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METHOD AND APPARATUS FOR HANDLING FILAMENTS

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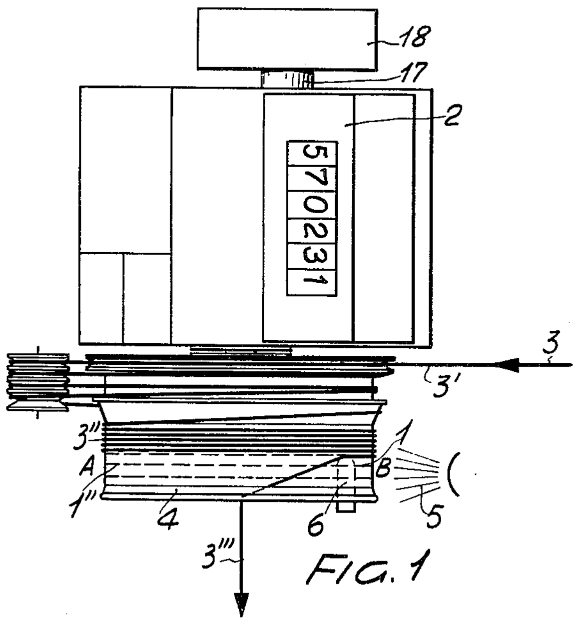

FIG. 1

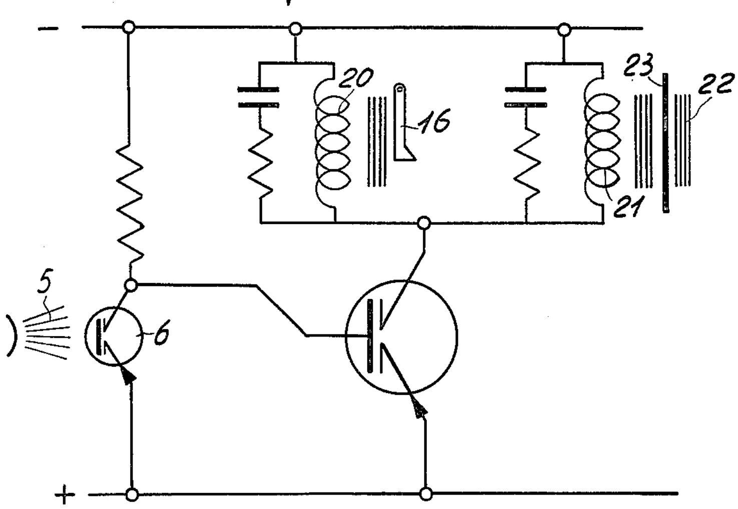

FIG. 3

INVENTORS
ALBERTO GUSTAVO SARFATI
GIUSEPPE VISCHIANI
BY Irwin S. Thompson
ATTORNEY

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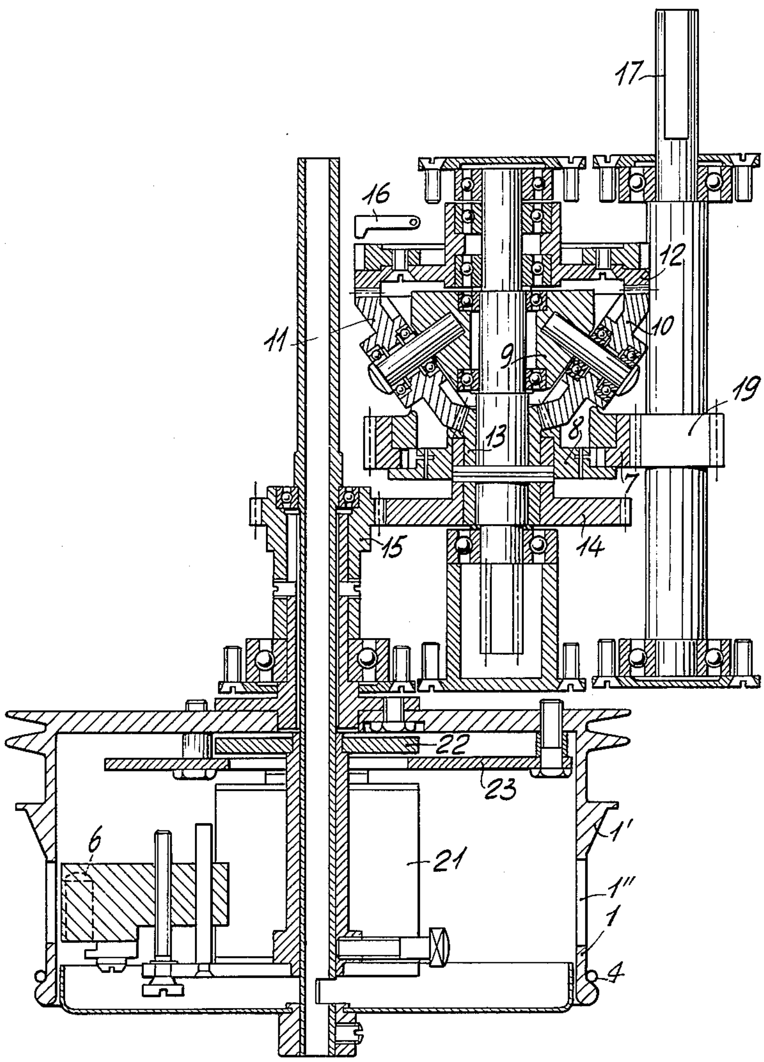

