

Description

This invention relates to coiling and storage of filamentary material and especially of optical fibres and optical fibre packages, and to installation systems for optical fibres.

Published European Patent application 108590 describes an apparatus and method for installing optical fibres in ducts by propelling the fibre along the duct by virtue of viscous drag of an injected gaseous propellant. In such installation the length of duct along which a fibre can be propelled or 'blown' depends upon the number of bends in the duct but typically may be 500 to 800 metres. It is often the case, however, that a much greater length of continuous fibre needs to be installed and in this instance several ducts are placed in series and the additional fibre for subsequent ducts is blown through the first duct and wound on to a drum. Once the fibre for the subsequent ducts has been blown through the first duct it is then blown through the next duct, and so on. However, before the second and subsequent blowing stages can be performed it is necessary to fleet the fibre from the drum to free the end and introduce the fibre to the duct in the correct manner. This means that between each blowing stage there is a delay while the fibre is fleeted and also both reeling and fleetting equipment is required.

It is also found that during fibre blowing installation the fibre package tends to move into the duct at varying speeds. When the fibre package has to be unwound from a reel the inertia of the reel presents significant problems when subject to frequent changes in feed rate, the reel either retarding the fibre or continuing to unwind at too great a rate giving rise to loose turns. One way of preventing the latter problem is to incorporate a friction brake on the reel, but this has the disadvantage of increasing tension on the fibre package making it more liable to damage should it rub on or be bent around an object in its path.

One of the objects of the present invention is to provide a system that enables optical fibre to be blown into a duct directly from a coil.

When a filamentary material is laid in a coil, then unless the container into which the filamentary material is laid is rotated each turn of the coil contains 360 degrees of torsion. It has previously been generally recognised as disadvantageous to have containers of filaments with stored torsion: in the case of metal filaments they can be springy and unmanageable and with optical fibres it has been recognised, for example as in EP-A-0039140, as a potential contributor to entanglement. Various techniques have been devised to prevent this storage of torsion in which the container or platform on to which the coil is laid is rotated in order to reduce or eliminate the torsion. Such a system is described in EP 0039140. However when filamentary material is stored in a coil

without torsion, or with less than 360 degrees of torsion per turn, simple pulling of the turns to unwind the coils reintroduces torsion unless the container or platform is again rotated, this time in the opposite direction to that in which it was rotated during coiling. For use in fibre blowing it is undesirable to have torsion in the fibre that is being installed in the duct as this may lead to greater lateral fibre movement and reduce blowing distances. This means that equipment for container rotation would be required both for winding and unwinding, and especially the latter can be inconvenient for in-field use. There is also the disadvantage that rotating the container can suffer from inertial problems the same as those previously mentioned for reels.

The pre-characterising part of claim 1 is based upon following document. In DE-A-2,202,177, Kabel- und Metallwerke Gutehoffnungshütte, there is described an apparatus for coiling flexible filamentary materials such as rope and stranded-wire. The apparatus is used in conjunction with annular containers which are maintained stationary during the coiling process. The apparatus is very simple, involving essentially only revolving parts, and is supported on legs over the container. The filamentary material is fed into the container via a feed pipe the upper end of which is centred on and rotated about the vertical axis of the container. The lower end of the feed pipe rotates about a second axis which is parallel to, and rotates about, the first axis. The second axis is the axis of the bottom aperture of a runner ring. The runner ring has an upper aperture within which is received a bearing which acts between the ring and an annular sleeve whose axis is common with that of the container. The upper aperture of the runner ring is also centred on the axis of the container.

The upper end of the feed pipe is secured centrally within and to the annular sleeve. A bearing is provided between the annular sleeve and the frame of the apparatus, and a belt drive acts on the outer periphery of the sleeve so as to rotate the sleeve and the feed pipe's upper end about the container axis. A second belt drive, which is derived from a drive common with that to the first belt drive, acts on the outer periphery of the runner ring rotating it and the feed pipe's lower end about the second axis.

This arrangement is compact and very simple - albeit hard to describe! Since essentially only rotating parts are involved, and since large bearings can readily be used, the apparatus is suitable for high winding speeds.

There is no suggestion that the apparatus is suitable for use in coiling optical fibres.

Accordingly to a first aspect the invention provides apparatus for forming a coil of filamentary material, the apparatus comprising: an annular container with an outer side wall and an inner wall substantially concentric with the outer side wall and defining there-

between a storage cavity; a rotatable filament carrier for distributing the filamentary material into the container in which the filamentary material is laid in the annular container in a sequence of turns about the inner wall, each turn being offset with respect to adjacent turns, while the container is maintained rotationally static; characterised in that the rotatable filament carrier is located within the container and in that the apparatus is suitable for coiling an optical fibre member, elastic filamentary material so coiled having 360 degrees of recoverable elastic torsion per turn.

In a second aspect the invention provides a container for use in such apparatus, the container having a substantially annular configuration with a top, a bottom, an outer sidewall, a substantially concentric inner sidewall, and within the region bounded by the inner sidewall a cavity defined by a through bore extending between the top and bottom of the inner sidewall, the container comprising a supply of optical fibre member laid in a sequence of turns about the inner sidewall of the container, the turns being offset with respect to adjacent turns and each turn having 360 degrees of recoverable elastic torsion.

