

Figure 3 is an enlarged diagrammatic plan view of the carrier table of the braiding machine of Fig. 2;

Figure 4 is an enlarged side elevation of the braid take-off assembly of the braiding machine of Fig. 2, illustrating modifications in accordance with the invention;

Figure 5 is a plan view of the portion of the braiding machine illustrated in Fig. 4; and

Figure 6 is a front view of the portion of the braiding machine illustrated in Fig. 4.

The packing 10 shown in Fig. 1 comprises a central core strand 12 and four outer core strands 14. Each of the core strands 12, 14 comprises a plurality of yarns of packing fibers. Braided around the core strands in a standard lattice braid pattern are a plurality of braid strands 16 and warp strands 18.

The braid strands 16 are interwoven about the outer core strands 14 and extend over them on the packing surface. The braid strands 16 all extend generally helically in a single direction presenting a helical pattern of parallel braid strands 16 extending in rows along the packing surface. The warp strands 18 extend helically in opposite direction in rows between the rows of braid strands 16.

The outer core strands 14 extend helically and, together with the braid strands 16, form ridges with intervening grooves at the position of the warp strands 18, defining a braid having a normal helical twist of the major braid pattern. The helix may describe 3-4 revolutions about the packing per linear foot of packing. The braid strands 16 lie at an angle to the helix of the braid and, in the illustrated embodiment, extend helically in the same direction as the braid helix.

The packing 10 may be made on the modified braiding machine 20 illustrated in Fig. 2. This braiding machine 20 comprises a conventional carrier table 22 having a plurality of tubular masts 24, 26 through which core strands 12, 14 extend from sources, not shown. Mast 24 for central core strand 12 is centrally positioned in table 22. Four masts 26 for outer core strands 14 are equidistantly positioned about the table. On the surface of the table 22 of braiding machine 20 are three carrier tracks 28, 30, 32. Track 28 has an approximately square configuration extending around central mast 24 and inside of the four masts 26. Tracks 30, 32 extend diagonally and cross each other, one track 30 extending on the outside of two diagonally opposite masts 26 and the other track extending on the outside of the other two diagonally opposite masts 26. A plurality of carriers 34 are located on each track carrying bobbins 36

(only two are illustrated in Fig. 2) of braid and warp strands 16, 18. As best shown in Fig. 3, in the illustrated embodiment, eight carriers 34 are utilized on track 28 for the warp strands 18 and six carriers 34 are utilized on each of tracks 30, 32 for the braid strands

16. The carriers are equidistantly spaced along the tracks and move in the directions indicated by the arrows in Fig. 3. As thus described the machine 20 is a standard carrier lattice braider. Strands 12, 14, 16, 18 extend from bobbin 36 to a condenser 38 for braiding in the normal manner.

The braiding machine 20 is modified above the table 22. Instead of the condenser and take-off wheel normally employed in such machines, the condenser 38 is modified to grip the packing 10 as it is braided and is mounted for rotation as braiding proceeds.

The modifications to the braid take-off assembly are shown in detail in Figs. 4, 5 and 6. As illustrated, a stationary platform 42 is supported above carrier table 22. A guide member 44 having an axially extending collar is fastened to the platform 42 with the collar extending through the platform 42 coaxially of the tracks 28, 30, 32 and mast 24 on carrier table 22. Bolts 46 extending through guide member 44 and platform 42 secure an external ring gear 48 to the upper side of the platform coaxially of member 44. A plurality of spaced bearings 50 on the upper surface of platform 42 support a rotatable take-off assembly platform 52. A tubular member 54 is connected to rotatable platform 52 and extends therefrom through guide 44 and platform 42. A flange 56 on member 54 supports a chain sprocket member 58 which is fastened on the upper side thereof. On the lower side of flange 56, condenser 38 is fastened. The condenser 38 comprises a pair of idler wheels 60, 62, one of which, 62, is grooved. The wheels 60, 62 are adjustable toward and away from each other to accommodate different size packings. Annular bearing 64 is positioned between guide member 44 and tubular member 54 and a disc bearing 66 is positioned between the face of sprocket member 58 and guide member 44.

