United States Patent [19]

White

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[45] **June 17, 1975**

[54] **OPENWORK CONVEYOR BELTING**

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[73] Assignee: **United Kingdom Atomic Energy Authority**, London, England

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[21] Appl. No.: **420,719**

Related U.S. Application Data

[63] Continuation of Ser. No. 245,482, April 19, 1972, abandoned.

[52] **U.S. Cl.** ..... **198/189**; 198/127 R; 198/181; 198/193; 198/203

[51] **Int. Cl.** **B65g 15/54**

[58] **Field of Search** ..... 198/136, 181, 182, 193, 198/195, 203, 208, 127 R

[56] **References Cited**

UNITED STATES PATENTS

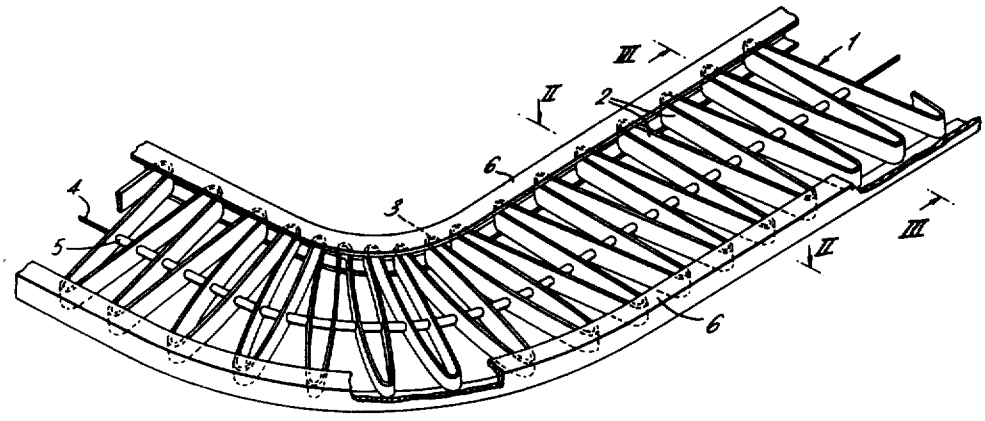
853,129	5/1907	Simpson	198/195
888,765	5/1908	Stevans	198/208
2,762,496	9/1956	McCaul	198/181
2,981,401	4/1961	Cumming	198/195
3,094,206	6/1963	Stewart et al.	198/181
3,111,215	11/1963	Tellefson	198/181
3,363,744	1/1968	Green et al.	198/136
3,570,651	5/1971	Lanham et al.	198/136
3,653,493	4/1972	Kerr	198/136
3,682,295	8/1972	Roinestad	198/136

Primary Examiner—Evon C. Blunk
Assistant Examiner—Jeffrey V. Nase
Attorney, Agent, or Firm—Larson, Taylor and Hinds

[57] **ABSTRACT**

Conveyor belt comprises a series of spaced transverse struts mounted on a flexible but inextensible element. The ends of the struts are interconnected to form a substantially zig-zag configuration, the interconnected ends being adapted for engagement in slideways thereby to constrain the belt to curves in the path of the conveyor and maintain its attitude in a horizontal plane.

22 Claims, 25 Drawing Figures



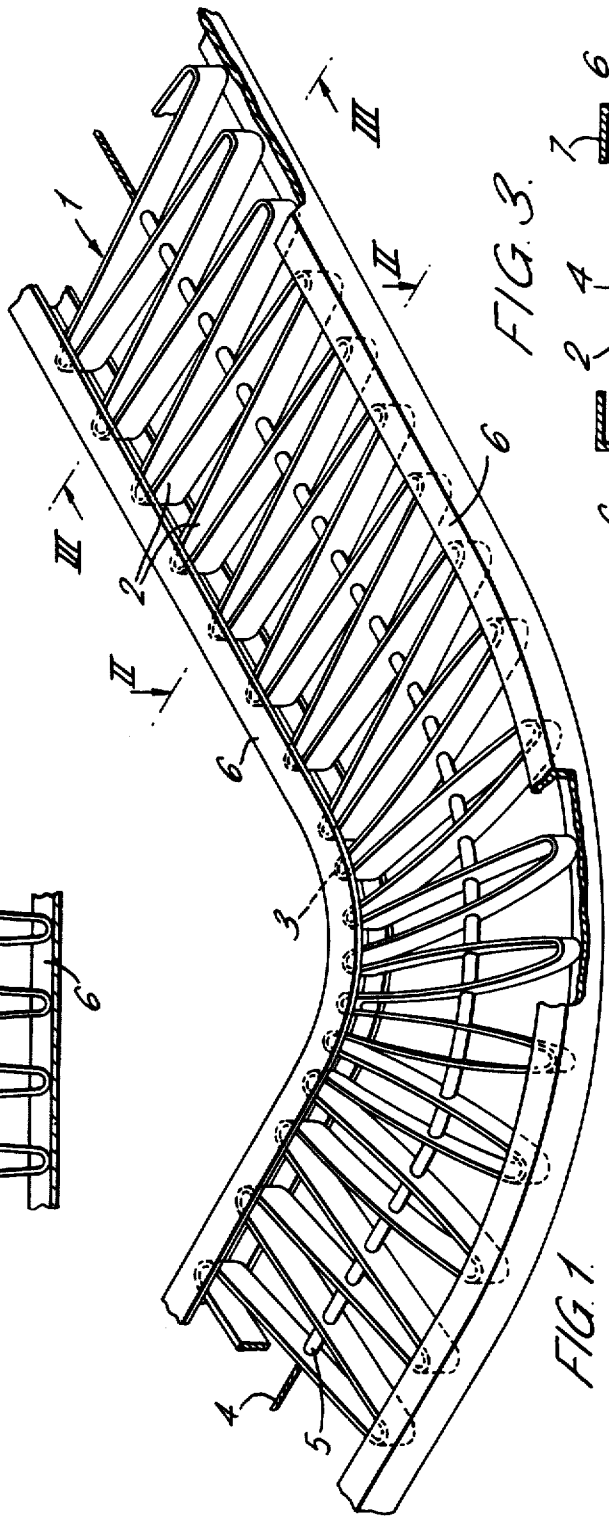


FIG. 1.