In a third aspect the invention provides a method of forming a containerised coil of optical fibre member, the method comprising the steps of:

locating a first section of a continuous optical fibre member in an annular storage cavity defined by an inner wall and an outer wall of an annular container;

retaining the optical fibre member in the fibre retaining portion of a fibre carrier located within said container;

rotating the fibre carrier about a fixed first axis located within the region defined by said inner wall;

cyclically moving the fibre retaining portion of said fibre carrier relative to said first axis so that the fibre member is progressively laid in the container in a sequence of turns about said inner wall, each turn being offset with respect to the preceding turn and containing 360 degrees of recoverable elastic torsion per turn.

A further aspect of the invention resides in a system of apparatus for installation of optical fibre transmission lines into an installation duct, the system comprising feeding means for feeding an end of an optical fibre member into an installation duct and for advancing said duct by viscous drag of an injected gaseous propellant; and an apparatus according to the first aspect of the invention at a remote end of said duct arranged to receive said end of said fibre member and to coil said fibre member within said container.

A further aspect of the invention resides in a system of apparatus for installation of optical fibre transmission lines into an installation duct, the system comprising:

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a supply of optical fibre member in an annular container, the container comprising an outer sidewall, an inner wall substantially concentric with the outer sidewall and defining therebetween a fibre member storage cavity, the fibre member lying in a sequence of turns about the inner sidewall of the container, the turns being offset with respect to adjacent turns and each turn having 360 degrees of recoverable elastic torsion; and adjacent said container, feeding means for feeding an end of the fibre package from said container into an installation duct and for advancing said end of said fibre package through said duct by fluid drag while said container is maintained rotationally stationary thereby relieving said 360 degrees of recoverable torsion as the fibre member is fed into the installation duct.

The invention is now described by way of example with reference to the following drawings in which:

Figure 1 is an exploded view of a container including coiled fibre;

Figure 2 shows a rosetting pattern for coiled fibre; Figure 3 shows a fibre rosetting head in position in a container;

Figure 4 shows an exploded view of a fibre package threaded through a funnel lid for paying out; Figure 5, 5a and 5b show, respectively, a prior art system for optical fibre storage after production and the system according to the invention;

Figures 6a and 6b show, respectively, a prior art system for fibre coiling during installation and the system according to the invention;

Figures 7a and 7b show alternative fibre blowing methods utilising the invention;

Figure 8 shows a rosetting head threaded to coil optical fibre in a container at an intermediate stage of colling in a fibre blowing installation;

Figure 9 shows two adjacent stages in a stage-by-stage fibre blowing installation utilising the invention;

Figures 10 to 12 show the stages of freeing the fibre end for a second or subsequent blowing stage, and

Figure 13 shows the last stage of paying out from a container.

In Figure 1 a container in the form of an annular pan 1 contains a coil of optical fibre package 2, the ends of which are marked with tabs 3 (only one shown). The fibre package 2 consists of a plurality of fibres encased in low density coating such as that described in EP 108590, although other suitable filamentary components or packages may also be handled in a way similar to that described herein for optical fibre packages. In particular it is envisaged that non packaged optical fibres may be stored in coils as described herein. The fibre package can be loaded into pans at the point of production and stored, for this purpose a retaining ring 4 and lid 5 are provided. Pans

of 500mm external diameter, 300mm internal diameter and 250mm depth may typically hold between 2 and 3.5km of fibre package that has a diameter of 2mm, the length depending upon the packing density.

When the fibre package is to be used it can conveniently be delivered to the point of use in the pan and installed directly from the pan. Coiling fibre package into another pan, for example after installation through the first stage of a multi-stage system, may also be performed conveniently in the field.

Figure 2 shows the preferred rosetting pattern in which the fibre package is laid in the pans by the technique shown in Figure 3. The rosetting pattern is a series of turns each of which is positioned eccentrically with respect to the pan centre and angularly incremented with respect to the previous turn. A rosetting head comprises a constant speed motor 6 which drives a drive gear 7 and rosetting gear 8 via a slipping clutch 9 that provides constant torque and variable speed. A fibre package feed wheel 10 is provided on the end of an arm 11 which is driven round and offset by the gears to create the rosetting pattern. As each turn of the rosette is laid it receives 360 degrees of torsion as a consequence of being fed in by the rotating arm. The fibre package is thus stored with torsion in each turn. The rosetting head and motor are designed so that the motor housing fits removably within the centre ring of the pan annulus with the arm 11 mounted above the level of the sides. To protect the fibre package and mechanism a lid incorporating a funnel or guide is placed over the pan. In Figure 3 the lid has a central funnel 12 and a guide extension 13, and is supported by a spacer ring 14. This whole lid assembly may be made integrally or in separate parts, but it is convenient for the lid 5 to incorporate a funnel 12 and be reversible so that for storage the lid is located with the funnel projecting inwardly into the centre of the pan annulus, the lid being inverted to the position shown in Figure 3 with the funnel outwardly for paying out and winding. In the case of paying out, the spacer ring 14 is not necessary because the rosetting head is removed and the fibre package is simply pulled out of the pan. Figure 4 shows the fibre package 2 threaded through a funnel lid, following this threading the lid is positioned on the pan and the fibre package pulled out, for example by blowing installation.

Figure 5 compares the prior art system (Figure 5a) with the system of coiling using the rosetting head and pans (Figure 5b). Figure 6a shows the prior art system of paying out an intermediate stage of a multi-stage installation process, this stage having been preceded by a winding process for transferring the fibre package from a take up drum to a fleeting machine. Figure 6b shows the relative simplicity of the rosetting head and pan method.

