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(54) A CONVEYOR FOR BULK MATERIALS

(71) We, MOLEDETH DEVELOPMENT COMPANY LIMITED, an Israeli Company of Plumer Square, Haifa, Israel, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:–

This invention relates to a conveyor for bulk materials and is an improvement in the conveyor disclosed and claimed in British Patent Specification No. 1 319 738, which latter will hereinafter be referred to as "the Parent Patent".

The invention claimed in the parent patent is a conveyor for transporting bulk material, comprising a pair of continuous flexible belts mounted so that the front surfaces of the belts face each other along a working stretch; drive means for moving the belts at the same speed; means for feeding bulk material between the front surfaces of the belts at a point before they enter said working stretch; and pressure means to apply fluid under pressure directly to the back surface of at least one of the belts along the working stretch for urging the front surfaces of the belts towards each other, the belts and the pressure means being constructed and arranged so that, along the working stretch, only the fluid pressure causes the middle portion of the front surface of each belt to be pressed into frictional engagement with said bulk material, and the opposite edge portions of the front surface of each belt on each side of the middle portion thereof to be pressed against each other into frictional gripping relationship, whereby said bulk material is fully enclosed between said belts and is transported thereby.

The working stretch of the belts may extend in a vertical or substantially vertical direction, or may be inclined to the vertical, and bulk material may be conveyed either up or down the working stretch.

An elevator-conveyor, of the kind described and claimed in the parent patent can be employed as a static installation, in a silo or the like, or alternatively it may be included in a mobile device such as, for example, a ship's unloader in which case the feed or input end of the conveyor must be of such a form that it can be introduced into a relatively confined region, such as a ship's hold. In either of the above applications the bulk material conveyed by the conveyor will be raised by the operation of the conveyor, and in such applications conveyors are usually termed "elevator-conveyors".

It is desirable that such elevator-conveyors should have as great a conveying capacity as is practically possible, both for obtaining a high speed of operation, so that a large amount of bulk material can be conveyed quickly, and also for obtaining a good operational efficiency. This latter quality is improved if, as envisaged in the parent patent, the belts of the conveyor are so designed that they bulge more readily in the middle than at the edges. The parent patent refers to the provision of reinforcing threads or wires along the edges to achieve this purpose. It has been found that such wires or threads pose operational and constructional problems which can be overcome, whilst still obtaining belts which bulge in the middle, by employing the present invention.

Therefore, according to the present invention there is provided a conveyor for transporting bulk material, comprising a pair of continuous flexible belts mounted so that the front surfaces of the belts face each other along a working stretch; drive means for moving the belts at the same speed; means for feeding bulk material between the front surfaces of the belts at a point before they enter said working stretch; and pressure means to apply fluid under pressure directly to the back surface of at least one of the belts along the working stretch for urging the front surfaces of the belts toward each other, the belts and the pressure means being constructed and arranged so that, along the working stretch, only the fluid pressure causes the middle portion of the front surface of each belt to be pressed into frictional engagement with said bulk material, and the opposite edge portions of the front surface of each belt on each side of the middle portion thereof to be pressed against each other into frictional gripping relationship, whereby said bulk material is fully enclosed between said belts and is transported thereby, at least one of the belts being formed of an elastic resiliently flexible, air impermeable material, and longitudinal edge portions of the said belt being provided with reinforcing plies so as to impart the required strength, and an increased rigidity, to the edge portion with respect to a longitudinal median portion of the belt.

Preferably the longitudinal median portion of the belt is reinforced against tearing by one or more plies of extendable material.

The present application has been divided out of copending British patent application 24398/77 (Serial No. 1 588 981) to which reference can, if necessary, be made for a further description of an elevator-conveyor of the general type to which the present invention relates.

For a better understanding of the present invention and to show how the same may be carried out in practice reference will now be made to the accompanying drawings in which:

Figure 1 is a cross-sectional view of one form of conveyor belt for use as part of a conveyor formed as an embodiment of the present invention; and

Figures 2, 3, 4, 5 and 5*a* are respective cross-sectional views of modifications of the edge portions of the conveyor belt shown in Figure 1.

In the parent patent reference is made to the possibility of constructing one or both of the belts in such a way that the central longitudinal portion is more yielding and can therefore bulge more readily than can the longitudinal edge portions whereby to ensure that the belt or belts can be readily deformed along a longitudinal middle portion so as to conform to the size and shape of the material enclosed thereby and transported. It is also important that, in addition to their flexibility, the longitudinal median portion of at least one of the belts should also have a high degree of elasticity with respect to the edge portions thereof so as to ensure that the belts, together with the material enclosed thereby, pass over the drums without the longitudinal edges separating and allowing the material to pour out. Thus, when the belts and enclosed material pass over an upper drum of the conveyor the longitudinal central section of one or both belts must be capable of stretching with respect to the longitudinal edge sections and then returning to the original dimensions thereof.

