

[54] YARN CONTROL DEVICE

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[63] Continuation-in-part of Ser. No. 734,956, June 6, 1968, abandoned.

[30] **Foreign Application Priority Data**

Oct. 20, 1967 Sweden.....14374/67

[52] **U.S. Cl.**.....**242/47.01**[51] **Int. Cl.**.....**B65h 51/02**[58] **Field of Search**.....242/36, 37, 39, 47.01, 47.08, 242/47.12, 47.13; 66/132; 139/122; 57/78, 80, 81, 83[56] **References Cited****UNITED STATES PATENTS**

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[57]

ABSTRACT

A yarn feeder having a slotted spool body on which yarn is wound for forming a yarn reserve. Winding means associated with the spool body selectively permits further windings of yarn to be wound onto said spool body. The yarn feeder includes sensing means associated with the yarn reserve and the slots for causing further yarn windings to be wound on the spool body whenever the yarn reserve falls below a predetermined minimum size. The sensing means includes a nozzle disposed adjacent the spool body for directing an air stream through the slots, which slots are partially covered by the windings of the yarn reserve so that the magnitude of the air stream passing through the slots is related to the number of windings contained in the yarn reserve. The sensing means also includes a device disposed adjacent the other end of the slots and responsive to the magnitude of the air stream flowing through the slots for controlling the winding means. The responsive device, in the disclosed embodiment, includes an operating member responsive to the air stream and connected to a switch for controlling the operation thereof, which in turn controls the relative rotation between the spool body and the winding means.

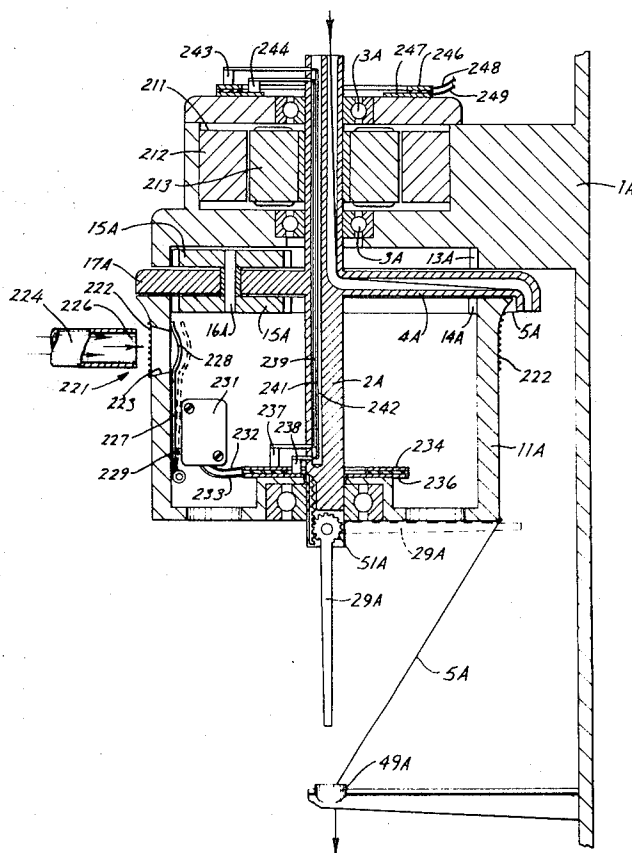
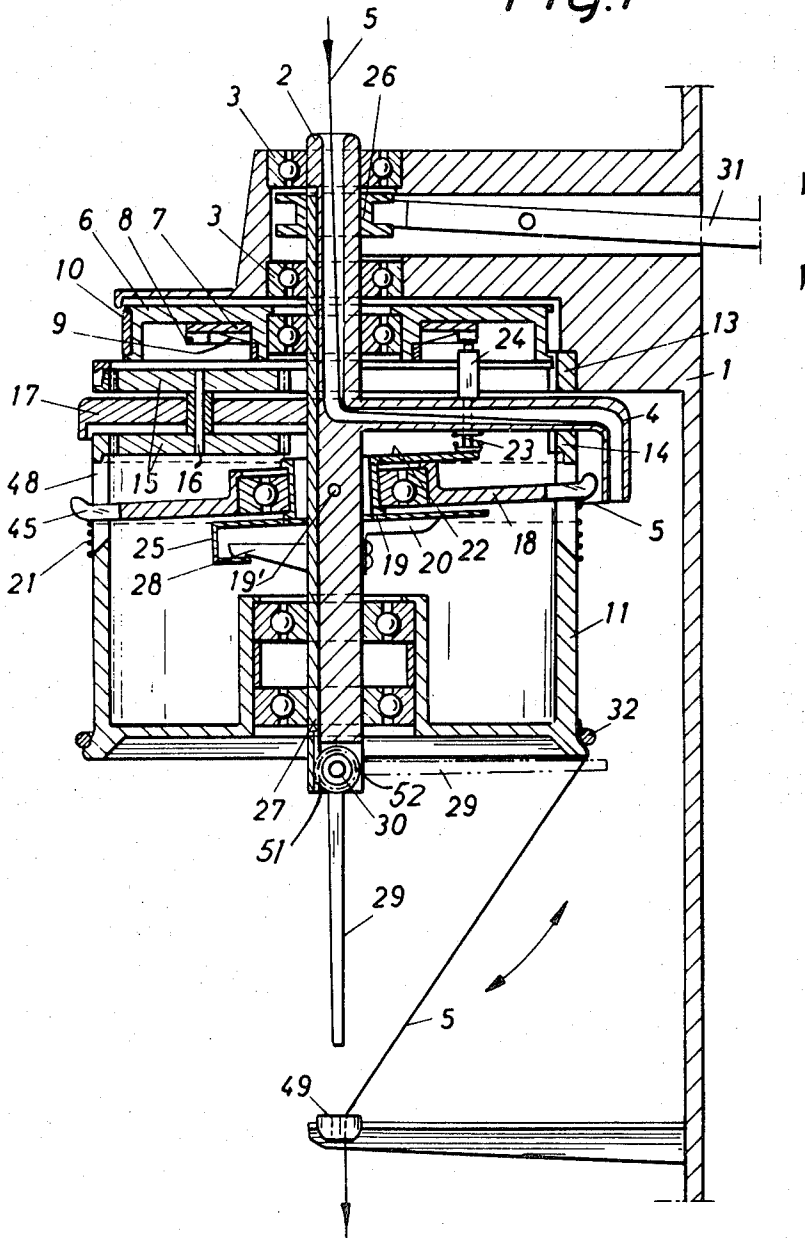
9 Claims, 7 Drawing Figures

