PATENT SPECIFICATION (11) 1 583 097

1 583 097

(21) Application No. 34358/77 (22) Filed 16 Aug. 1977
(31) Convention Application No. 51/116157 (32) Filed 28 Sept. 1976 in
(33) Japan (JP)
(44) Complete Specification published 21 Jan. 1981
(51) INT. CL.³ C03B 37/16
(52) Index at acceptance
C1M 400 403 PD
D1J BA

(72) Inventors HISAO MINEZAKI
AKIO HANEDA
ASANORI MASAKI
TAKEO HANZAWA
YUKIO UCHIIKE

(19)

(54) METHOD AND APPARATUS FOR WINDING CONTINUOUS GLASS FIBRE STRAND

(71) We, NITTO BOSEKI CO. LTD., a Japanese company, of No. 1, Aza Higashi, Gonome, Fukushima-shi, Fukushima, Japan, 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: —

This invention relates to a strand cutting device for a continuous glass fibre winding apparatus wherein a fully wound spool is rotationally indexed to a standby position and simultaneously replaced by an empty spool, and in which the glass fibre strand bridging the loaded and empty spools is cleanly severed to enable the removal of the loaded spool and its replacement by a new empty spool.

In a conventional continuous strand winding apparatus, a loaded or fully wound spool is moved from the winding position to a standby position and replaced by an empty spool, and the strand length that is thus formed between the end sections of the spools must therefore be cut so that the winding operation may continue on the new or empty spool. In the prior art such strand cutting has been implemented by applying tension to the bridging strand, as by changing the relative rotational speeds of the two spools using a brake on the empty spool, or by applying a cutting edge to the strand. Both methods require an intricate and costly turntable mechanism, however, and are further disadvantageous in that they cause the severed ends of the strand to become markedly fluffed and split.

According to the invention, in a continuous glass fibre strand winding apparatus comprising a turntable, at least a pair of rotatably driven spools mounted on the turntable at winding and standby positions, means for continuously supplying a glass fibre strand to the spool at the winding position for winding thereon, means for rotating the turntable when the spool at the winding position becomes fully loaded thereby to index the loaded spool from, and the empty spool from the standby position to, the winding position, and simultaneously to form a bridge strand between the loaded and empty spools, and means for severing the bridge strand to enable continued winding on the empty spool; the severing means is characterised by a nozzle disposed adjacent the bridge strand and oriented such that a water jet supplied, in use, therefrom laterally strikes the bridge strand in a direction substantially perpendicular to the strand; and means for supplying pressurized water to the nozzle in synchronization with the rotation of the turntable.

The invention also includes a method of continuously winding glass fibre strand utilising at least a pair of rotatably driven spools at winding and standby positions, the method comprising continuously supplying a glass fibre strand to the spool at the winding position for winding thereon; indexing the spools when the spool at the winding position becomes fully loaded thereby to index the loaded spool from, and the empty spool from the standby position to, the winding position, and simultaneously to form a bridge strand between the loaded and empty spool; and severing the bridge strand, to enable continued winding on the empty spool, by causing a water jet to strike the bridge strand in a direction substantially perpendicular to the strand.

According to this invention it is therefore unnecessary to establish a rotational speed difference between the loaded and empty spools, and no strand cutting edge is necessary. The application of a water jet to the length of the strand bridging the two spools produces a sharp cut-off and avoids any lateral fluffing or end splitting

perpendicular to the strand direction. The overall construction of the cutting device is thus relatively simple, and does not in any way interfere with the structure or functioning of the turntable or other indexing mechanism.

In the accompanying drawings: —

Figure 1 shows a plan view of a glass fibre strand cutting and winding apparatus according to this invention, and

Figure 2 shows a perspective view of the apparatus of Figure 1.

Referring to the accompanying drawings, an outer end surface 2 of a turntable 1 is divided into two symmetrical areas or work stations by a separator 3, although three or more such areas could also be provided. Winding spools 4, 5 of the cage bar type are removably mounted on the turntable at each of the respective work areas. The turntable 1 is intermittently rotated 180° by a driven shaft 6 such that when one of the spool mounts is at a strand winding position the other spool mount is at a standby position. Thus, when a spool becomes fully wound at the winding position it is rotated or advanced to the standby position and simultaneously replaced by an empty spool at the winding position. The spools 4 and 5 are each rotated in a clockwise winding direction by respective drive devices 7 and 8.