A frame 70 is mounted on and extends above rotatable platform 52. Take-off wheel 40, is supported by shaft 72 substantially tangentially to the axis of rotation of platform 52. Lever arms 74, connected at one end to frame 70, support a nip roll 76 against wheel 40 also tangentially to the axis of rotation of platform 52. Springs 77 urge nip roll 76 toward wheel 40. A worm gear 78 is mounted on one end of shaft 72 for driving wheel 40.

A worm shaft 80 supported by frame 70 and platform 52 has a pinion 82 at one end engaging ring gear 48 for driving shaft 80 as platform 52 is rotated. Worm shaft 80 has a worm 84 at its other end engaging worm gear 78 to drive wheel 40. In the illustrated embodiment the wheel 40 is driven to have its peripheral surface move one foot for every 3-4 revolutions of platform 52. At the other end of shaft 72 another gear 86 is provided which engages a gear 88 on the shaft 90 supporting one of lever arms 74. Sprocket

SPECIFICATION

Braided packing and method and apparatus for making packing

5 Braided packings are used extensively in industry for a variety of sealing purposes. Typically packings are made of flax, jute, asbestos or fibers of synthetic material, such as polytetrafluoroethylene, which are formed into yarns or strands and which are braided together. The resulting packing may have a square cross-section and a herringbone weave pattern extending in an axial direction along the packing and typical packings of this kind are illustrated in U.S. Patent No. 3,646,846.

10 When standard prior art packings are wrapped around a shaft, however, they do not provide a uniform fiber density. As they are wrapped about a shaft, the fibers in the packing at the inner diameter are compressed and those at the outer diameter are elongated. The result, with an initially square cross-section packing, is a trapezoidal cross-section providing a leakage path larger at the outer diameter than at the inner diameter. Additionally, the sealing characteristics of typical packings are static and substantial compression is required to effect sealing. Compression of the packing to control leakage causes increased pressure on the shaft and forces out lubrication from the packing, overheating and shortening the life of the packing and contributing to shaft wear.

35 In U.S. Patent 4,100,835, issued July 18, 1978, a braided packing is disclosed which has a normal helical twist. The packing has a density of improved uniformity requiring less pressure for sealing, thereby enhancing packing and shaft life. The packing also functions to provide hydrodynamic sealing characteristics when properly oriented relative to shaft rotation, further reducing sealing pressure required and further contributing to extended packing and shaft life.

45 The method and apparatus disclosed in U.S. Patent 4,100,835, however, limit the style of the twisted braid which can be made. Thus, in making the braid, only the principal braid strands, all extending in the same helical direction, could be employed; warp strands extending helically in the opposite direction could not be employed due to inherent limitations in the disclosed method of making the braid which requires disabling the track normally carrying warp strands. The inability to utilize warp strands in the braid limited the size and the density of packings which could be made with a normal helical twist. Additionally, because of the normal direction of twist in the yarns employed as braid strands, it is desirable that operation of braiding machinery be limited to braid the braid strands in one direction; thus suitable braid would be produced having a helical twist only in a single

direction.

The invention provides braided packing comprising a plurality of outer core strands extending generally axially along the packing, a plurality of rows of braid strands braided about the core strands and a plurality of rows of warp strands braided between the rows of braid strands, characterised in that the outer core strands and the rows of braid and warp strand extend helically along the packing, the outer core strands forming with the rows of braid strands and with the intervening rows of warp strands a braid having a normal helical twist in one direction, the braid strands extend over the core strands in a helical direction at an angle to the outer core strands and the normal helical twist, and the warp strands extend in a helical direction opposite that in which the braid strands extend.