During fibre blowing installations the fibre package 2 is fed directly from the pan to the blowing head. Two systems are shown in Figure 7 where the con-

tinuous length of fibre package to be installed is greater than twice the maximum blowing distance, which in general means installations exceeding 1000 metres. In Figure 7a tandem blowing is utilised, the fibre package being fed into a first blowing head 15 and blown for, say 500 metres at which point the duct 16 is vented and the fibre package proceeds directly into another blowing head 15'. The installation depicted in Figure 7b is interrupted after each 500 metres or so of duct and the fibre package is rosetted into a pan 1 as it emerges from the far end of the duct 16.

Figure 8 shows how the pan and rosetting head are set up after the leading end of the fibre has been received at the far end of the duct 16. While the head is set up it will usually be necessary to suspend blowing through the duct 16. After setting up the head the leading end of the fibre is flagged and placed in the bottom of the tray, the rosetting commenced and the blowing through the duct recommenced. Figure 9 illustrates two adjacent stages 17 and 18 during a multi-stage installation, the fibre package being paid out from stage 17 and wound in at stage 18. When this is completed stage 18 will be paid out to the subsequent stage after the leading end has been recovered as described later.

Two stages (usually the first two) in an installation may be achieved without a winding stage even for non tandem blowing. In this instance the pan of fibre package is located between the first and second duct stages. The uppermost end of the fibre package is paid out and blown along the first duct stage (which may be the end of the installation or be a winding stage). When the requisite length has been blown through the first duct the blowing operation is stopped and the second end of the fibre package (which is at the bottom of the pan) is located and that end is blown through the second duct (again to an end of the installation or a winding stage). The operation of locating the second (bottom) end of the fibre package is the same as for locating the leading end after a winding stage and is described next.

Figures 10, 11 and 12 illustrate a sequence of steps to free the leading end of a fibre package that is located at the bottom of the wound fibre package in a pan having a fixed bottom. One end of the fibre package is at a remote location of the installation either having been blown there from the top of the pan or having been retained at the remote location while the remainder of the fibre package was blown through a duct. Thus the continuous length of fibre package 2 extends from duct 16, through a funnel lid 5 to the coil in the pan. The lid is removed from the tray and carefully laid to one side and the rosetting head (if winding has just taken place) is carefully removed by freeing the fibre package from the feed reel. Several spacer lugs 19, for stability at least three, are then located on the sides of the pan, and a second empty pan located upside down on top of the lugs 19. The pans and lug

assembly are then inverted to decant the coiled fibre package into the empty pan so that the end of the fibre previously underneath is now exposed on the top of the coil. This end is then fed through the funnel lid and into the blowing head for the next stage. It is found useful to lightly tape the fibre package extending from duct 16 to the side of the pan at the location referenced 20. The pan spacers are removed and the funnel lid replaced.

It will be realised that the pan spacers 19 serve to prevent the fibre package that hangs over the edge of the pan from being squashed between the pans during the inversion procedure. The lugs may be separate components or be attached to the pans, and they may be modified to function also as catches or clips for the lid. Alternative ways of preventing the fibre package from being squashed can be used. For example, a slot for the fibre package may be provided in the side wall of the pans or a tubular spacer may be inserted into the centre of the pans. The tubular spacer is particularly preferred because it enables free passage from the fibre all around the outside of the pan. A suitable form of tubular spacer comprises a tube of external diameter slightly less than the internal diameter of the inner wall of the pan 1 so that it will fit within the inner walls of the upper and lower pans, a central portion of the tubular spacer having an enlarged diameter so that it will not enter within the inner walls and holds the pans apart.

Figure 13 shows the last section of fibre package emerging from the top of the funnel lid when both ends of the package are installed in ducts. Pulling the turns directly out of the pan causes the 360 degrees torsion in each turn to be relieved so that the last turn pulls out freely and the installed fibre package is free of torsion. The taping of the fibre package at point 20 should be sufficiently light for the fibre package to pull free without damage. In the event that the taping is too strong sensors on the blowing head interrupt the blowing so that the lid can be lifted and the tape removed.

Although the winding arrangement has been described with regard to storage after production and during blowing operations, the technique is also applicable as an alternative to reeling on other installation procedures, and the filament need not be a fibre blowing package. A further advantage of the invention is that in paying out from a pan, the rate of paying out closely follows the demand rate and therefore the problems encountered with reel inertia or moving containers do not occur. The filament is therefore relatively free from tension and in the event of the filament being a fibre, this makes it far less liable to damage.

In the event that the continuous length of filament being handled is greater than that which can be wound into a single pan (which can of course be provided in a variety of sizes) a continuation pan can be loaded in the same way as described with respect to a single pan, except that there is no free end to lay in

the bottom of the pan and a free passage for the length of fibre package extending from the base of the continuation pan to the previous pan is required. This free passage may be provided by taping the fibre package to the side of the pan and/or lid out of the way of the rosetting head.

When a length of fibre is wound into two (or more) adjacent pans in this way it is possible to simultaneously access both ends of the fibre by freeing (through inversion) the end of the fibre laid at the base of the first pan, the second being available at the top of the second end (or last filled) pan. Each end may then be introduced to a respective duct and blown in, thereby enabling simultaneous installation of two adjacent stages of ducting. Starting at a central location and utilising tandem blowing (booster injection of compressed gas, preferably preceded by venting) this enables installation of several kilometres of fibre in a single operation.