Fig.1



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Fig. 2

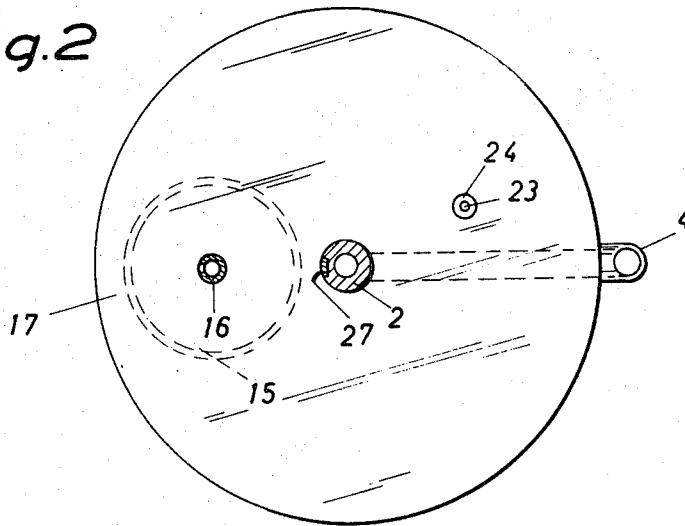
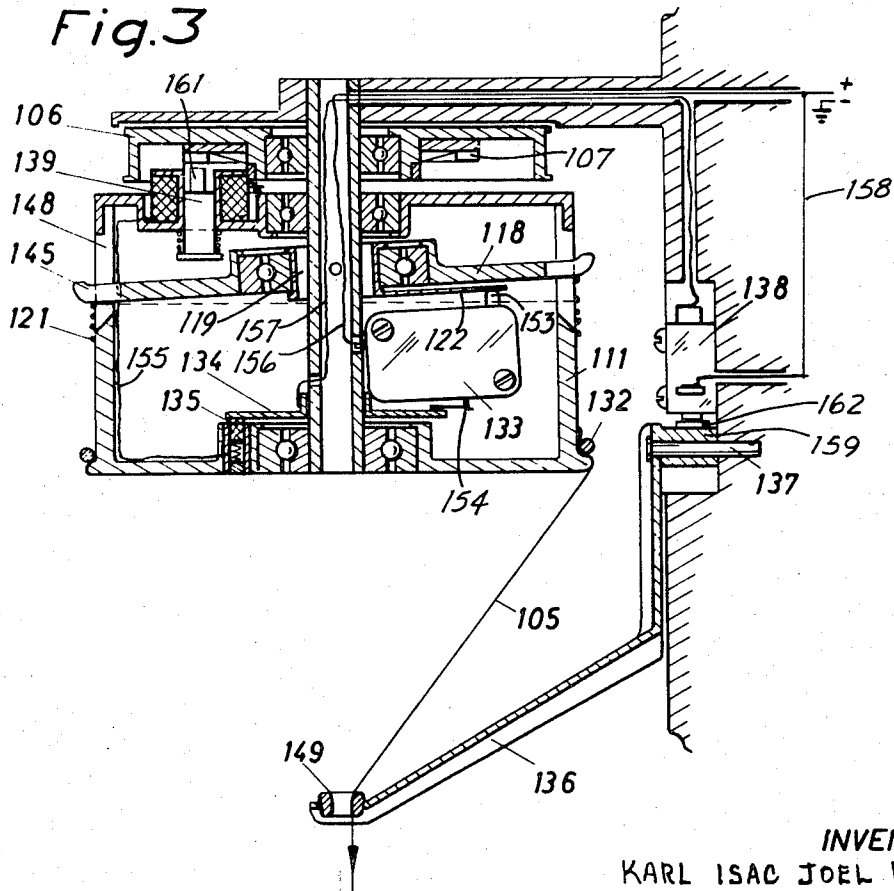