85 The invention includes braided packing comprising a plurality of outer core strands extending generally axially along the packing and a plurality of rows of braid strands braided about the core strands, characterised in that the outer core strands extend helically along the packing and form with the rows of braid strands a braid having a normal helical twist in a helical direction and the braid strands extend over the core strands in the same helical direction at an angle to the outer core strands and said normal helical twist.

The invention also provides a method of braiding comprising extending braid strands from a plurality of carriers to a point of convergence and moving the carriers which carry the braid strands in one direction about said point in a predetermined braiding pattern thereby forming at said point of convergence a braid comprising rows of braid strands, characterised by gripping the braid at the point of convergence and rotating the braid about its axis at the point of convergence as the carriers are moved in said one direction to cause the rows of braid strands to be braided into a braid with a normal helical twist.

The invention also provides braiding apparatus comprising a plurality of strand carriers movable in the apparatus in a predetermined braiding pattern and a condenser above the carriers, the condenser comprising means for gripping a braid formed by strands extended from the carriers as the carriers are moved in said pattern and is supported for rotation about the path of the braid, and drive means for rotating the condenser as the braid is formed.

The invention will now be further described with reference to the accompanying drawings, in which:

125 *Figure 1* is a side elevation of packing made according to the invention, partially illustrating the braiding of the packing strands;

Figure 2 is an isometric, somewhat diagrammatic view of a braiding machine modified in accordance with the invention;

members 92, 94 connected to gear 88 and nip roll 76 are driven by chain 96. Preferably nip roll 76 is driven at a peripheral speed slightly greater than wheel 40, about 5%

- 5 faster to prevent slack from developing in braid extending about the wheel 40. Optionally, saw-toothed members may be provided in the slots 98 in wheel 40 and roll 76 to grip the packing, although if roll 76 is driven
10 faster than wheel 40 it may be desired to omit teeth from the roll 76 to avoid damaging the packing; alternatively either of the wheel or roll may be covered with a covering having a textured surface to assist in gripping the pack-
15 ing.

- Platform 52 is driven by chain 100 extending from sprocket member 58 to another sprocket 102 which is connected to right angle drive 104. Drive 104 is driven by chain
20 106 extending about sprocket members 108, 110. Sprocket member 110 is mounted on shaft 112 driven by change gears 114, 116, shown in Fig. 1, which are connected to the main machine drive. Gears 114, 116 may be
25 changed to alter the drive speed of the take-off assembly relative to the carriers to accommodate various braid sizes.

- Extending from frame 70 above wheel 40 is a guide tube 118 extending to a basket 120
30 behind the machine for collecting packing as it is braided. Basket 120 is mounted on rotatable platform 122 which is connected to the machine drive for synchronous rotation in the same direction as platform 52. The rota-
35 tion of platform 122 and basket 120 prevents tangling of the packing as it is delivered to the basket.

- The braiding method performed by the machine is modified by the condenser of the
40 take-off assembly. Thus, the strands 12, 14, 16, 18 extend to a point of convergence at condenser 38 and are interwoven in normal manner as carriers 34 move bobbins 35 on tracks 28, 30, 32 about table 22. Wheels 60,
45 62, however, hold the packing as it is braided. The packing extends from condenser 38, between wheel 40 and roll 76, once around the wheel 40, between wheel 40 and roll 76 again and then through tube 118 to
50 rotating basket 120. As the take-off assembly is rotated while braiding progresses, condenser wheels 60, 62 continuously turn the packing 10 about its axis resulting in a normal helical twist being formed in the braid. The
55 take-off assembly rotation is proportional to the braiding machine drive speed.

- Advantageously, the helical twist can be formed in either direction. Although the illustrated machine is arranged to turn the take-off
60 assembly in only one direction and thus to form a braid helix in one direction, the helix can be formed in the opposite direction simply by altering the drive to the take-off assembly to reverse the direction of its rotation while
65 maintaining the direction of motion of the

carriers 34 in table 22 and the normal braiding pattern. As another advantage, the method permits the incorporation of warp strands into the braid. The operation of the
70 take-off assembly and the performance of the method, however, is independent of the incorporation of warp strands and even core strands; thus helical braiding can be accomplished with a variety of braid styles.