Referring now to Figure 1 there is shown a belt construction capable of fulfilling these requirements in a particularly advantageous manner. As seen in the drawings a belt 85 formed of a suitable, resiliently flexible, rubber or plastics material is reinforced at its longitudinal edges with layers of embedded reinforcing plies 86 which can, for example, be made of polyester nylon. The longitudinal median portion of the belt is, in this example, also strengthened by the provision of an embedded ply 87 of an elastic material such as, for example, polyester "stretch" or other suitable extendable materials. As can be seen the ply 87 is arranged to overlap, at its longitudinal edges, the lowermost reinforcing ply 86.

The reinforced edge portions of the belt thus are provided with the required strength and are also provided with an increased rigidity with respect to the longitudinal median portion.

The provision of the central elastic ply 87 is designed to impart to the belt a resistance to tearing in the event of high mechanical stress to the belt, and particularly in the event of damage to the belt. Without such a reinforcement the initiation of a tear in a belt would rapidly result in the tear proceeding along the length of the belt. Where the belts are used under conditions where the chances of mechanical damage are minimal the provision of this central reinforcing ply can be dispensed with. Where, however, these conditions are not minimal the central reinforcing ply can, if required, be supplemented by one or more additional elastic plies. Similarly, the number of reinforcing edge plies of which there are three in the examples specifically shown in the drawings, can be varied in accordance with the requirements.

In one specific example a rubber belt having a width of 110 cms. was provided with reinforcing edge plies of between 15 and 20 cms. width, the overall thickness of the belt being about 6 mm.

Whilst the surface of the belt or belts in contact with the material to be conveyed can be smooth, difficulties may arise in the conveying of material which is either very fine and powdery or is covered by a powder-like coating or is otherwise difficult to grip. For these purposes the belt surface requires an increased gripping quality. In the embodiment shown in Figure 1 the longitudinal median portion of that surface of the belt which is to come into contact with the material is pitted by means of successive rows of recesses 88. Such pitting enables the belt to grip the conveyed material with minimal slippage. On the other hand, material which has become lodged in the recesses 88 is effectively dislodged when the belt flexes while passing over the drum.

The pattern, shape and sizes of the recesses are chosen in accordance with the characteristic of the material to be gripped and conveyed. Under certain conditions these recesses can be replaced by projections which also impart to the belt the required gripping properties.

Figures 2-5*a* show various constructions of the longitudinal edge portions of the belt which facilitate the effective sealing of the juxtaposed belts against the egress of material or of the ingress of air.

Thus, in the embodiment shown in Figure 2 the belt is additionally provided, on an outer surface, with a longitudinally extending, flexible rib 89 which can be pressed downwardly against the belt surface.

In the embodiment shown in Figure 3 the belt is additionally provided with a longitudinally extending rib 90 similar to the rib illustrated in Figure 2 with the region between the rib and the belt being filled with a resilient filler 91 so as to prevent the lodging of material in this region.

Whilst the ribs 89 and 90 are shown as formed integrally, as one piece with the outer surface of the belts, the ribs may alternatively be formed as a separate piece of a hard wearing material such as, for example, polyurethane which can if necessary be replaced when worn.

In the embodiment shown in Figure 4 of the drawings, the belt shown is provided, in addition to reinforcing plies with a pair of longitudinally extending projecting ribs 92 on an inner surface of the belt.

In the embodiment shown in Figure 5 of the drawings the belt shown is provided with a sealing bead 93 bonded to the belt in a longitudinal groove thereof on an inner surface, again in addition to the reinforcing plies which are shown but not referenced.

It will be appreciated that the additional sealing means illustrated in Figures 2 to 5 of the drawings are to be found in both longitudinal edge portions of one or both of the belts, only one edge being shown as the other is identical.

In an alternative construction shown in Figure 5*a* and designed for use with a conveyor having a unitary box construction surrounding the working stretch of the belts, the juxtaposed edge portions of one of the belts are provided on the inner surface thereof with grooves 93*a* which define, together with the juxtaposed belt surface, continuous channels running along the length of the juxtaposed edges. These channels are open to the atmosphere before entering and after leaving the air boxes whereby air, leaking into this channel from the unitary air box can be continuously bled away without reaching the enclosed contents of the belts.