Instead of decanting wound fibre from one pan to another it is also possible to provide a pan with an openable base, thus enabling inversion and access to the covered end without decanting: such a pan could, in some instances and with suitable modification, be mounted with the turns in a vertical plane and accessed from each side for paying out.

With the preferred rosetting pattern and a 2mm fibre package it is preferred to load the pans with the offset increment between turns being such that 100 turns provides a 360 degrees repetition cycle. This is relatively loose packing but is less likely to result in tangles on rapid paying out, which can occur if a turn that is being paid out lifts an adjacent turn. Maximum packing density is of the order of 200 turns per 360 degrees repetition cycle.

Although the technique and apparatus has been described in relation to optical fibre packages and fibre blowing it is applicable in other situations. One particular advantage of the invention is that the ends of the filament or line are stationary and thus they can be connected to a transmission system so that the line can be monitored, for example, during paying out or communication maintained to remote moving apparatus to which a line is being paid out or wound in. This is particularly relevant for optical fibre systems where communication through moving terminals via split rings is not possible.

Claims

1. Apparatus for forming a coil of filamentary material (2), the apparatus comprising:

an annular container (1) with an outer sidewall and an inner wall substantially concentric with the outer sidewall and defining therebetween a storage cavity;

a rotatable filament carrier for distributing the



assembly are then inverted to decant the coiled fibre package into the empty pan so that the end of the fibre previously underneath is now exposed on the top of the coil. This end is then fed through the funnel lid and into the blowing head for the next stage. It is found useful to lightly tape the fibre package extending from duct 16 to the side of the pan at the location referenced 20. The pan spacers are removed and the funnel lid replaced.

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Claims

1. Apparatus for forming a coil of filamentary material (2), the apparatus comprising:

an annular container (1) with an outer sidewall and an inner wall substantially concentric with the outer sidewall and defining therebetween a storage cavity;

a rotatable filament carrier for distributing the



filamentary material into the container in a sequence of turns about the inner wall, each turn being offset with respect to adjacent turns, while the container is maintained rotationally static;

characterised in that the rotatable filament carrier is located within the container and in that the apparatus is suitable for coiling an optical fibre member, elastic filamentary material so coiled having 360 degrees of recoverable elastic torsion per turn.

2. Apparatus as claimed in claim 1, wherein the rotatable filament carrier rotates about a fixed first axis located within the region defined by said inner wall.

3. Apparatus as claimed in claim 1 or claim 2, wherein the rotatable filament carrier comprises a capstan located within said container and which in use rotates about a second axis to advance the filamentary material to create the sequence of turns.

4. Apparatus as claimed in claim 3 as dependent on claim 2, wherein in use said capstan reciprocates to provide off-set between the adjacent turns of the coiled material.

5. Apparatus as claimed in claim 4 wherein rotation of said filament carrier about said first axis causes rotation of said second axis about said first axis, the reciprocation of said capstan involving a further cyclical change in relative orientation between the two axes.

6. Apparatus as claimed in any one of the preceding claims wherein motive means to drive said rotatable filament carrier are provided within the region defined by said inner wall.

7. Apparatus as claimed in claim 6 wherein said motive means is part of an assembly which is adapted to receive said container, the motive means fitting removably within the region defined by the inner wall of said container.

8. Apparatus as claimed in claim 6 or claim 7 wherein said rotatable filament carrier is readily demountable from said motive means.

9. Apparatus as claimed in any one of the preceding claims wherein, within the region bounded by the inner sidewall, the container has a cavity defined by a through bore extending between the top and bottom of the inner sidewall.

10. Apparatus as claimed in any one of the preceding claims, wherein the container comprises a removable funnel-shaped cap member which provides the top (5) of the container and through which the filamentary material passes during formation of the coil.

11. Apparatus as claimed in any, one of the preceding claims, wherein the container comprises a lower part (1) providing the storage cavity and a removable upper part (5) which extends the outer sidewall and defines the cavity within which the filament carrier rotates.

12. Apparatus as claimed in claim 11, wherein, in

the lower part (1) of said container, the upper periphery of said inner sidewall is substantially level with the upper periphery of said outer sidewall.

13. Apparatus as claimed in any one of the preceding claims wherein the rotatable filament carrier is arranged such that the sequence of turns repeats every 100 to 200 revolutions.

14. Apparatus as claimed in any one of the preceding claims wherein the container has an openable base.

15. Apparatus as claimed in claim 14, wherein the base of the container can be released from a full container without first emptying the container.

16. A container for use in the apparatus of claim 1, the container having a substantially annular configuration with a top, a bottom, an outer sidewall, a substantially concentric inner sidewall, and within the region bounded by the inner sidewall a cavity defined by a through bore extending between the top and bottom of the inner sidewall, the container comprising a supply of optical fibre member laid in a sequence of turns about the inner sidewall of the container, the turns being offset with respect to adjacent turns and each turn having 360 degrees of recoverable elastic torsion.

