A creel includes a yarn package of the rotational type, which is mounted on a yarn package holder, and yarn guiding apparatus. The yarn guiding apparatus includes a first, second, third and fourth yarn guiding means. The first yarn guiding means is attached to a first end of a pivoting member. The pivoting member pivots about a pivot axis spaced from the first end. In use yarn is drawn from the yarn package and about the first, second, third and fourth yarn guiding means. The yarn is unwound by applying tension to the yarn. During unwinding, the point at which the yarn leaves the yarn package traverses axially back and forth across the yarn package. Because the first yarn guiding means is free to rotate about the pivot axis, the tension in the yarn acts to move the first guide means to a position substantially in alignment with that point.
IN OR RELATING TO CREELS
CROSS REFERENCE TO RELATED APPLICATION

[0001] This application is a national stage application of International Application No. PCT/GB2007/050024, filed on Jan. 17, 2007, which claims priority to United Kingdom Patent Application No. 0600884.1, filed on Jan. 17, 2006, the entire disclosures of which are incorporated herein.

FIELD OF THE INVENTION

[0002] This invention relates to an improvement in the delivery of yarn from wound yarn packages on a creel. More specifically, the invention relates to a creel having tensioned yarn guide means.

BACKGROUND OF THE INVENTION AND RELATED ART

[0003] It is normal for creels to include wound yarn packages arranged on rotating horizontal axes. EP 0567497 discloses a creel with horizontally mounted yarn packages, wherein the yarns are drawn horizontally or vertically from the yarn package and delivered via yarn guides, such as rollers and pins, to a further process, such as a fabric producing machine. The yarn package, being relatively free to rotate, is unwound by applying tension to the yarn.

[0004] U.S. Pat. No. 5,805,134 discloses a braking mechanism for automatically stopping the rotating axis of each yarn package should tension in the yarn reduce due to breakage of the yarn or stoppage of the supplied machine. The braking mechanism comprises two horizontal rollers, the second of which is attached to a pivoted arm. The pivoted arm has attached to it a flexible member that is wrapped around the axle of the yarn package. The pivoted arm is biased to rotate the second roller downwards, which tightens the flexible member applying a braking force to the yarn package axle. When tension is applied to the yarn, the second roller is urged upwards about the pivot of the connecting arm, such that the tension of the flexible member is relaxed allowing the yarn package to unwind.

[0005] When unwinding yarn packages, the point at which the yarn leaves the yarn package traverses back and forth across the width of the yarn package. In creels according to U.S. Pat. No. 1,134 the yarn also traverses back and forth across the rollers. This movement generates axial tension in the yarn, which creates shearing forces at the yarn package and rollers as the yarn traverse, in an oscillating manner, over the lower yarn layer and roller respectively.

[0006] In some applications such as when unwinding carbon fibres, the individual fibres that make up the yarn are sensitive to shearing forces. Fibre damage is not desirable as, amongst other things, it can cause small lengths of fibre to break off and fur up machines further along the production process. This is a particular problem in ovens, where regular maintenance downtime is required to clean the ovens of damaged fibre.

[0007] To reduce fibre damage caused by movement across the rollers, the rollers are generally ceramic coated or hard anodized.

[0008] It is desirable to incorporate larger yarn packages into creels in order to gain the maximum running time between yarn package changes. For this reason, creels capable of unwinding yarn packages as large as 300 kg and greater are being required. As yarn packages get larger they also get wider. Consequently, creels according to U.S. Pat. No. 1,134 require wider first and second rollers capable of allowing the yarn to traverse the full width of the yarn package as it unwinds. This considerably increases the creel cost and size.

[0009] The traversing of the yarn across the yarn package also introduces fluctuations in the tension of the yarn, created by changes in the distance that the yarn travels within the creel. Ideally the tension should be constant.

[0010] A similar problem is involved in the winding process of putting the yarn onto the yarn package. Here, it is known to use a bow bar to counteract the change in distance as the yarn traverses across the width of the yarn package. Bow bars are not suitable for the unwinding process as a large diameter bar would be required in order to reduce damage to the yarn caused by bending about a small radius. Furthermore, it is desirable in the unwinding process to use rolling guides rather than fixed guides. Thus, because a bow bar is bent, it is not practical to use a rotating bow bar.