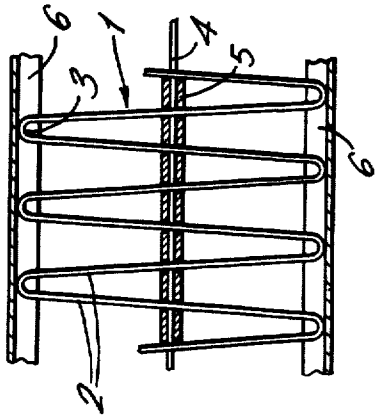


FIG. 2.

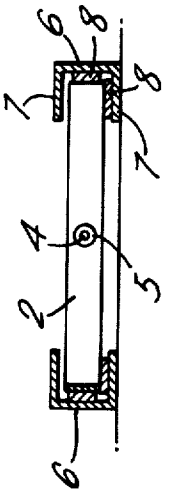


FIG. 3.

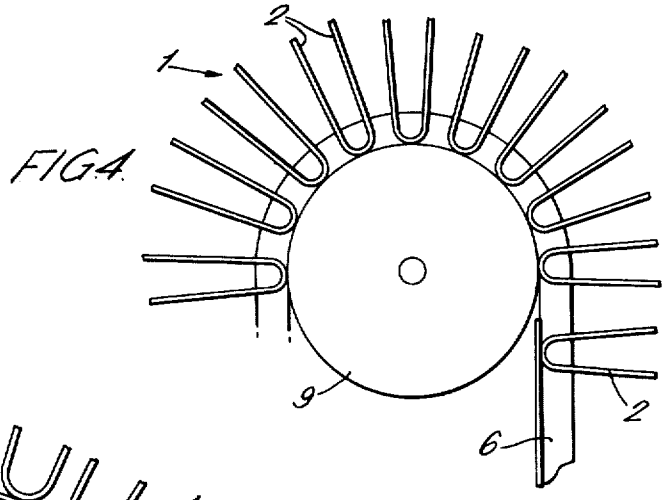


FIG.4

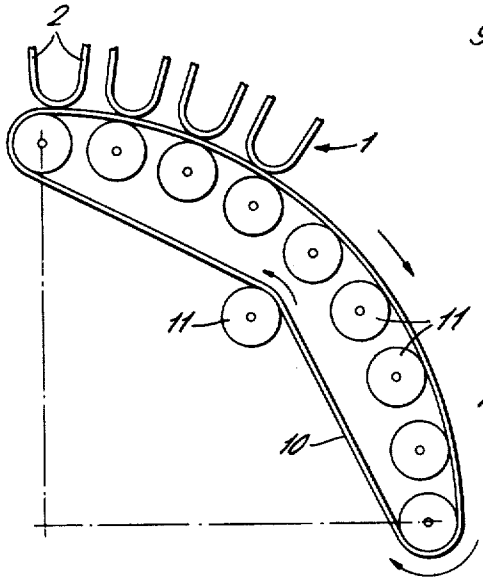


FIG.5.

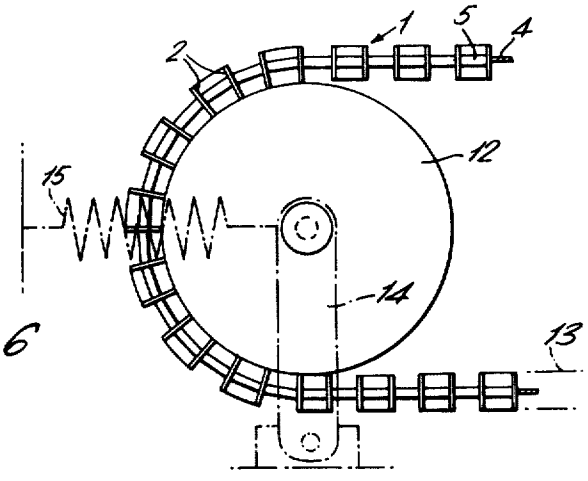
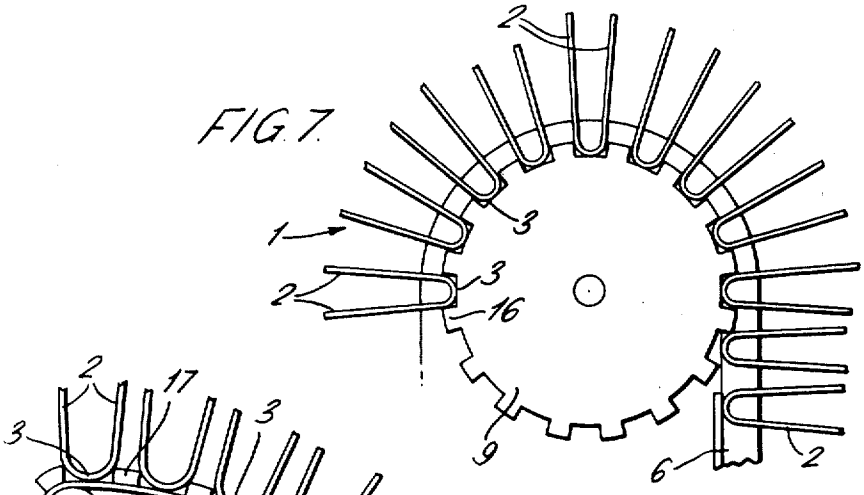


FIG.6

FIG. 7.



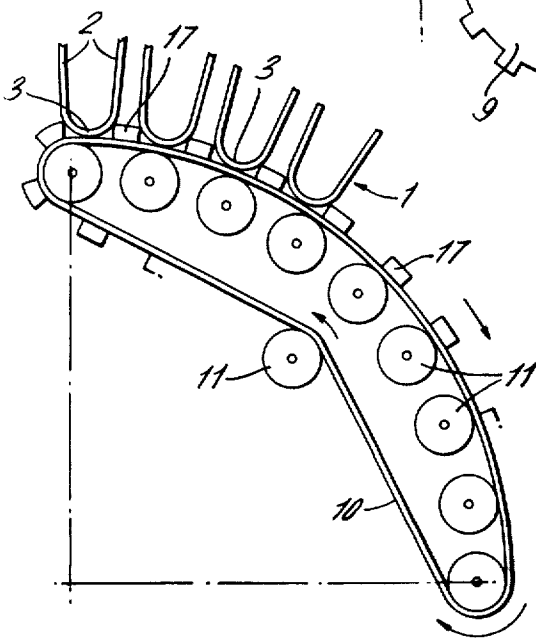


FIG. 8.

