

PATENT SPECIFICATION

(11) 1261727

DRAWINGS ATTACHED

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 DIJ 10 1M 1X 7
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(54) IMPROVEMENTS IN AND RELATING TO WINDING APPARATUS

(71) We, K. D. G. INSTRUMENTS LIMITED, a British Company of Brookside Avenue, Rutsington, Sussex, 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:—

The present invention relates to the high speed winding of linear material on to packages. The wound material may be string, cord wire, and especially textile yarn and thread, and the material may be of circular or none circular cross-sectional shape. Ribbon or tape material can be wound by apparatus in accordance with the invention, but for convenience the wound material will hereinafter be referred to as thread. It is to be understood that the invention is not thereby limited to the winding of thread.

The package on to which thread is wound can be a cop, reel, spool or other form, and may have a cylindrical or conical external surface to receive the winding, and the package may or may not have one or more flanges. Thread may be wound on to such packages in transfer from one process to another in the course of manufacture, or for final winding before sale. The winding may be a simple winding, with successive turns closely side by side, and with successive layers wound from end to end in alternate directions, or the winding may be in cross-lay in which the wound thread is traversed rapidly from end to end of the wound length, every few turns, so that turns of adjacent layers cross at a substantial angle and form a pattern in which there may be one, one and a half, two or more 'loops' in the wound length of the package. In some cases, the winding may be random and with a traverse such as to provide an approximately level wind.

It is desirable to produce a wound package at high speed. It is also desirable that the winding should be truly cylindrical or conical, as required, under appropriate tension

to provide a firmly wound package and, where an end flange is not used, with a flat end surface free from bulges. Hitherto, so far as we are aware, it has not been possible in winding to cross-lay such material on to a package at high speed so as to form an acceptably cylindrical or conical package; in practice it has not been possible to carry out precision cross-lay winding at speeds at much above 2,000 r.p.m. of the package.

The present invention includes a method of and apparatus for winding thread on to a package in which the thread is guided and traversed by passing through a slot formed in a rotating hollow guide.

In accordance with the present invention there is provided a winding apparatus for winding thread on to packages, and comprising thread guiding means, said guiding means including a guide drum formed by first and second members having adjacent cylindrical surfaces, said surfaces being complementarily shaped and spaced to form a thread guiding slot, said slot comprising an even number of helical segments, each segment being a segment of a helix of the same pitch and having the same angular extent around said cylindrical surface, successive segments being segments of alternately left handed and right handed helices, means for rotating said members together about an axis, thread guide means providing edges extending parallel to the axis of said drum for guiding a thread to enter said slot at a first point and to emerge from the slot at a second point, said first and second points being disposed approximately in a plane which is at right angles to said axis of rotation.

With this arrangement, as the guide rotates, the thread will be traversed; the points at which the thread enters and leaves the slot are substantially in the same plane, at right angles to the axis of the drum, the drum and the package being rotated about their respective axes at a speed ratio appropriate to the desired lay.

In an apparatus embodying the invention it

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SPECIFICATION AMENDED - SEE ATTACHED SLIP

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has been found possible to wind packages with sufficient precision at high package speeds of at least 10,000 r.p.m. The apparatus permits variation in the speed ratios of the package and the guide, to vary the pattern of lay from parallel loops to cross-lay with one, one and half, or more loops laid on the length of the package.

Other features and advantages of the invention will appear from the following description of an embodiment thereof, given by way of example, in conjunction with the accompanying drawings, in which:—

Figure 1 is a diagram showing the general arrangement of an apparatus for winding cylindrical packages;

Figure 2 is a plan view of a practical form of thread winding apparatus, of the type indicated in Figure 1;

Figure 3 is a side view of the same apparatus, looking in the direction of arrow 3 in Figure 2;

Figure 4 is a development of the cylindrical surface of the guide drum, on a reduced scale;

Figure 5 is a diagrammatic cross sectional view of the guide drum taken on the line 5—5 in Figure 6;

Figure 6 is a diagrammatic longitudinal sectional view of the guide drum taken on the line 6—6 in Figure 5;

Figure 7 is a diagrammatic view looking in the direction 7 in Figure 5, and indicating the movement of the thread during the first ninety degrees of movement of the guide drum, and

Figure 8 is a diagrammatic view looking in the direction 7 in Figure 5, when the guide drum has revolved ninety degrees from the position of Figure 6 and indicates the movement of the thread material between ninety and one hundred and eighty degrees movement of the guide drum.

