United States Patent [19]

Van Kempen et al.

[11] **3,713,649**

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[54] CONVEYOR SYSTEM

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[52] **U.S. Cl.** **271/79,** 198/180, 211/124, 214/1.7, 226/92, 294/99

[51] **Int. Cl.**.....**B65h 5/08,** B65h 29/04

[58] **Field of Search**.....271/79, 85, 82, 75, 76, 77, 271/78, 45; 226/92; 214/1.7; 198/180; 294/99; 211/124

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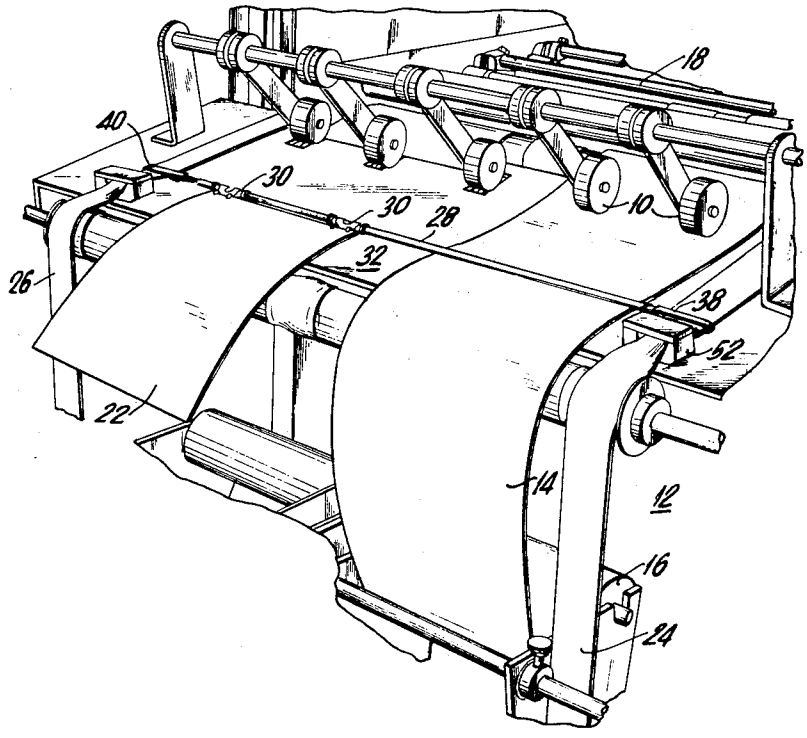
[57] **ABSTRACT**

In the conveyor system disclosed a rod grasps the forward ends of sheets to be conveyed by means of clips articulated on the rod. The rod extends between two parallel endless belts to which it may be engaged and disengaged. When engaged clasps extending from the ends of the rod embrace the belts and grip the webs of the belts. The belts pass through tapered openings in respective warping blocks so as to be squeezed and allow an operator to fit the belts into the clasps. Respective 180° twists in the belts reverse the warping each increment of each belt undergoes during each successive passage through the respective warping blocks. The rod may grasp and draw both individual sheets and continuous sheets through a processing apparatus.