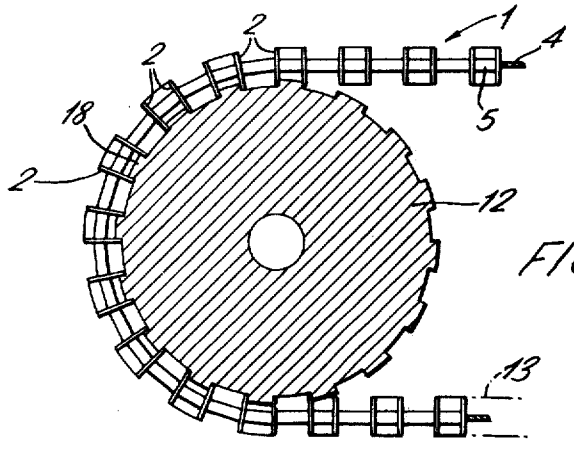


FIG. 9.

FIG. 10.

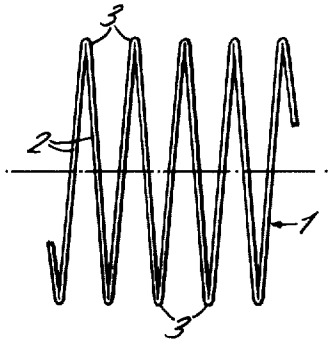


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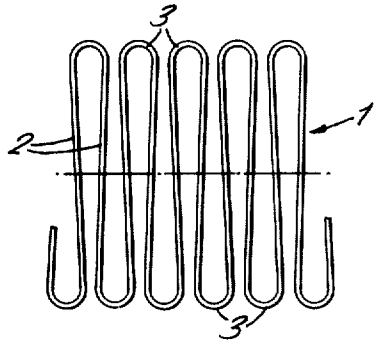


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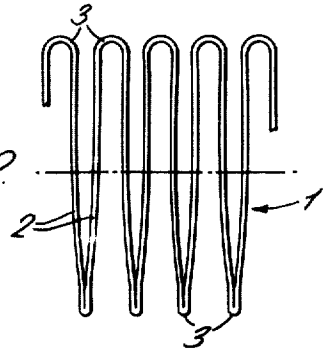


FIG. 13.

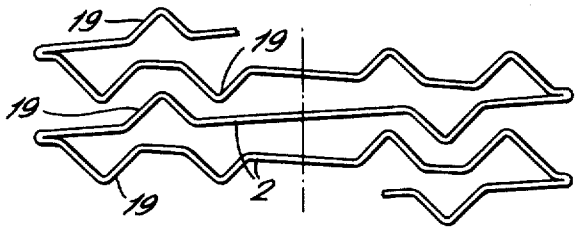


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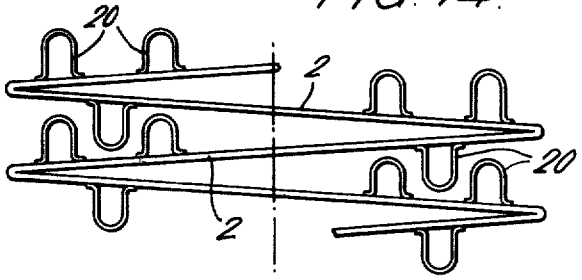


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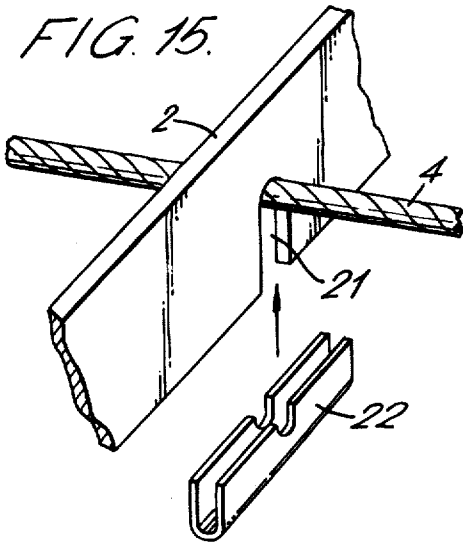


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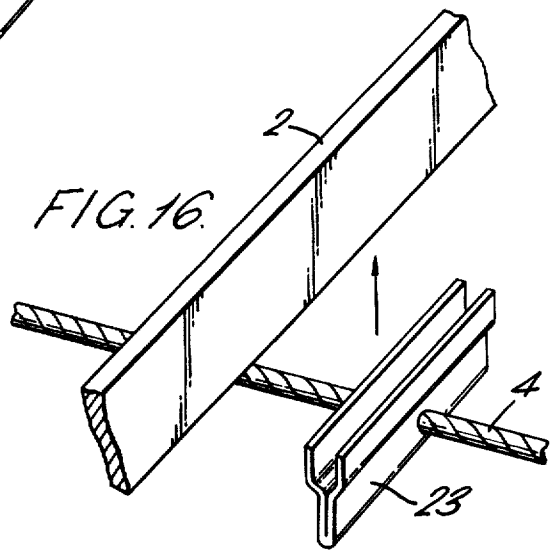


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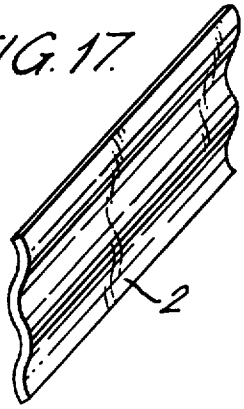


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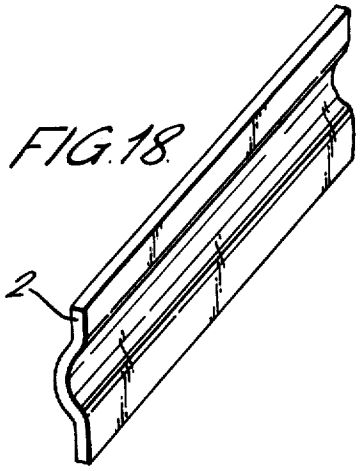