SUMMARY OF THE INVENTION

[0011] According to one aspect of the present invention a creel comprises at least one yarn package holder for mounting a yarn package of the rotational type, wherein each yarn package holder has a corresponding yarn guide apparatus that comprises a moveable first yarn guide means, the yarn being drawn from the yarn package to the first yarn guide means under tension, said tension causing the first yarn guide means to move towards (to a position substantially in alignment with) the point at which the yarn leaves the yarn package.

[0012] Preferably, the first yarn guide means is movable generally lengthwise in relation to the yarn package.

[0013] Suitably, each yarn guide apparatus may comprise guiding means and the first yarn guide means may be slidably mounted on the guiding means. Preferably, the guiding means may be arranged perpendicular to the axis of the yarn package. The guiding means may be substantially straight. Alternatively, the guiding means may be arcuate. Preferably, the guiding means may comprise a rod or tube of a substantially constant cross section.

[0014] Alternatively, each yarn guide apparatus may comprise a pivoted member, wherein the first yarn guide means is attached to said pivoted member. The pivoted member may rotate about an axis and the moveable first yarn guide means may be located spaced from the pivot axis. The axis may be fixed in relation to the yarn package holder. The axis may be perpendicular to the axis of the yarn package holder and preferably the axis of rotation may be substantially horizontal.

[0015] Preferably, each yarn guide apparatus may comprise a second yarn guide means, wherein the yarn may be drawn from the first yarn guide means to the second yarn guide means.

[0016] Preferably, the pivoted member may include a first elongate section and the first yarn guide means may be located towards a first end of the elongate section and the pivot axis may be located at a second end of the elongate section.

[0017] Preferably, the second yarn guide means may be attached to the pivoted member and may preferably be located spaced closer to the rotation axis of the pivoted mem-
ber than the first yarn guide means. Preferably, the location of the second yarn guide means may substantially correspond to the location of the pivot axis.

[0018] Preferably, at least one of the yarn guide means may be rotatable and may preferably comprise rollers or pulleys. Preferably, the axis of the rollers may be parallel to the axis of the yarn package holder. Preferably, the rollers may retain the yarn such that the yarn does not move significantly in the axial direction of the yarn guide. The rollers may comprise a varying diameter to retain the yarn or alternatively may comprise a constant diameter, wherein the yarn guide means comprises one or more guides to retain the yarn on the roller. Preferably, the guides may be pins and may be ceramic coated.

[0019] Preferably, the yarn package holder may be mounted substantially horizontally. Preferably, the pivot axis is mounted above the axis of the yarn package holder. Preferably, the first yarn guide means is located beneath the axis of the yarn package holder. Preferably, the pivoted member may comprise a second counterbalance section, which may be arranged on an opposing side of the pivot axis to the first yarn guide means.

[0020] Preferably, the counterbalance is balanced such that the only rotational force applied to the yarn guide means about the pivot axis is generated by the tension in the yarn.

[0021] Preferably, the pivot axis of the pivoted member may be arranged level with the centre of the width of the yarn package holder axis. Alternatively, the pivot axis may be arranged to one side of the yarn package holder. Preferably, the rotation radius may be substantially longer than the width of the yarn package holder. Preferably, the radius may be at least twice the width of the package holder. More preferably, the radius may be at least three times the width of the package holder. Still more preferably, the radius may be at least four times the width of the package holder. Preferably, the first yarn guide means is located toward the rear of the creel with respect to the yarn package holder.

[0022] According to a further aspect of the present invention, a method of unwinding at least one yarn package of the rotational type comprises applying tension to a yarn that is routed from each yarn package on a creel, wherein for each yarn package the creel comprises a yarn package holder for mounting the yarn package and a corresponding yarn guide apparatus comprising a moveable first yarn guide means, the yarn being drawn from the yarn package via the first yarn guide means under tension, said tension causing the first yarn guide means to move to a position substantially in alignment with the point at which the yarn leaves the yarn package.

