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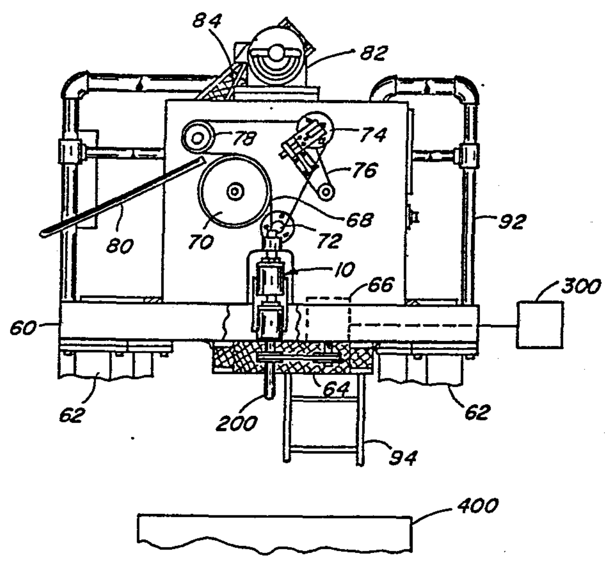
(54) **Strand distributing apparatus and method.**

(57) Method and apparatus are provided for distributing a continuously advancing strand in adjacent coils in a non-rotating surface. The apparatus features electronic speed regulating means for continuously varying the speed of rotation of a piddler tube which advances the strand to the surface. The method comprises electronically varying the speed of rotation of a piddler tube in accordance with a specific curve.



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STRAND DISTRIBUTING APPARATUS AND METHOD

Background of the Invention

Field of the Invention

The present invention relates to method and apparatus for distributing a continuously advancing strand in adjacent coils on a non-rotating surface, and more particularly to distributing a continuously advancing tow of yarn into a stationary tow can in superimposed, coiled layers.

The Prior Art

Piddler mechanisms with deflectors for tow strand collection are known. The tow strand ordinarily is forwarded at constant speed downwardly through a rotating piddler tube (with or without deflector) for collection in a tow can which is also being rotated to achieve a uniform deposit of the tow without fiber entanglement. See for example U.S. Patents 2 971 683 to Paulsen and 3 706 407 to King et al., both of which are hereby incorporated by reference.

Mechanical reliability and thus productivity would be increased by eliminating rotation of the tow can. However, with the tow being delivered at constant speed and the piddler tube being rotated at a constant speed, the tow strand would be laid in the can in successive circular convolutions of identical radius. To overcome this problem, the present invention was developed.

Pertinent prior art is U.S. Patent 3 445 077 to Cole et al., hereby incorporated by reference, wherein continuously advancing strand is distributed by a rotating tube into compact layers of spiral convolutions on a non-rotating receiving platform. The rotating tube is cyclically operated between conditions of non-linear angular acceleration and non-linear angular deceleration by cyclically reversed, non-linear control of a variable speed transmission. The present invention permits elimination of the variable speed transmission(s) and associated mechanical devices to improve mechanical reliability, and this productivity.

Summary of the Invention

The present invention provides a method and apparatus for distributing a continuously advancing strand in adjacent coils on a non-rotating surface.

The apparatus comprises a rotatable piddler tube for advancing a strand to the surface; means for rotating the piddler tube; and electronic speed regulating means for continuously varying the speed of rotation of the piddler tube. It is preferred that the means for rotating the piddler tube comprises a motor which belt drives the piddler tube, and that the electronic speed regulating means be a controller which drives the motor. The piddler tube preferably has a deflector attached thereto for directing the exiting strand to the surface.

The method comprises electronically varying the speed of rotation of a piddler tube, which advances the strand to the surface, in accordance with a curve generated as follows:

$$t_{total} = \sum_{n=1}^{T} t_n = \sum_{n=1}^{T} \frac{\pi d_n}{s} \qquad (I)$$

wherein t_n is the time for one revolution in seconds for a loop diameter d_n, t_{total} is the cumulative time to form a loop of diameter d_n, and s is the constant strand delivery speed; and

$$(RPM)_n = \frac{60}{t_n} \qquad (II)$$

wherein $(RPM)_n$ is the revolutions per minute corresponding to a loop diameter of d_n. The preferred curve is that shown in Figure 1. t is the length of time required to fill the tow can.