17. A container according to claim 16 in which the turns comprise a sequence of respectively eccentric circles.

18. A system of apparatus for installation of optical fibre transmission lines into an installation duct, the system comprising: a supply of optical fibre member in an annular container (1), the container comprising an outer sidewall, an inner wall substantially concentric with the outer sidewall and defining therebetween a fibre member storage cavity, the fibre member lying in a sequence of turns about the inner sidewall of the container, the turns being offset with respect to adjacent turns and each turn having 360 degrees of recoverable elastic torsion; and adjacent said container, feeding means (15) for feeding an end of the fibre package from said container into an installation duct (16) and for advancing said end of said fibre package through said duct by fluid drag while said container is maintained rotationally stationary thereby relieving said 360 degrees of recoverable torsion as the fibre member is fed into the installation duct.

19. A system as claimed in claim 18 wherein said container is as claimed in claim 16.

20. A system according to claim 18 or claim 19 further comprising means for coiling excess fibre package emerging from an end remote from the installation end into a second annular container (1) also having a top (5) a bottom, an outer sidewall and a substantially concentric inner wall in a sequence of turns each turn having 360 degrees of recoverable elastic torsion and being offset with respect to adjacent turns, the second annular container also being maintained



rotationally stationary while the fibre package is coiled into the second annular container along a helical path.

21. A system of apparatus for installation of optical fibre transmission lines into an installation duct (16) the system comprising:

feeding means (15) for feeding an end of an optical fibre member into an installation duct (16) and for advancing said end of said fibre member through said duct by viscous drag of an injected gaseous propellant; and an apparatus according to claim 1 at a remote end of said duct arranged to receive said end of said fibre member and to coil said fibre member within said container.

22. A system as claimed in claim 21, further comprising adjacent said feeding means (15) a supply of optical fibre member in an annular container (1) the container comprising an outer sidewall, an inner wall substantially concentric with the outer sidewall and defining therebetween a fibre member storage cavity, the fibre member lying in a sequence of turns about the inner sidewall of the container, the turns being offset with respect to adjacent turns and each turn having 360 degrees of recoverable elastic torsion, the fibre member passing from said container via said feeding means into said installation duct (16) the container being maintained rotationally static while the fibre member is withdrawn therefrom.

23. A method of forming a containerised coil of optical fibre member, the method comprising the steps of:

locating a first section of a continuous optical fibre member in an annular storage cavity defined by an inner wall and an outer wall of an annular container;

retaining the optical fibre member in the fibre retaining portion of a fibre carrier located within said container;

rotating the fibre carrier about a fixed first axis located within the region defined by said inner wall;

cyclically moving the fibre retaining portion of said fibre carrier relative to said first axis so that the fibre member is progressively laid in the container in a sequence of turns about said inner wall, each turn being offset with respect to the preceding turn and containing 360 degrees of recoverable elastic torsion per turn.

24. A method as claimed in claim 23 wherein the fibre winding pattern is such that the sequence of turns repeats every 100 to 200 turns.

Patentansprüche

1. Apparatur zum Bilden einer Spule von fadenförmigem Material (2), wobei die Apparatur aufweist:
einen ringförmigen Behälter (1) mit einer äußeren Seitenwand und einer inneren Wand, welche im wesentlichen mit der äußeren Seitenwand konzen-

trisch ist und dazwischen einen Speicherrhohlraum definiert;

einen rotierbaren Faserträger zum Verteilen des fadenförmigen Materials in den Behälter in einer Sequenz von Windungen um die innere Wand, wobei jede Windung bezüglich benachbarter Windungen versetzt ist, während der Behälter rotierend statisch gehalten wird;

dadurch gekennzeichnet, daß

der rotierbare Fadenträger sich innerhalb des Behälters befindet und daß die Apparatur geeignet ist zum Spulen eines optischen Faserelementes, eines elastischen fadenförmigen Materials, welches derart gespult ist, daß es 360° aufhebbare elastische Torsion per Wicklung besitzt.

2. Apparatur nach Anspruch 1, wobei der rotierbare Fadenträger um eine feste erste Achse rotiert, welche sich innerhalb des durch die innere Wand definierten Gebietes befindet.

3. Apparatur nach Anspruch 1 oder 2, wobei der rotierbare Fadenträger einen innerhalb des Behälters befindlichen Capstan aufweist, und welcher beim Einsatz um eine zweite Achse rotiert, um das fadenförmige Material fortzubewegen, um die Sequenz von Windungen zu erzeugen.

4. Apparatur nach Anspruch 3, wenn er von Anspruch 2 abhängt, wobei sich im Einsatz der Capstan hin und her bewegt, um einen Versatz zwischen benachbarten Windungen des gespulten Materials bereitzustellen.

5. Apparatur nach Anspruch 4, wobei eine Rotation des Fadenträgers um die erste Achse eine Rotation der zweiten Achse um die erste Achse verursacht, wobei die Hin- und Herbewegung dieser Winde eine weitere zyklische Veränderung der relativen Orientierung zwischen den zwei Achsen mit sich bringt.

6. Apparatur nach einem der vorhergehenden Ansprüche, wobei Antriebseinrichtungen zum Antreiben des rotierbaren Fadenträgers innerhalb des durch die innere Wand definierten Gebietes eingerichtet sind.

7. Apparatur nach Anspruch 6, wobei die Antriebseinrichtung ein Teil eines Aufbaus ist, welcher zum Aufnehmen des Behälters angepaßt ist, wobei die Antriebseinrichtung innerhalb des durch die innere Wand des Behälters definierten Bereiches entferntbar hineinpaßt.

8. Apparatur nach Anspruch 6 oder 7, wobei der rotierbare Fadenträger leicht demontierbar von der Antriebseinrichtung ist.