[0023] The present invention includes any combination of the herein referred to features or limitations.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] The present invention can be carried into practice in various ways but several embodiments will now be described, by way of example, with reference to the accompanying drawings, in which:

[0025] FIG. 1 is a rear perspective view of one yarn package of a creel according to the present invention and in a first position corresponding to the yarn being unwound from around the middle of the yarn package;

[0026] FIG. 2 is a rear perspective view of the creel in a second position corresponding to the yarn being unwound from near the left hand end of the yarn package;

[0027] FIG. 3 is a rear perspective view of the creel in a third position corresponding to the yarn being unwound from near the right hand end of the yarn package;

[0028] FIG. 4 is a side perspective view of the creel;

[0029] FIG. 5 is a top perspective view of the creel; and

[0030] FIG. 6 is a detailed perspective view showing part of the creel according to a second embodiment of the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

[0031] A creel generally comprises multiple yarn packages arranged on a frame in a grid-like manner. Each yarn package is mounted on the frame in a predetermined area, each area being substantially the same and in accordance with the creel described herein.

[0032] As shown in FIG. 1, a preferred embodiment of a creel includes a yarn package 2, which is mounted on a yarn package holder 4, and a yarn guiding apparatus. As shown in FIG. 4, the yarn guiding apparatus includes a first 6, second 8, third 9, and forth 10 yarn guiding means, and a pivoting member 12 that rotates about a pivot axis 14 (FIG. 1). Yarn 16 is drawn from the yarn package and through the creel by the first, second, third, and forth yarn guiding means.

[0033] The yarn package 2 is of a rotational type with the yarn 16 wound in a spiral pattern back and forth across the yarn package. The yarn package holder 4 is of any well known rotational type and the yarn package is mounted thereon such that the yarn package is free to rotate. According to the first embodiment the axis of the yarn package is substantially horizontal. The yarn package holder is mounted on a frame 18.

[0034] The pivoting member 12 swings about the pivot axis 14. The pivoting member 12 is substantially elongate and is shown in the Figures as a straight rod. The first yarn guiding means 6 is attached to a first end of the pivoting member 12 by a stub axle. The pivot axis 14 is attached to the pivoting member 12 spaced from the first yarn guiding means 6 and towards a second end of the pivoting member. The second end of the pivoting member is on the opposing side of the pivot axis 14 to the first yarn guiding means 6 and comprises a counterbalance section 22. The counter balance section may be removable from the pivoting member, for instance if the creel does not provide sufficient space it may be necessary to remove the counter balance section and operate the creel with said section. It will be appreciated that when operating the creel without the counterbalance section, the advantageous effect, as herein described, of the pivoting member having a zero net bending moment will be lost. However, by reducing the pivoting member’s weight the bending moment urging the un-balanced pivoting member to its centre point can be minimised. Accordingly, with sufficient tension in the yarn the pivoting member will still be moved substantially in alignment with the point at which the yarn leaves the yarn package. The counterbalance section includes a rod that extends from the distal end of the pivoting member 12 at an angle of approximately 90°. A counter balance weight 24 is movably attached to the rod such that the balance of the pivoting member can be altered. The counterbalance section operates in any well known method.

[0035] The pivot axis 14 is attached to the frame 18 such that the pivoting member 12 swings about an axis. The pivot axis is arranged substantially perpendicular to the axis of the yarn package and in a horizontal plane such that the pivoting
member 12 swings in a vertical plane. Ideally the counterbalance weight is arranged to act as a perfect counterbalance to the first end such that, in isolation, the pivoting member 12 produces a zero net bending moment about the pivot axis 14, such that, as will become clear, in use the only force acting on the pivoting member is generated by the tension in the yarn.

[0036] The pivot axis is shown arranged substantially in line with the centre of the width of the creel package. However, the invention would work equally with the pivot axis arranged to either side.

[0037] FIG. 4 shows the location of the pivot axis 14 and first yarn guiding means 6. The pivot axis is located rearwardly and upwardly of the creel package axis. The first yarn guide is located rearwardly and downwardly of the creel package.

[0038] The second yarn guiding means 8 is shown in the Figures as being attached to the pivoting member 12 at a position forward of the pivot point 14. However, it will be appreciated that whilst ideally the second yarn guiding means should be located as close to the pivot position as possible so that its movement is reduced to a minimum, the present invention would work equally with the second yarn guiding means attached at any location on the pivoting member 12 or alternatively to any suitable position on the frame.