21 Claims, 10 Drawing Figures



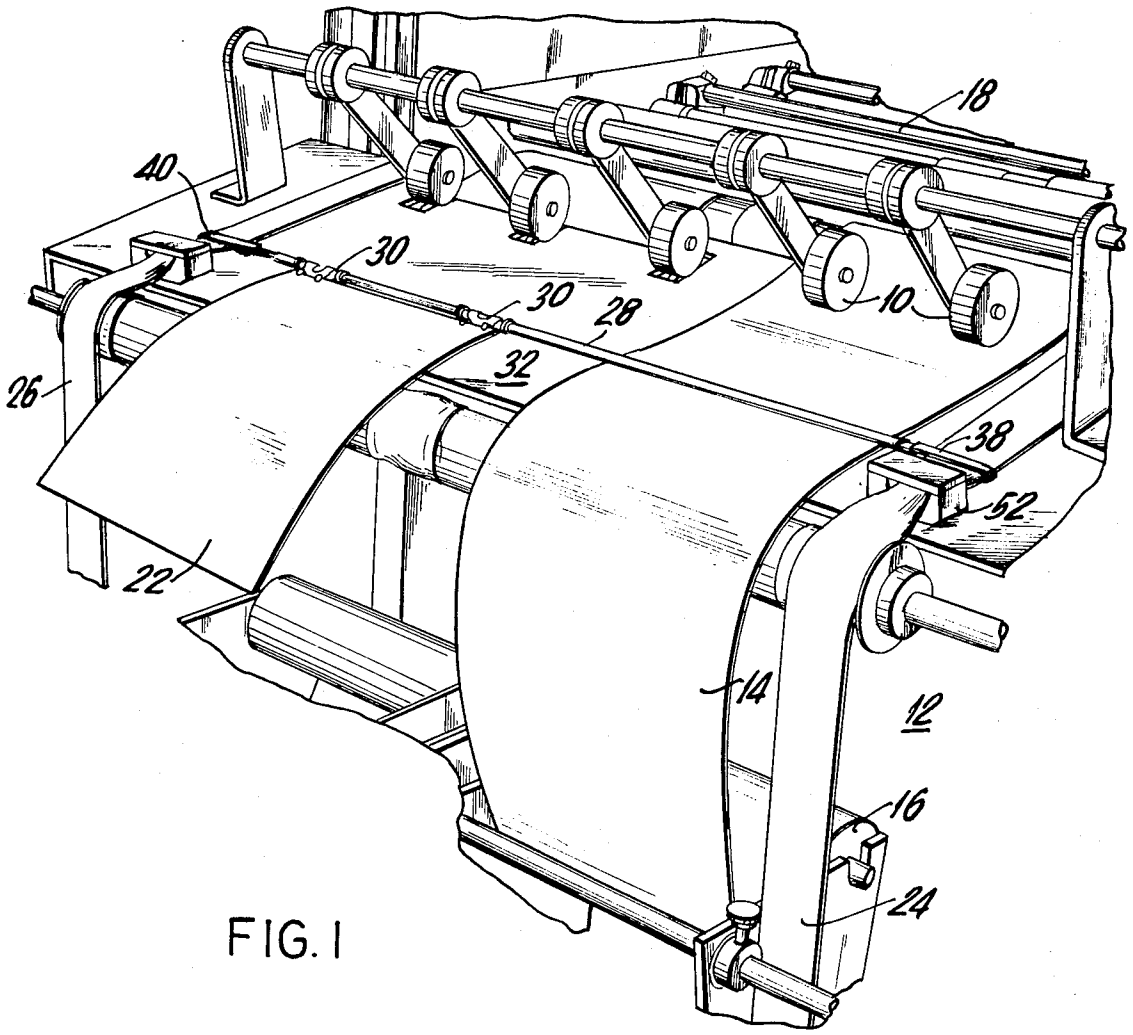


FIG. 1

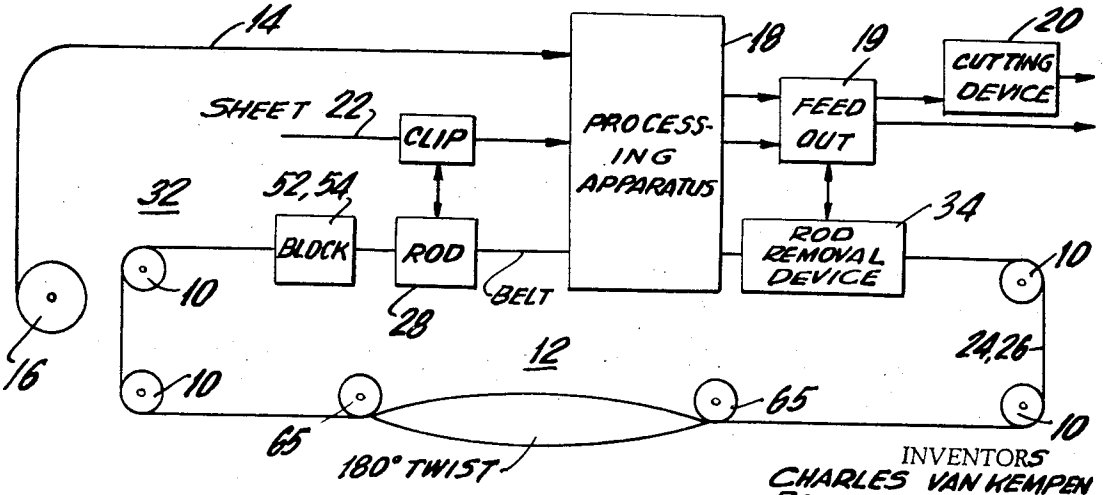


FIG. 2

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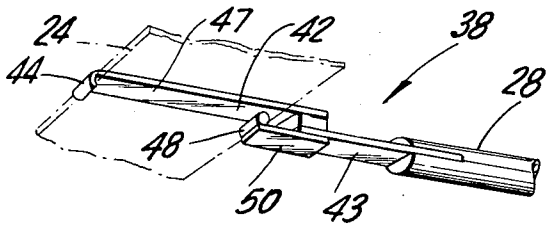