9. Apparatur nach einem der vorhergehenden Ansprüche, wobei der Behälter innerhalb des durch die innere Seitenwand begrenzten Bereiches einen Hohlraum hat, der durch eine Durchbohrung definiert ist, die sich zwischen dem Oberteil und Unterteil der inneren Seitenwand erstreckt.

10. Apparatur nach einem der vorhergehenden



Ansprüche, wobei der Behälter ein entfernbares trichterförmiges Kappenelement aufweist, welches das Oberteil (5) des Behälters bereitstellt und durch welches das fadenförmige Material während der Bildung der Spule hindurchgeht.

11. Apparatur nach einem der vorhergehenden Ansprüche, wobei der Behälter einen unteren Teil (1) bereitstellt, welcher den Speicherhohlraum umfaßt, und einen entfernbaren oberen Teil (5), welcher die äußere Seitenwand ausdehnt und den Hohlraum definiert, innerhalb dessen der Fadenträger rotiert.

12. Apparatur nach Anspruch 11, wobei in dem unteren Teil (1) des Behälters die obere Peripherie der inneren Seitenwand im wesentlichen auf gleicher Höhe ist mit der oberen Peripherie der äußeren Seitenwand.

13. Apparatur nach einem der vorhergehenden Ansprüche, wobei der rotierbare Fadenträger so angeordnet ist, daß die Sequenz der Windungen sich alle 100 bis 200 Umdrehungen wiederholt.

14. Apparatur nach einem der vorhergehenden Ansprüche, wobei der Behälter eine Basis hat, die sich öffnen läßt.

15. Apparatur nach Anspruch 14, wobei die Basis des Behälters von einem vollen Behälter losgelöst werden kann, ohne den Behälter zuerst zu leeren.

16. Behälter zur Verwendung in der Apparatur nach Anspruch 1, wobei der Behälter eine im wesentlichen ringförmige Konfiguration besitzt mit einem Oberteil, einem Unterteil, einer äußeren Seitenwand, einer im wesentlichen konzentrischen inneren Seitenwand, und innerhalb des durch die innere Seitenwand begrenzten Bereiches einem Hohlraum, der durch eine Durchbohrung definiert ist, die sich zwischen dem Ober- und Unterteil der inneren Seitenwand erstreckt, wobei der Behälter einen Vorrat an optischem Faserelement aufweist, welches in einer Sequenz von Windungen um die innere Seitenwand des Behälters gelegt ist, wobei die Windungen in bezug auf benachbarte Windungen versetzt sind und jede Windung 360° aufhebbarer elastischer Torsion besitzen.

17. Behälter nach Anspruch 16, in welchem die Windungen eine Sequenz jeweils exzentrischer Kreise aufweisen.

18. Apparatusystem zum Installieren von optischen Faserübertragungsleitungen in eine Installationsröhrenleitung, wobei das System aufweist:

einen Vorrat an optischem Faserelement in einem ringförmigen Behälter (1), wobei der Behälter aufweist: eine äußere Seitenwand, eine mit der äußeren Seitenwand im wesentlichen konzentrische Innenwand und dazwischen einen Faserelementspeicherhohlraum definiert, wobei das Faserelement in einer Sequenz von Windungen um die innere Seitenwand des Behälters herumliegt, die Windungen in bezug auf nebenliegende Windungen versetzt sind und jede Windung 360° aufhebbare elastische Torsion besitzt; und

neben dem Behälter eine Zuführeinrichtung (15) zum Zuführen eines Endes des Faserpaketes von dem Behälter in eine Installationsröhrenleitung (16) und zum Fortbewegen des Endes des Faserpaketes durch die Röhrenleitung mittels Fluidreibung, während der Behälter rotierend stationär gehalten wird, wodurch die 360° aufhebbare Torsion beseitigt werden, wenn das Faserelement der Installationsröhrenleitung zugeführt wird.

19. System nach Anspruch 18, wobei der Behälter so ist, wie in Anspruch 16 beansprucht.

20. System nach Anspruch 18 oder 19, weiterhin aufweisend eine Einrichtung zum Spulen eines überschüssigen Faserpaketes, welches aus einem von dem Installationsende entfernten Ende austritt in einen zweiten ringförmigen Behälter (1), der auch ein Oberteil (5), ein Unterteil, eine äußere Seitenwand und eine im wesentlichen konzentrische Innenwand hat, in einer Sequenz von Windungen, wobei jede Windung 360° aufhebbare elastische Torsion besitzt und in bezug auf benachbarte Windungen versetzt ist, der zweite ringförmige Behälter auch rotierend stationär gehalten wird, während das Faserpaket in den zweiten ringförmigen Behälter entlang eines schraubenförmigen Pfades gespult wird.

21. Apparatusystem zum Installieren optischer Faserübertragungsleitungen in eine Installationsröhrenleitung (16), wobei das System aufweist:

eine Zuführeinrichtung (15) zum Zuführen eines Endes eines optischen Faserelementes in eine Installationsröhrenleitung (16) und zum Fortbewegen des Endes des Faserelementes durch die Röhrenleitung mittels Zähigkeitsreibung eines injizierten gasförmigen Treibmittels; und

eine Apparatur nach Anspruch 1 bei einem entfernten Ende der Röhrenleitung, angeordnet zum Empfangen des Endes des Faserelementes und zum Spulen des Faserelementes innerhalb des Behälters.