[0039] As shown in FIG. 4, the third 9 and forth 10 yarn guiding means are attached to a braking member 26. The braking member is rotatable about a rod 28 with an axis that is fixed to the frame. The third yarn guiding means is arranged on the braking member forward of the rod and at a first end of the braking member. The forth yarn guiding means is attached rearwardly of the rod and at a second end of the braking member. A first end of a flexible member such as a rope 30 is fixed to the braking member at the second end. The rope is arranged to wrap around a radial surface of the creel package holder 4 with its second end fixed to the frame. The braking member is biased to rotate the third yarn guiding means downwardly by a spring 32. Such rotation tensions the rope 30, which applies a braking force to the creel package holder to resist rotation of the creel package.

[0040] Each of the first 6, second 8, third 9 and forth 10 yarn guiding means comprise any well known arrangement capable of guiding the yarn about the path whilst retaining the position of the yarn on the yarn guiding means, for example, fixed rods or rollers. The axes of the rods or rollers are arranged parallel to the axis of the yarn package. The yarn guide means are shown in FIGS. 1-6 as comprising well known pulley type rollers that have a varying diameter. The diameter of the roller increases from the middle, outwardly toward the radial edge. It is well known that the geometry of such rollers maintain the yarn position with respect to the roller by urging the yarn toward the smallest diameter section at the centre of the roller.

[0041] In use yarn is drawn rearwardly from the yarn package 2 and about the first yarn guiding means 6 and then upwardly and about the second yarn guiding means 8. The yarn is then routed according to any well known creel layout, which, as shown in the Figures, may be forwardly and over then under the third 9 and forth 10 yarn guiding means respectively. After the forth yarn guiding means, the yarn is guided upwardly and away from the creel by further yarn guiding means and toward a production process such as a converting oven or fabric producing machine.

[0042] The yarn is unwound by applying tension to the yarn. When the yarn undergoes tension, the forth yarn guiding means 10 is urged upwardly against the biasing force of spring 32. This relaxes the tension in the rope 30 that releases the braking force applied by it to the yarn package holder 4 thus allowing the yarn package holder to rotate. Consequently the yarn is unwound. Should the tension reduce or be lost, the forth yarn guiding means is urged downwardly by the spring, which reappplies the braking force to the yarn package holder such that the yarn package does not rotate.

[0043] As tension in the yarn is applied and the yarn unwound, the point at which the yarn leaves the yarn package traverses axially back and forth across the yarn package, thus generating forces in the axial direction with respect to the yarn package. Because the first yarn guiding means is free to rotate about the pivot axis 14 and thus to traverse across the yarn package on a somewhat arcuate path, the tension forces act to move the first yarn guiding means to a position substantially in alignment with the point at which the yarn leaves the yarn package. Consequently, the yarn is drawn from the yarn package in a line that is substantially perpendicular to the yarn package axis.

[0044] The tension moves the first yarn guiding means due in part to friction between the yarn and yarn guiding means but also due to the geometry of the pulleys. The first yarn guiding means moves to find equilibrium of the forces. Thus when the yarn is unwinding from near the left hand side of the yarn package, the pivoting member 12 is urged, by the tension in the yarn to the position shown in FIG. 2. As the yarn continues to unwind and traverses back towards the centre of the yarn package, the pivoting member moves towards the centre position shown in FIG. 1. As the yarn is unwound further the yarn tension urges the pivoting member towards the position shown in FIG. 3, which shows the yarn being unwound when near the right hand side of the yarn package.

[0045] It will be appreciated from the foregoing that in use the pivoting member 12 rotates back and forth between the two extreme positions shown in FIGS. 2 and 3 respectively. Stops (not shown) may be used to restrict the pivoting member from moving past the extremities of the yarn package, which may otherwise occur due to inertia. The pivoting member may also comprise any well known damping means (not shown) either within the pivot point or acting externally on the pivoting member, for example springs, in order to reduce the inertial effects.

[0046] FIG. 6 shows an additional or alternative arrangement for any of the yarn guiding means wherein the rollers 34 comprise a constant diameter. In some applications, the tension in the yarn may create sufficient friction between the yarn and roller in order to maintain the position of the yarn on the roller, thus, in the case of the first yarn guiding means, creating the forces necessary to move the roller. In other applications this frictional force may not be sufficient and, as such, the yarn guiding means includes two rods 36, 37. The two rods are fixed with respect to the axis of the roller and are arranged on either side of the yarn in order to restrict the axial movement of the yarn.