FIG. 2

INVENTORS
ALBERTO GUSTAVO SARFATI
GIUSEPPE VISCHIANI
By Irwin S. Thompson
ATTY.

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METHOD AND APPARATUS FOR HANDLING FILAMENTS

Alberto Gustavo Sarfati and Giuseppe Vischiani, Busto Arsizio, Italy, assignors to Sobrevin Soc. de Brevets Industriels Etablissement

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9 Claims. (Cl. 33—125)

In the textile industry it is, of course, very difficult to measure the length of a filament accurately or to adjust the tension thereof at the output as it is being unwound from one device and being wound onto some other device such as reels, bobbins, cheeses or the like, more particularly at very high speeds and with the abrupt accelerations which are inevitable when the filament is wound onto bobbins which are in shape conical or at least other than cylindrical. The accuracy of the known measuring devices is unsatisfactory; they may give an error of as much as 7%, a figure which is excessive when an accurate estimation of the length of large quantities of filaments is required. This calculation has previously been made only approximately on the basis of the mean count of the filament (weight per unit of length).

In their turn the devices for the adjustment of the tension of a filament do only partially fulfil the requirements and they sometimes cause considerable inconveniences.

It is well known that, when a thread or filament is unwound from a feed member especially in the case of particularly elastic filaments such as "nylon," "Helanca," "Lastex" and so on there arise strong variations of tensions which are due to the form of the feed member as well as to volume-variation thereof during the unwinding operation, said variations being possibly innate within the filament itself and having their origin for instance during the original winding of the filament on the member.

Said variations of tensions cause considerable defects in the textiles and therefore, because of the many discarded and sub-choice products they mean a lot of trouble for the manufacturers.

A device according to this invention serves to solve both these problems and to obviate all the above mentioned disadvantages. As a measuring device it serves to execute high precision measurements under all conditions of unwinding of the filament being measured i.e. even at very high speeds and with abrupt and very frequent accelerations.

In the device according to the invention, a member is rotated by an independent drive—i.e., is not driven by the filament—at a mean tangential speed corresponding to the speed of the filament and whenever said device is used as a measuring device, said member is connected to a revolution counter or the like which measures filament length indirectly on the basis of the revolutions performed by the rotating member; and a stock of filament accumulates in a number of convolutions on the rotating member, the filament being supplied to the rotating member substantially tangentially (sideways), and departing from the rotating member substantially axially thereof (over end); and automatic means are provided to prevent the stock of filament which accumulates on the rotating member from exceeding a desired mean limit. In a preferred but non-limitative embodiment, the independently driven rotating member takes the form of a pulley rotated by mechanisms which maintain the peripherical velocity of the pulley greater than the mean speed of the filament until the complete stock of filament has been formed on the rotating member or pulley, whereafter the said automatic means operate to interrupt the rotation of the rotating member and simultaneously to brake the same to inhibit the accumulation of an excessive stock of filament.

2

The filament which leaves the pulley over end runs below a preferably resilient ring which maintains the filament in engagement with the side surface of the pulley, to control the unwinding of the filament.

The pulley has at least one transparent part in the zone corresponding to the required limit for the stock of filament, so that a beam of light can pass through the transparent part and act on a photoelectric cell or a phototransistor to operate means for accelerating or decelerating the pulley when the stock of filament accumulated thereon tends to decrease or increase respectively.

Preferably, the mechanisms for accelerating and decelerating the pulley comprise a multiple-ratio differential.

For a better understanding of the invention, the accompanying drawings illustrate the aforesad preferred non-limitative embodiment of the device according to the invention.

In the drawings:

FIG. 1 is a plan view, in very diagrammatic form, of the device according to the invention;

FIG. 2 is an axial section through a practical construction, and

FIG. 3 illustrates an electronic circuit for automatic control of the maximum limit for the stock of filament on the pulley.