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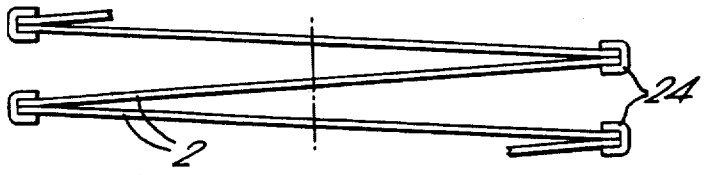


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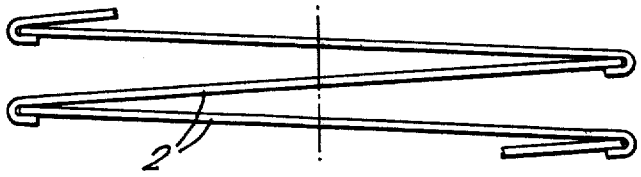


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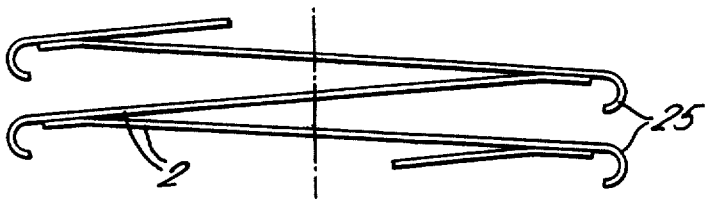
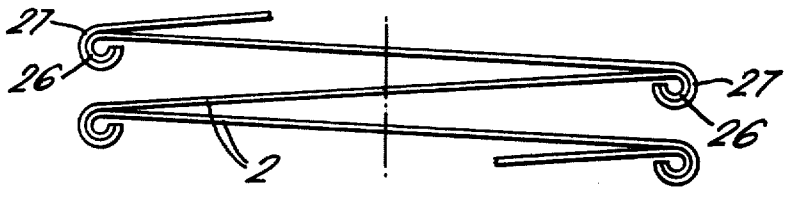


FIG. 22.



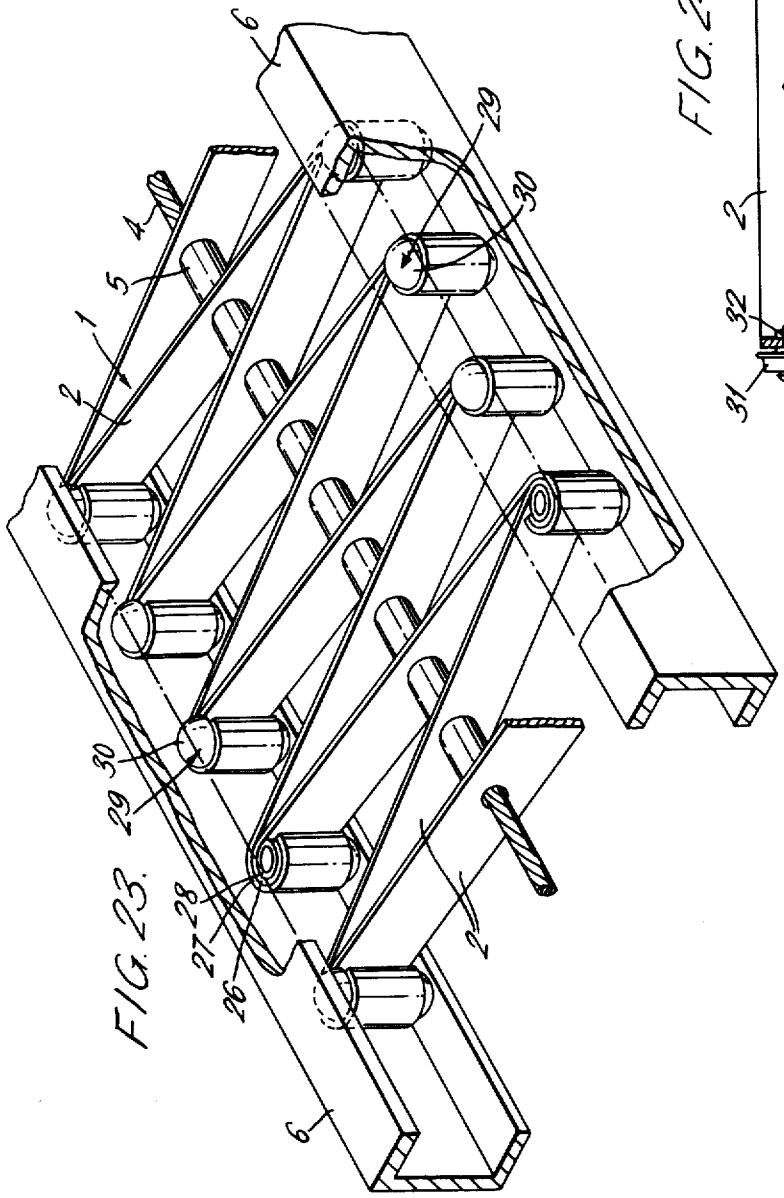


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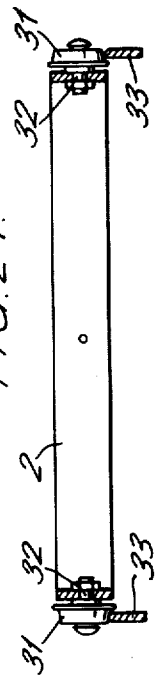


FIG. 24.