[0047] In an alternative embodiment, the pivot axis 14 is arranged perpendicular to the axis of the yarn package but inclined at an angle to the horizontal. In all instances, except the vertical, the pivoting member 12 may still be balanced such that, in use, the only rotating force applied about the pivot axis is caused by the yarn tension. When inclined to the vertical, the arrangement still operates in accordance with the present invention, however before moving the first yarn guiding means, the yarn tension must first overcome the inertia of the
pivoting member. Equally, the counter balance may be arranged such that, in isolation, the pivoting member has a net bending moment urging the pivoting member towards a vertical position.

[0048] In a further embodiment, the first yarn guide means is slidably mounted on a guide member such as a rail or rod. The rod is arranged parallel and in line to the axis of the yarn package and attached at both ends to the frame. The embodiment operates equally independent of the position of the guide member, but will be described herein with the guide member arranged rearwardly and downwardly of the yarn package axis. The second yarn guide means is arranged, as in the first embodiment, rearwardly and upwardly of the yarn package axis but attached to the frame. The third and forth yarn guide means are arranged substantially as before and in accordance with the first embodiment.

[0049] The first yarn guiding means is substantially in accordance with the first embodiment but includes a mounting hole that is coincident with the axis of the roller. The mounting hole includes a bearing such that the first yarn guide is mounted on the rod with the rod being arranged within the mounting hole and the bearing cooperates with the rod so that the yarn guide can slide axially along the rod with minimal friction. In use, the tension in the yarn acts to slide the yarn guide back and forth across the rod substantially as before in the first embodiment.

[0050] The guide member may be straight or alternatively, in order to compensate for the varying yarn length between the yarn package and second yarn guiding means, the guide member may be arcuate.

[0051] The creel according to the present invention has several benefits over existing creels. The width of the yarn guiding means is reduced. There is also reduced variation in the yarn length, which results from the yarn traversing back and forth and is measured from the yarn package, about the first yarn guide means and to the second yarn guide means. Furthermore, the yarn is unwound without causing the yarn to traverse across the roller.

1. A creel comprising at least one yarn package holder for mounting a yarn package of the rotational type, wherein each yarn package holder has a corresponding yarn guide apparatus that comprises a moveable first yarn guide means, the yarn being drawn from the yarn package to the first yarn guide means under tension, said tension causing the first yarn guide means to move towards the point at which the yarn leaves the yarn package.

2. The creel according to claim 1, in which the tension causes the first yarn guide means to move to a position substantially in alignment with the point at which the yarn leaves the yarn package.

3. The creel according to claim 1, in which the first yarn guide means is movable generally lengthwise in relation to the yarn package.

4. The creel according to claim 1, in which each yarn guide apparatus comprises a pivoted member, wherein the first yarn guide means is attached to said pivoted member.

5. The creel according to claim 1, in which each yarn guide apparatus comprises a second yarn guide means, wherein the yarn may be drawn from the first yarn guide means to the second yarn guide means and the location of the second yarn guide means substantially corresponds to the location of a pivot axis.

6. The creel according to claim 1, in which at least one of the yarn guide means is a rotatable roller.

7. The creel according to claim 6, in which each roller retains the yarn such that the yarn does not move significantly in the axial direction of the yarn guide.

8. The creel according to claim 1, in which the pivoted member comprises a counterbalance, which is arranged on an opposing side of a pivot axis to the first yarn guide means.

9. The creel according to claim 8, in which the counterbalance is balanced such that the only rotational force applied to the first yarn guide means about the pivot axis is generated by the tension in the yarn.

10. The creel according to claim 1, in which a rotation radius is substantially longer than a width of the yarn package holder.

11. A method of unwinding at least one yarn package of the rotational type comprising applying tension to a yarn that is routed from each yarn package on a creel, wherein for each yarn package the creel comprises a yarn package holder for supporting the yarn package and a corresponding yarn guide apparatus comprising a moveable first yarn guide means, the yarn being drawn from the yarn package via the first yarn guide means under tension, said tension causing the first yarn guide means to move to a position substantially in alignment with the point at which the yarn leaves the yarn package.

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