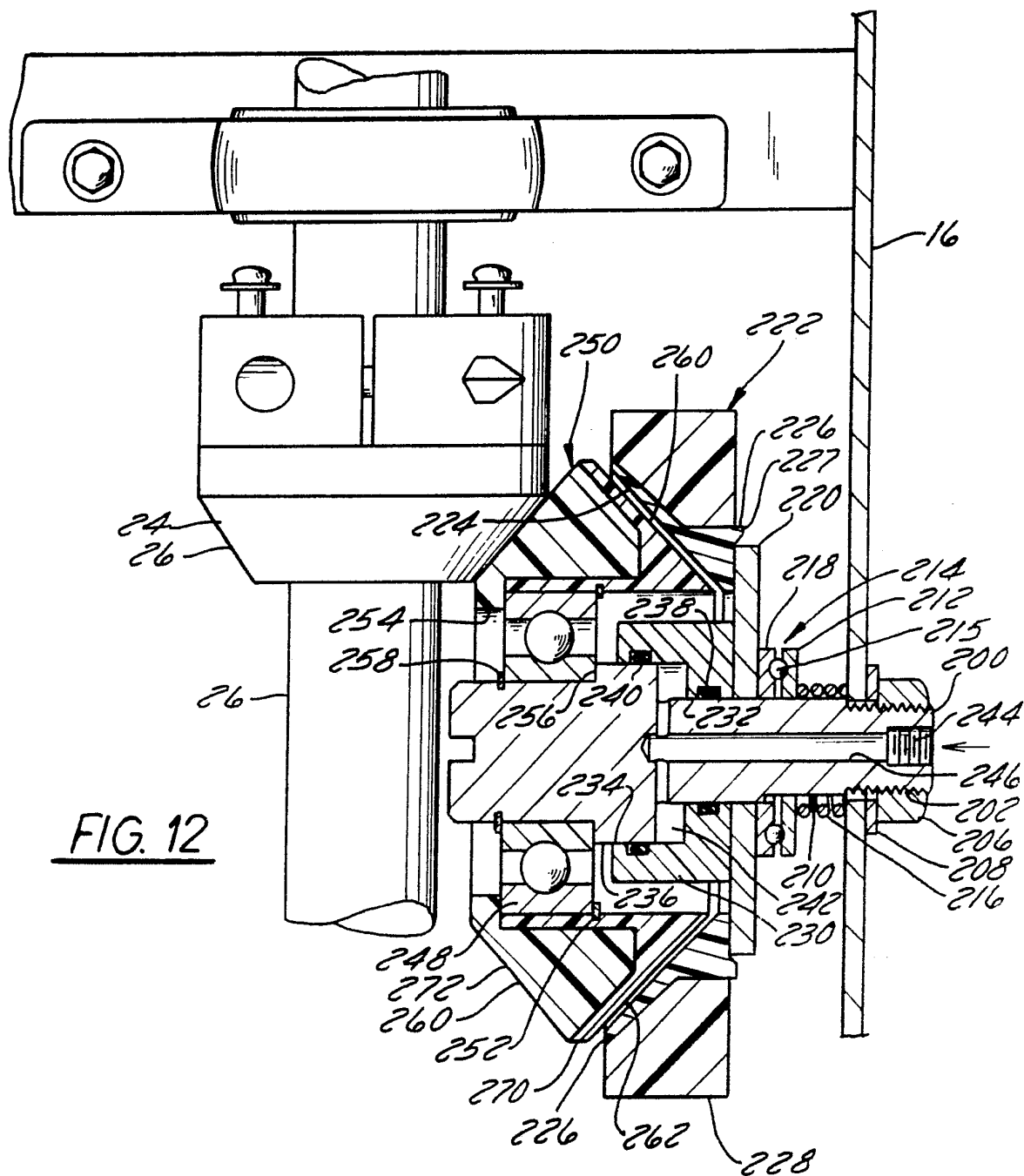


FIG. 9





INTERNATIONAL SEARCH REPORT

PCT/US 91/05706

International Application No

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC		
Int.Cl. 5 B65G47/26; B65G13/071; B65G13/073		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
Int.Cl. 5	B65G	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹		
Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
A	EP,A,0 149 694 (LSW MASCHINENFABRIK) 31 July 1985 see page 12, paragraph 3 - page 13, paragraph 1; figures 1-3 ---	1-4,8, 10,11,14
A	GB,A,2 004 242 (HAMMOND) 28 March 1979 see page 5, line 62 - line 97; figures 1,2,6,7 ---	1,4,5,8, 10,14
A	EP,A,0 190 506 (SPONMECH) 13 August 1986 see page 3, line 1 - line 19; figure ---	1,3,4,8, 10,14
A	BE,A,870 482 (LAJOT) 2 January 1979 see page 5, line 15 - page 6, line 26; figures 2,3 --- -/--	1,4,8, 10,14,17
¹⁰ Special categories of cited documents : ¹⁰ "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "&" document member of the same patent family		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
2 16 DECEMBER 1991	20 JAN 1992	
International Searching Authority	Signature of Authorized Officer	
EUROPEAN PATENT OFFICE	NEVILLE D.J. <i>D.J. Nevill</i>	

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	AT,B,384 595 (TGW TRANSPORTGERÄTE) 10 December 1987 see page 3, line 34 - line 40; figure 1 ---	4
A	DE,A,3 426 598 (SCHWÄMMLE) 7 February 1985 see page 7, last paragraph - page 8, line 15; figures 2,3 ---	8,9

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO. US 9105706
SA 51609**

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information. 16/12/91

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A-0149694	31-07-85	DE-A- 3401634	25-07-85
GB-A-2004242	28-03-79	US-A- 4193492	18-03-80
		AU-B- 522622	17-06-82
		AU-A- 3991878	20-03-80
		CA-A- 1089394	11-11-80
		DE-A- 2840044	29-03-79
		JP-A- 54093571	24-07-79
EP-A-0190506	13-08-86	AU-B- 574881	14-07-88
		AU-A- 5186186	17-07-86
		CA-A- 1259940	26-09-89
		DE-A- 3565384	10-11-88
		JP-A- 61188308	22-08-86
		US-A- 4733772	29-03-88
BE-A-870482	02-01-79	None	
AT-B-384595	10-12-87	AT-A,B 384595	10-12-87
DE-A-3426598	07-02-85	None	