United States Patent [19]

Leach et al.

[11] **3,851,698**

[45] **Dec. 3, 1974**

[54] **MANUFACTURE OF MULTI-FOLD YARNS**

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[22] Filed: **Jan. 11, 1973**

[21] Appl. No.: **322,870**

[30] **Foreign Application Priority Data**

Jan. 14, 1972 Great Britain 1904/72

[52] **U.S. Cl.** **57/91,** 57/36, 57/38.3, 57/90, 57/156

[51] **Int. Cl.** **D01h 13/02,** D01h 1/02

[58] **Field of Search** ..... 57/90, 91, 34 R, 36, 38.3, 57/156, 157 R, 160

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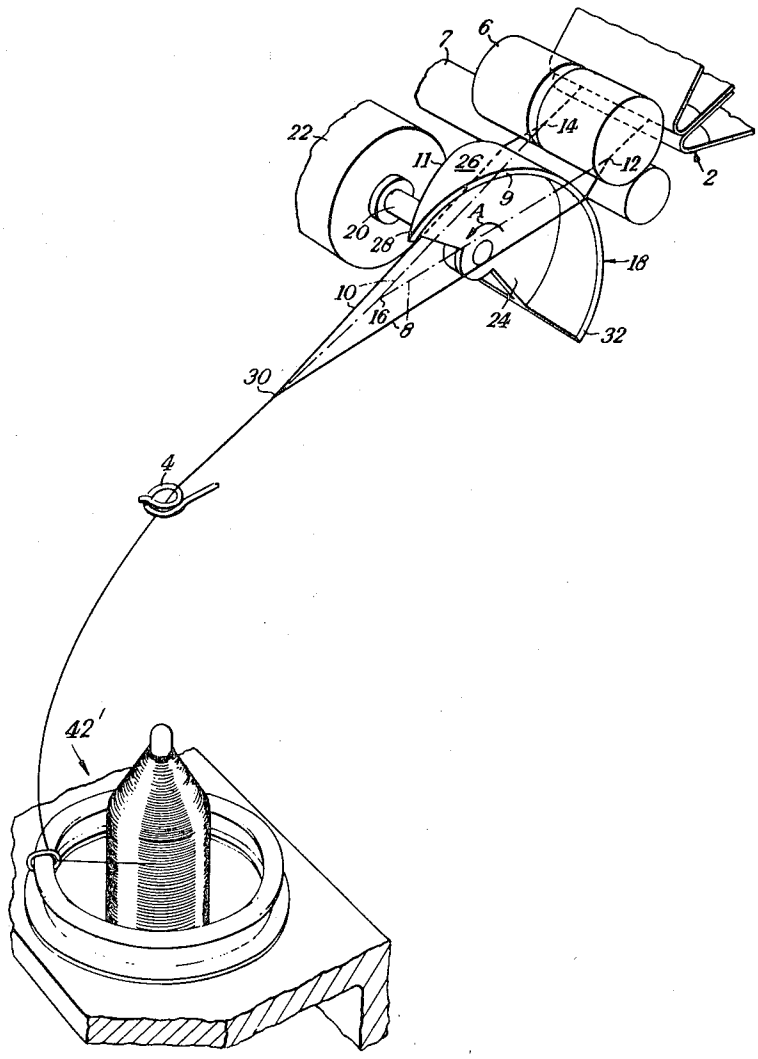
Primary Examiner—John Petrakes

[57] **ABSTRACT**

A multi-ply yarn is made by inserting unidirectional twist into two or more strands combined by feeding from separate feed points in converging paths to a combining point while increasing the separation of the converging strands against component forces acting on the strands, and then subsequently decreasing or allowing a decrease in the separation of the converging strands. Preferably the increase in separation of the converging strands is effected by a rotating cam.