Figure 1 indicates the general arrangement of a thread winding apparatus shown, by way of example, in this case for winding thread from a package at 10 on to a package at 11. The thread 12 passes from the package 10, over a guide 13, through two electrically controllable thread tensioning devices 14, 15 thence through a horizontal slot in a guide plate 16 and through a guide drum 17 of which the axis is horizontal and therefore parallel to the slot in guide plate 16. The thread emerges from the guide drum and passes over the horizontal edge of a further guide plate 18, and is then wound on to the package at 11; the thread is traversed back and forth along the length of the package by the guiding action of the drum.

The guide drum 17 and package 11 are mounted on shafts 20 and 21 respectively, the shafts being driven at a predetermined speed ratio through a gear box 22 and clutch 23 from a prime mover 24. The guide drum

17 is carried on an arm 19 pivoted at 25, and substantially counterbalanced by an adjustable tension spring 26; movement is damped by dash-pot 27. The thread is wound on to the package 11 and as the package increases in diameter the wound package, which bears against guide plate 18, presses against the plate so that arm 19 pivots; the guide plate remains in contact with the surface of the wound thread on the package 11 under the tension of spring 26.

It is desirable that the tension on the thread as it is being wound should be varied in accordance with the wound diameter of the package, and so a control means 28, responsive to movement of arm 19, is arranged to vary the tension effected by the tensioning devices 14 and 15.

A practical form of apparatus for winding thread, in which a very high winding rate can be achieved, is shown in Figures 2 and 3. This apparatus comprises base plates 30 and 31 mounted on supports 32. Base plate 30 carries a prime mover, corresponding to 24 in Figure 1, consisting of an electric motor. On base plate 31 are mounted two similar vertical, parallel support plates 33 and 34 and a third support plate 35 parallel to the other two. A main drive shaft 36 is journaled in the two plates 33 and 34, the shaft being driven by a belt drive including pulley 37 on the shaft of motor 24, a pulley 38 on shaft 36 and driving belt 39.

Clutch 23 is disposed on shaft 36, for coupling pulley 38 to shaft 36; the shaft 21 on which the package 11 is wound is driven from shaft 36 by a drive which includes a pinion 40 on shaft 36, meshing with an idler gear 41, mounted on shaft 42 journaled in the plate 33, gear 41 in turn meshing with a gear 43 on a further shaft 44, journaled in the plates 33 and 34. So that the gear ratio afforded by these gears may be readily changed, the gears 40, 41 and 43 are arranged on the outside of plate 33, as will be seen in Figure 2.

An infinitely variable ratio drive is provided between shaft 44 and shaft 21. This comprises a taper pulley 45 on shaft 44 and a further taper pulley 47, of opposite taper, on shaft 21. A flat belt 48 couples the two taper pulleys 45 and 47 on the lateral position of the belt on the two pulleys, and the tension of the belt, is controlled by a pivoted spring loaded jockey pulley 50. Pulley 50 is mounted on a block assembly 51, which can be moved laterally to shift the belt and thereby to change the effective speed ratio between shafts 44 and 21; the block assembly can move along a guide bar 52 mounted at its end in plates 33 and 34. In this way, shaft 21 can be driven at the desired winding speed, the winding speed of shaft 20 with respect to shaft 21 being determined primarily by the gear ratio of

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5 the gear train 40, 41, 43 with small variations made possible by the variable gear provided by pulley 45, belt 48 and pulley 47. The end of shaft 21 has a reduced portion 21a as shown, on which is disposed a suitable friction clutch means or the like to receive and hold the package 11.

10 The mechanism as thus far described operates to drive the spindle 21, on which the package 11 is secured, at a predetermined speed from the shaft of motor 24. Means are also provided for driving the shaft 20, on which the guide drum 17 is carried. The drive is effected in a manner which permits the guide drum to be movable towards and away from the winding of package 11.

15 For this purpose, shaft 20 is carried in two arms 54, 55, which are rigidly fixed to a cross shaft 49, carried in its ends in bearings in the support plates 34 and 35. The two arms are bridged by two bars 56, 57, which together correspond to the guide member 16 of Figure 1, the adjacent edges of the bars being slightly spaced apart so as to provide between them a guide slot 58 for the thread. Guide plate 18 is mounted on a bar 59 also carried between the two arms 57 and 58.

20 An arm 60, fastened to shaft 49 so as to move integrally with arms 54, 55, is attached to one end of spring 26, the other end of which is anchored to the base plate 31. Also attached to arm 60 is one end of dash-pot 27, the other end of which is also attached to the same base plate. The effect of the tension of spring 26 is made adjustable, for example by providing alternative attachment holes 61 for the spring, so that the moving system including guide drum 17, arms 54, 55 and arm 60, and the attached parts, is substantially counterbalanced about shaft 49.