Fig. 3



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Fig. 5

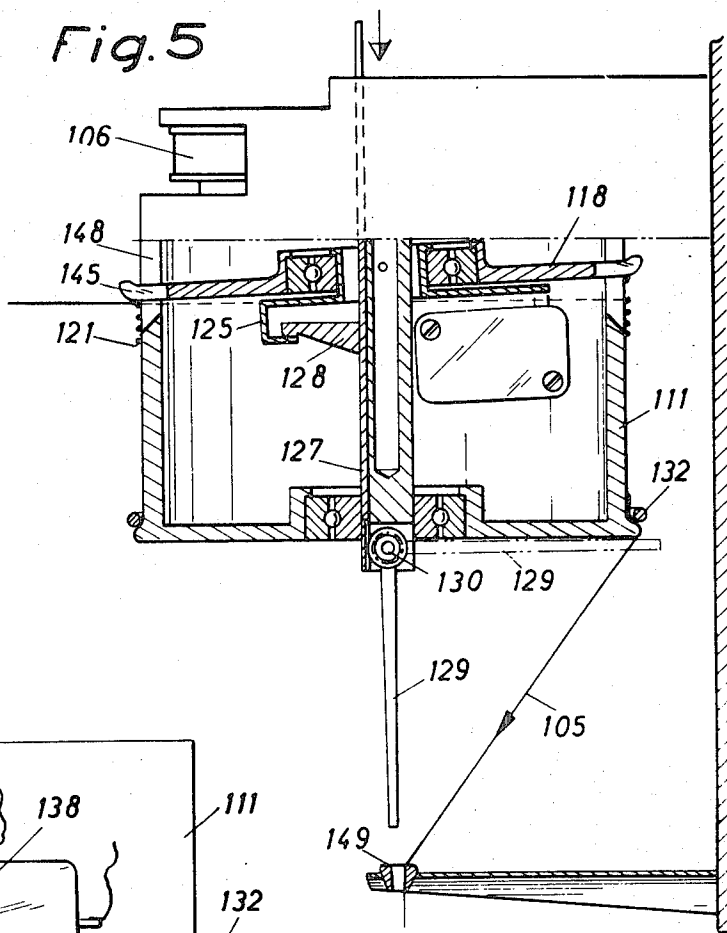
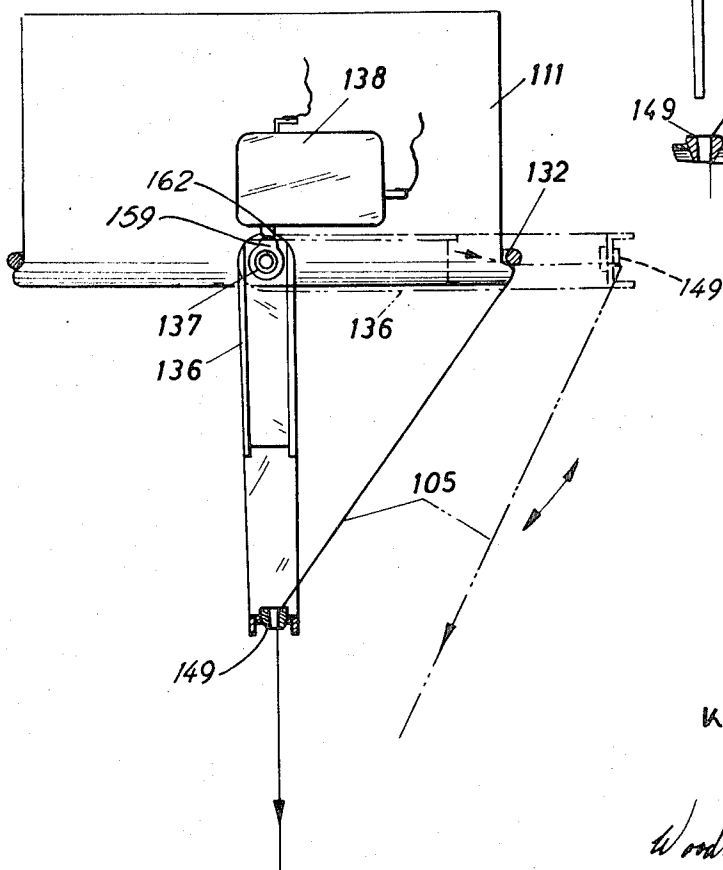


Fig. 4



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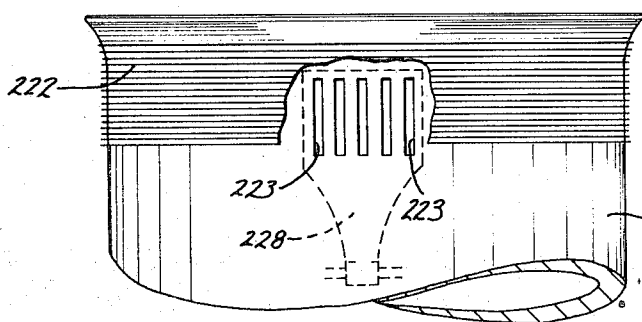
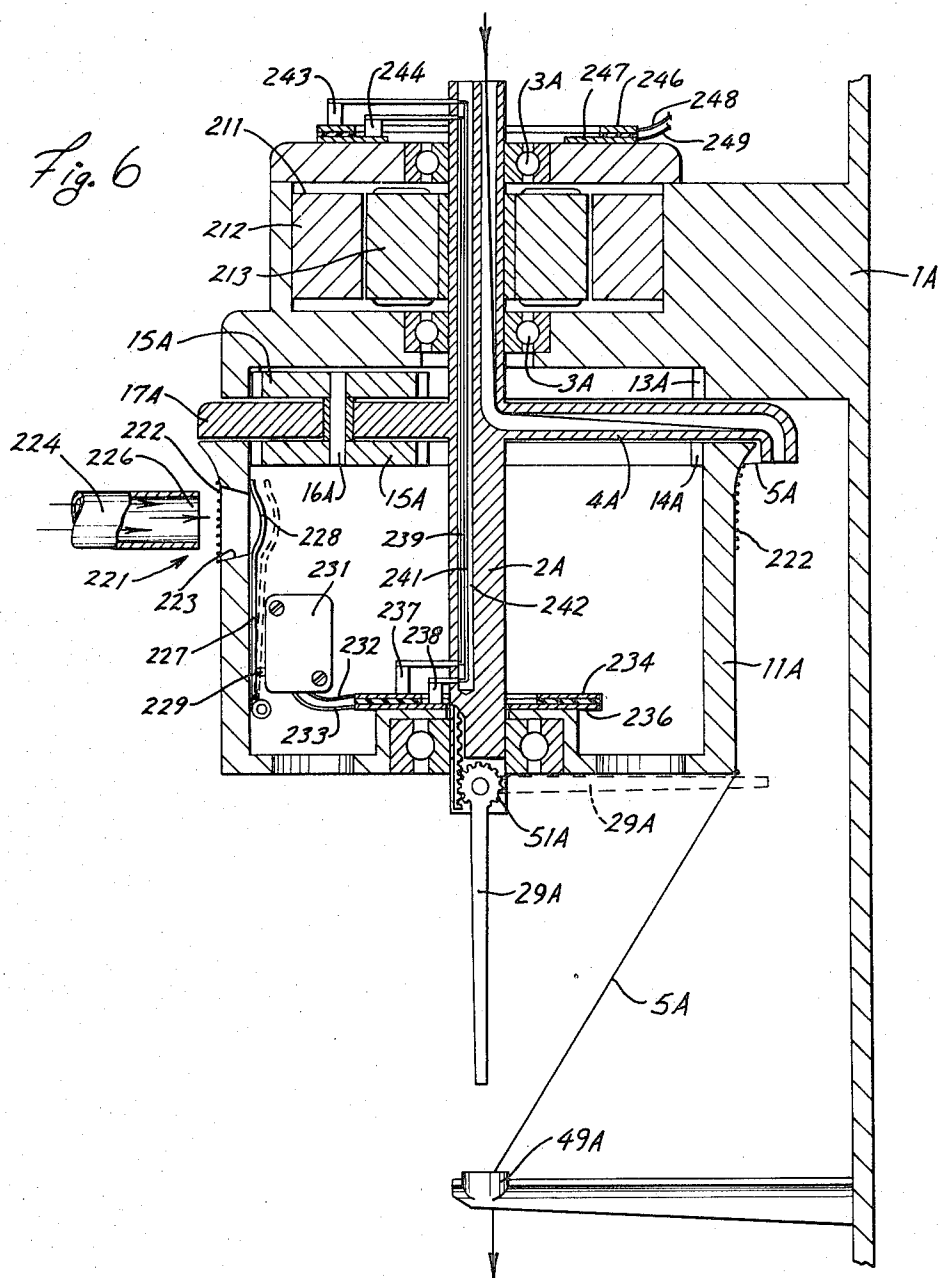