6 Claims, 4 Drawing Figures



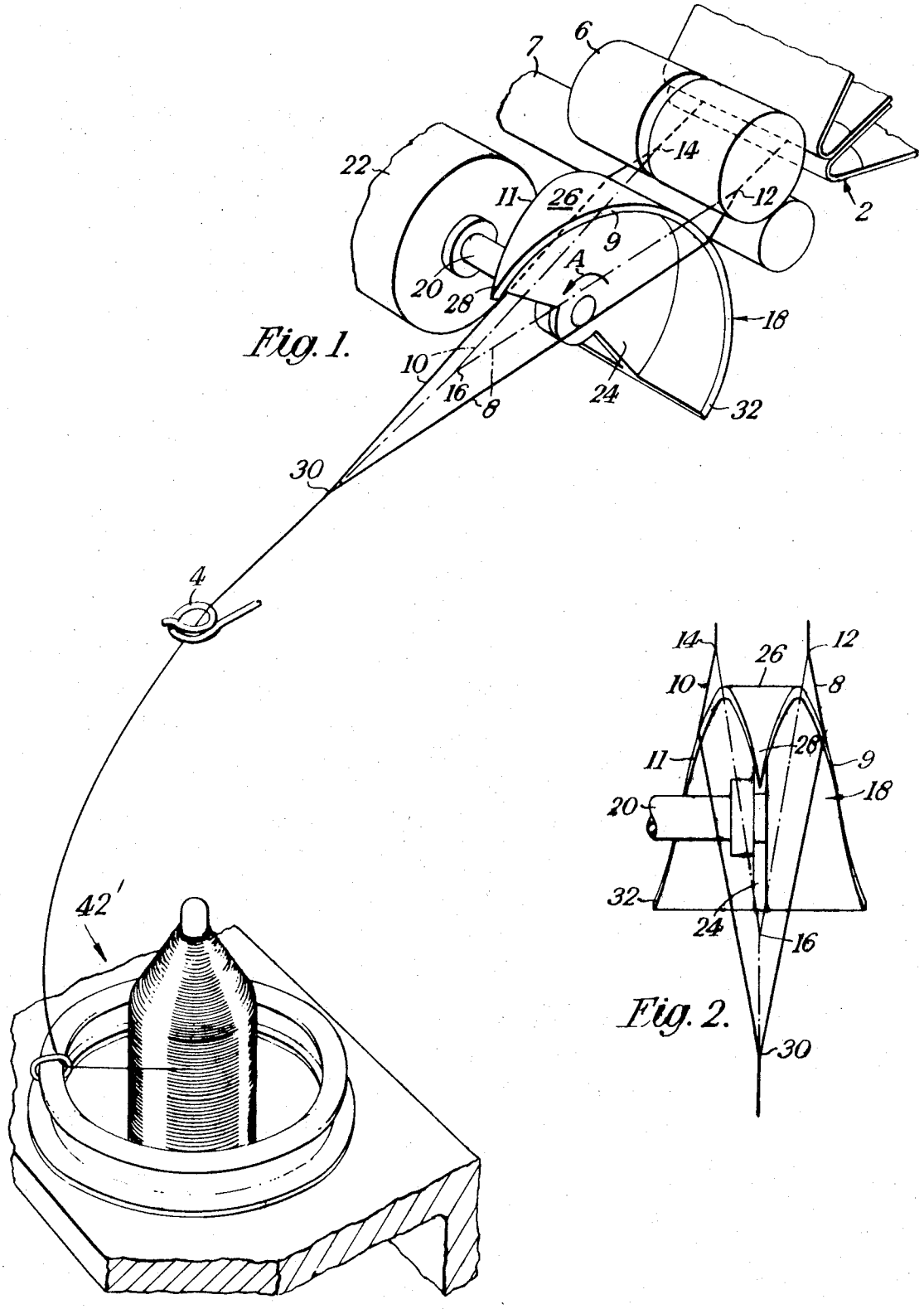
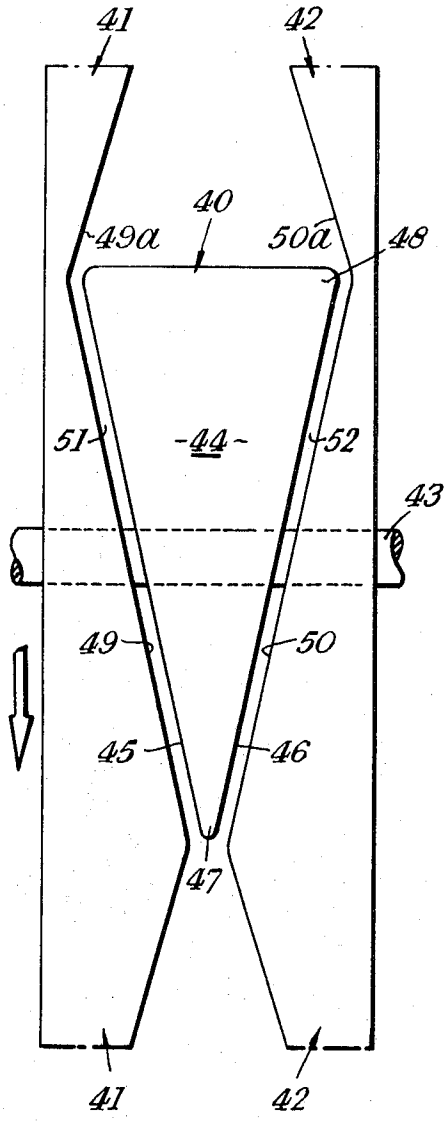