25 Shaft 20 is driven from shaft 36 by means of a chain drive. A sprocket 63 is secured to shaft 36 and chain 64 passes round the sprocket and round a sprocket 65 on an extension of shaft 49. The chain is tensioned by an adjustable jockey sprocket 66. A further short chain drive from shaft 49 to shaft 20 is provided by means of sprocket 67, sprocket 68 and chain 69. Since the arms 54 and 55 pivot about shaft 49, the arms can pivot whilst the drive to shaft 20 is maintained.

30 In the design of high speed thread handling devices, the limitation on the speed that can be used is set largely by the need to keep within the breaking strength of the thread. In the case of a high speed thread winding device such as that described, limitation is set to a large extent by the nature of the thread traversing guide, especially in relation to the tensioning means for the thread. The tension must be adequate to avoid defects such as poorly shaped ends, with a cylindrical or conical wind; loose winding of

the thread on the package may result, which increases the diameter of the wound package and effecting its 'feel'. On the other hand, the higher the tension, the more likely become breakages of the thread, due to the increased forces arising from small rapid movements of the thread, and especially those due to the thread guiding and tensioning means.

70 In the embodiment of the invention being described, a particularly satisfactory winding device is embodied. This is shown more clearly in Figure 2, and diagrammatically in Figures 4 to 8.

80 As shown in Figure 2, the guide is formed as a continuous slot, having a shape which lies on the surface of a right circular cylinder. A convenient method of forming the slot, and the method adopted in the embodiment of the invention being described, is for the slot to be defined by the complementarily shaped edges of two cylindrical members, as shown at 71 and 72 respectively in Figure 2, which together make up the winding guide drum 17. The two cylindrical sections are securely mounted on shaft 20, so that at all times the two sections move together, leaving the slot, shown at 73, of constant dimension. The slot is composed of a series of sections, each section being a segment of a helix. There are an even number of sections; each helix is of the same pitch and occupies the same angular extent of the periphery of the drum. The helical segments are alternately left-handed and right-handed. The arrangement is such that the thread can enter the slot at one point, pass into the interior of the drum and emerge from the slot at a second point, the two points being substantially in the same plane transverse to the axis of rotation of the drum; further, as the drum rotates, the points of entry and emergence of the thread into and from the drum will change and will move in a direction along the drum axis but will always lie in a plane at right angles to that axis.

90 There are various configurations of slot which will meet these conditions, but the preferred form is one in which the slot is formed from four helical sections, the thread entering and leaving the slot at substantially diametrically opposite points. This arrangement is adopted in the mechanism described and shown, and the slot will be seen in Figures 2, 4, 7 and 8. The slot has four sections 74, 75, 76 and 77, each occupying 90° of the periphery of the drum cylinder. The thread, guided by the slot 58 between guide bars 56 and 57, enters the drum at one point such as 79 passing over the central shaft 20 and emerging from the slot at a point 78, defined by the intersection of the edge of the guide plate 18 and the slot in the drum.

100 The slot section 74 is part of a true helix, as will be seen from the development of 130

Figure 4, so that if the thread is initially at the point *a*, indicated in Figure 7 then if the drum is rotated through equal angular increments, indicated at *b*, *c*, *d*, *e*, *f* and *g* the thread will be displaced by equal linear displacements indicated by points *b'*, *c'*, *d'*, *e'*, *f'* and *g'* along the upper edge of the guide plate 18. Thus, if the shaft rotates at uniform speed, the thread will be guided at a linear speed along the edge of plate 18, in the direction of arrow 81. During the next quarter revolution of the drum, then in similar manner equal angular displacements of the drum in the direction of arrow 82, corresponding to points *h*, *j*, *k*, *l*, *m* and *n*, the thread will be guided through successive equal increments *h'*, *j'*, *k'*, *l'*, *m'* and *n'*, as indicated in Figure 8. The thread will accordingly be moved at linear speed in the reverse direction, indicated by arrow 82. In this way the thread is wound with a linear speed of traverse along the package 11.

Because of the symmetry of slot 73, at the moment when the thread is, for example, leaving the slot at point 78, in Figure 4, corresponding to, say, point *a* in Figure 6, it will enter the drum through the point 79 corresponding to point *n* in Figure 8, which is diametrically opposite. As seen in Figure 4, point 79 lies immediately behind point 78. Again, when the thread is emerging from any other point it will enter the drum at a point which in Figure 7 lies immediately behind that point and so at all times the thread within the drum will be in a direction substantially at right angles to the axis of the drum, in the manner indicated in Figure 6.

