Jan. 1, 1952 A. K. LANDAU 2,581,261

TAPE FOR DRIVING PULLEYS

Filed Sept. 15, 1949

2 SHEETS—SHEET 1

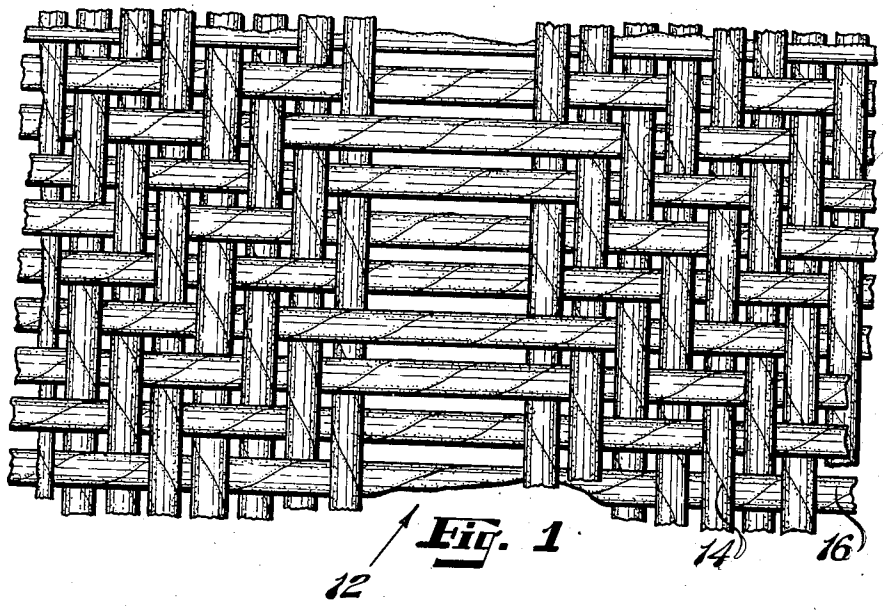


Fig. 1



Fig. 2

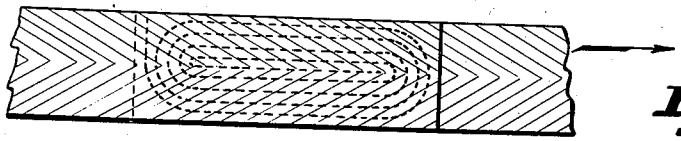


Fig. 3

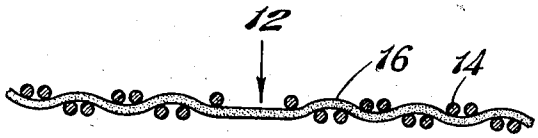


Fig. 4

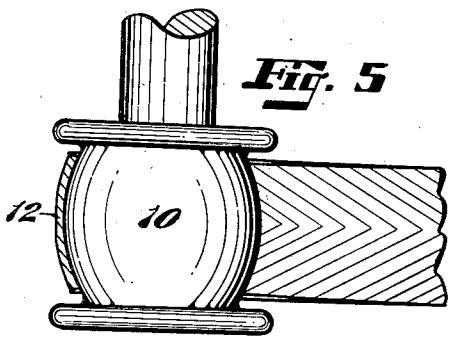


Fig. 5

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2 SHEETS--SHEET 2

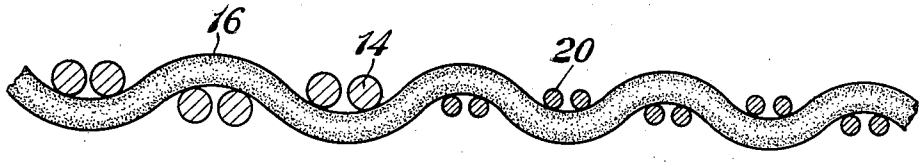


Fig. 6

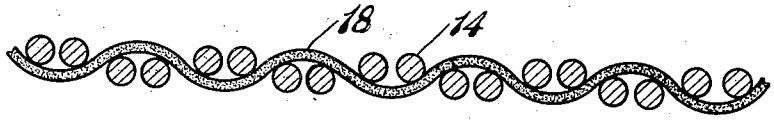


Fig. 7

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UNITED STATES PATENT OFFICE

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TAPE FOR DRIVING PULLEYS

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6 Claims. (Cl. 139—383)

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This invention relates to endless tapes or bands for use in driving crowned pulleys and more particularly to tapes employed to drive crowned whorl type spindles in the spinning and twisting of textile strands. In one aspect, this invention consists in a tape having a loosely woven mid-portion whereby flexibility of the tape is improved, substantial power is saved, and a more even distribution of contact on the whorl is effected. In another aspect this invention consists in a tape having increased porosity in its mid-portion whereby the air normally entering between the tape and the whorl passes through the tape without causing any substantial disconformity in the tape. Still another aspect of my invention, consists in a tape having a mid-portion which is thinner and in which the longitudinal strength members have been reduced or omitted whereby the main driving force of the tape will be applied more at the margins of the tape where it will engage the whorl or pulley in the area of reduced radius of the whorl or pulley above and below the crest of the crown.