FIG. 3

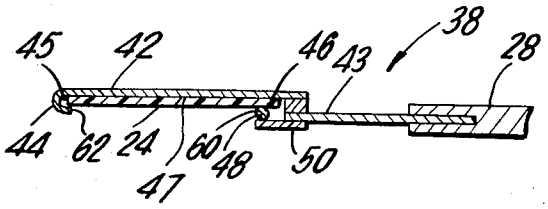

FIG. 4

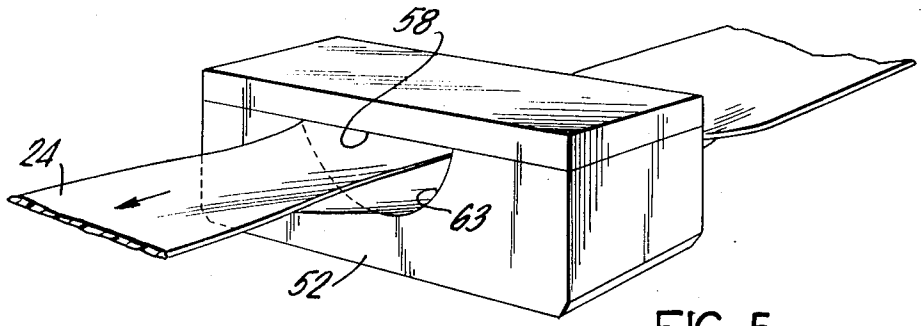

FIG. 5

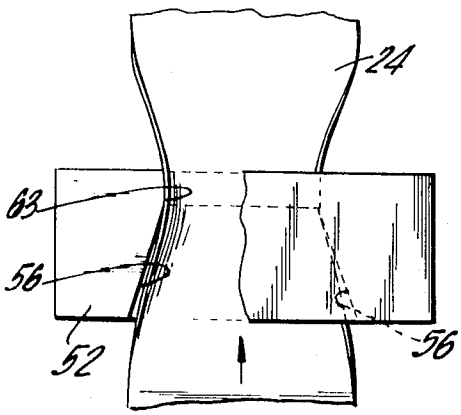

FIG. 6

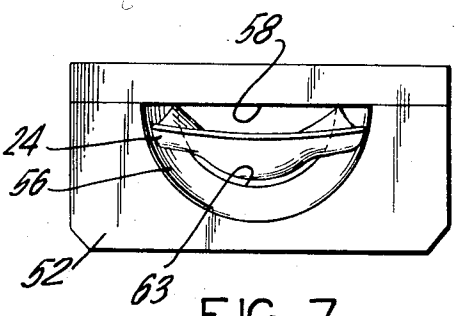

FIG. 7

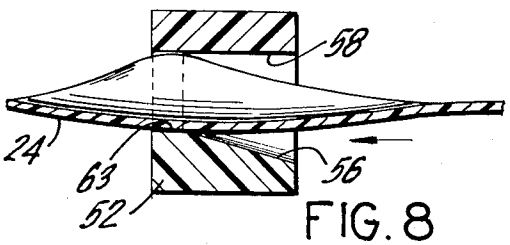

FIG. 8

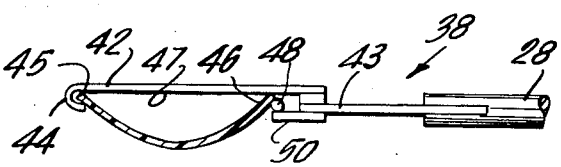

FIG. 9

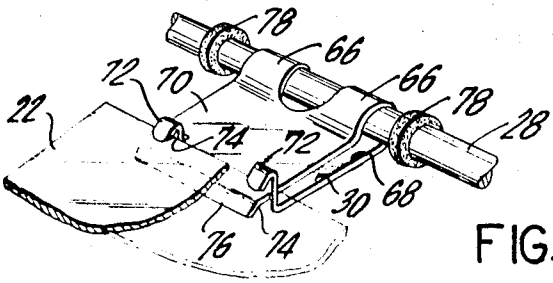

FIG. 10

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CONVEYOR SYSTEM

BACKGROUND OF THE INVENTION

This invention relates to conveyor systems, and particularly, to conveyor systems for transporting individual sheets of material through processing apparatuses. The invention has special, although not exclusive, relevance to systems for conveying photographic material through a number of photographic baths and dryers.