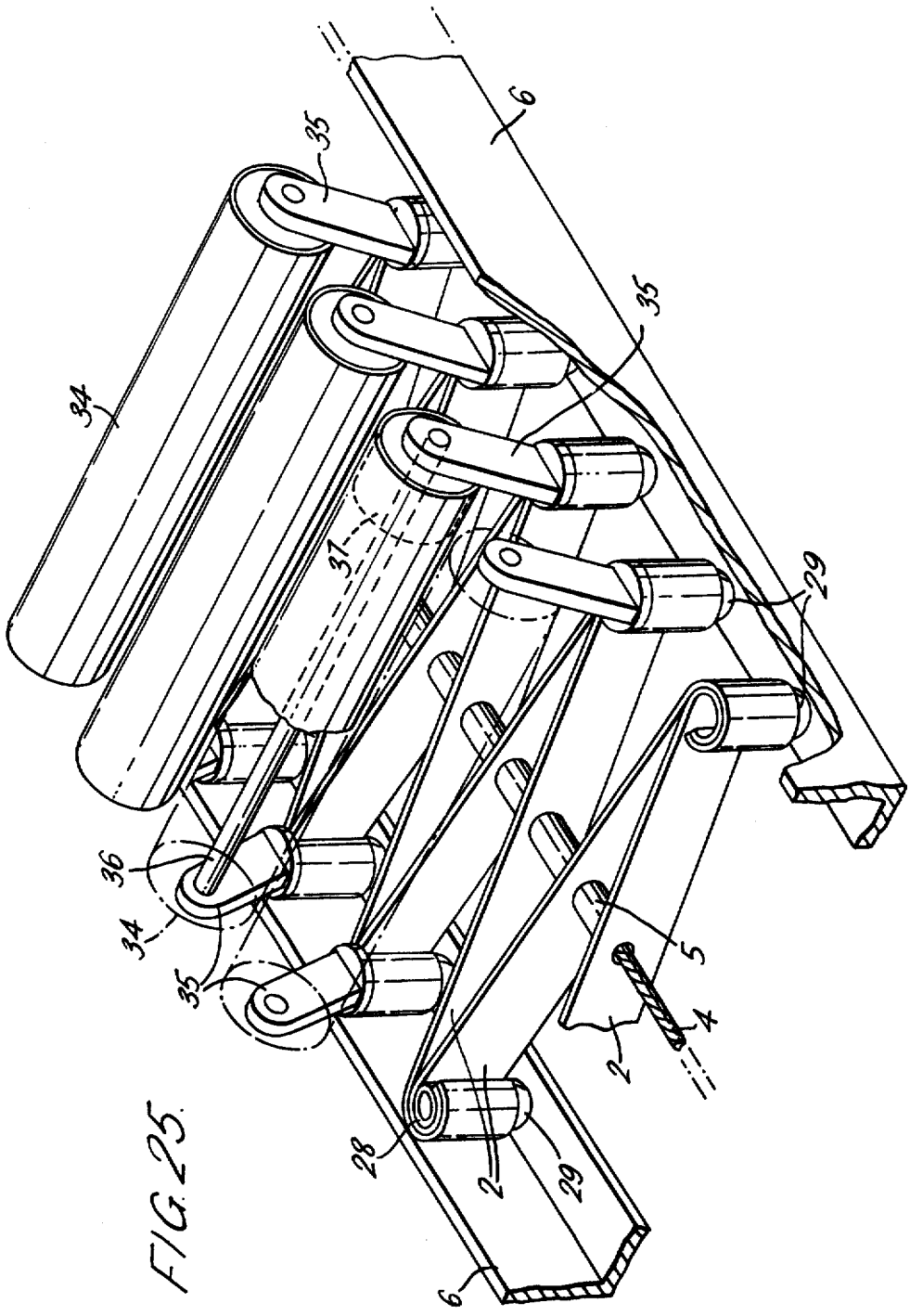


FIG. 25.

OPENWORK CONVEYOR BELTING

This is a continuation of application Ser. No. 245,482, filed Apr. 19, 1972, and now abandoned.

BACKGROUND OF THE INVENTION

The present invention relates to conveyor belting of openwork type and to conveyor systems in which such belting is used.

It has been established for some time that there is usefulness in many applications for a belt construction which can be caused to follow a path including curves in the plane of the belt. This capability must be additional to the more usual mode of flexure which is required for lapping over rolls and pulleys.

SUMMARY OF THE INVENTION

According to the invention a openwork conveyor belt comprises a series of transverse struts located in spaced relationship on a flexible but substantially inextensible element, the struts projecting to either side of the element and alternately interconnected at their ends to form a substantially zig-zag or serpentine configuration, the interconnected ends being adapted for engagement directly or indirectly with guide means by which to constrain the belt to curves in its path and in the absence of other support to maintain the attitude of the struts in the requisite plane.

The load carrying surface is constituted by the upper edges of the struts and spacing between them gives rise to the openwork character. Around a curve it is the strut ends on the inside of the curve which essentially must have a running engagement with the guide means by which the curve is defined. Such engagement may be indirect by virtue of the provision on the strut ends of anti-friction elements, such as rollers.

The strutting is conveniently strung on the flexible element with spacer pieces intervening between adjacent struts. With the element situated at the mid-depth of the struts a greater stability of the conveying surface is achieved, bearing in mind that the belt tension can only be present in the flexible element. A single element is best located centrally of the belt width. The use of more than one element is not excluded, especially if positioned near the centre.

The form of construction using alternate interconnections produces in effect a continuous strut array rather in the manner of a concertina. This concept lends itself to the use of a zig-zag folded strip to act as the strutting, the separation between the V or U legs of the strip being maintained by the spacer pieces. The strip may be of uniform width with plain edges; alternatively the edges may be lightly indented or otherwise fashioned for imparting pattern or grip to conveyed articles or for modifying the flexural characteristics of the strip. A metal strip, for example, can be readily selected to allow the elastic flexing action which assists in accommodating the forces generated as a result of drawing the inside edges over a curve-defining guide means. These edges, as constituted by the interconnectd strut ends may be adapted in a variety of ways to reduce frictional effects. With a construction based on the folding of strip, the folds may be arranged to clamp in position an anti-friction attachment; alternatively the connecting pieces used in a composite construction of the concertina may themselves incorporate low friction rubbing pads.

A conveyor system utilising belting as above described would additionally comprise the guide means for constraining the belt to curves in its path and a drive means for imparting movement to the belt along that path.