6
7
14
22
11
26
12
2
9
A
20
28
18
10
16
8
24
32
30
4
42'

Fig. 1.

14
26
12
10
8
11
28
9
18
20
32
24
16
30

Fig. 2.


41
42
40
49a
50a
48
51
44
52
43
49
50
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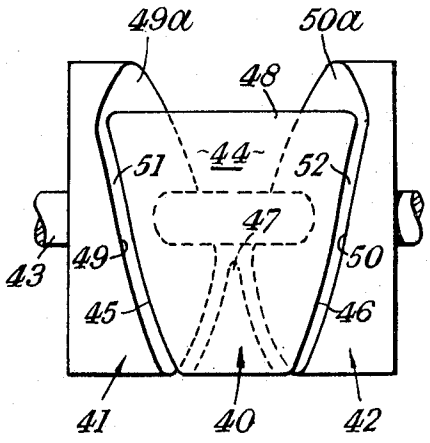
46
47
41
42

Fig. 3.


49a
50a
48
51
44
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43
49
50
45
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41
40
42

Fig. 4.

MANUFACTURE OF MULTI-FOLD YARNS

The present invention relates to a method of and apparatus for spinning multi-ply yarns.

It is known to make a two-ply yarn by inserting, by means of a ring and traveller a uni-directional twist into two strands combined by feeding them from separate feed points through a strand converging guide which causes them to follow converging paths and which is oscillated continuously to vary the length of each strand path between its feed point and the point at which the strands combine. The strand converging guide comprises a strand collecting ring or arrangement of fingers which converges the strands and which is oscillated by means of a cam and lever arrangement, excursion of the ring or finger arrangement in one sense moving the converging strands against strand tension into strand paths in which they combine progressively closer to the feed points and excursion of the ring or finger arrangement in the opposite sense allowing the strands to return to strand paths in which they combine progressively further away from the feed points.

The arrangement for varying the strand paths hereinbefore described is however crude and produces a low level of strand twist in the yarn wound on to the ring and traveller, because the twist changes are carried out slowly.

The present invention seeks to improve strand twist levels in such yarns.

According to one aspect of the present invention, there is provided a method of making a multi-ply yarn comprising the steps of inserting uni-directional twist into two or more strands combined by feeding them from separate feed points in converging paths to a point of which they combine while increasing the separation of the converging strands against component forces on the strands and then subsequently decreasing or allowing a decrease in the separation of the strands.