Fig. 7

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YARN CONTROL DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of my copending application Ser. No. 734-956, filed June 6, 1968, now abandoned and entitled "A Yarn Control Device".

FIELD OF THE INVENTION

This invention relates to an improved yarn feeding unit, particularly a unit having an improved yarn reserve sensing means, for supplying yarn to a textile machine.

BACKGROUND OF THE INVENTION

In the operation of a yarn feeding unit having a feed control device, or "feeder", for a textile machine, it is known to operate same in a manner termed "continuous" or "positive" which means that the yarn is fed onto, and withdrawn from, the feed control device at the same rate, such rate being normally but not necessarily constant at a predetermined value. It is also known to operate a textile machine in a manner termed "intermittent" which means that although the rate of feed to, and rate of withdrawal from, the feed control device will average the same over the operation of the machine, such rates are wholly independent of each other as of any given moment or over short increments of time. In previous practice, yarn feeding devices of each type have been known and machines have been known for operation selectively in either of one or the other mode. It is a major purpose of this invention to provide a yarn feed control device which in a simple manner can be converted from one to the other mode of operation and thereby lend corresponding flexibility to a textile machine equipped therewith and otherwise capable of both modes of operation, or to provide a single easily convertible feed control device for a group of textile machines of both types.

It is known to wind yarn on a cylindrical body perpendicularly to the shaft through the body and at the same time to withdraw the yarn in axial direction, the size of the yarn layer being thereby sensed by photoelectric devices. Such a device is particularly suitable to be used in jacquard machines or machines with intermittent yarn feeding. However, on most jacquard machines there is knitted a smooth product which normally makes highly desirable the provision of a positive yarn feeding. The present invention makes it possible to combine these two feeding types and by the invention there are obtained considerably cheaper devices for the sensing of the just wound yarn reserve on the spool body.

A storing feeder may, of course, be driven centrally by means of a tape of the same kind as the one used on common tape feeders or any other type of driving belt or chain. If the yarn is not withdrawn in an axial direction from the spool body of the feeder but is unwound in the same direction as it is wound on the body, the yarn will be fed without sliding over the cylindrical body for the reason that the yarn is formed in windings on the same. It is thus ensured that an absolutely positive and sliding-less yarn feeding is obtained. For special bindings, one needs of course two or more tapes

each driving the cylindrical bodies at different speeds. In such a way the feeders may be divided into groups each having its special yarn need.

Feeders are already available in the market in which the yarn manually is arranged in several windings about two spool bodies one beside the other, one body having for its object to separate the yarn windings by means of grooves in the body. However, all of them have a serious drawback. If for any reason the yarn is not consumed due to lack of demand in the machine, e.g., when many needle latches are closed, there is no practical way of uncoupling the feeder and yarn that is not consumed will be fed in such a way that malfunctions can occur.

This drawback is overcome according to the invention by the yarn being either unwound perpendicularly to the center line of the spool body for positive feeding such that the unwinding will be equal to the winding onto the spool body or in an axial direction in relation to the spool body for intermittent yarn consumption.

A preferred form of yarn feed control device in accordance with this invention comprises a spool body on which the yarn is wound so as to form a yarn reserve, the spool body having means for controlling the quantity of the yarn reserve under the influence of the yarn wound onto the spool body. The yarn feed control device includes a yarn withdrawal means which is brought from one position which renders possible an unwinding of yarn from the spool body only perpendicularly in relation to its axis for positive yarn feeding to another position which renders an unwinding of yarn along the axis of the spool body for intermittent yarn consumption. The feed control device coacts with a yarn supply device so that during positive yarn consumption the yarn withdrawal from the spool body will be equal to the winding on of the yarn, but at intermittent yarn consumption the yarn quantity stored on the spool body is reduced to a selected minimum value before further yarn is wound on the spool body.

According to a preferred embodiment of the invention the yarn withdrawal means comprises an adjustable arm which in one end position stands perpendicularly to the axis of the cylindrical body and in its other end position forms an elongation of the same. This makes it possible, as long as the arm extends perpendicularly to the center line of the spool body, to let the feed control device function as a positive feeder while, when the arm is folded down such that the yarn is withdrawn in the longitudinal direction of the spool body, the positive yarn feeder is uncoupled and the knitting machine may use up yarn intermittently. When any error which may occur has been corrected or a special knitting has been carried out, the arm is reset in the perpendicular position in relation to the spool body and the feeder will again function in a positive yarn feeding manner.

With a preferred device according to the invention the positive yarn feeding may quickly be changed to a jacquard feeder which always has a reserve of yarn ready to be used for the intermediate need in the several knitting locations. If a smaller yarn quantity is knitted, the reserve grows on the storing feeder or yarn feed control device until it reaches a predetermined maximum. When the yarn reserve on the reserve feeder has reached a certain minimum quantity, further yarn is

automatically wound on the spool body so that the yarn reserve will never be used up completely.

