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FABRIC YIELD COMPUTING DEVICE

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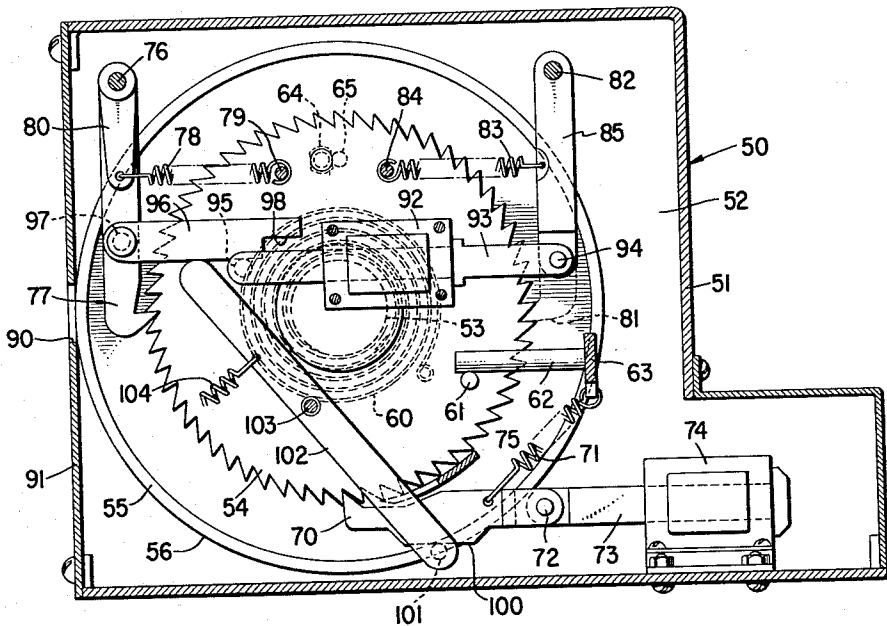


Fig. 3

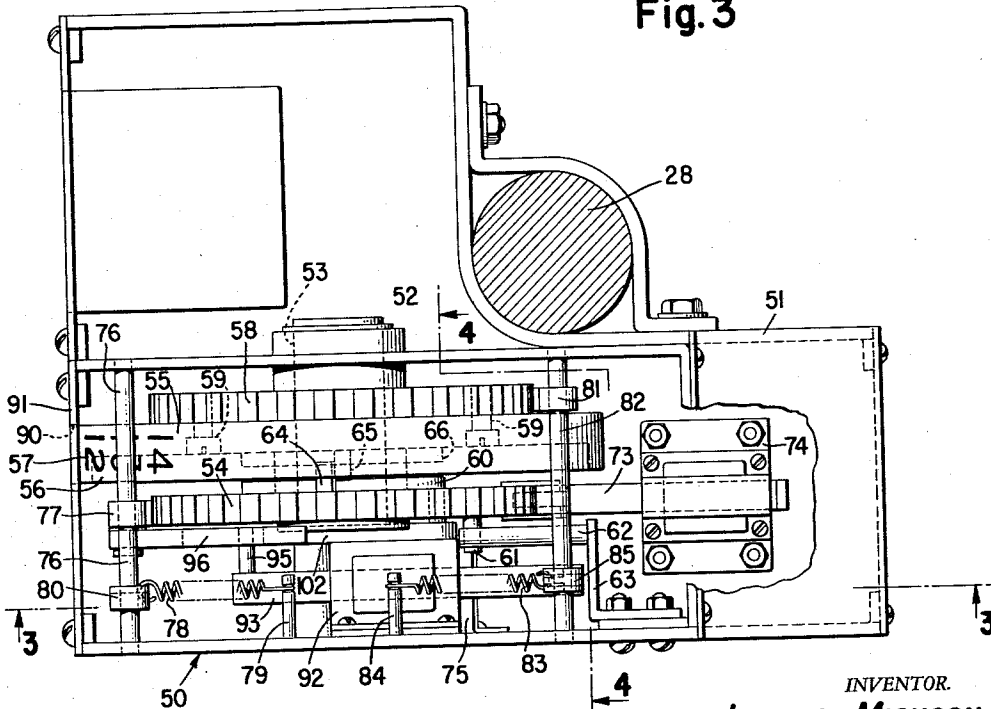


Fig. 2

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FABRIC YIELD COMPUTING DEVICE

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This invention relates to the manufacture of fabric and more particularly to the measurement and indication of the yield of a fabric during manufacture.

Although this invention will be described hereinbelow as applied to circular knitting machinery, this invention may be used to advantage with any known mechanism for concatenating yarn, thread or other fibers into fabrics by either weaving or knitting processes.

In a circular knitting machine, each yarn which is directed to the needles is formed by the needles into a row or course of loops which are combined or concatenated by the needles in various ways with preceding rows or courses of loops to form the fabric. The number of courses, sometimes called stitches, formed by the circular knitting machine is thus the product of the number of yarn feeds existent on the machine and the number of revolutions completed by the machine.