According to a second aspect of the present invention, there is provided apparatus for making a multi-ply yarn comprising twisting means for inserting unidirectional twist into a strand formation in which two or more strands are combined and means producing the strand formation and applying it to said twisting means comprising feeding means for feeding said two or more strands from spaced feed points in converging paths to a combining point at which they combine to form said strand formation and strand separating means for increasing the separation of the converging strands against component forces on the strands, and then subsequently decreasing or allowing a decrease in the separation of the converging strands.

Two embodiments of the invention will now be described by way of example with reference to the accompanying drawing in which:

FIG. 1 is a perspective view of apparatus according to the invention;

FIG. 2 is a front view of a cam employed in the apparatus shown in FIG. 1;

FIG. 3 is a developed plan of an alternative cam which may be employed in apparatus according to the invention; and

FIG. 4 is a plan view of the cam shown in FIG. 3.

Referring firstly to FIG. 1, two strands 8 and 10 in the form of worsted rovings are fed by a conventional apron drafting system 2 to a pair of delivery rollers 6 and 7, which advance the strands 8 and 10 at constant

and equal speeds from the nip thereof at spaced points 12 and 14. The strands 8 and 10 pass over converging camming edges 9 and 11 of a rotary cam 18, from which the strands converge to combine and be twisted into a two-ply yarn by a conventional ring and traveller take-up device, which has a lappet 4 and is shown schematically at 42'. The unidirectional twist imparted to the yarn by the take-up device causes the converging strands 8 and 10 to combine at a combining point 30 with twist induced by the unidirectional twist into the strands. The distance of the convergence point from the feed points 12 and 14 is varied as hereinafter described by varying the separation of the converging strands under the control of the cam 18.

The cam 18, which is mounted on a drive shaft 20 driven by electric motor 22 through a speed reduction drive now shown, is arranged continuously to rotate in the direction indicated by the arrow A in the drawing. The cam 18 has a central web 24 which supports a cam portion 26 which lies in a cylindrical surface having an axis coincident with the rotary axis of the drive shaft 20. The cam portion 26 is of triangular shape and extends over an arc of the cylindrical surface of about 210°, the web 24 being cut away so as not to extend beyond the arc of the cam 18.

In operation, the cam 18 is rotated at about 75 rpm and the two strands 8 and 10 are delivered by the delivery rollers 6 and 7 at a feed speed of about 15 m/min. Upon each revolution of the cam 18, a nose 28 thereof enters the space between the strands 8 and 10 which without restraint from the cam 18 converge along paths of minimum separation as shown in broken line in the drawing, to a combining point 16 where they combine and become twisted together by the take-up device. As the cam 18 rotates the camming edges 9 and 11 come to bear against the two strands 8 and 10 causing them to increase their separation as shown in full line in the drawing, thereby bringing the point 30 at which they combine to positions progressively further away from the feed points 12 and 14. The position of the yarn relative to the axis of rotation of the cam 18 is such that before the strands are dropped from the trailing edge 32 of the cam the nose 28 of the cam re-enters the space between the strands and the edges 11 and 9 take up the strands from the trailing edge. Thus the convergence point 30 is caused to move still further toward the lappet 4 until the cam has turned through a sufficient angle that the trailing edge 32 has passed between the strands for the second time thus producing the position of maximum separation. When dropped from the trailing edge the strands are free to return to the original separation under the influence of tension and the twist inserted by the ring and traveller 42'. The strands are free until the cam has completed 360° from the original position whereupon the nose 28 re-enters the space between the strands as shown in FIG. 1 for another cycle.

The component forces which act on the strands during combining are the tension on each strand acting on a direction away from the combining point towards the cam, the tension on the twofold yarn acting away from the combining point towards the take-up device; the torque on the twofold yarn; the torque on each strand; and a small couple on the combining strands derived from the tension in the strands and the small but finite separation of the strands in the twofold yarn.