22. System nach Anspruch 21, weiterhin neben der Zuführeinrichtung (15) aufweisend:

einen Vorrat eines optischen Faserelementes in einem ringförmigen Behälter (1), wobei der Behälter aufweist: eine äußere Seitenwand, eine Innenwand, die im wesentlichen mit der äußeren Seitenwand konzentrisch ist und dazwischen einen Faserelementspeicherhohlraum definiert, wobei das Faserelement in einer Sequenz von Windungen um die innere Seitenwand des Behälters liegt, die Windungen bezüglich benachbarter Windungen versetzt sind und jede Windung 360° aufhebbare elastische Torsion besitzt, das Faserelement von dem Behälter über die Zuführeinrichtung in die Installationsröhrenleitung (16) geführt wird und der Behälter rotierend statisch gehalten wird, während das Faserelement davon zurückgezogen wird,

23. Verfahren zum Bilden einer Spule eines optischen Faserelementes in einem Behälter, wobei das Verfahren die Schritte aufweist:



Orten eines ersten Abschnittes eines kontinuierlichen optischen Faserelementes in einem ringförmigen Speicherraum, der durch eine innere Wand und eine äußere Wand eines ringförmigen Behälters definiert ist;

Zurückhalten des optischen Faserelementes in dem Faserrückhalteteil eines in dem Behälter befindlichen Faserträgers;

Rotieren des Faserträgers um eine feste erste Achse, die sich innerhalb des durch die innere Wand definierten Gebietes befindet;

zyklisches Bewegen des Faserrückhalteteils des Faserträgers relativ zu der ersten Achse, so daß das Faserelement fortschreitend in den Behälter gelegt wird in einer Sequenz von Windungen um die innere Wand, wobei jede Windung in bezug auf die vorhergehende Windung versetzt ist und 360° aufhebbare elastische Torsion pro Windung enthält.

24. Verfahren nach Anspruch 23, wobei das Faserwicklungsmuster so ist, daß sich die Sequenz von Windungen alle 100 bis 200 Windungen wiederholt.

Revendications

1. Appareil pour confectionner une bobine de matériau en forme de filaments (2), le dispositif comprenant:

un récipient annulaire (1) avec une paroi latérale extérieure et une paroi intérieure, sensiblement concentrique à la paroi latérale extérieure et définissant entre les deux une cavité de stockage;

un support de filament rotatif pour distribuer le matériau en filaments dans le récipient en une séquence de spires autour de la paroi intérieure, chaque spire étant décalée par rapport aux spires adjacentes, pendant que le récipient reste non rotatif;

caractérisé en ce que le support de filament rotatif est situé dans le récipient et en ce que l'appareil convient pour l'enroulement d'un élément en fibres optiques, le matériau en filaments élastiques ainsi enroulé ayant une torsion élastique récupérable de 360 degrés par spire.

2. Appareil selon la revendication 1, dans lequel le support de filament rotatif tourne autour d'un premier axe fixe situé dans la région définie par ladite paroi intérieure.

3. Appareil selon la revendication 1 ou 2, dans lequel le support de filament rotatif comprend un cabestan logé dans ledit récipient et qui, en service, tourne autour d'un second axe pour avancer le matériau en filaments afin de créer une séquence de spires.

4. Appareil selon la revendication 3, dépendant de la revendication 2, dans lequel, en service, ledit cabestan effectue un mouvement de va-et-vient pour produire le décalage entre les spires adjacentes du

matériau enroulé.

5. Appareil selon la revendication 4, dans lequel la rotation dudit support de filament autour dudit premier axe provoque la rotation dudit second axe autour dudit premier axe, le mouvement de va-et-vient dudit cabestan entraînant une modification cyclique supplémentaire de l'orientation relative entre les deux axes.

6. Appareil selon l'une quelconque des précédentes revendications, dans lequel des moyens moteurs pour entraîner ledit support de filament rotatif sont prévus dans la zone définie par ladite paroi intérieure.

7. Appareil selon la revendication 6, dans lequel lesdits moyens moteurs font partie d'un ensemble agencé pour recevoir ledit récipient, les moyens moteurs étant montés de façon amovible dans la zone définie par la paroi intérieure dudit récipient.

8. Appareil selon la revendication 6 ou 7, dans lequel ledit support de filament rotatif est facilement démontable desdits moyens moteurs.

9. Appareil selon l'une quelconque des précédentes revendications dans lequel, à l'intérieur de la zone définie par la paroi latérale intérieure, le récipient comprend une cavité définie par un alésage traversant, s'étendant entre la partie supérieure et le fond de la paroi latérale intérieure.

10. Appareil selon l'une quelconque des précédentes revendications, dans lequel le récipient comprend un élément de couvercle amovible en forme d'entonnoir constituant la partie supérieure (5) du récipient et que traverse le matériau en filaments pendant la formation de la bobine.

11. Appareil selon l'une quelconque des précédentes revendications, dans lequel le récipient comprend une partie inférieure (1) formant cavité de stockage et une partie supérieure amovible (5) s'étendant sur la paroi latérale extérieure et définissant la cavité dans laquelle tourne le support de filament.

12. Appareil selon la revendication 11, dans lequel, dans la partie inférieure (1) dudit récipient, la périphérie supérieure de ladite paroi latérale intérieure est sensiblement au niveau de la périphérie supérieure de ladite paroi latérale extérieure.

13. Appareil selon l'une quelconque des précédentes revendications, dans lequel le support de filament rotatif est agencé de manière à répéter la séquence de spires toutes les 100 à 200 révolutions.