Referring to FIGS. 1 and 2, the device comprises a rotating member 1 formed by a pulley having a cylindrical part 1'' connected to a conical part 1' as shown in FIG. 2. The pulley 1 is independently driven—i.e., it is not driven by the filament 3. The same arrives in the tangential direction indicated by an arrow in FIG. 1—i.e., sideways—and accumulates in a number of turns or convolutions 3'' on the surface of the pulley 1, then departs therefrom axially as indicated by arrow 3'''—i.e., over end. The pulley 1 is rigidly secured to a revolution counter 2 which provides an indirect measurement of the length of incoming filament when the device is to be used as a measuring device.

Automatic means which will be described hereinafter ensure that the stock 3'' of filament which accumulates on the surface of the pulley 1 cannot exceed a limit denoted by chain line A–B. Accordingly, either the whole pulley 1 or at least a portion 1'' thereof is made of a transparent substance through which passes a light beam 5 from a lamp so placed that the beam 5 is incident on a photo electric cell or phototransistor 6 forming part of an electric circuit shown in FIG. 3. The weak photoelectric current, after appropriate amplification by the transistor, is operative on electromagnetic elements controlling the mechanical elements shown in FIG. 2, to reduce the speed of the pulley 1 when the limit A–B is about to be exceeded and to increase the speed of the pulley 1 when the limit A–B has not yet been reached. The conical part 1' of the pulley helps to push the stock of filament towards the transparent cylindrical part.

The devices illustrated in FIG. 2 which will now be described are for accelerating or decelerating the pulley 1 from its mean speed. Since the filament 3 is present on the pulley in a number of turns to form the stock 3'', the device serves to accumulate a mean discrete length of filament (corresponding to the sum of the lengths of all the turns forming the stock 3'') independently of any accelerations, however frequent, of the filament. To maintain the unwinding filament in engagement with the periphery of the pulley 1, a resilient ring or brake means 4 is provided below which the filament passes, the same remaining in engagement with the pulley side surface as far as the end flange thereof. This helps to control unwinding.

It will be apparent from the foregoing that whenever the device is used as a measuring device the filament length can be measured very accurately, since the filament is not slowed down or pulled because of inertia of the masses accompanying the filament in its movement (masses of the pulley **1** and of all the mechanisms associated therewith).

The mechanisms comprising the multiple-ratio differential are illustrated in FIG. 2 and operate as follows:

The movement of the pulley **1** is transmitted thereto by a drive shaft **17** by means of the system formed by a gear **19** which transmits the motion to a gear **7**; the same, through a free wheel **8**, transmits the motion to the group of satellites **9–11** of the differential. The same has a small planet gear **13**. A large planet gear **12** can be selectively locked by means of a pawl **16** operated by an electromagnet **20** (FIG. 3). The small planet gear **13** is rigidly secured to a cylindrical gear **14** (FIG. 2) which transmits the motion through the gear **15** to the pulley **1** on which the filament **3** winds. Inside the pulley **1** is an electromagnetic brake comprising windings **21**, an armature **22** and a rotating disc **23** made of copper or some other conductive substance. As previously stated, the pulley **1** has the transparent portion **1″**, and a phototransistor **6** is placed inside the pulley **1** in registration with the part **1″**, and the associated lamp **5** is placed outside the pulley **1** in registration with the part **1″**.

Through the agency of the electronic circuit under the control of the phototransistor **6**, the windings of the electromagnets controlling the pawl **16** and the brake **21** pick up when the phototransistor is not illuminated, and drop when the phototransistor is illuminated. As will be apparent, as the pulley **1** rotates, the filament **3** is received thereon in the form of parallel and contiguous turns, and when the turns start to cover the transparent part **1″** of the pulley, the light reaching the phototransistor **6** is interrupted or reduced. Through the agency of the electronic circuit shown in FIG. 3, current is supplied either to winding **20**, which disengages the pawl **16** for the large planet wheel **12**, or to the winding **21**, which controls the electromagnetic brake operative on the pulley. Disengagement of the pawl **16** allows the large planet wheel **12** to rotate, with the result that the small planet wheel **13** which transmits the movement to the pulley **1**, slows down abruptly; the deceleration is assisted by the fact that there is a step-up ratio between the large planet wheel **12** and the small planet wheel **13**. This deceleration is further assisted by the retarding action of the electromagnet **21**, and the pulley **1** slows down to stop completely after a few revolutions. If at this time the filament **3‴** which is maintained in engagement with the edge of the pulley **1** by the resilient ring **4** is being unwound over end, as shown in FIG. 1, the turns **3″** disposed on the pulley **1** will gradually unwind until they cease to interrupt the light and the phototransistor is illuminated again. The electronic circuit so acts that the pawl **16** can stop the movement of the large planet wheel **12** while the electromagnetic brake **21–23** becomes deenergised. The pulley **1** restarts until the accumulation of filament **3″** on the pulley interrupts the light again, whereafter the cycle just described is repeated.