- 75 After the braid is formed, it may be impregnated with lubricants and be pressed to a square cross-sectional configuration in the usual manner.

- Other embodiments of this invention will be
80 apparent to those skilled in the art which are within the scope of the following claims.

CLAIMS

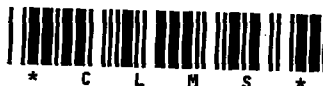
1. Braided packing comprising a plurality
85 of outer core strands extending generally axially along the packing, a plurality of rows of braid strands braided about the core strands and a plurality of rows of warp strands braided between the rows of braid strands,
90 characterised in that the outer core strands and the rows of braid and warp strand extend helically along the packing, the outer core strands forming with the rows of braid strands and with the intervening rows of warp strands
95 a braid having a normal helical twist in one direction, the braid strands extend over the core strands in a helical direction at an angle to the outer core strands and the normal helical twist, and the warp strands extend in a
100 helical direction opposite that in which the braid strands extend.

2. Braided packing as claimed in claim 1, in which the normal helical twist and the
105 braid strands both extend in the same helical direction.

3. Braided packing as claimed in either of the preceding claims, in which a central core strand extends axially along the packing centrally of the outer core strands, the outer core
110 strands being spaced equidistantly about the central core strands.

4. Braided packing comprising a plurality of outer core strands extending generally axially along the packing and a plurality of rows
115 of braid strands braided about the core strands, characterised in that the outer core strands extend helically along the packing and form with the rows of braid strands a braid having a normal helical twist in a helical
120 direction and the braid strands extend over the core strands in the same helical direction at an angle to the outer core strands and said normal helical twist.

5. A method of braiding comprising extending braid strands from a plurality of carriers to a point of convergence and moving the
125 carriers which carry the braid strands in one direction about said point in a predetermined braiding pattern thereby forming at said point
130 of convergence a braid comprising rows of



members 92, 94 connected to gear 88 and nip roll 76 are driven by chain 96. Preferably nip roll 76 is driven at a peripheral speed slightly greater than wheel 40, about 5% faster to prevent slack from developing in braid extending about the wheel 40. Optionally, saw-toothed members may be provided in the slots 98 in wheel 40 and roll 76 to grip the packing, although if roll 76 is driven faster than wheel 40 it may be desired to omit teeth from the roll 76 to avoid damaging the packing; alternatively either of the wheel or roll may be covered with a covering having a textured surface to assist in gripping the packing.

Platform 52 is driven by chain 100 extending from sprocket member 58 to another sprocket 102 which is connected to right angle drive 104. Drive 104 is driven by chain 106 extending about sprocket members 108, 110. Sprocket member 110 is mounted on shaft 112 driven by change gears 114, 116, shown in Fig. 1, which are connected to the main machine drive. Gears 114, 116 may be changed to alter the drive speed of the take-off assembly relative to the carriers to accommodate various braid sizes.

Extending from frame 70 above wheel 40 is a guide tube 118 extending to a basket 120 behind the machine for collecting packing as it is braided. Basket 120 is mounted on rotatable platform 122 which is connected to the machine drive for synchronous rotation in the same direction as platform 52. The rotation of platform 122 and basket 120 prevents tangling of the packing as it is delivered to the basket.

The braiding method performed by the machine is modified by the condenser of the take-off assembly. Thus, the strands 12, 14, 16, 18 extend to a point of convergence at condenser 38 and are interwoven in normal manner as carriers 34 move bobbins 35 on tracks 28, 30, 32 about table 22. Wheels 60, 62, however, hold the packing as it is braided. The packing extends from condenser 38, between wheel 40 and roll 76, once around the wheel 40, between wheel 40 and roll 76 again and then through tube 118 to rotating basket 120. As the take-off assembly is rotated while braiding progresses, condenser wheels 60, 62 continuously turn the packing 10 about its axis resulting in a normal helical twist being formed in the braid. The take-off assembly rotation is proportional to the braiding machine drive speed.