The guide means may take the form of a channel section having a channel width large enough to receive the strut ends. Guide means in the form of a channel is suitable for guiding the conveyor belting around bends of large radius. In the case where the conveyor belting is required to negotiate horizontal bends of sharp radius a guide wheel may be provided on the inside radius of the bend the edge of the conveyor belting on the inside radius of the bend running in contact with this guide wheel. To reduce friction effects in guiding the conveyor belting around bends of larger radius where space availability precludes the use of a large diameter guide wheel on the inside curvature of the bend a support belt may be provided running on rollers in contact with the edge of the conveyor belting on the inside radius of the bend.

Drive means for the conveyor belting may be arranged to make driving engagement with the belting in the region of the flexible element. In this region belting using struts of strip form would present strip edges for engagement with a sprocket wheel or projections on a drive belt. The conveyor belting may also be driven by frictional drive from guide wheels at the points of sharp bends in the belting. Alternatively where the belting is guided around bends of larger radius by a support belt running on rollers such a support belt may be power driven to drive the conveyor belting by frictional engagement therewith. Further the guide wheels at bends of sharp radius in the belting or a support belt at bends of larger radius may be formed with sprocket teeth engaging between the ends of the struts at the edge of the conveyor belting.

In the case of conveyor belting made from zig-zag folded strip to define the struts the use of bends of sharp radii interconnecting the ends of adjacent struts means that the conveyor belting can negotiate tight horizontal bends. In this case, however, the gaps between adjacent pairs of interconnected struts at the outer radius of the bend will be large so that small articles can fall through the gaps or become trapped. The gaps may be reduced by employing bends of larger radius interconnecting the ends of the struts or the gaps may be reduced by bending the struts to form projections extending transversely into the gaps the projections on any one strut being staggered with respect to the projections on the adjacent struts. Alternatively additional members may be fitted projecting transversely from the struts into the gap in the manner of the projections described above.

A preferred form of conveyor belting in accordance with the invention comprises individual cross struts the ends of the cross struts being of rolled tubular form, one end of each cross strut being formed to a smaller diameter than the diameter of the other end, the corresponding ends of adjacent cross struts being interconnected by the smaller diameter rolled end of the one cross strut fitting inside the corresponding larger diameter rolled end of the other cross strut. The rolled ends of the cross struts may provide location for antifriction rolling elements or sliding bearing pads which run in a guide channel alongside each edge of the belting. For instance the antifriction bearing pads may be in the

form of domed headed rivets fitted inside the interconnected rolled ends of each adjacent pair of cross struts the domed heads of the rivets constituting the antifriction bearing pads for the conveyor belting.

In another form of conveyor belting in accordance with the invention free running rollers extending across the width of the belting are mounted from the cross struts of the conveyor belting.

In the form of conveyor belting in which the ends of the cross struts are of rolled tubular form for interconnection one with the other the rollers may be mounted on shafts extending between brackets fitted in the rolled ends of the cross struts along each edge of the conveyor belting. The brackets along one edge of the belting may be inclined in one direction with respect to the longitudinal axis of the belting whilst the brackets along the other edge of the belting are inclined in the opposite direction so that the shafts carrying the rollers extend transversely across the width of the belting between corresponding brackets on either edge of the belting.

DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will now be described by way of example with reference to the accompanying drawings in which:

FIG. **1** is an isometric view of part of a conveyor system,

FIG. **2** is a cross section along the line II—II in FIG. **1**,

FIG. **3** is a cross section along the line III—III in FIG. **1**,

FIGS. **4**, **5** and **6** are details of the conveyor system shown in FIG. **1**,

FIGS. **7**, **8** and **9** are modifications of the arrangements of FIGS. **4**, **5** and **6**,

FIGS. **10**, **11** and **12** are details in plan view of various forms of conveyor belting fabricated from folded strip,

FIGS. **13** and **14** are details in plan view of modified forms of conveyor belting,

FIGS. **15**, **16**, **17** and **18** are isometric details of constructional modifications of the type of conveyor belting shown in FIG. **1**,

FIGS. **19**, **20**, **21** and **22** are details in plan view of various forms of conveyor belting constructed from individual components,

FIG. **23** is an isometric view of part of a second form of conveyor system,

FIG. **24** is a detail of a modified form of guide means for conveyor belting in accordance with the invention,

FIG. **25** is an isometric view of part of a third form of conveyor system.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the arrangement shown in FIG. **1** of the drawings an openwork conveyor belting **1** is formed from a flat metal strip which is bent to form a substantially zig-zag or serpentine configuration. The belting **1** can be regarded as consisting as a series of cross struts **2** which are alternately interconnected at their ends by U-bends **3**.

As shown in FIG. **2** a flexible steel cable **4** passes through holes in the centre of each cross strut **2** and adjacent cross struts **2** are spaced apart by tubular distance pieces **5** threaded on the cable **4**.

The edges of the conveyor belting **1** run in slideways **6** which constrain the conveyor belting **1** to a required path. The U-bends **3** interconnecting the ends of the cross struts **2** of the conveyor belting **1** run between upper and lower side flanges **7** of the slideways **6** and as shown in FIG. **3** the slideways **6** may be fitted with flat, wear resistant, plastic guide strips **8**. As shown in FIG. **1** the slideways **6** can define horizontal curves in the conveyor path particularly when the curves are of large radii. For tight curves, as shown in FIG. **4**, friction can be substantially reduced by fitting a wheel **9** which engages with the edge of the conveyor belting **1** on the inside radius of the curve. To reduce friction around horizontal curves of large radii, where space availability precludes the use of a large diameter idler wheel, the arrangement of FIG. **5** can be employed, wherein a support belt **10** running on rollers **11** engages with the edge of the conveyor belting **1** on the inside radius of the curve.

A conveyor system employing conveyor belting **1** in accordance with the invention may include several straight track sections and any required number of tight curves or curves of larger radii, which may be of left or right hand curvature. Preferably the conveyor belting **1** is in the form of a closed loop running at each end of its operative upper surface over a horizontal roller **12** as shown in FIG. **6**, and having a lower return section **13** between the rollers **12**. As shown schematically in FIG. **6** one or both of the rollers **12** may be mounted at its axis on a swing link **14** so that tension can be applied to the conveyor belting **1** by means exemplified by a spring **15** acting on the swing link **14** in FIG. **6**.