If the peripheral speed of the pulley **1** is arranged to be slightly greater than the mean linear reference speed of the filament, the electronic control cycle operates at intervals. If an appropriately arranged revolution counter **2** (FIG. 1) denotes the number of revolutions of the pulley **1**, an indirect indication is thereby provided of the length in metres of the filament delivered by the pulley **1**. Preferably, the revolution counter is of the presetable kind and can be associated with shears or some other means for cutting the filament to the required length; alternatively, the revolution counter can operate on the driving machine or on the control elements thereof to change the operations.

The above mentioned device is very well suited to adjust the tension of the filament coming from **3** and winding at **3″** in a considerable number of turns on the member **1** to equalize the tension thereof.

At the moment of its over end unwinding in **3‴** the filament behaves as if it were unwinding from a member which always has the same diameter and precisely always at the same braking conditions due to the elastic ring **4** and always at the same conditions of tangential friction on the smooth edge of member **1**. It is thus possible to have a filament enter sideways in **3′** at a braking condition varying between 80 and 150 g. and come out over end in **3‴** at a constant braking condition of 8 g.

If the device is only used for adjusting the tension of a filament, same need not be provided with a revolution counter. If, on the contrary, it should be used both for the adjustment of the filament and for the measuring thereof then it should obviously be provided with such a revolution counter.

The device of the invention may therefore be used at pleasure for "measuring" a filament, for "adjusting" the tension of the filament or for both these purposes.

The thread filament, or filament twist may be of any possible kind and is therefore not limited to be used in the textile industry. Also the various parts of the device illustrated can vary within the limits of the particulars given in the claims, without departing from the scope of the invention.

What is claimed is:

1. A method of handling a filament of indeterminate length, comprising winding the filament on a drum from a direction substantially tangential to the drum at a first linear velocity of the filament to form a single layer of turns of filament on the drum, advancing said layer by pressure of the last turn of the layer, simultaneously withdrawing said filament from the drum in a direction substantially endwise of the drum at a second velocity of the filament which is substantially different from said first velocity, and exerting on said filament as it leaves the drum a retarding force that maintains the withdrawn filament at constant tension.

2. A method as claimed in claim **1**, said first velocity being variable and said second velocity being substantially constant.

3. A method as claimed in claim **2**, and rotating the drum at an angular velocity that varies as said first velocity.

4. Apparatus for handling a filament of indeterminate length, comprising a drum, means for rotating the drum, means for feeding a filament onto the drum from a first direction substantially tangential to the drum, means for unwinding the filament from the drum in a direction substantially endwise of the drum, means for accelerating and decelerating the rotation of the drum, and means for exerting on said filament as it leaves the drum a retarding force that maintains constant the tension in the unwinding filament regardless of the speed of rotation of the drum.

5. Apparatus as claimed in claim **4**, said last-named means comprising brake means carried by and rotatable with the drum.

6. A method of handling a filament of indeterminate length, comprising winding the filament on a drum from a direction substantially tangential to the drum at a first linear velocity of the filament, simultaneously unwinding the filament from the drum in a direction substantially endwise of the drum at a second linear velocity of the filament which is substantially different from said first velocity, maintaining a plurality of turns of said filament on the drum, and decreasing said first velocity when said number reaches a predetermined maximum and increasing said first velocity when said number falls below a predetermined minimum.

7. A method as claimed in claim **6**, and counting the revolutions of the drum thereby to indicate the length of filament handled.

8. Apparatus for handling a filament of indeterminate length, comprising a drum, means for rotating the drum, means for feeding a filament onto the drum from a first direction substantially tangential to the drum, means for unwinding the filament from the drum in a direction substantially endwise of the drum, means for varying the speed of rotation of the drum thereby to permit winding of the filament on the drum at a linear velocity different from the linear velocity of unwinding of the filament from the drum, and means responsive to the number of turns of filament on the drum to vary the speed of rotation of the drum to maintain said number near a constant value.

9. Apparatus as claimed in claim 8, the last-named means including photoelectric means for sensing said number of turns.

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ISAAC LISANN, *Primary Examiner.*