In photographic systems, it is desirable to pass either continuous sheets or individual sheets of photographic material such as photographic papers through a number of baths and drying apparatuses. If this is to be done conveniently and automatically, it is necessary that a quick method of drawing these sheets through the apparatuses be available. Prior art systems have been effective for drawing continuous sheets of material through the processing apparatuses. This is because it requires only a single forward edge to be lead through the processing apparatus to initiate feed-through of the entire continuous sheet. Thus, no matter how cumbersome the initial lead through process was, or no matter how cumbersome it is to attach the continuous sheet to a conveyor system, it has to be done only once and therefore, the burden of accomplishing this is acceptable even if difficult. However, when the same difficult or complex engagement problem occurs many times in the course of feeding individual sheets through processing apparatuses, considerable time may be wasted by operators attending the processing apparatuses. At the same time excessive repetition of a complex process may result in unreliable conveyance of the sheets through the processing apparatus. Prior art belt systems have also had the difficulty of assuring the positive control of the material which is to be drawn through the processing apparatus.

An object of the invention is to improve conveying systems.

Another object of the invention is to avoid the disadvantages of prior art conveyor systems.

Still another object of the invention is to enable conveyor systems to draw sheet material through processing apparatuses simply and effectively.

Still another object of the invention is to enable an operator to apply sheet material to a conveyor system simply without performance of complex steps while nevertheless, having the conveyor system transport the sheets effectively and reliably.

Yet another object of the invention is to avoid the danger of disengagement of the sheets from the conveyor system during passage through the processing apparatuses.

Still another object of the invention is to render conveyor systems capable of conveying both individual sheets as well as continuous sheets without the danger of harming either.

Yet another object of the invention is to include in a processing system a conveyor system and a processing apparatus wherein sheets of material to be processed may easily be drawn through the processing apparatus with great reliability and without complex manual steps to be performed by an operator.

Still another object of the invention is to improve conveyor belt systems.

Still another object of the invention is to render conveyor belt systems simply engageable to the material to be conveyed and without the danger of losing the material to be conveyed.

Still another object of the invention is to improve means for grasping the material to be conveyed.

SUMMARY OF THE INVENTION

According to a feature of the invention, these and other objects of the invention are obtained by holding the material to be conveyed with carrier means, and engaging the carrier means to belt means with grasping means which extend from one face of the belt means around one of the edges and toward the other edge so as to form a recess for gripping the belt means by an edge and holding means for forming an abutment that keeps the belt means in the recess.

According to another feature of the invention, warping means in the path of the belt means warp the belt means transversely throughout its longitudinal direction so as to move the edges of the belt means closer together and make them fit between the grasping means and the abutment means.

According to still another feature of the invention, the warping means include blocks embracing the belt means and forming an interior passage that tapers in the direction of movement of the belt means.

According to still another feature of the invention, the interior passage has a flat portion intercepting a frusto-conical portion.

According to still another feature of the invention, the block forms a first interior surface for applying an edge restraining force when the belt passes through the block and a second surface for applying a force transverse to the surface when the belt travels through the block.

According to yet another feature of the invention, the abutment means forms a second gripping means which has a resilient interference fit about the outer edge of the belt means.

According to still another feature of the invention, the belt means is endless.

According to yet another feature of the invention, the belt means includes a single 180° twist so as to form a Moibus strip.

According to yet another feature of the invention, second belt means travel parallel to the first belt means and second engagement means on the carrier means engage the second belt means.

According to yet another feature of the invention, the carrier means includes a rod extending between the engagement means. A plurality of clips grasp the material to be carried or transported.