The present invention improves mechanical reliability by eliminating the equipment needed for tow can rotation. Fiber density in the tow can is increased due to the tow strand being laid in adjacent coils. Reduced inventories of parts are necessary and an 0.3 percent increase in fiber yield has been realized.

Brief Description of the Drawings

Figure 1 plots revolutions per minute (RPM) of the piddler tube on the vertical axis versus the total time (t_{total}) in seconds on the horizontal axis wherein t_{total} is cumulative time to form a loop of diameter d_n, the maximum loop diameter d_1 being at the left and the minimum loop diameter d_n (d_{22} in Table I) being at the right. The curve depicts formation of one layer of coils which is distributed from maximum diameter to minimum diameter, i.e., during acceleration of piddler tube speed to a maximum. Obviously, tow will be distributed in coils until the tow can is full. The curve of Figure 1 therefore for the second coiled layer would be the mirror image of the curve shown in Figure 1, with the coil being formed with increasing diameters rather than decreasing diameters. Figure 2 shows a piddler mechanism 10 as installed on a piddler stand.

Description of the Preferred Embodiment

It is to be understood that only enough of the piddling device has been shown in the drawing to enable those skilled in the art to understand and appreciate the underlying concept of the strand distributing method and apparatus comprising the present invention. For more detail on the piddlng mechanism, reference may be had to U.S. Patent 3 706 407 to King et al., incorporated by reference above, more specifically to Figures 3 and 9 and accompanying discussion. Figure 2 of the present invention is very similar to Figure 3 of King et al.; the drive mechanism for roll 78 is believed to differ slightly from that depicted, i.e., roll 78 is directly driven by motor 82. Also, the deflector of Figure 9 in King et al.

is attached to piddler mechanism 10 in the present invention.

Piddler mechanism 10 is vertically disposed on a superstructure 60 supported on legs 62 at a sufficient elevation to allow positioning of a non-rotating surface 400, such as the bottom of a tow can, below to receive the piddler delivery. A belt connection 64 is extended from the piddler tube pulley to a motor 66 carried by the superstructure 60 for rotating the piddler tube. Motor 66 is a DC drive motor driven by a DC drive controller (Louis Allis Type 3151 Model #73104J-100000). Rotational speed for the piddler tube is constant; when the tow can is no longer rotated, the tow strand will then be laid in successive circular convolutions of identical radius, which is unacceptable.

To achieve an acceptable deposit or lay of fiber tow into cylindrical tow can 400 a speed controller 300 (Figure 2) with electrical circuitry in accordance with a control curve is necessary. As the deflector 200 speed increases, the diameter of the loop of tow strand decreases; conversely, as the deflector 200 speed decreases, the diameter of the loop of fiber increases. The tow strand continues to travel at constant speed, which will be determined based on the denier of the tow being processed. The means for rotating the piddler tube comprises motor 66 which belt drives (64) the piddler tube with accompanying deflector 200. The electronic speed regulating means is a solid state electronic controller 300 (Model 6504-S3495 available from Seco Electronics) which drives motor 66.

The circuitry of controller 300 was developed in accordance with a curve generated as follows:

$$t_{total} = \sum_{n=1}^{T} t_n = \sum_{n=1}^{T} \frac{\pi d_n}{s} \qquad (I)$$

t_n is the time for one revolution in seconds for a loop diameter d_n, t_{total} is the cumulative time to form loops of diameter(s) d_n, and s is the constant strand delivery speed.

$$(RPM)_n = \frac{60}{t_n} \qquad \text{(II)}$$

$(RPM)_n$ is the revolutions per minute of the piddler tube corresponding to a loop diameter of d_n. Using formulas I and II above, and given that s is 33 feet (10 m) per second, d_n varies from a maximum diameter of 48 inches (1.2 m) to a minimum diameter of 6 inches (0.15 m), and the tow has a width of one inch (0.025 m), the tow has a total denier range of 140 000 to 400 000 (50 denier per end). Table I shows calculation of t_{total} and $(RPM)_n$ for plotting the curve of Figure 1.