The "reserve" feeder is intended to be used mainly in such cases when the yarn is not consumed at a constant speed, e.g., when knitting on jacquard machines, cotton machines, different kinds of flat knitting machines, stocking knitting machines, warp machines and weaving looms. On many machines there is, however, manufactured a smooth product, i.e., a product in which the yarn is used up at a constant speed. In the manufacture of such a product there is always obtained, without comparison, the best product under the intermediary of a forced feeding, i.e., positive yarn feeding. The so-called tape feeder is the best known device for obtaining such a positive yarn feeding.

No other feeders offer the advantages of the "reserve" feeder, namely to keep a just wound reserve of yarn which has been tested to its strength e.g., for the immediate need at each knitting location. It could be said that by means of the reserve feeder there is provided a spool which never grows thinner or shorter. Any errors on the yarn are discovered within a length of ten to fifty meters of the same before the knitting point and thus the machine may be stopped without any violent braking and the risk of errors in the product is considerably reduced.

All jerks and tension increases which are not strong enough to break the yarn are thus completely eliminated. It is of course these advantages that eliminate at least 90 percent of all the machine interruptions and they should be available also with a positive feeding of yarn to the machine. The present invention provides a feeder which could be used with the same advantages for yarn storing (according to the foregoing) with intermittent or altering yarn consumption as for a positive yarn control when such is needed. In both cases there is obtained a tested and just wound reserve of yarn which is continuously renewed.

There are two embodiments of the apparatuses for the rewinding and storing of yarn for the immediate need at different types of textile machines. One of these embodiments is characterized in that the spool body rotates when the yarn is wound on the same. The other one is characterized by a stationary spool body on which the yarn is wound either by a concentrically arranged winding device in the shape of a wheel with a flange and an opening in the flange through which the yarn passes, or a rotating arm.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a vertical section through a feeder or feed control device with a stationary spool body and a driven yarn winding arm rotating about said body.

FIG. 2 is a plan view of the same feeder.

FIG. 3 shows a vertical section through a feeder with a rotating spool body.

FIG. 4 is a side elevation of the same showing essentially the device for the yarn withdrawal from the spool body.

FIG. 5 shows a vertical section through a feeder with a rotating spool body according to FIG. 3 but using the swingable control arm of FIG. 1.

FIG. 6 shows a vertical section through a feeder with a stationary spool body and rotatably driven yarn winding arm according to a further embodiment and particularly utilizing a modified yarn sensing device.

FIG. 7 is a fragmentary side elevational view of the upper part of the spool body with a number of threads on the spool cut away for revealing a part of the mantle of the spool body.

DETAILED DESCRIPTION

The feeder according to FIGS. 1 and 2 uses a stationary spool body 11 and comprises a stand 1 in which a shaft 2 is journaled by ball bearings 3. The shaft 2 has a projecting arm 4 with a bent outer end through which the yarn 5 runs. Mounted on the shaft 2 is a flanged wheel 6 similar to a pulley. A ring 7 with abutments 8 is arranged on the mounting housing or hub of this pulley-like wheel. The ring 7 is pressed by a spring washer 9 against the wheel so as to be driven thereby. The wheel 6 is driven by a thin belt 10 (or a V-belt or circular belt) at a suitable speed. One or more units may be driven by one and the same belt exactly like the yarn feeding wheels on tape feeders. The spool body 11 is mounted on an elongation of the shaft 2. An internally toothed ring 13 is stationarily arranged in the apparatus stand 1. A similar gear ring 14 is mounted on the upper part of the spool body. Two sprockets 15 run against said gear rings 13, 14, said sprockets 15 being fixedly interconnected by means of a shaft 16 which is mounted in a second arm 17 extending from the shaft 2. The gear rings 13 and 14 as well as the sprockets 15 thus comprise a conventional planetary gear system which is designed in a well known manner to provide suitable drive ratios between the associated meshing pairs of gears so as to prevent the spool body 11 from rotating relative to the frame.

So as to prevent the yarn 5 at the spool body from winding onto previously wound yarn windings, the feeder is provided with a toothed disk 18 which is relatively rotatably mounted on a sleeve 19 by means of an intermediate ball bearing. Sleeve 19 is connected to shaft 2 by means of pin 19', which pin 19' permits the sleeve 19 and the disk 18 mounted thereon to tilt relative to the axis of the shaft 2. By means of the pressure spring 20 the toothed disk 18 is urged to take an inclining position in relation to the shaft 2. As the stored quantity of yarn 21 on spool 11 diminishes, the teeth 45 on the disk 18 which project outwards through slots 48 in the spool body 11 can press the remainder of the stored yarn 21 down on the spool body due to the pressure from the spring 20. A flange 22 on the sleeve 19 then presses against a pin 23 which thereby is displaced in its guide 24 such that it catches the abutments on the ring 7 as driven by means of the belt 10. The shaft 2 with the arms 4 and 17 and the sprockets 15, the sleeve 19 with the flanges 22 and 25 are then rotated with the same speed as the driving wheel 6. The yarn 5 is then wound about the stationary spool body 11 just under the highest tooth 45 of the toothed disk 18 due to the rotation of the arm 4 around the spool. The yarn is by the teeth 45 of the disk 18 successively pushed downwards on the spool body 11 and then one yarn winding presses another winding in front of itself without any risk that one winding could be formed on top of another winding and that fibers or torn fibrils be clamped. When the yarn reserve 21 has reached a sufficient size, i.e., a sufficiently great number of yarn windings have been laid side by side on the spool, the resistance of the yarn reserve overcomes the force of the spring 20, whereupon the disk 18 moves to a more

horizontal position. The pin 23 is thus disengaged from the ring 7 provided with abutments, such that the shaft 2 with all the components mounted thereon comes to a stand still. The yarn winding is then interrupted. In this way the device functions as a yarn storing feeder for all kinds of more or less continuous yarn consumption.

During certain types of knitting positive yarn feeding is necessary. The feeder described here is provided with a device rendering it suitable to be used also for positive yarn feeding. A rod 27 is provided at one end with gear teeth 51 and is positioned displaceably in a longitudinal slot in the shaft 2. The rod is provided with a radially projecting arm 28 which is engageable with the flange 25 for altering the inclination of the sleeve 19 and of the disk 18. An arm 29 is journaled on a pin 30 in a slot in the lower end of the shaft 2 and is provided at one end with a gear wheel 52. By means of gear 52 meshing with gear rack 51 on rod 27 the arm 29 may be folded up by means of a lever 31, which acts through a disk 26 on the shaft 2. The arm 29 will then be positioned an angle of 90° to the shaft 2.