These and other features of the invention are pointed out in the claims. Other objects and advantages of the invention will become obvious from the following detailed description when read in light of the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a processing system embodying features of the invention;

FIG. 2 is a schematic drawing illustrating in block diagram form the system of FIG. 1;

FIG. 3 is a perspective view illustrating a clasp grasping a belt in FIG. 1;

FIG. 4 is a section of the clasp with the belt in FIG. 3;

FIG. 5 is a perspective view of a belt in FIG. 1 passing through the warping block of FIG. 1;

FIG. 6 is a plan view of FIG. 5, partly in section;

FIG. 7 is an elevation of the belt passing out of the block in FIG. 5;

FIG. 8 is a longitudinal section of the belt passing out of the block in FIG. 5;

FIG. 9 illustrates a section of the belt in FIG. 1 in its initial engagement stage with the clasp of FIG. 1; and

FIG. 10 is a sectional view of one of the clips on the rod in FIG. 1.

DESCRIPTION OF PREFERRED EMBODIMENTS

In FIGS. 1 and 2, a ganged set of downwardly biased rollers 10 of a photographic processing machine 12 embodying features of the invention, guide a picture-wide, elongated, continuous sheet 14 of photographic material from a roll 16 into the processing apparatus 18 of the machine. The term "continuous sheet" is used herein to distinguish it from individual sheets and refers to the continuous supply of the sheet 14 that passes off the roll 16 in ribbonlike fashion. The processing apparatus 18 performs the usual photographic processing functions on the material by passing it through various developing and fixing baths as well as drying devices. The continuous sheet 14 emerges from the processing apparatus in finished form. A feed-out device 19 passes it to a transverse cutting device 20 to separate the continuous sheet into individual sheets.

Simultaneously with the processing of the continuous sheet 14, the machine 12 also handles individual sheets, such as the sheet 22 appearing to the left of the sheet 14 in FIG. 1 and appearing diagramatically below the sheet 14 in FIG. 2. In FIG. 2, it will be understood that the individual members are shown only in schematic or block diagram form to illustrate their functional relationship. The most significant relationships in FIG. 2 are the functional relationships which are shown by the arrows. For clarity, the elements are shown juxtaposed in a manner corresponding as closely as possible to their actual relationships. Since the sheet 22 would normally be hidden by the sheet 14 in FIG. 2, the individual sheet is shown offset from the continuous sheet 14.

To process individual sheets, such as 22, a pair of comparatively stiff nylon endless belts 24 and 26 draw a clip rod 28 between them. The rod 28 holds the forward edge of the sheet 22 by means of spaced clips 30. The rod 28 is substantially cylindrical throughout most of its length and the clips 30 freely articulate on the rod. The belts 24 and 26 advance the rod 28 which draws the sheet 22 through the processing apparatus 18 from a loading table 32. The rod 28 draws the sheet through the various baths and drying apparatuses. As the sheet 22 emerges from the processing apparatus, a suitable rod removal device 34 detaches the rod from the belts so that the feed-out device 19 passes the sheets which are still being held by the rod 28 to an operator. The rod removal device may, if desired, by inwardly operated or may be replaced by a manual operation.

The sheet-controlling rod 28 grasps the endless moving belts 24 and 26 by means of two engagement clips or clasps 38 and 40 that project outwardly from the ends of the rod. Details of the clips 38 and 40 appear in the perspective drawing of FIG. 3 and the sectional drawing of FIG. 4. In these figures, only the clip 38 is shown. However, the clip 40 is represented thereby, because it constitutes a substantially, identical mirror image of the clip 38.

The clip 38, shown in FIGS. 3 and 4 is composed of a strip-like plate 42 terminating at a stepped portion or assembly 43 which is welded or otherwise gripped on the end of the rod 28. The plate 42 also terminates in a downward back-curve portion 44. The back-curve portion guides one side of the belt 24 near its outer edge 45. The guiding action is both vertical and horizontal, because the back-curve portion extends under the edge of the belt. Gripping the web of the belt 24 near its inner edge 46 is the lower interior surface 47 of the plate 42 and a gripping pin 48 fixedly mounted on a metal extension 50 that is welded to the stepped portion 43.

The pin 48 and the surface 47 of the plate 42 form an interference fit that tightly grips the web of the belt 24. In this manner, longitudinal movement of the belt 24 is transmitted to the clip and hence the rod. The back-curve portion 44 of the plate 42 prevents the belt 24 from escaping laterally from between the gripping surfaces of the surface 47 and the pin 48. The engagement clip 40 similarly grips the belt 26 on its inner portion and holds it laterally at its outer edge and thereby imparts the movement of the belt to the rod.