WHAT WE CLAIM IS:-

1. A conveyor for transporting bulk material, comprising a pair of continuous flexible belts mounted so that the front surfaces of the belts face each other along a working stretch; drive means for moving the belts at the same speed; means for feeding bulk material between the front surfaces of the belts at a point before they enter said working stretch; and pressure means to apply fluid under pressure directly to the back surface of at least one of the belts along the working stretch for urging the front surfaces of the belts toward each other, the belts and the pressure means being constructed and arranged so that, along the working stretch, only the fluid pressure causes the middle portion of the front surface of each belt to be pressed into frictional engagement with said bulk material, and the opposite edge portions of the front surface of each belt on each side of the middle portion thereof to be pressed against each other into frictional gripping relationship, whereby said bulk material is fully enclosed between said belts and is transported thereby, at least one of the belts being formed of an elastic resiliently flexible, air impermeable material, and longitudinal edge portions of the said belt being provided with reinforcing plies so as to impart the required strength, and an increased rigidity, to the edge portion with respect to a longitudinal median portion of the belt.

2. A conveyor according to Claim 1, wherein said longitudinal median portion of the belt is reinforced against tearing by one or more plies of an extendable material.

3. A conveyor according to Claim 1 or 2, wherein there is provided on a surface of the belt, and adjacent each longitudinal edge, one or more projecting ribs.

4. A conveyor according to Claim 3, wherein the said rib of the belt is directed at an acute angle with respect to said outer surface of the belt.

5. A conveyor according to Claim 4, wherein a resilient filler material is bonded between the said rib and the said surface of the belt.

6. A conveyor according to Claim 3, wherein the said rib is formed of a hard wearing material secured to the said belt.

7. A conveyor according to Claim 3, wherein the said rib is replaceably secured to the said belt.

8. A conveyor according to any of Claims 1 to 7, wherein there is formed on an inner surface of the belt and adjacent each longitudinal edge thereof, one or more projecting ribs.

9. A conveyor according to any one of Claims 1 to 7, wherein there is formed on an inner surface of the belt, and adjacent each longitudinal edge thereof, a continuous groove.

10. A conveyor according to any one of Claims 1 to 9, wherein the inner surface of

said median portion of the belt is provided with increased gripping characteristics.

11. A conveyor according to Claim 10, wherein the said inner surface of the belt is formed with recesses or projections.

12. A conveyor having a belt, substantially as hereinbefore described by way of example and with reference to the accompanying drawings.

13. A conveyor as claimed in any preceding claim, wherein both belts are formed with reinforcing plies along the longitudinal edges thereof.

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1588983 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

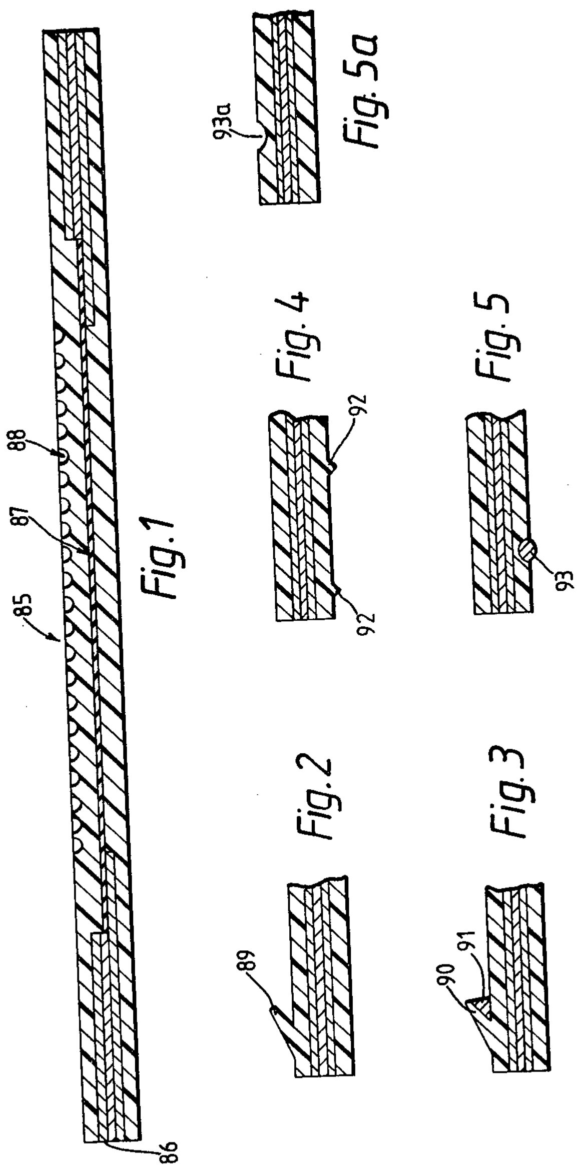

Fig.1

Fig.2

Fig.3

Fig.4

Fig.5

Fig.5a