Propulsion of the conveyor belting **1** may be achieved in one or more of several ways. For example the wheel **9** in the arrangement of FIG. **4**, may be power driven to drive the conveyor belting **1** by frictional engagement therewith. Alternatively, as shown in FIG. **7** the wheel **9** may have teeth **16** engaging between the U-bends **2** at the ends of the cross struts **2** of the conveyor belting **1**. Similarly in the arrangement of FIG. **5** the belt **10** may be in frictional engagement with the edge of the conveyor belting **1** and the belt **10** may be driven by driving of one or more of the rollers **11** which support the belt **10**. Again, as shown in FIG. **8** the belt **10** may have teeth **17** engaging between the U-bends **3** at the edge of the conveyor belting **1**.

The roller **12** in the arrangement of FIG. **6** may be power driven to drive the conveyor belting **1** by friction, or, as shown in FIG. **9**, the roller **12** may have teeth **18** which engage between the cross struts **2** of the conveyor belting **1**.

Other ways for driving of the conveyor belting **1** include a toothed drive belt running on spaced rollers beneath a straight section of the conveyor belting **1** the teeth on the drive belt engaging from beneath between the cross struts **2** of the conveyor belting **1**.

Referring to FIG. **1** again it will be seen that the gaps between the ends of adjacent cross struts **2** of the conveyor belting **1** are much greater at the outside radius of a curve than at the inside radius of the curve. This is particularly so in the case of a conveyor belting in which the U-bends **3** at the ends of the cross struts **2** are of sharp radius, as shown in FIG. **10**, which is necessary if the conveyor belting is to be capable of negotiating very tight horizontal curves. In some cases fairly close spacing between the ends of the cross struts **2** at the outside of a curve may be desirable so that small goods

cannot fall through the conveyor belting or become trapped. In such cases the gaps can be reduced by making the U-bends 3 at the ends of the cross struts 2 of large bend radius as shown in FIG. 11. On an installation where the horizontal curves are all in the same direction a compromise arrangement might be used as shown in FIG. 12 wherein the U-bends 3 along one edge of the conveyor belting 1 are of large bend radius to minimise the gaps between the cross struts 2 when this edge of the belting 1 passes around the outside radius of a curve, whereas the U-bends 3 along the other edge of the conveyor belting 1 are of sharp bend radius to allow this edge of the belting 1 to negotiate tight horizontal curves in the track of the belting 1.

As shown in FIG. 13 the openwork nature of the gaps between the cross struts 2 may be reduced by bending of the cross struts 2 to form lateral projections 19 thereon. The projections 19 on adjacent cross struts 2 are staggered so that they intermesh and do not interfere with the bending of the cross struts 2 relative to each other as the conveyor belting passes around a curve. In the arrangement of FIG. 14 U-shaped members 20 attached to the cross struts 2 perform a similar function to the projections 19 on the cross struts 2 in the arrangement of FIG. 13.

In the arrangement of FIG. 1 the cable 4 passes through a hole in the centre of each cross strut 2 which necessitates the awkward business of threading the cable through the holes in the cross struts 2. However as shown in FIG. 15 slots 21 can be provided in the cross struts 2 instead of holes, so that the cable 4 can be simply dropped into position in the slots 21 and retained in position by a bridge piece 22 spot welded to each of the cross struts 2. Another method would be for the cable 4 to run below the conveyor belting 1, as shown in FIG. 16, passing through holes in separate bifurcated brackets 23 which fit over and are spot welded to the cross struts 2.

Stability of the conveyor belting 1 in the horizontal plane is affected by the resistance of the cross struts 2 to transverse bending and within limits the thicker the cross struts 2 and the stiffer the conveyor belting 1, the better, so long as the conveyor belting 1 remains sufficiently flexible to negotiate horizontal curves. However when the conveyor belting 1 has to negotiate vertical curves, such as when passing around the horizontal roller 12 shown in FIG. 6, each cross strut 2 has to flex in torsion. Consequently if the cross struts 2 are too thick or too deep the torsional stiffness will be too great for a vertical curve of reasonable radius to be negotiated. This difficulty can be avoided by corrugating or dishing the cross struts 2 longitudinally as shown in FIGS. 17 and 18 giving similar torsional flexibility to a thin flat cross strut but increasing the resistance to transverse bending.

Referring now to FIGS. 19, 20, 21, 22 these show a conveyor belting formed from individual cross struts 2.

In FIG. 19 the ends of adjacent cross struts 2 are joined by U-shaped clips 24 which are spot welded to the ends of the cross struts 2.

In FIG. 20 one end of each cross strut 2 is bent over and spot welded to the end of the adjacent cross strut 2.

In FIG. 21 the ends of adjacent cross struts 2 are spot welded together in face to face contact, one end of each cross strut 2 having a U-shaped bend 25.

In FIG. 22 the ends of the cross struts 2 are of rolled tubular form, one end 26 of each cross strut 2 being formed to a smaller diameter than the other end 27. The smaller diameter end 26 of each cross strut 2 fits inside the larger diameter end 27 of the adjacent cross strut 2.

FIG. 23 shows a detail of a conveyor system employing conveyor belting 1 of the form shown in FIG. 22.

In the arrangement of FIG. 23, as in the case of FIG. 1, a flexible cable 4 passes through holes in each cross strut 2 and adjacent cross struts 2 are spaced apart by tubular distance pieces 5 threaded on the cable 4. As in the arrangement of FIG. 22 the smaller diameter rolled end 26 of each cross strut 2 fits inside the larger diameter rolled end 27 of an adjacent cross strut 2. A ferrule 28 is fitted inside the smaller diameter rolled end 26 of the cross strut 2 of each interconnected pair of cross struts 2. Pins 29 fitted into the ferrules 28 at each end have domed heads 30 which act as bearing pads providing edge support for the conveyor belting 1 by running in the slideways 6 which constrain the conveyor belting 1 to a required path. Such an arrangement of antifriction bearing pads is suitable particularly for small light duty conveyors. However for large heavy duty conveyors the arrangement of FIG. 24 is more suitable. In the arrangement of FIG. 24 a wheel 31 is mounted at the interconnected ends of each adjacent pair of cross struts 2 by a stub shaft 32, the wheels 31 running on parallel rails 33 which constrain the conveyor belting to the required path.