I have found that, in constructing tapes for use in driving crowned pulleys such as the whorls of a spinning frame or twister, the following points should be kept firmly in mind: First the friction of bending a tape increases as the cube of the tape's thickness, therefore the tape should be kept as thin as possible. Second, the tape should be kept thin for another reason. The speed of the whorl is a function of the speed of the tape, and the radius of the whorl plus one half of the thickness of the tape. Thus the thinner the tape, the faster will the whorl spin under identical conditions of power consumption, or to put it more aptly, the thinner tape can travel slower, but yet drive the whorl at the correct speed. Third, in a vertical, crowned whorl it is desirable to have the tape drive near its margins, that is, above and below the crest of the crown of the whorl, in order to obtain the benefit of the reduced radius of the whorl off the crest of the crown. Fourth, the strength of the tape is important and cannot be sacrificed beyond a certain minimum, however, failure of tapes generally occurs at the point of connection between the ends of the tapes and not by virtue of strength failure. Therefor high strength is not a prerequisite. A fifth consideration relates to what is known as "scuffing." When a tape drives firmly against the crest of the crown, the margins of the tape also come into contact with the whorl above and below the crest. Since the radius of the whorl is less in the area above and below the crest of the crown, and the tape is travelling at a greater speed than that part of the whorl, the tape margins constantly rub against the whorl. Such rubbing is of course microscopic but assumes substantial proportions over extended operations. Sixthly, it should be borne in mind that the tape attempts to drag air in between itself and the whorl. This results in the tape ballooning or puckering out in the middle after extended use and eventually hastens failure through uneven conditions of wear.

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Other factors for consideration include the method of connecting the belt ends, the surface friction condition of the tape against the whorl, and the skin friction between the tape and the surrounding air. This latter consideration assumes substantial proportions in a spinning mill having, for instance, 50,000 spindles. During the operations of such a mill, there will be a total of 25 miles of tape, all travelling at about 20 miles per hour. The skin friction of the tape to the surrounding air is substantial, and since the said friction increases as the cube of the tape's velocity, it will be seen that the slower the tape travels, the better, other things being equal.

Tapes have been constructed in the past without any special recognition for these factors. They range in thickness from .035" to .077", have a weight equivalent of 25 to 60 yards per pound, and a breaking strength between 200 lbs. and 280 lbs. They are generally woven in a tight basket or herringbone weave generally 5/8" wide and when on the whorl they drive directly on the crest of the crown thereof. Some thought has been given to reinforcing the center of the tape in order to reduce the tendency of the tape to "pucker" out, and one attempt has been made specifically to reduce the thickness of the tape. However, all hitherto known tapes fall far short of the optimum efficiency that I have found to be obtainable.

Among the objects of my invention is the provision of a tape which will be comparable to conventional tapes in other ways, but which will present less friction to bending in conformance with the crown of the whorl. Another object of my invention is to provide a tape which will drive primarly at its margins, that is, off the crest of the crown of the whorl. A further object of my invention is to provide a tape which will not "pucker" after extended use, and which will present a substantially uniform surface contact against the crown of the whorl. Another object of my invention is the provision of a tape which will be able to travel slower than conventional tapes thereby reducing windage loss, but at the same time drive the spindle at the same speed as the conventional tape.

In the accomplishment of these objects, in a preferred embodiment, I weave the tape in the

conventional manner, but instead of employing a full warp, I leave out one or more of the central warp strands or "ends." It is a feature of my invention that the tape thus produced has a partial gap down its center line. It is thinner in its mid-portion than conventional tapes and thereby presents less friction to transverse bending. Also longitudinal bending is slightly improved. Furthermore, the reduced thickness centrally figures in increasing whorl R. P. M. By omitting a plurality of the central warp strands, the tape load at the crest of the crown is distributed on less warp strands than conventionally and consequently they stretch more than the marginal strands. This tends to shift the load out towards the margins of the tape, off the crest of the crown, and in the area of reduced radius. The increased porosity of the tape caused by the omission of the warp strands likewise serves to vent the air trapped between the whorl and tape, thereby reducing puckering and promoting even wearing conditions. Furthermore, the reduced bulk of the tape centrally also reduces the inertia in that area and in turn reduces the tendency to "pucker."