The belts 24 and 26 pass through respective nylon warping blocks 52 and 54 which are mounted on the loading table 32. Details of a block are shown in FIGS. 5 through 8. The description of one block applies equally as well to the other since both of these blocks are identical. The block in FIGS. 5 through 8 includes a lower interior frusto-conical surface 56 whose diameter decreases in the direction of the movement of the belt 24. Intersecting the frusto-conical surface is a flat surface 58 tapered inwardly in the direction of the belt movement. The two surfaces together warp the belt transversely. In particular, they force the edges of the belts 45 and 46 inwardly and upwardly as shown in FIGS. 5 through 8. The belts force the edges 45 and 46 inwardly enough to be sufficiently close so that as the belt emerges from the block, the distance between the edges 45 and 46 is less then the distance between the interior points 60 and 62 on the clips 38 and 40. At the exit end of block 52 the frustoconical surface 56 terminates in a short semi-cylindrical surface 63.

Because of the temporarily close distance between the edges of the belts, an operator at the loading table can fit the clips 38 and 40 about the edges of the belts as shown in FIG. 9. If the belts were allowed to continue moving with the clips attached as shown in FIG. 9, the comparatively stiff belt might retain the ends 60 and 62 of the clip 38. However, by pressing the clip 38 downwardly and the upper hump 64 of the transverse center of each belt upwardly, an operator forces the edges 45 and 46 of the belt into the clip. The hump may be pressed upwardly with the fingers or by the pressure against the table 32. The belt then assumes the position shown in FIGS. 3 and 4. The upward force upon the hump 64 and the downward force on the clip creates outward vector forces which causes the edge 46 to slide into the interference fit between the pin 48 and the surface 47 so that these grip the belt. In the process of

pushing the hump 64 of the belt 24 upwardly, the back-curve portion 44 of the plate 46 applies the reactive force necessary to keep the belt 24 from moving laterally outward.

The belt 26 fits into the clip 40 in exactly the same manner when the operator applies the downward pressure onto the clip and the upward pressure onto the hump on the other side of the loading platform. The material of the belt has sufficient stiffness to remain in the position shown in FIGS. 3 and 4 thereby drawing the paper through the processing apparatus.

At the exit of the processing apparatus, the feed-out device 19 passes the rod 28 through the rod removal device. Thereafter, as shown between the two lower rollers 10, the belt is twisted 180°. Additional rollers such as rollers 65 may be used to confine the twist longitudinally. This 180°-twist has considerable importance for the operation of the belt. This is because if the belts were not so twisted, they would be warped in the same direction from continuous passage through the warping blocks 52 and 54. Ultimately, the belts would lose their resilience and retain a permanent set that would prevent them from remaining within the clips 38 and 40. In effect, they would retain their bowed condition shown in FIG. 9 continuously. After an operator attempted to press them into the position shown in FIG. 4, they would return resiliently to the position shown in FIG. 9. However, by twisting them 180°, each section of the belt is warped in the opposite direction each time it passes through the blocks.

In effect, the 180° twist forms Moibus strips. As is well known, it is a property of a Moibus strip to have only a single surface. The upper surface of each increment as it passes through the block, becomes a lower surface the next time it passes through the block. Thus the web at each increment is flexed or warped first in one direction and then in the other direction. In this manner, the flexibility and resilience of the belts are retained so that the clips 38 and 40 can grasp them.

In operation then, each belt 24 and 26 passes through the blocks 52 and 54, and as they pass through the blocks, an operator places the rod 28 so that the clips 38 and 40 fit over the belts 24 and 26. The operator then applies the clips 38 and 40 to the belts 24 and 26 so that they engage as shown in FIG. 9. He then presses downwardly on the clips and upwardly on the humps of the belts until they assume the positions shown in FIGS. 3 and 4.

Before even placing the rod onto the loading station, the operator must, of course, attach the sheet 22 to the rod by means of the clips 30. The rod then draws the sheet 22 through the processing apparatus where the sheet 22 is applied to various baths, solutions and drying apparatus. At the exit portion of the apparatus, the rod removal device 34 removes the rod 28 and allows the operator to remove the sheet 22 together with the rod. The rod may also be removed manually.

The belts 24 and 26 are twisted 180°. Thus a surface which was at the top of any one increment is now placed at the bottom. More particularly, thus a surface of an increment, which travelled around the outer periphery of the endless travel of the belt, is now on the inside of the periphery. When the increment returns to the block 36, the previously upward facing surface of an increment now faces downwardly.