This disposition of the thread passing through the guide drum appears to be of determining importance in enabling a high speed of winding of the package to be obtained.

While the embodiment of the invention described is shown as winding a parallel sided package, the mechanism can be readily adapted for winding non-cylindrical packages, such as conical packages; the length of the winding on the package is determined by the axial extent of the helical segments of the slot 73, but a guide drum can be readily removed and replaced when another winding length is desired. Different lays of thread can be obtained by changing the change gears 40, 41 and 43 and the variable ratio friction gear provided by taper pulleys 45 and 47 and the movable belt 48 enables the winding speed to be adjusted to a small degree, to make it possible to wind closely threads of different count.

The tensioning adjusting means operates in the manner described in connection with Figure 1, but is not shown in Figures 2 and 3. A convenient method of effecting the desired control is to arrange for movement

of arms 54 and 55 to control a variable resistor, in turn controlling the current fed to the variable tensioning devices 14, 15.

WHAT WE CLAIM IS:—

1. A winding apparatus for winding thread on to packages, and comprising thread guiding means, said guiding means including a guide drum formed by first and second members having adjacent cylindrical surfaces, said surfaces being complementarily shaped and spaced to form a thread guiding slot, said slot comprising an even number of helical segments, each segment being a segment of a helix of the same pitch and having the same angular extent around said cylindrical surface, successive segments being segments of alternately left handed and right handed helices, means for rotating said members together about an axis, thread guide means providing edges extending parallel to the axis of said drum for guiding a thread to enter said slot at a first point and to emerge from the slot at a second point, said first and second points being disposed approximately in a plane which is at right angles to said axis of rotation.

2. A thread winding apparatus for winding thread on to packages, and comprising thread guiding means, said guiding means including a guide drum formed by first and second members having parts that are hollow cylinders, the surfaces of said cylinders being coaxial and of the same external diameter, the adjacent edges of the cylindrical parts of said members being complementarily shaped and spaced to form a thread guiding slot, support means for retaining said members with said edges in fixed relative position, said support means permitting said members to rotate together about an axis whilst retaining said edges in said fixed relative position, said slot comprising an even number of helical segments, each segment being a segment of a helix of the same pitch and having the same angular extent around said cylindrical surface, successive segments being segments of alternately left-handed and right-handed helices, thread guide means providing guiding edges parallel to said axis for guiding a thread to enter said slot at a first point to pass into the interior of said hollow cylinders and to emerge from said slot at a second point, said first and second points moving in a direction along the said axis as said members rotate, said first and second points at any one time during rotation lying approximately in a plane at right angles to said axis.

3. An apparatus in accordance with claim 1 or claim 2, wherein said first and second points lie approximately on a diameter of said cylinder or cylinders.

4. An apparatus in accordance with any



Figure 4, so that if the thread is initially at the point *a*, indicated in Figure 7 then if the drum is rotated through equal angular increments, indicated at *b*, *c*, *d*, *e*, *f* and *g* the thread will be displaced by equal linear displacements indicated by points *b'*, *c'*, *d'*, *e'*, *f'* and *g'* along the upper edge of the guide plate 18. Thus, if the shaft rotates at uniform speed, the thread will be guided at a linear speed along the edge of plate 18, in the direction of arrow 81. During the next quarter revolution of the drum, then in similar manner equal angular displacements of the drum in the direction of arrow 82, corresponding to points *h*, *j*, *k*, *l*, *m* and *n*, the thread will be guided through successive equal increments *h'*, *j'*, *k'*, *l'*, *m'* and *n'*, as indicated in Figure 8. The thread will accordingly be moved at linear speed in the reverse direction, indicated by arrow 82. In this way the thread is wound with a linear speed of traverse along the package 11.

Because of the symmetry of slot 73, at the moment when the thread is, for example, leaving the slot at point 78, in Figure 4, corresponding to, say, point *a* in Figure 6, it will enter the drum through the point 79 corresponding to point *n* in Figure 8, which is diametrically opposite. As seen in Figure 4, point 79 lies immediately behind point 78. Again, when the thread is emerging from any other point it will enter the drum at a point which in Figure 7 lies immediately behind that point and so at all times the thread within the drum will be in a direction substantially at right angles to the axis of the drum, in the manner indicated in Figure 6.

This disposition of the thread passing through the guide drum appears to be of determining importance in enabling a high speed of winding of the package to be obtained.