An alternative form of cam for carrying out the invention, shown in FIGS. 3 and 4, is formed from a separating barrel cam element 40 arranged between two outer barrel cam elements 41 and 42 and all carried on a common shaft 43.

The separating cam element 40 has a cam portion 44 which is of triangular shape and which extends over a cylindrical surface of about 210° and the cam portion 44 presents camming edges 45 and 46 which converge at a nose 47 and which are separated by a maximum distance at the trailing edge 48 of the separating cam element 40. The underside of the camming edges 45 and 46 is cut away so as not to interfere with the strands 8 and 10.

The outer cam elements 41 and 42 have undercut guide edges 49 and 50 which are arranged adjacent to and are of corresponding shape to the repsective camming edges 45 and 46 whereby to define strand passages 51 and 52 therewith on either side of the separating cam element 40. The rear portions 49*a* and 50*a* of the guide edges 49 and 50 converge gradually towards each other behind the trailing edge of the separating cam element 40.

In operation the cam is rotated and the cam portion 44 of the separating cam element 40 acts to increase and decrease the separation of the strands in the same manner as the cam portion 26 of the cam described with reference to FIGS. 1 and 2. However in this embodiment as the strands leave the camming edges 45 and 46 at the trailing end 48 of the separating cam element 40, they contact repsective rear portions 49*a* and 50*a* of the guide edges 49 and 50 of the outer cam elements 41 and 42 and are positively guided thereby towards each other to return to their paths of minimum separation.

When the yarn produced by the apparatus hereinbefore described with reference to the drawings is untwisted to remove the uni-directional twist insertd by the ring and traveller it is seen that each strand has repeated along its length alternating zones of opposite twist of an SZSZ repeating pattern, each twist zone being about 10 cm long.

An advantage of the method and apparatus according to the invention is that no twist-restricting force is placed upon the strands as their separation is increased or during the subsequent decrease in separation. More twist is thus incorporated into the yarn as strand twist.

We claim:

1. Apparatus for spinning a multi-ply yarn comprising:

feed means for feeding two strands from spaced points in converging paths to a combining point,

twisting means downstream of the combining point for inserting twist into the combined strands which runs back to the combining point,

separating cam means having first and second camming edges and arranged between the feed means and the combining point,

separating cam drive means for rotating said separating cam means whereby one edge of the separating cam means engages one of the converging strands and the other edge of the separating cam means engages the other of the converging strands to increase progressively the separation of the strands to a maximum separation whereupon the strands disengage from said camming edges and decrease in separation.

2. Apparatus for spinning a multi-ply yarn comprising:

feed means for feeding two strands from spaced points in converging paths to a combining point,

twisting means downstream of the combining point for inserting twist into the combined strands which runs back to the combining point,

a separating cam having a pair of mutually inclined camming edges which converge at a leading edge of the cam and which have their maximum separation at a trailing edge,

separating cam driving means for rotating said separating cam, whereby the leading edge of the separating cam enters between the converging strands and the strands pass along respective camming edges to increase the separation of the strands to a maximum at the trailing of the separating cam and whereby the strands are released from the camming edges at the trailing edge of the separating cam and decrease in separation.

3. An apparatus as claimed in claim 1 and further including guide means which engage with the strands as they are released from the camming edges and guide them towards one another.

4. An apparatus as claimed in claim 3 wherein the guide means includes two further cams arranged one on each side of the separating cam and rotatable therewith, a guide edge on each of said further cams having a portion adjacent the trailing edge of the separating cam, the said portions of the guide edges gradually converging towards each other behind the trailing edge of the separating cam whereby the strands are positively guided towards each other after they have been released by the separating cam.

5. An apparatus as claimed in claim 4 wherein each guide edge includes a further portion adjacent to, and corresponding in shape to a respective one of the camming edges of the separating cam whereby to define a passage between the further portion of the guide edge and the respective camming edge.

6. An apparatus as claimed in claim 2 wherein the camming edges are provided on a part cylindrical surface.

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