The pin 48 on each of the clips 38 and 40 is peculiarly adaptable for receiving the belts 24 and 26 and gripping them. Because of its cylindrical surface, the belt 24 can easily slip between pin 48 and the surface 47 of the plate 42, that is to say the curvature of the pin 48 and the surface 47 form a simple entrance channel so that the web of the belt 24 can easily be forced between the interference fit formed by the pin and surface. On the other hand, the interference fit over the longitudinal contact area between the pin and the web of the belt 24 as well as the contact area between the surface 48 and the web 24 cause the clip 38 to grip the belt tightly.

According to one embodiment of the invention, the back-curve portion 44 simply provides a loose guide that helps the clip provide a reactive force when the web of the belt 24 is forced over the pin 48. Thereafter, it forms an abutment edge which prevents the belt 24 from sliding out of the grip formed by the pin 48 of the surface 47.

However, according to another embodiment of the invention, the back curve portion 44 forms a tight fit around the web of the belt 24 near the edge 45. In this embodiment sharpened edges are avoided near the point 62 to prevent the portion from interfering with insertion of the belt into the clip 38. This discussion, of course, applies equally to the clip 40 and the belt 26. The clips 30 articulated about the rod 28 and holding sheets such as sheet 22 are composed of a single sheet of resilient metal forming an arcuate portion 66 which fits loosely about the rod 28. A lower plate portion 68 is biased by the arcuate portion away from an upper plate portion 70. Upstanding inverse V-shaped elements 72 at the end of the lower portion 68 extend through recesses 74 in the upper portion 70. The elements 72 then abut downwardly with their ends against a tongue 76. The outwardly biasing forces supplied by the arcuate portion 66 to the upper and lower portions 68 and 70 thus bias the ends of the elements 72 against the tongue 76. Retaining rings 78 of plastic or rubber material fitting tightly around the rod 28 and thereby fixed in position, maintain the longitudinal positions of the clips 30.

An operator utilizes the clips 30 by squeezing the upper and lower portions 68 and 70 together and then sliding the forward edge of a sheet such as the sheet 22 between the elements 72 and the tongue 76. The operator then releases the upper and lower portions 68 and 70. Several clips 30 may be used to hold a single sheet. The sheet may either be an individual sheet, such as the sheet 22 or a continuous sheet such as the sheet 14.

The invention makes it possible to draw sheet material through processing apparatuses simply and effectively. Either single sheets or continuous sheets may be drawn through. An operator can apply the sheet material to a conveyor system simply without performance of complex steps. Nevertheless, the conveyor system transports the sheets effectively and reliably. The system which includes the pin 48 and the plate 42 to grip the belts as well as the back-curve portion 44 avoids the danger of disengagement of the sheets from the conveyor system during passage through the processing apparatus. The blocks 52 and 54 as well as the twists in the belt help in this regard.

According to another embodiment of the invention are blocks **52** and **54** are turned upside down and the belts **24** and **26** warped to form an upward hump **64**. The clips **38** and **40** are then also turned upside down and placed with the plate under the belts **24** and **26** and with the pins **48** over the belts.

Also according to another embodiment of the invention, the additional blocks corresponding to the blocks **52** and **54** replace the **180°** twists in the paths of the belts. These blocks warp the belts in a direction opposite to the blocks **52** and **54** and thus avoid distortion of the belts.

While embodiments of the invention have been described in detail, it will be obvious to those skilled in the art that the invention may be embodied otherwise without departing from its spirit and scope.

What is claimed is:

1. A conveyor system comprising transport belt means having a pair of longitudinal edges, carrier means for moving items to be transported, engagement means on said carrier means for engaging said carrier means with said belt means; said engagement means including grasping means extending from one face of said belt means around one of said edges and toward said other edge and forming a recess for gripping said belt means by an edge, and holding means forming an abutment for keeping said belt means in the recess; said abutment being located near the other edge; and belt warping means in the path of said belt means for warping said belt means transversely across its longitudinal direction so as to move said edges closer together and fit between said grasping means and said abutment.

2. A system as in claim **1**, wherein said grasping means extend across one face of said belt means to said holding means and terminate in said holding means.

3. A system, as in claim **1**, wherein said warping means includes block means embracing said belt means and forming an interior passage tapering in the direction of movement of said belt means.