It is common practice in the art to provide counting devices for measuring and recording the number of revolutions completed by circular knitting machines, thus recording either directly or in the form of a sub-multiple, the number of courses completed by the machine. The measurement thus obtained, however, is meaningless in terms of the fabric being manufactured, for quite obviously any given number of courses if tightly knitted will produce fabric of a higher yield than if loosely knitted.

There are innumerable factors which may influence the density or yield of a fabric in terms of weight of the fabric per unit area which bear no relation to number of revolutions or speed of operation of the machine. For instance, the yarn tension, the condition of the yarn, the stroke of the knitting needles, the frictional resistance to movement of the knitting needles in the cylinder, and the tension applied to the fabric as it is being knitted are but a few examples of such variables.

It is also known in the art to measure the quantity or yardage of fabric produced. Here again the yardage measurement does not provide an indication of the yield of the fabric.

Measurements of fabric yield which have been used heretofore might be categorized as one of two types, i.e., the spot check method in which a unit area, usually one square inch of fabric, is analyzed and its yield calculated, or the averaging method wherein the weight of a quantity of fabric is measured directly or calculated. These known yield measuring methods have in common the disadvantages that they cannot in practice be effected until relatively long after the fabric has been knit and they require considerable dexterity and calculation on the part of the machine operator. For use in attaining a machine adjustment to produce fabric of a given yield, therefore, these known methods are slow, inefficient, and wasteful of production. The spot check method indicates nothing of the fabric condition beyond the area checked and large discrepancies in fabric weight may go unnoticed. The averaging method, likewise, does not provide a true picture. A bolt of fabric which averages 7 ounces may in fact contain half 5 ounce and half 9 ounce cloth with little or none of 7 ounce yield.

It is an object of this invention to provide a means for measuring and continuously indicating the yield of a fabric being produced during the operation of a fabric manufacturing machine, so that the machine operator is provided with a continuous indication of the fabric yield

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and may thereby maintain his machine in condition of adjustment to produce a fabric of uniform predetermined yield throughout.

A further object of this invention is to provide a fabric yield measuring and indicating means which is responsive to the fabric closely adjacent to the point at which the fabric is being manufactured, this providing for an immediate indication to the machine operator of the effect of the machine adjustments or fabric yield so that uniformity of fabric yield may be maintained efficiently and without loss of production or fabric spoilage.

Another object of this invention is to provide a novel and effective fabric yield measuring and indicating device readily applicable to a circular knitting machine which does not adversely influence the production of fabric on the machine and which may be calibrated readily and easily to accommodate a wide variety of sizes and types of knitting machines.

In accordance with the present invention, measurements are made simultaneously of the number of courses being made in the fabric and of the length or quantity of fabric as it is being manufactured. These separate measurements are supplied continuously to a device which combines, calculates from the measurements, and displays as a result thereof indicia directly related to the fabric yield. The device of this invention may be so calibrated and provided with indicia as to read directly in terms of fabric yield of weight per unit area. The calibration and indicia may also be chosen in terms of units directly related to fabric yield, as for instance, in courses per inch.

In the accompanying drawings of a preferred embodiment of this invention:

FIG. 1 represents a vertical cross sectional view of a portion of a circular knitting machine having my invention applied thereto,

FIG. 2 represents top plan view of the computing device of this invention with portions or the casing thereof removed and broken away,

FIG. 3 is a cross sectional view of the computing device of this invention taken substantially along line 3—3 of FIG. 2 and represents a side elevational view of the mechanism within the casing, and

FIG. 4 is a cross sectional view of the computing device of this invention taken substantially along line 4—4 of FIG. 2 and represents a rear elevational view of the computing device.

FIGURE 1 illustrates those portions of a conventional circular knitting machine which will be necessary for an understanding of this invention. The knitting machine includes a housing ring 12 which may be supported from the floor on a plurality of legs. Journaled in the housing ring is a gear ring 13 having a depending flange 14 formed with gear teeth 15 and an upstanding flange 16 to which a cylinder 17 is secured as by fastenings 18. The gear ring is turned by a pinion 19 meshing with the teeth 15, and is driven, for instance, by an electric motor. The gear ring 13 is constrained rotatably in the housing ring by a retaining ring 20 which is secured to the housing ring.

The outer wall of the cylinder 17 is formed with evenly spaced vertical slots 21 each slidably accommodating a latch needle 22 formed with a butt 23. As the cylinder is rotated, the needle butts are successively influenced first by a needle raising cam 24 carried by the retaining ring 20 and then by a stitch cam 25 carried by a section block 26 on the cam retaining ring so as to form a row or course of stitches in a fabric F by the incorporation therein of loops formed from a yarn Y which is fed to the needles as the needles are being influenced by the cams 24 and 25. There may be a plurality of yarns fed to the needles about the cylinder, each such yarn feed

being accompanied by a corresponding pair of needle raising and stitch cams 23, 24 so that in each revolution of the cylinder, as many courses will be knit as there are yarn feeds arranged about the cylinder.