Reference numeral 9 designates a strand traversing or level wind device, and reference numeral 10 designates a strand guide device that operates to guide the incoming strand 12 onto an end section 13 of the spool 5 when the latter becomes fully wound. At approximately the same time the turntable drive is actuated to rotate the loaded spool 5 to the standby position and simultaneously deliver an awaiting empty spool 4 to the winding position. Such turntable rotation or indexing automatically introduces the strand 12 to the end section 11 of the new spool 4, whereat it forms a bridging strand length 16 spanning the gap between the ends of the spools 4, 5. The end sections 11, 13 comprise reduced diameter portions of the spools.

As in the conventional device, the end surface of the separator 3 is recessed from the end surfaces 14 and 15 of the spools 4 and 5, respectively, so that the strand 12 can be bridged in a straight line between the end sections 11, 13 as the turntable 1 is being rotated. After the strand bridge 16 is severed the loaded spool 5 at the standby position is removed and replaced by an empty or new spool. The cut ends of the strands adhere to their respective spools owing to both the laminar circular air flow established around the peripheral surfaces of the rapidly turning spools and stickiness caused by the lubricants and coating agents applied to the glass fibers during their draw forming.

The strand bridge is cut-off during the continuous winding operation by a water jet 18 from a nozzle 17 disposed perpendicular to the direction of the strand bridge, whereby the water jet impinges on the strand bridge at a right angle.

The nozzle 17 is fixedly secured to the frame of the apparatus by a supply pipe 19 connected to a pressurized water source (not shown). The water supply is actuated by a control device (not shown) in synchronization with the intermittent rotation and stop of the turntable, such that immediately after the turntable becomes at rest, as shown in FIG. 2, he water jet is initiated.

Reference numeral 20 designates an apertured pipe for jetting cleaning water onto the concave sidewalls 21 or 22 of the separator 3. Lubricants, surface coating agents, etc. applied to the glass fibre strand during its draw forming operation are liable to adhere to the sidewalls of the separator during winding, and frequent cleaning is thus required. It is preferable to avoid wetting the strand being wound during the cleaning operation, whereby the pipe 20 is mounted parallel to the separator 3 at the standby position so that the water jets 23 only strike the sidewall 21 thereat.

The mechanism whereby the strand 16 is cleanly severed by the water jet 18 in a perpendicular sectional plane is not fully understood, although it is believed probable that the cutting action derives from the low shear force resistance property of glass fibres.

The cutting of the strand is independent of the tension applied to the strand bridge 16, and is effected as long as the strand bridge is laid in a straight line between the two spools. Thus, the cutting action takes place even though the two spools are rotated at equal speeds. This avoids a drawback of the prior art tension severing method, whereby the empty spool must be braked and thereafter brought up to full winding speed again, which disrupts the smooth continuity of the winding operation.

Various experiments were conducted winding glass fibre strands having weights of 80, 160 and 320 gms./km. under the conditions set forth below.

First, the inside diameter of the nozzle 17 was set at 8 mm, the distance between the end of the nozzle and the strand bridge 16 was 370 mm, and the water jet was allowed to strike the strand bridge under a pressure of 1.5-2.0 kg/cm^2. All of the different size strands were sharply severed in 3-5 seconds by the water jet, and thereafter continued to be wound on the empty spools.

When the inside diameter of the nozzle was reduced to 3 mm the strands could not be cut because of an insufficient quantity of water. When the nozzle diameter was increased to 5 mm cutting could be achieved, but it was necessary precisely to control the direction of the water jet such that it was accurately centered on the strand bridge 16.

In contrast, when the nozzle diameter was increased to more than 10 mm the quantity of water was too great, as a result of which the severed strand was caused to swing and it was impossible to wind it on the empty spool.

At the stated water pressure, the best results were thus obtained with an inside nozzle diameter on the order of 8 mm.

When the distance between the end of the nozzle and the strand bridge was reduced to 250 mm the water jet pressure was too high, whereby the severed strand was caused to swing and it could not be wound on the empty spool. On the other hand, when the distance was set at 450 mm the water jet pressure was too low to achieve efficient strand cutting. Thus, with the given water pressure and nozzle diameter parameters, the most suitable distance between the end of the nozzle and the strand bridge was found to be 300-400 mm.