FIG. 25 shows a detail of a conveyor system of the type disclosed in FIG. 22 but adapted by the provision of rollers 34 to operate as an accumulator conveyor. In the arrangement of FIG. 23 support brackets 35 for the rollers 34 are fitted projecting upwards from the ferrules 28 at the interconnecting ends of the cross struts 2. Each roller 34 is mounted on a shaft 36 extending between corresponding brackets 35 on either edge of the conveyor belting 1. The brackets 35 along one edge of the conveyor belting 1 are all angled in one direction with respect to the longitudinal axis of the conveyor belting 1, whilst the brackets 35 along the outer edge of the conveyor belting are angled in the opposite direction. By this means the rollers 34 extend transversely across the conveyor belting 1. Bushes 37 fitted in the ends of the rollers 34 support the rollers 34 on the shaft 36. Dome headed pins 29 fitted in the ferrules 28 at the interconnecting end of the cross struts 2 on the underside of the conveyor belting 1 act as bearing pads running on the slideways 6 which in this case are of L cross section.

In operation of the type of conveyor system shown in FIG. 25 articles can accumulate against a stop at any point on the conveyor. The conveyor keeps running and at the point at which the articles accumulate the rollers 34 rotate beneath the articles as they pass under the articles. By this means sliding friction of the conveyor against the underside of the stationary articles is avoided.

I claim:

1. A conveyor having an openwork endless conveyor belt having lateral edges and comprising a series of struts, each strut extending from a transverse end at one lateral edge of the conveyor belt transverse to the direction of travel of the conveyor to a transverse end at the other lateral edge of the conveyor belt, and located in spaced relationship from each other in the di-

rection of travel and interconnected at their said transverse ends to form a substantially zig-zag configuration each strut having a cross-section, viewed in a vertical plane parallel to the said direction of travel, which is thin in the said direction of travel and elongated perpendicular to the said direction of travel so that each strut is sufficiently spring-like to flex, between its transverse ends, to negotiate both horizontal axis curves and vertical axis curves, spacer means disposed centrally between said transverse ends between each strut and its adjacent struts for maintaining a substantially uniform spacing between each strut and its adjacent struts, a flexible inextensible means extending in the said direction of travel and located centrally between the transverse ends for comprising and locating said spacer means, guide means for receiving the interconnected ends for confining the said interconnected ends against movement perpendicular to the said direction of travel both (a) in the plane of the conveyor and (b) perpendicular to the plane of the conveyor, and drive means for driving the belt in said direction of travel.

2. A conveyor according to claim **1**, said flexible inextensible means comprising a cable extending in the direction of travel of the conveyor, and said spacer means comprises spacer elements on the cable between the adjacent struts.

3. A conveyor according to claim **1**, said guide means comprising guide ways of channel section on each side of the conveyor, each receiving the interconnected transverse ends on that side of the conveyor.

4. A conveyor according to claim **1**, including a guide wheel on an inside radius of a bend and wherein the edge of the conveyor belt on the inside radius runs in contact with the guide wheel.

5. A conveyor according to claim **4** wherein the belt is driven by engagement with the guide wheel.

6. A conveyor according to claim **5** wherein the guide wheel has teeth for engaging the interconnected transverse ends for driving the conveyor belt.

7. A conveyor according to claim **1**, including rollers operatively connected to an edge of the conveyor belt on an inside radius of a bend and including a support belt for said conveyor running on said rollers.

8. A conveyor according to claim **7** wherein the support belt is driven by the rollers and the support belt has teeth engaging the conveyor belt between the interconnected transverse ends of the struts.

9. A conveyor according to claim **1**, said belt being in the form of a closed loop running at each end of its operative upper surface over a horizontal axis roller and having a lower return section between the horizontal axis rollers.

10. A conveyor according to claim **9** wherein the belt is driven by engagement with at least one horizontal axis roller.

11. A conveyor according to claim **10** wherein at least one horizontal axis roller has teeth in engagement with the belt between the struts for driving the belt.

12. A conveyor according to claim **9**, including a swing link having a spring acting thereon, and wherein at least one of the horizontal axis rollers is mounted at its axis on said swing link so that tension can be applied to the conveyor by said spring.

13. A conveyor according to claim **1** wherein the interconnected transverse ends form U bends.

14. A conveyor according to claim **1** having a horizontal axis curve wherein the interconnected transverse ends along the edge of the belt defining an outer arc of the curve form U bends and the interconnections along the edge of the belt defining an inner arc of the curve form V bends.

15. A conveyor according to claim **1** wherein the struts are formed with projections extending transversely into the spaces between struts, the projections of any one strut being staggered with respect to the projections of the adjacent struts.

16. A conveyor according to claim **1** wherein projection members are attached to the struts and arranged to extend transversely into the spaces between struts the projection of any one strut being staggered with respect to the projections of the adjacent struts.

17. A conveyor according to claim **1** wherein the interconnected transverse ends form V bends.

18. A conveyor according to claim **1** wherein the ends of the struts are joined together and adapted for engagement with the slideways by U shaped clips enclosing the ends of the struts.

19. A conveyor according to claim **1** wherein the ends of the struts are of rolled tubular form, one end of each strut being formed to a smaller diameter than the other end which is formed to a larger diameter, the smaller diameter end of each strut fitting inside the larger diameter end of the adjacent strut to interconnect the ends and adapt the ends for engagement with the guide means.

20. A conveyor according to claim **19** wherein the tubular joined ends of the struts carry headed pins, the heads forming upper and lower bearing pads for engaging the upper and lower side flanges of the slideways.

21. A conveyor according to claim **19** and having free running rollers extending across the width of the belt, the rollers being mounted on shafts extending between brackets fitted in the rolled ends of the cross struts along each edge of the conveyor belt, the brackets along one edge being inclined in one direction with respect to the longitudinal axis of the belt whilst the brackets along the other edge of the belt are inclined in the opposite direction so that the shafts carrying the rollers extend transversely across the width of the belt between corresponding brackets on either edge of the belt.

22. A conveyor according to claim **1**, wherein said drive means engages the struts.

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