In one embodiment of the novel tape of my invention, I employ filling strands of reduced size either as a feature alone or in conjunction with other features of my invention mentioned above. In this way I am able to reduce the average thickness of the tape without impairing its longitudinal strength. In general, it is an accepted principle in textile manufacture that the best results are obtained when the warp and filling are the same size. However, I have discovered that this principle does not apply to the special case of tapes, and that an improved construction is obtained by making the tape in direct contravention to the said principle.

In another embodiment of my invention, I employ center warp strands of reduced weight, thereby improving the bending qualities of the tape, promoting marginal drive, reducing scuffing and puckering.

Further objects and features of my invention will best be understood and appreciated from a detailed description of a preferred embodiment thereof selected for purposes of illustration and shown in the accompanying drawings, in which:

Fig. 1 is a fragmentary, greatly magnified, diagrammatic plan view of the mid-portion of the tape of my invention, showing four warp strands omitted,

Fig. 2 is a view in side elevation showing the ends of the tape sewn together as for forming an endless drive tape,

Fig. 3 is a plan view of the arrangement shown in Fig. 2,

Fig. 4 is a fragmentary view in cross section of the mid-portion of the tape of my invention showing four warp strands omitted,

Fig. 5 is a view in side elevation of the spindle with the tape, partially in section, on the whorl,

Fig. 6 is a cross sectional view of the tape of my invention employing reduced size central warp strands, and

Fig. 7 is a cross sectional view illustrating the tape of my invention employing a reduced size filling strand.

In the preferred embodiment herein shown in Fig. 1 the tape is illustrated as a herringbone weave, with four of its central warp strands omitted as indicated at **12**. It is 5/8" wide, is .035" thick at its margins, and has **41** warp strands or "ends" **14**. The warp strands or

"ends" are staple cotton having a weight equivalent of 16/3 and are set up as for 45 ends with spaces where the central four would otherwise be. For filling **16**, the tape is provided with 30 strands or "picks" per inch, likewise having a weight equivalent of 16/3. This tape has a breaking strength of 172.4 lbs. which is slightly lower than conventional tape but which I have found to be satisfactory in operation.

In its application to a spinning frame, a length of the tape is cut off and both ends thereof are sewn together to form an endless tape, as shown in Figs. 2 and 3. Thereupon the tape is placed on the whorls in the conventional manner with the tape seating midway on the crown **10** as shown in Fig. 5.

In Fig. 4, it will be seen that the area in the center of the tape indicated at **12** is substantially thinner than towards the margins of the tape. Thus, when the tape bends to conform to the crown of the whorl, the area of the tape where the principal bending friction takes place, the center, will present substantially less resistance to bending than conventional tapes. Furthermore, due to the absence of warp strands centrally, the air impelled between the whorl and tape will vent through the tape rather than causing any disconformity or "puckering." The absence of center warp strands also tends to shift the load off the crest of the crown to the tape margins and the area of smaller radius on the whorl.

In addition to this it will be noted that inasmuch as the tape is thinner centrally where it bears upon the crest of the crown and thicker towards its edges, there will be less scuffing action due to conformance to the crown of the whorl than in conventional tapes.

During actual operations, the warp strands will tend to shift partly towards the center and tend to equalize the gap made by the omission of the central warp strands. However, due to the fact that the crown will bear also in this area, there is a counter tendency for the warp strands to separate and remain in compression against the marginal warp strands. Therefore the center remains substantially porous and thinner, and the warp strands never actually equalize the spacing between them.

Tests have demonstrated that with a pulley of 4" diameter to drive the tape turning at 2820 R. P. M., and with a whorl diameter of $1\frac{1}{16}$", the spindle speed developed by the tape herein described as a preferred embodiment will be 10,500 R. P. M., and that the power consumption will be on the order of 169 spindles per horsepower. Conventional tapes on the whole achieve results vastly inferior to this, generally developing in the neighborhood of only 10,200 revolutions on the driving pulley spindle to 2820 revolutions on the driving pulley and have horsepower equivalents of between 67 and 122 spindles per horsepower. If the conventional tape is brought down to a thickness of around .035, it will develop only about 10,350 revolutions for a driving pulley speed of 2820 and its horsepower equivalent will be in the neighborhood of 170 spindles per horsepower. This horsepower equivalent seems to measure favorably with my tape, but it must be borne in mind that with my tape it will be possible to reduce the R. P. M. of the driving motor by over 2%, and thereby effect a power saving through reduced windage and friction loss of upwards of 4%.