Advantageously, the helical twist can be formed in either direction. Although the illustrated machine is arranged to turn the take-off assembly in only one direction and thus to form a braid helix in one direction, the helix can be formed in the opposite direction simply by altering the drive to the take-off assembly to reverse the direction of its rotation while maintaining the direction of motion of the

carriers 34 in table 22 and the normal braiding pattern. As another advantage, the method permits the incorporation of warp strands into the braid. The operation of the take-off assembly and the performance of the method, however, is independent of the incorporation of warp strands and even core strands; thus helical braiding can be accomplished with a variety of braid styles.

After the braid is formed, it may be impregnated with lubricants and be pressed to a square cross-sectional configuration in the usual manner.

Other embodiments of this invention will be apparent to those skilled in the art which are within the scope of the following claims.

CLAIMS

1. Braided packing comprising a plurality of outer core strands extending generally axially along the packing, a plurality of rows of braid strands braided about the core strands and a plurality of rows of warp strands braided between the rows of braid strands, characterised in that the outer core strands and the rows of braid and warp strand extend helically along the packing, the outer core strands forming with the rows of braid strands and with the intervening rows of warp strands a braid having a normal helical twist in one direction, the braid strands extend over the core strands in a helical direction at an angle to the outer core strands and the normal helical twist, and the warp strands extend in a helical direction opposite that in which the braid strands extend.

2. Braided packing as claimed in claim 1, in which the normal helical twist and the braid strands both extend in the same helical direction.

3. Braided packing as claimed in either of the preceding claims, in which a central core strand extends axially along the packing centrally of the outer core strands, the outer core strands being spaced equidistantly about the central core strands.

4. Braided packing comprising a plurality of outer core strands extending generally axially along the packing and a plurality of rows of braid strands braided about the core strands, characterised in that the outer core strands extend helically along the packing and form with the rows of braid strands a braid having a normal helical twist in a helical direction and the braid strands extend over the core strands in the same helical direction at an angle to the outer core strands and said normal helical twist.

5. A method of braiding comprising extending braid strands from a plurality of carriers to a point of convergence and moving the carriers which carry the braid strands in one direction about said point in a predetermined braiding pattern thereby forming at said point of convergence a braid comprising rows of



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braid strands, characterised by gripping the braid at the point of convergence and rotating the braid about its axis at the point of convergence as the carriers are moved in said one direction to cause the rows of braid strands to be braided into a braid with a normal helical twist.

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6. A method as claimed in claim 5, in which warp strands are extended from a plurality of carriers to said point of convergence and the carriers carrying the warp strands are moved in a direction opposite said one direction as the carriers carrying the braid strands are moved in said one direction and as the braid is rotated about its axis to form rows of warp strands in the braid between the rows of braid strands.

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7. A method of braiding as claimed in claim 5 or claim 6, in which the braid is rotated continuously at a speed proportional to the speed of the carriers.

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8. A method of braiding as claimed in claim 5 or claim 6, in which the braid is moved axially from the point of convergence as the braid is formed.

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9. A method as claimed in claim 5, or claim 6, in which a plurality of outer core strands are extended from points about which the carriers carrying the braid strands move to the point of convergence and the braid strands are braided about the outer core strands.

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10. A method as claimed in claim 9, in which a central core strand is extended from a point centrally of said carriers to the axis of the braid at the point of convergence.

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11. Braided packing substantially as hereinbefore described with reference to Fig. 1 of the accompanying drawings.

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12. A method of braiding substantially as hereinbefore described with reference to the accompanying drawings.