TABLE I

n	d_n (inches)/(m)	$(RPM)_n$	t_{total} (seconds)	
1	48/1.2	157.6	.381	t_1
2	46/1.2	164.4	.746	$t_1 + t_2$
3	44/1.1	171.9	1.095	$t_1 + t_2 + t_3$
4	42/1.1	180.1	1.428	" $+ t_4$
5	40/1.0	189.1	1.745	" $+ t_5$
6	38/1.0	199.0	2.047	" $+ t_6$
7	36/0.91	210.1	2.332	" $+ t_7$
8	34/0.86	222.4	2.602	" $+ t_8$
9	32/0.81	236.3	2.856	" $+ t_9$
10	30/0.76	252.1	3.094	" $+ t_{10}$
11	28/0.71	270.1	3.316	" $+ t_{11}$
12	26/0.66	290.9	3.522	" $+ t_{12}$
13	24/0.61	315.1	3.713	" $+ t_{13}$
14	22/0.56	343.8	3.887	" $+ t_{14}$
15	20/0.51	378.2	4.046	" $+ t_{15}$
16	18/0.46	420.2	4.189	" $+ t_{16}$
17	16/0.41	472.7	4.316	" $+ t_{17}$
18	14/0.36	540.2	4.427	" $+ t_{18}$
19	12/0.30	630.3	4.522	" $+ t_{19}$
20	10/0.25	756.3	4.601	" $+ t_{20}$
21	8/0.20	945.4	4.665	" $+ t_{21}$
22	6/0.15	1260.5	4.712	" $+ t_{22}$

I CLAIM:

1. Apparatus for distributing a continuously advancing strand in adjacent coils on a non-rotating surface, comprising:

a rotatable piddler tube for advancing a strand to the surface;

means for rotating said piddler tube; and

electronic speed regulating means for continuously varying the speed of rotation of said piddler tube.

2. The apparatus of claim 1 wherein the means for rotating the piddler tube comprises a motor which belt drives said piddler tube, and wherein the electronic speed regulating means is a controller which drives said motor.

3. The apparatus of claim 2 wherein said piddler tube has a deflector attached thereto for directing the exiting strand to the surface.

4. Method for distributing a continuously advancing strand in adjacent coils on a non-rotating surface, comprising electronically varying the speed of rotation of a piddler tube, which advances the strand to the surface, in accordance with a curve generated as follows:

$$t_{total} = \sum_{n=1}^{T} t_n = \sum_{n=1}^{T} d_n \frac{\pi d_n}{s} \qquad (I)$$

wherein t_n is the time for one revolution in seconds for a loop diameter d_n, t_{total} is the cumulative time to form a loop of diameter d_n, and s is the constant strand delivery speed; and

$$(RPM)_n = \frac{60}{t_n} \qquad (II)$$

wherein $(RPM)_n$ is the revolutions per minute corresponding to a loop diameter of d_n.