WHAT WE CLAIM IS:—

1. A continuous glass fibre strand winding apparatus comprising a turntable, at least a pair of rotatably driven spools mounted on the turntable at winding and standby positions, means for continuously supplying a glass fibre strand to the spool at the winding position for winding thereon, means for rotating the turntable when the spool at the winding position becomes fully loaded thereby to index the loaded spool from, and the empty spool from the standby position to, the winding position, and simultaneously to form a bridge strand between the loaded and empty spools, and means for severing the bridge strand to enable continued winding on the empty spool, wherein the severing means is characterised by a nozzle disposed adjacent the bridge strand and oriented such that a water jet supplied, in use, therefrom laterally strikes the bridge strand in a direction substantially perpendicular to the strand; and means for supplying pressurized water to the nozzle in synchronization with the rotation of the turntable.

2. Apparatus according to claim 1, wherein the inside diameter of the nozzle is approximately 8 mm, the water supplied thereto is at a pressure of from 1.5 to 2.0 kg/cm^2, and the distance between the end of the nozzle and the strand bridge is from 300 to 400 mm.

3 Apparatus according to claim 1, substantially as described with reference to the accompanying drawings.

4. A method of continuously winding glass fibre strand utilising at least a pair of rotatably driven spools at winding and standby positions, the method comprising continuously supplying a glass fibre strand to the spool at the winding position for winding thereon; indexing the spools when the spool at the winding position becomes fully loaded thereby to index the loaded spool from, and the empty spool from the standby position to, the winding position, and simultaneously to form a bridge strand between the loaded and empty spools; and severing the bridge strand, to enable continued winding on the empty spool, by causing a water jet to strike the bridge strand in a direction substantially perpendicular to the strand.

5. A method according to claim 4, wherein the jet is produced by supplying water at a pressure of from 1.5 to 2.0 kg/cm^2 to a nozzle having an inside diameter of approximately 8 mm; and the distance between the end of the nozzle and the strand bridge is from 300 to 400 mm.

6. A method according to claim 4, substantially as described with reference to the accompanying drawings.

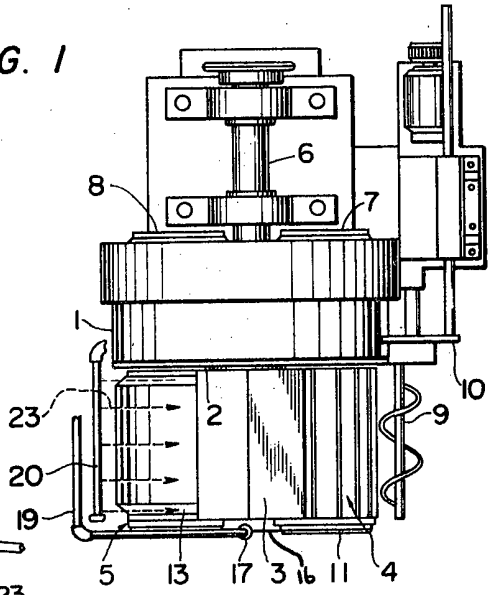
7. A spool which has been wound with a glass fibre strand by a method according to any one of claims 4 to 6.

For the Applicants:
GILL, JENNINGS & EVERY,
Chartered Patent Agents,
53 to 64 Chancery Lane,
London, WC2A 1HN.

Printed for Her Majesty's Stationery Office by The Tweeddale Press Ltd., Berwick-upon-Tweed, 1980.
Published at the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1583097 COMPLETE SPECIFICATION
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

FIG. 1



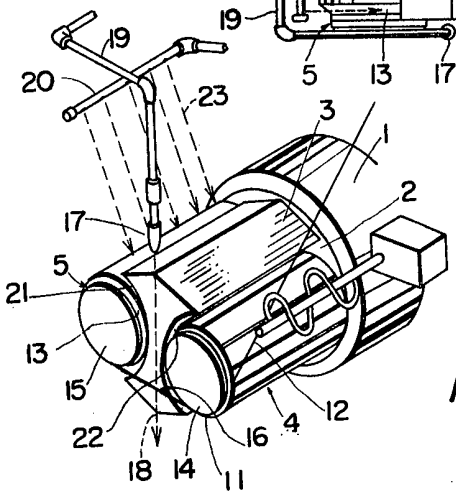


FIG. 2