While the embodiment of the invention described is shown as winding a parallel sided package, the mechanism can be readily adapted for winding non-cylindrical packages, such as conical packages; the length of the winding on the package is determined by the axial extent of the helical segments of the slot 73, but a guide drum can be readily removed and replaced when another winding length is desired. Different lays of thread can be obtained by changing the change gears 40, 41 and 43 and the variable ratio friction gear provided by taper pulleys 45 and 47 and the movable belt 48 enables the winding speed to be adjusted to a small degree, to make it possible to wind closely threads of different count.

The tensioning adjusting means operates in the manner described in connection with Figure 1, but is not shown in Figures 2 and 3. A convenient method of effecting the desired control is to arrange for movement

of arms 54 and 55 to control a variable resistor, in turn controlling the current fed to the variable tensioning devices 14, 15.

WHAT WE CLAIM IS:—

1. A winding apparatus for winding thread on to packages, and comprising thread guiding means, said guiding means including a guide drum formed by first and second members having adjacent cylindrical surfaces, said surfaces being complementarily shaped and spaced to form a thread guiding slot, said slot comprising an even number of helical segments, each segment being a segment of a helix of the same pitch and having the same angular extent around said cylindrical surface, successive segments being segments of alternately left handed and right handed helices, means for rotating said members together about an axis, thread guide means providing edges extending parallel to the axis of said drum for guiding a thread to enter said slot at a first point and to emerge from the slot at a second point, said first and second points being disposed approximately in a plane which is at right angles to said axis of rotation.

2. A thread winding apparatus for winding thread on to packages, and comprising thread guiding means, said guiding means including a guide drum formed by first and second members having parts that are hollow cylinders, the surfaces of said cylinders being coaxial and of the same external diameter, the adjacent edges of the cylindrical parts of said members being complementarily shaped and spaced to form a thread guiding slot, support means for retaining said members with said edges in fixed relative position, said support means permitting said members to rotate together about an axis whilst retaining said edges in said fixed relative position, said slot comprising an even number of helical segments, each segment being a segment of a helix of the same pitch and having the same angular extent around said cylindrical surface, successive segments being segments of alternately left-handed and right-handed helices, thread guide means providing guiding edges parallel to said axis for guiding a thread to enter said slot at a first point to pass into the interior of said hollow cylinders and to emerge from said slot at a second point, said first and second points moving in a direction along the said axis as said members rotate, said first and second points at any one time during rotation lying approximately in a plane at right angles to said axis.

3. An apparatus in accordance with claim 1 or claim 2, wherein said first and second points lie approximately on a diameter of said cylinder or cylinders.

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of claims 1, 2 or 3, wherein said segments are four in number.

5 5. An apparatus in accordance with any of claims 1, 2, 3 or 4, and comprising a package winding support means, and means for driving said support means in synchronism with rotation of said members.

10 6. An apparatus in accordance with claim 5, and comprising a common driving means for said package support means and said means and drive means for establishing a speed ratio between them fixed in use.

15 7. An apparatus in accordance with claim 6, and comprising means for adjusting said speed ratio.

20 8. An apparatus in accordance with any preceding claim, and comprising thread tensioning means for controlling the tension of thread fed to said guiding means.

25 9. An apparatus in accordance with claim 8, and comprising means for adjusting automatically the tension of the thread in accordance with the external diameter of a package on to which thread from said guiding means is wound.

10. An apparatus in accordance with any preceding claim, and comprising a guide

plate, over the edge of which thread from said guiding means passes to a package on to which the thread is wound.

30 11. An apparatus in accordance with claim 10, wherein said guide plate is resiliently mounted with respect to the package, and is biased against the surface of thread wound on said package.

35 12. An apparatus in accordance with claim 11, wherein said guiding means and said guide plate are together resiliently mounted.

40 13. An apparatus in accordance with claim 12, wherein said guiding means and said guide plate are carried on a counterbalanced arm.

45 14. An improved winding apparatus substantially as described with reference to the accompanying drawings.

15. Thread packages wound by apparatus in accordance with any of the preceding claims.

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PATENTS ACT 1949

SPECIFICATION NO 1261727

In accordance with the Decision of the Principal Examiner, acting for the Comptroller-General, dated 13 December 1973 this Specification has been amended under Section 14 in the following manner:-

Page 1, line 83, page 4, line 89, *after being insert* at all times

Page 4, line 121, *delete* any one time *insert* all times

Page 5, line 11, *delete* means *insert* members

THE PATENT OFFICE
21 January 1974

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