5. The method of claim 4 wherein the curve is that of Figure 1.

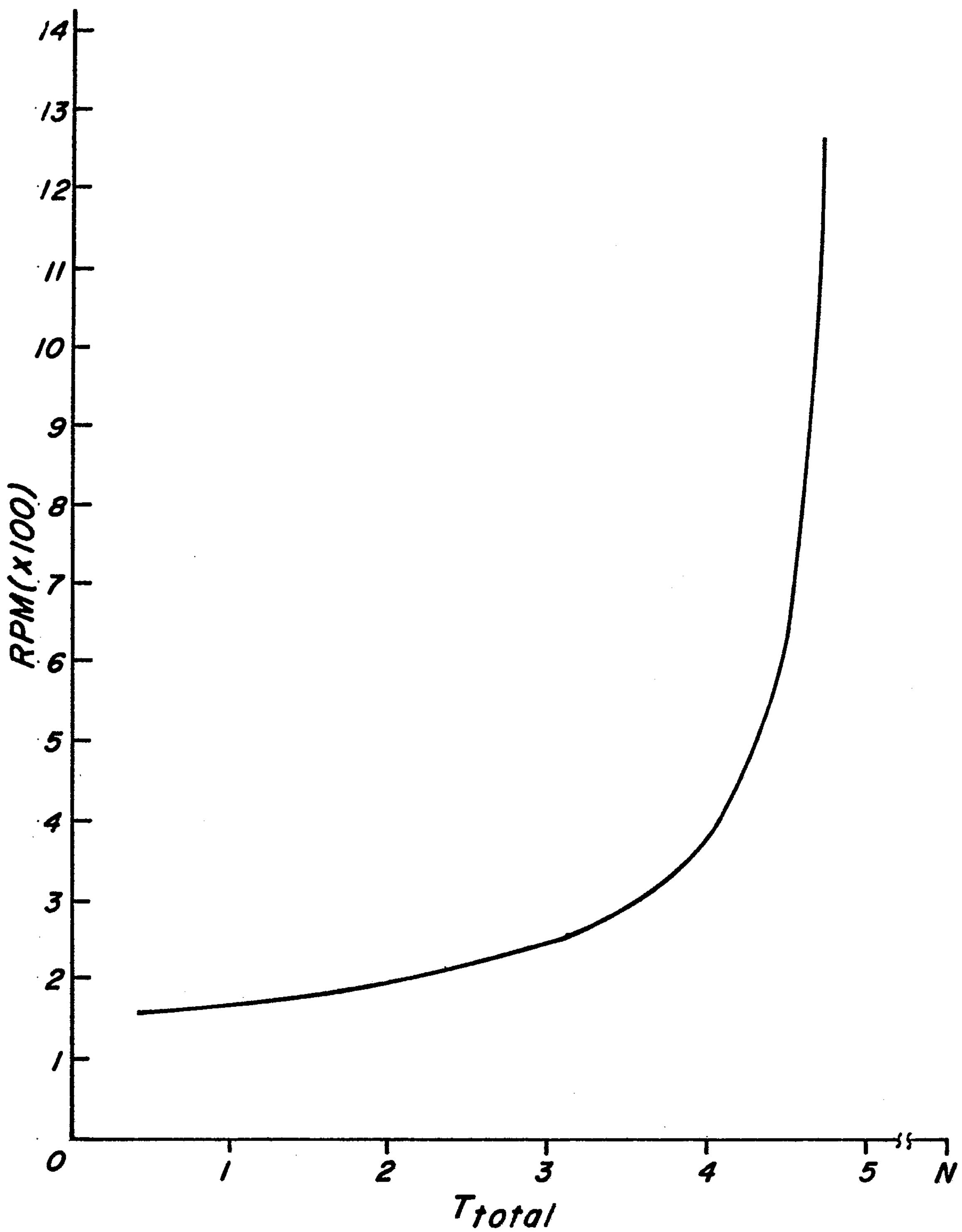

FIG. 1

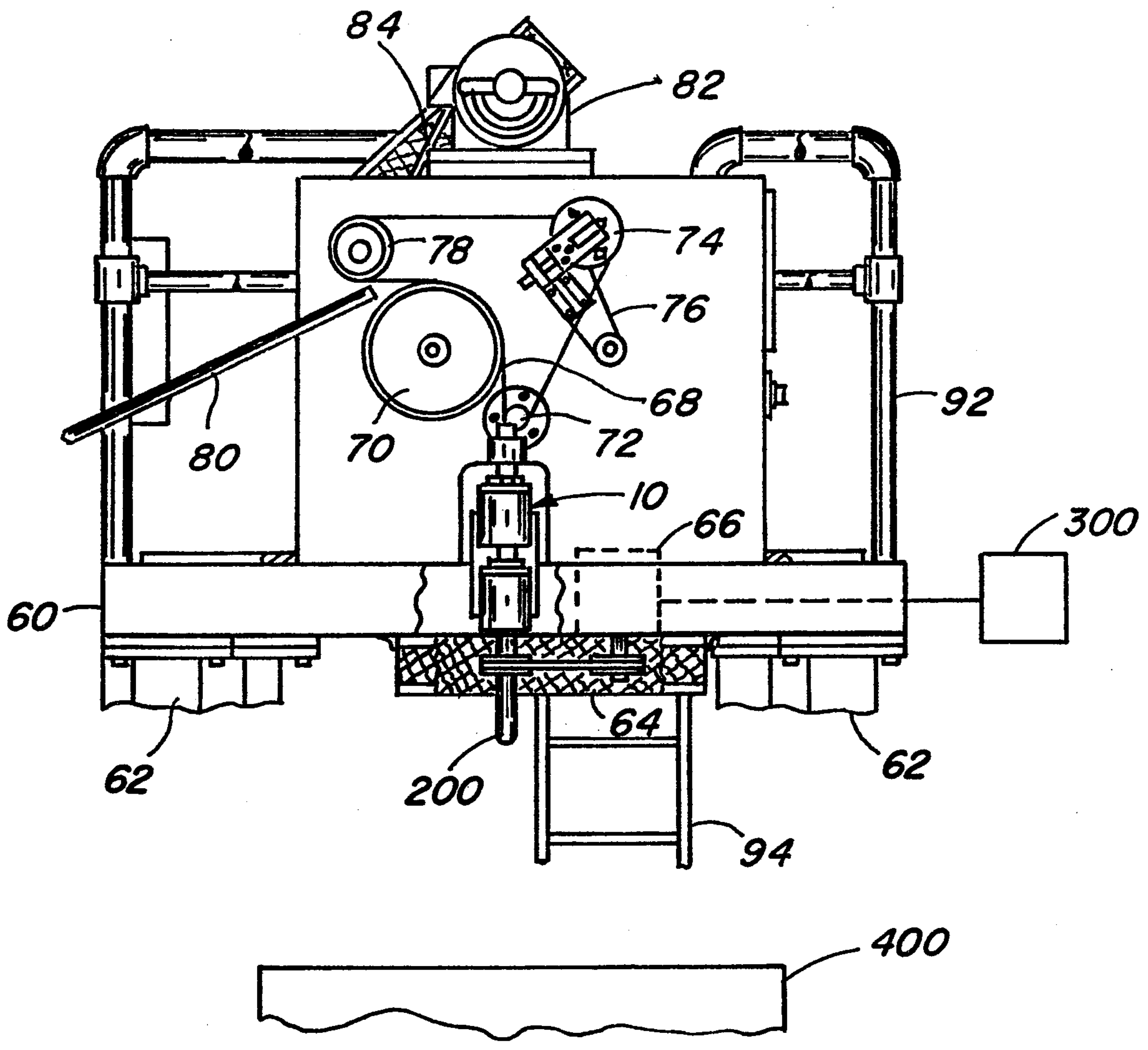

FIG. 2

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EUROPEAN SEARCH REPORT

0123839

Application number

EP 84102663.6

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
D,A	US - A - 3 706 407 (KING et al.) * Fig. 2 * --	1,2,3	B 65 H 54/80
D,A	US - A - 3 445 077 (J.I. COLE et al.) * Fig. 2 * --	1,2,3	
A	DE - A1 - 2 433 535 (FRISCH KABEL- UND VERSEILMASCHINENBAU GMBH) * Fig. 1,2 * --	1,2,3	
A	DE - A1 - 2 417 206 (KABEL- UND METALLWERKE GUTEHOFFNUNGSHÜTTE KABELWERK BERLIN GMBH) * Fig. * ----	1,2,3	TECHNICAL FIELDS SEARCHED (Int. Cl. 3) B 65 H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	12-06-1984	NETZER

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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