4. A system, as in claim **3**, wherein said passage has a flat portion intercepting a frusto-conical portion.

5. A system as in claim **3**, wherein said block means form a first interior surface for applying an edge restraining force when said belt passes through said block means and a second surface for applying a force transverse to the surface of said belt means when said belt means travels through said block means.

6. A system as in claim **1**, wherein said abutment means forms a second gripping means having a tight fit across the surfaces of the belt means about the outer edge of said belt means.

7. A system as in claim **1**, wherein said belt means is endless.

8. A system as in claim **7**, wherein said belt means includes a single 180° twist.

9. A system as in claim **1**, further comprising second belt means travelling parallel to said first belt means and second engagement means on said carrier means for engaging said second belt means.

10. A system as in claim **9**, wherein said carrier means includes a rod extending between said engagement means and a plurality of clips for grasping the material to be conveyed.

11. A system as in claim **1**, wherein said grasping means includes a plate portion extending from one edge of the belt to another and forming said holding means at one edge, and a second plate portion secured to the first one and extending to the other surface of the belt, and further including a cylindrical pin between the first plate portion and the second plate portion, the pin and the first plate portion forming a gap for receiving an edge of the belt means, the gap being sufficiently small to form an interference fit.

12. A system as in claim **1**, further comprising second belt means having two longitudinal edges and travelling parallel to said first belt means, and second engagement means on said carrier means for engaging said second belt means, said second engagement means including second grasping means extending from one face of said second belt means around one of said edges and toward the other edge and forming a recess for gripping said second belt means by an edge, said second engagement means further including holding means forming an abutment for keeping said second belt means in the recess, second belt warping means in the path of said second belt means for warping said second belt means transversely through its longitudinal direction so as to move the edges of said second belt means closer together and to fit between said second grasping means and said abutment means.

13. A system as in claim **12**, wherein said carrier means includes a rod extending between said engagement means and a plurality of clips for grasping the material to be carried.

14. A system as in claim **13**, wherein each of said warping means includes a block embracing said belt means and forming an interior passage tapering inwardly in the direction of movement of said belt means.

15. A system as in claim **14**, wherein the passage in each of said block means includes a flat portion intercepting a frusto-conical portion.

16. A system as in claim **14**, wherein said block means forms a first interior surface for applying an edge restraining force when said belt means passes through said block means and a second surface for applying a force transverse to the surface when said belt means travels through said block means.

17. A carrier comprising rod means, a sheet of resilient material bent around said rod means and forming a first flat portion and a second flat portion joined by an arcuate portion, said arcuate portion having a shape such as to bias said first and second flat portions away from each other, said arcuate portion surrounding said rod means, said flat portions having respective ends, the end of the first of said flat portions having a pair of projections extending towards the second flat portion, recesses in said second flat portion, said projections extending through said recesses and terminating in V elements, the end of said V elements extending back toward said second flat portion, the biasing of said first flat portion away from said second flat portion by said arcuate portion causing said elements to be biased toward said second flat portion.

18. A carrier as in claim **17**, wherein said arcuate portion extends sufficiently around said rod means so as to form a reverse arc and cause the spacing between said first flat portion and said second flat portion to be close enough to prevent substantial radial movement of said clips relative to said rod means.

19. A carrier as in claim 17, wherein said rod means include a plurality of spaced rings for limiting movement of said clips in the axial direction on said rod means.

20. A carrier as in claim 17, wherein said rod means terminate at longitudinal ends in engagement means adapted to hold respective moving belts each having opposing surfaces and opposite edges, said engagement means including grasping means adapted to extend from one face of a belt around one of the edges and toward the other edge so as to form a recess for gripping said belt by an edge, and holding means forming an abutment spaced near the other edge for keeping the belt in the recess.

21. A clip for grasping a belt comprising engagement means including grasping means adapted to extend from one face of the belt around one of the edges and toward the other edge of the belt and forming a recess for gripping the belt by and edge, and holding means forming an abutment for keeping the belt in the recess said abutment being spaced near the other edge, said grasping means extending to said holding means, said holding means and a portion of said grasping means being formed from a single metal plate and terminating at the holding means in a back-curve portion that is adapted to pass completely around the edge of a belt, said grasping means including a portion of said plate and forming a step, said grasping means further including an extension toward said holding means from said step, said extension being adapted to pass over the surface of the belt opposite to the surface of the belt near the plate, a cylindrical pin secured to said extension and forming a gap between the pin and the plate.

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