For adjustment to positive feeding, the arm 31 is swung manually or mechanically in a counter-clockwise direction according to FIG. 1, the disk 26 with the rod 27 and the arm 28 then being moved downwards. The rack 51 causes the gear 52 to rotate whereby the arm 29 is swung upwards such that it will stand perpendicularly to the shaft 2 as indicated by dash-dot lines in FIG. 1. The downward movement of rod 27 also causes arm 28 to engage the flange 25 which forces the sleeve 19 with the disk 18 mounted thereon to take a somewhat more inclined position than the one shown in the figure. As a result of the increasing inclination the pin 23 is displaced in its guide 24 so as to engage the abutments of wheel 7 such that the winding arm 4 and shaft 2 are forced to rotate with the same speed as the pulley 6. The belt 10 is driven with such a speed that the yarn wound on the spool body at all times corresponds to the yarn need of the knitting machine. The expression "yarn need" is here used to indicate all positive feeding of a yarn length which to some extent is smaller than the yarn length the knitting machine would require if the maximum speed of the yarn were not determined by the devices for the positive feeding. With the arm 29 in the positive feeding position illustrated by dash-dot lines in FIG. 1, the arm 29 will rotate with the shaft 2 whereby the yarn 5 will be caught by the arm 29 in the way shown in the figure due to the fact that the tension ring 32 keeps the yarn close to the spool body 11. Since the yarn as it extends between the ring 32 and guide 49 is normally under tension, the engagement of the yarn by the free end of the rotating arm 29 causes the yarn to be pulled or drawn out from the tension ring 32 as the arm rotates thereby providing for a continuous or positive feed of yarn to the knitting machine. When the arms 4 and 29 rotate with a predetermined speed, the knitting system will not knit a larger yarn length per machine turn than what is permitted by the apparatus in question. For a return to a free yarn feeding to the knitting machine, the position of the arm 29 is changed to return it to its downward axial position where it does not engage the yarn 5. This adjustment may be performed centrally by means of a pattern chain or a drum. When knitting measured lengths there is ob-

tained the advantage that all products, e.g., sweaters and pullovers, will be of equal lengths.

Another and simpler construction of yarn storing feeder with a possibility of positive feeding will be described in the following with reference to FIGS. 3 and 4. The feeder illustrated in FIGS. 3 and 4 possesses many parts or components which are structurally and functionally similar or identical to corresponding parts and components of the feeder illustrated in FIG. 1, and thus said corresponding parts of the embodiment of FIG. 3 will be referred to by the same reference numeral as used to designate corresponding parts of the embodiment of FIG. 1 but with the number 100 added thereto. This feeder operates with a rotating spool body 111. In the same way as in the previously described feeder the stored yarn 121 influences the inclination of the toothed disk 118 in relation to the diametric plane of the spool body. In this case the disk 118 also controls a micro switch 133 which in turn controls the connection between the pulley 106 driven by the knitting machine and the spool body 111. Particularly, the switch 133 is disposed within the spool 111 and is provided with a conventional depressible plunger 153 which is disposed so as to be positioned in abutting contact with the flange 122 of the spool 119, the plunger 153 controlling in a conventional manner the opening and closing of the contacts of the switch 133. The switch 133 is connected to an external source of power by means of a first electrical lead 156, with the switch 133 also having a further electrical lead 154 in the form of a slip contact, which slip contact 154 is disposed in engagement with a disk-shaped conductor 134, which conductor is insulated from the spool body 111. The disk-shaped conductor 134 is in turn engaged by a further slip contact 135 as provided on one end of a further electrical lead 155, which electrical lead is in turn connected to a coupling magnet 139, such as a solenoid, as mounted on the spool body 111. Coupling magnet 139 has a conventional extendable plunger 161 which is adapted to extend so as to engage the abutments of the ring 107 for permitting the spool 111 to be rotatably driven by the wheel 106. The switch 133 thus controls the supply of yarn to the spool body 111 when the yarn feeding device is being utilized for intermittent yarn feeding since the switch 133 coacts with the tilting disk 118 for permitting the spool body 111 to be selectively rotated whenever the number of windings 121 on the spool body decrease below a predetermined number, whereupon rotation of the spool body 111 by wheel 107 results in further windings being placed on the spool body.

As illustrated in FIG. 3, the yarn when withdrawn from the spool body 111 passes through the eye 149 of a control arm 136, which control arm is pivotally mounted on the frame 101 for swinging movement between a first position wherein the eye 149 is substantially axially aligned and spaced from the spool body 111 (as illustrated in solid line in FIGS. 3 and 4), which thus results in axial withdrawal of the yarn from the spool body so as to permit intermittent feeding of yarn, and a second position wherein the eye 149 is substantially radially spaced outwardly from the periphery of the spool body (as illustrated in dash-dot lines in FIG. 4) so as to permit a positive or continuous withdrawal or feeding of yarn from the spool body.

When one wishes to obtain a positive yarn feed, the arm 136 is swung through an angle of approximately 90° into the dash-dot position illustrated in FIG. 4. The arm 136 is provided with an eccentric 159 thereon, which eccentric is rotatably supported on the pin 137 as fixedly secured to the frame 101. The rotational movement of arm 136 into the positive feed position illustrated by dash-dot lines in FIG. 4 causes the eccentric to coact with the plunger 162 of a switch 138, resulting in closure of the contacts of the switch 138. The switch 138 is connected to a source of power by means of a first lead line 158, and is also connected to a further electrical lead line 157, which lead line is also connected to the disk-shaped conductor 134. The closure of the switch 138 by the swinging movement of the arm 136 into the dash-dot position of FIG. 4 thus results in the current flow through lead line 157, conductor 134 and lead line 156 whereby coupling magnet 139 is energized so that plunger 161 engages the ring 107 for causing the spool 111 to be positively rotatably driven by wheel 106. The spool body 111 is thus positively rotatably driven at the same speed as the pulley 106 so long as the arm 136 is in the position for positive feeding.