Another embodiment of the tape of my invention is shown in part sectionally in Fig. 6 and

comprises 46 warp strands or ends having weights and being arranged as follows: 15 ends at 16/3 as indicated by reference numeral 14, 15 ends at 20/2 as indicated by reference numeral 20 and 16 ends at 16/3; and 30 picks per inch at 16/3 as indicated by reference numeral 16. Tape so constructed has most of the same desirable characteristics as the tape described in the preferred embodiment above. However, it will be noted that the venting action of the preferred embodiment will be greater than in the embodiment now being described. Tests have shown that the tape constructed in this manner will only develop 10,350 R. P. M. on the spindle for a driving pulley speed of 2820 R. P. M. However the horsepower equivalent for this embodiment of my tape is considerably higher, being 190 spindles per horsepower. This likewise represents an efficiency saving of upwards of 4% of the entire power consumption of the spindle tape drive.

In Fig. 7 the tape is shown as having a reduced size filling or pick 18. This may be employed in either the embodiment wherein ends are omitted or in the embodiment wherein the ends are of reduced size. The reduction of the pick size has some effect in reducing the strength of the tape but it is to be noted that such reduction is not critical, and is more than offset by the efficiency saving attained by the reduction in thickness of the tape.

As for the type of weave of the tape, herringbone or other twill weave fabric is preferred but it is to be understood that basket or other types of weaves are permissible. The invention herein described is not intended to be limited to the type of weave. However, it is significant to note that herringbone weave seems to present less skin friction to the air and therefore is preferable for spindles.

Numerous variations of the embodiments herein shown are possible without departing from the spirit of the invention. For instance the central ends may be of reduced size and also some of them may be omitted. The important factor in this connection being that the central one third of the cross section of the tape is going to weigh substantially less per inch as a total mass than one half the combined weight per inch of the remainder of the tape. In the preferred embodiment outlined above I calculate this central one third to be about 20% lighter, whereas the embodiment having reduced size center warp strands, the center warp strands weigh as much as 40% less, taken as a mass.

Since further variations will now be apparent to those skilled in the art, it is not intended to confine the invention to the precise limits of the embodiments herein described but rather to limit it in terms of the appended claims.

Having thus described an illustrative embodiment of the process of my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. An endless driving tape for a crowned pulley comprising warp strands spaced to form a tight weave transversely of the tape in the marginal areas thereof, the said warp strands spaced apart in the central area of the tape to form a loose weave along the said central area thereof, and filling strands spaced evenly along the entire length of the said tape, whereby the tape will have increased porosity and flexibility in the said central area, will be thinner in the said central area so that the central area will arc over the central portion thereof, and will bear on the pulley in the marginal areas of the tape to each side of the crown of the said pulley to effect the main driving force between the tape and the pulley.

2. An endless driving tape for a crowned pulley comprising warp strands extending longitudinally of the tape, and filling strands extending transversely of the tape, the said warp strands being spaced in the marginal two thirds of the tape at the rate of 45 strands to the total width of the tape, and at a similar rate in the central one third thereof with a plurality of warp strands omitted, so that the central one third of the tape is more flexible than the outer thirds to arc over the crowned portions of a pulley and wherein the outer thirds effect the main driving force.

3. A drive tape for a crowned pulley comprising a twill weave fabric having warp strands extending longitudinally of the tape, filling strands of a substantially lighter weight than the said warp strands interwoven therewith, the said warp strands being spaced further apart in the mid area than at the margins thereof as by omitting a central warp strand in the weaving of the tape, so that the central one third of the tape is more flexible than the outer thirds to arc over the crowned portions of a pulley and wherein the outer thirds effect the main driving force.

4. A drive tape for a crowned pulley comprising a twill weave fabric having warp strands extending longitudinally of the tape, filling strands interwoven therewith, and the total weight per inch of the center one third of the tape being substantially less than one half the total weight per inch of the tape in the remaining two thirds of the tape, so that the central one third of the tape is more flexible than the outer thirds to arc over the crowned portions of a pulley and wherein the outer thirds effect the main driving force.

5. A drive tape as described in claim 4 further characterized by the total weight per inch of the center one third of the tape being at least 20% less than one half of the total weight per inch of the tape in the remaining two thirds of the tape.

6. An endless driving tape for a crowned pulley comprising warp strands extending longitudinally of the tape, filling strands interwoven therewith, and the total weight per inch of the center one third of the tape being substantially less than one half of the total weight per inch of the tape in the remaining two thirds of the tape, so that the central one third of the tape is more flexible than the outer thirds to arc over the crowned portions of a pulley and wherein the outer thirds effect the main driving force.

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