14. Appareil selon l'une quelconque des précédentes revendications, dans lequel le récipient comporte une base ouvrante.

15. Appareil selon la revendication 14, dans lequel la base du récipient peut être démontée d'un récipient plein sans vider le récipient auparavant.

16. Un récipient prévu pour être utilisé dans l'appareil de la revendication 1, le récipient ayant une configuration sensiblement annulaire avec une partie supérieure, un fond, une paroi latérale extérieure, une paroi latérale intérieure sensiblement concentrique



et, dans la zone définie par la paroi latérale intérieure, une cavité définie par un alésage traversant s'étendant entre la partie supérieure et le fond de la paroi latérale intérieure, le récipient comprenant une réserve d'élément en fibres optiques disposé en une séquence de spires autour de la paroi latérale intérieure du récipient, les spires étant décalées par rapport aux spires adjacentes et chaque spire ayant une torsion élastique récupérable de 360 degrés.

17. Un récipient selon la revendication 16, dans lequel les spires comprennent une séquence de cercles respectivement excentriques.

18. Un système d'appareils pour l'installation de lignes de transmission à fibres optiques dans une conduite d'installation, le système comprenant: une réserve d'élément à fibres optiques dans un récipient annulaire (1), le récipient comprenant une paroi latérale extérieure, une paroi intérieure sensiblement concentrique à la paroi latérale extérieure et définissant entre les deux une cavité de stockage d'élément en fibres, l'élément en fibres étant déposé en une séquence de spire autour de la paroi latérale intérieure du récipient, les spires étant décalées par rapport aux spires adjacentes et chaque spire ayant une torsion élastique récupérable de 360 degrés et, à proximité dudit récipient, des moyens d'alimentation (15) pour alimenter une extrémité de la bobine de fibres à partir dudit récipient, dans une conduite d'installation (16) et pour avancer ladite extrémité de ladite bobine de fibres à travers ladite conduite par entraînement fluïdique pendant que ledit récipient est maintenu fixe en rotation de manière à compenser ladite torsion récupérable de 360 degrés pendant que l'élément en fibres est avancé dans la conduite d'installation.

19. Un système selon la revendication 18 dans lequel ledit récipient est conforme à la revendication 16.

20. Un système selon la revendication 18 ou 19, comprenant en outre des moyens pour enrouler l'excédent de bobine de fibre sortant d'une extrémité éloignée du côté installation dans un second récipient annulaire (1) comprenant également une partie supérieure (5), un fond, une paroi latérale extérieure et une paroi intérieure sensiblement concentrique, en une séquence de spires, chaque spire ayant une torsion élastique récupérable de 360 degrés et étant décalée par rapport aux spires adjacentes, le second récipient annulaire étant également maintenu non-rotatif pendant l'enroulement de la bobine de fibres dans le second récipient annulaire suivant un trajet hélicoïdal.

21. Un système d'appareils pour l'installation de lignes de transmission à fibres optiques dans une conduite d'installation (16), le système comprenant: des moyens d'alimentation (15) pour alimenter une extrémité d'un élément en fibres optiques dans une conduite d'installation (16) et pour avancer ladite extrémité dudit élément en fibres à travers ladite

conduite par entraînement visqueux d'un gaz propulseur injecté; et un appareil selon la revendication 1 à une extrémité éloignée de ladite conduite, agencé pour recevoir ladite extrémité dudit élément en fibres et pour enrouler ledit élément en fibres dans ledit récipient.

22. Un système selon la revendication 21, comprenant en outre adjacente auxdits moyens d'alimentation (15) une réserve d'élément en fibres optiques dans un récipient annulaire (1), le récipient comprenant une paroi latérale extérieure, une paroi intérieure sensiblement concentrique à la paroi latérale extérieure et définissant entre les deux une capacité de stockage d'élément en fibre, l'élément en fibre étant déposé en une séquence de spires autour de la paroi latérale intérieure du récipient, les spires étant décalées par rapport aux spires adjacentes et chaque spire ayant une torsion élastique récupérable de 360 degrés, l'élément en fibre passant à partir dudit récipient, par l'intermédiaire desdits moyens d'alimentation, dans ladite conduite d'installation (16), le récipient étant maintenu non-rotatif pendant le dévidage l'enlèvement de l'élément en fibre dudit récipient.

23. Un procédé de formation d'une bobine d'élément en fibres optiques conditionnée dans un récipient, le procédé comprenant les étapes:

de mise en place d'une première partie d'un élément en fibres optiques continu dans une cavité de stockage annulaire définie par une paroi intérieure et une paroi extérieure d'un récipient annulaire;

de maintien de l'élément en fibres optiques dans la partie retenant la fibre d'un support de fibre situé dans ledit récipient;

de rotation du support de fibre autour d'un premier axe fixe situé dans la zone définie par ladite paroi intérieure;

de déplacement cyclique de la partie retenant la fibre dudit support de fibre par rapport audit premier axe de manière que l'élément en fibres soit placé progressivement dans le récipient dans une séquence de spires autour de ladite paroi intérieure, chaque spire étant décalée par rapport à la spire précédente et comprenant une torsion élastique récupérable de 360 degrés par spire.

24. Un procédé selon la revendication 23, dans lequel le schéma d'enroulement des fibres est tel que la séquence des spires se répète toutes les 100 à 200 spires.