When the spool body 111 is being rotated, whether being used for intermittent or positive feeding, the yarn is supplied to the spool 111 so as to be wound thereon directly under the toothed disk 118, the yarn being supplied to the spool 111 by conventional means such as illustrated in greater detail in my prior U.S. Pat. No. 3,419,225.

FIGS. 6 and 7 illustrate therein a modified yarn feed control device which incorporates therein a different yarn sensing means, thereby permitting elimination of the toothed disk 18 or 118 used in the embodiments illustrated in FIGS. 1 and 3, respectively. The yarn feed control device disclosed in FIGS. 6 and 7 is substantially similar to the yarn feed control device illustrated in FIG. 1 and thus the parts of the control device of FIG. 6 will be referred to by the same reference numerals used to designate corresponding parts of the device of FIG. 1 but with the suffix A added thereto.

The feeder of FIGS. 6 and 7 uses a stationary spool body 11A and comprises a frame or stand 1A in which a shaft 2A is journaled by ball bearings 3A. The shaft 2A has a projecting arm 4A with a bent outer end through which runs the yarn 5A. A conventional motor 211, having a stator 212 fixed relative to the frame 1A and a rotor 213 fixed relative to the shaft 2A, is provided for permitting selective rotation of the shaft 2A. The frame 1A is also provided with an internally toothed ring 13A fixedly secured thereto, and a similar internal gear ring 14A is fixed to the upper part of the spool body 11A. Two sprockets 15A run against said gear rings 13A and 14A. The sprockets 15A are fixedly interconnected by a shaft 16A which is mounted in a second arm 17A fixedly secured to and extending radially from the shaft 2A. The gear rings 13A and 14A, as well as the sprockets 15A, thus comprise a conventional planetary gear system which is designed in a well known manner to provide suitable drive ratios between the associated meshing parts of the gears to prevent the spool body 11A from rotating relative to the frame 1A. This is achieved in the illustrated embodiment by making the sprockets 15A of the same diameter, and by making the gear rings 13A and 14A of equal diameter.

The feeder of FIGS. 6 and 7 is also provided with a control lever 29A pivotally mounted at the lower end of the spool for permitting the device to be used for either positive or intermittent yarn feeding. This structure, which is substantially identical to the structure disclosed in FIG. 1, includes a gear 51A secured to the lever 29A and disposed in meshing engagement with a slidable toothed rod 27 which is slidably disposed in the shaft 2A and is slidably moved by means of the actuating arm, such as the arm 31 illustrated in FIG. 1.

To prevent the yarn 5A adjacent the spool body 11A from winding onto previously wound yarn windings, the feeder is provided with a sensing means 221 for controlling the size of the yarn reserve 222 wound around the spool body. The spool body 11A is provided with one or more narrow slots 223 extending through the wall thereof, which slots extend substantially in the axial direction of the spool body and are disposed adjacent the upper end of the spool body in the region of the yarn reserve 222 whereby the individual windings of the yarn reserve 222 pass over the slots 223. A stationary nozzle 224 is disposed closely adjacent the spool body 11A and has a discharge orifice 226 disposed directly adjacent and substantially in alignment with the slots 223. The nozzle 226 is connected to a suitable pump or pressure source (not shown) for permitting air to be blown through the nozzle 226 and against the slotted portion of the spool body 11A.

The sensing means 221 further includes an elongated plate or lever member 227 disposed internally of the spool body 11A, the plate being fixedly secured to the spool body adjacent its lower end thereof. The upper end of the plate 227 is here, and preferably, formed with a dished or slightly concave configuration 228, which dished portion is disposed directly behind and overlying the slots 223. The actuator plate 227 is maintained in engagement with the actuator button 229 of a conventional microswitch 231, which switch 231 is normally maintained in an open position when the plate 227 is in the solid line position of FIG. 6, whereby movement of the plate 227 to the dotted line position of FIG. 6 causes a closure of the switch 231.

The switch 231 is connected by leads 232 and 233 to conductive plates 234 and 236, which plates have slip contacts 237 and 238 disposed in engagement therewith. The slip contacts 237 and 238 are carried by and rotate with the shaft 2A and are connected to suitable conductive elements 239 and 241 which extend through an opening 242 formed axially of the shaft 2A. The other end of the conductive elements 239 and 241 are provided with further slip contacts 243 and 244 thereon slidably disposed in conductive engagement with suitable fixed conductive plates 246 and 247, which plates are suitably energized by conductive elements 248 and 249.

The switch 231, as stationarily disposed within the interior of the spool body 11A, is electrically connected in series with the driving motor 211 so that the switch 231 is thus effective in controlling the energization of the motor 211, which in turn directly controls the rotation of the shaft 2A so as to control the winding of the yarn 5A onto the spool body 11A.

In operation, the air flowing through the nozzle 224 tends to flow through the slots 223 and impinge against the dish-shaped portion 228 of the actuating plate 227. However, the free flow of air is restricted and substan-

tially reduced due to the presence of the numerous windings of the yarn reserve 222, which windings extend substantially transversely across all of the slots 223 and thereby effectively reduce the free flow area of the slots. When a sufficient quantity of yarn windings are contained within the yarn reserve 222, then the flow area of the slots 223 is reduced to a sufficient extent that the air flowing through the slots is likewise reduced so that the air is unable to cause deflection of the plate 227. In this condition, the plate 227 will remain in the solid line position as illustrated in FIG. 6, in which position the switch 231 remains open, whereupon the motor 211 remains deenergized and the shaft 2A is thus stationary. Further yarn windings are thus not wound onto the spool and accordingly no increase in the size of the yarn reserve occurs.

However, as the yarn reserve 222 grows smaller due to the withdrawal of yarn from the spool, the number of individual windings contained in the yarn reserve 222 is reduced so that fewer windings extend across the slots 223 and the effective flow area through the slots is increased. When the yarn reserve 222 is reduced to a predetermined minimum number of windings, the effective flow area through the slots is sufficient to permit adequate flow of air through the slots 223 so as to cause the plate 227 to be resiliently deflected inwardly into the dotted line position illustrated in FIG. 6, which movement of plate 227 causes inward depression of switch button 229 to cause the microswitch 231 to be closed. Closure of switch 231 results in energization of motor 211, whereupon shaft 2A is rotated which in turn results in rotation of the arm 4A whereby yarn 5A is then fed through the arm and wound onto the spool body 11A so as to again increase the number of windings contained in the yarn reserve 222. When the number of windings in a yarn reserve again reaches a desired predetermined maximum, the effective flow area of the slots 223 is again effectively reduced due to the increased size of the yarn reserve 222, whereupon the quantity of air flowing through the slots 223 is likewise reduced whereupon the plate 227 will return to its normal position (shown in solid lines in FIG. 6) whereupon the switch 231 will again open and cause deenergization of the motor 211.

The operation of the control lever 29A permits the feeder to be operated in either a positive or intermittent manner in the same manner as described above with respect to the embodiment illustrated in FIG. 1, and thus further description thereof is not believed necessary.

While the sensing means illustrated in FIGS. 6 and 7 has been disclosed in association with a stationary spool body, it will be recognized that this sensing means, with certain modifications which will be obvious in light of the foregoing, could also be used with feeders possessing a rotating spool body. Further, while the sensing means had been disclosed in combination with a feeder having a control arm permitting both intermittent and positive feeding, it will be recognized that the sensing means 221 could also be desirably used in combination with a conventional feeder which is designed primarily for intermittent feeding, such as disclosed in my prior U.S. Pat. No. 3,419,225.

Although a particular preferred embodiment of the invention has been disclosed in detail for illustrative

purposes, it will be recognized that variations or modifications of the disclosed apparatus, including the rearrangement of parts, lie within the scope of the present invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A device for controlling the feeding of yarn to a textile machine, comprising:

a spool body;

winding means for winding yarn on said spool body in response to relative rotation between said spool body and said winding means to form a yarn reserve on said spool body;

electrical circuitry means for controlling relative rotation between said spool body and said winding means for controlling the winding-on operation; and

sensing means for controlling the size of said yarn reserve under the control of the quantity of yarn wound on the spool body, said sensing means including:

a. opening means formed in and extending through said spool body in the region of said yarn reserve whereby the yarn elements contained in said yarn reserve extend across said opening means,

b. nozzle means positioned on one side of said yarn reserve and disposed adjacent said spool body for directing a stream of gaseous fluid toward one end of said opening means, and

c. responsive means connected to said electrical circuitry means and positioned on the other side of said yarn reserve and adjacent the other end of said opening means for controlling the relative rotation between said winding means and said spool body in response to the flow of gaseous fluid through said opening means, said responsive means including a movable operating member disposed in the path of the gaseous fluid after it flows through said opening means and said yarn reserve, said operating member being positioned so that the flow impinges thereon and moves said operating member from a first to a second position in response to flow of a predetermined magnitude through said opening means and said yarn reserve for activating said electrical circuitry means to cause additional yarn to be wound on said spool body.

2. A device according to claim 1, further including drive means connected to said electrical circuitry means and connected to one of said spool body and said winding means for causing rotation thereof, and said responsive means including electrical switch means for controlling said drive means, said operating member being connected to said switch means for moving same between open and closed positions in response to movement of said operating member by said flow of gaseous fluid through said opening means.

3. A device according to claim 2, wherein said nozzle means is disposed exteriorly of said spool body and has a discharge orifice disposed adjacent the external periphery of said spool body, and said switch means being disposed in the interior of said spool body.

4. A device according to claim 3, wherein said operating member is maintained in said first position

and said switch means is maintained in said open position whenever the yarn reserve on said spool body exceeds a predetermined minimum, said operating member being moved to said second position to cause closing of said switch means whenever said yarn reserve falls below said predetermined minimum and uncovers a greater portion of said opening means so as to permit an increased flow of gaseous fluid through said opening means to impinge on and move said operating member.

5. A device according to claim 1, wherein said opening means includes a plurality of closely adjacent, narrow, circumferentially spaced slots formed in and extending radially through the wall of said spool body, said slots being disposed in the region of the yarn reserve so that the slots are partially covered by the yarn windings.

6. A device according to claim 5, wherein said nozzle means is connected to a source of compressed air and has a discharge orifice disposed closely adjacent one radial end of said slots for causing a stream of air to flow radially through said slots, the magnitude of the stream of air flowing radially through said slots being dependent upon the magnitude of the area of the slots left uncovered by said yarn reserve, and said operating member being movably mounted directly adjacent the other radial end of said slots whereby the air stream passing through said slots impinges on said operating member, and means coaxing with said operating member for permitting movement thereof from said first position to said second position when the air stream passing through said slots exceeds a predetermined minimum.

7. A device according to claim 6, wherein said slots are substantially parallel to one another and are individually elongated in a direction substantially parallel

with the longitudinal axis of said spool body.

8. A device according to claim 1, wherein said spool body is stationarily mounted, and said winding means is mounted for rotation.

9. A device for controlling the feeding of yarn to a textile machine, comprising:

a spool body;

winding means for winding yarn on said spool body in response to relative rotation between said spool body and said winding means to form a yarn reserve on said spool body;

yarn control means selectively operable to permit unwinding of yarn from said spool body either continuously at substantially the same rate at which it is wound on the spool body or intermittently at a rate independent of the rate at which it is wound on the spool body; and

sensing means for controlling the size of said yarn reserve under the control of the quantity of yarn wound on the spool body, said sensing means including:

a. opening means formed in said spool body in the region of said yarn reserve whereby the yarn elements contained in said yarn reserve extend across said opening means,

b. nozzle means disposed adjacent said spool body for directing a stream of gaseous fluid toward said opening means, and

c. responsive means for controlling the relative rotation between said winding means and said spool body in response to the flow of gaseous fluid through said openings, said responsive means including a movable operating member disposed in the path of the gaseous fluid as it flows through said opening means and movable in response to the magnitude of said flow.

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