Each yarn Y is fed to the needles from a supply cop supported above the housing ring on a yarn stand, a portion of which is indicated at 28 in FIG. 1. The fabric, as it is knit, is drawn downwardly through the cylinder by a conventional fabric take-up driven by a pair of diametrically opposed take-up driving brackets secured to the gear ring 13, one of said take-up driving brackets being indicated in FIG. 1 as 29.

Secured on one of the take-up driving brackets 29 is a support frame 30 carrying a stud shaft 31 on which is journaled a fabric driven wheel 32 provided peripherally with fabric engaging pins 33. Secured coaxially with the wheel 32 is a sprocket wheel 34 engaging an endless chain 35 which also passes about an idler sprocket 36 journaled in the support frame 30. In the preferred embodiment illustrated in the drawings one of the links 37 of the chain is formed higher than the remainder of the links providing a cam surface 38 engageable with a contact arm or roller 39 of an electrical switch 40 secured on the take-up driving bracket 29. The switch 40 is of the normally open variety and is closed momentarily by the cam surface 38 upon the passage of a predetermined quantity of fabric relatively to the fabric driven wheel 32. Each closure of the switch 40 thus reflects the measurement of a discrete quantity of fabric produced by the knitting machine and the specific quantity so measured may be preselected in various ways as by a selection of the size of the fabric drive wheel 32, a selection of the length of the chain 35, by providing a plurality of higher links 37 in evenly spaced relation about the chain, or the like. A lead from the switch 40 may be directed by way of a brush 41 in the gear ring 13 and a slip ring 42 in the housing ring 12 to the outside of the knitting machine.

Secured on a boss 43 on the take-up driving bracket 29 is a cam lug 44 disposed for engagement with a contact arm or roller 45 of an electrical switch 46 secured on a bracket 47 carried on the housing ring 12. The switch 46 is of the normally open variety and is closed momentarily by the cam lug 44 once during each revolution of the cylinder 17. Each closure of the switch 46 thus reflects the measurement of the number of courses of knitting which are completed during each revolution of the knitting machine.

The leads from both switches 40 and 46 are directed to a computing device indicated generally as 50 preferably contained in a casing 51 secured to the yarn stand 28 or a similar position on the knitting machine where it may be viewed readily by the knitting machine operator even at a considerable distance from the machine. It is a function of the computing device continuously to combine the measurements of the fabric courses and of the quantity of fabric being produced as to result in the display of indicia representing the yield of the fabric being produced continually during the operation of the machine.

Referring to FIGS. 2, 3 and 4 illustrating the computing device, a partition 52 inside the casing 51 supports a headed stud 53 on which are journaled a driving ratchet wheel 54 and an indicating wheel 55 having a smooth cylindrical periphery 56 on which indicia 57 are marked. A retrograde ratchet wheel 58 is secured as by fastening screws 59 to the indicating wheel.

A coil spring 60 is secured at one extremity to the driving ratchet wheel 54 and at the other extremity to the stud 53 and is arranged to bias the driving ratchet wheel into an at-rest position as determined by a stop pin 61 protruding from the driving ratchet wheel for engagement with an abutment pin 62 carried on a bracket 63 secured to the casing.

An operative connection exists between the driving

ratchet wheel 54 and the indicating wheel whereby the indicating wheel will be driven in one direction by the driving ratchet wheel. To this end a drive lug 64 extends laterally from the driving ratchet wheel and is positioned to abut one side of a pin 65 extending laterally from the indicating wheel. As viewed in FIG. 3 clockwise movement of the driving ratchet wheel 54 will be transmitted to the indicating wheel by the drive lug 64 and pin 65. A coil spring 66 secured at one extremity to the indicating wheel 55 and at the other extremity to the stud 53 serves to bias the indicating wheel toward an at-rest position as determined by engagement of the pin 65 with the driving lug 64.

The driving ratchet wheel 54 is indexed during the operation of the knitting machine by means of a device 15 pawl 70 biased into engagement with the ratchet wheel by a spring 71 and pivoted as at 72 to the armature or plunger 73 of an electric solenoid 74 secured in the casing 51. The solenoid 74 is connected electrically with the switch 46 so as to be operated to impart a driving stroke to the pawl 70 upon each revolution of the knitting machine sensed by the switch 46. A ratchet wheel guard plate or shield 75 may be secured on the casing 51 to provide for the indexing of a predetermined number of ratchet wheel teeth on each operative stroke of the pawl 20 70. It will be appreciated that the pawl 70 could be actuated directly by the cam lug 44; however, the use of a switch 46 and solenoid 74 provides for any desired favorable location of the computing device on the knitting machine.

Secured on a rock shaft 76 journaled between the casing 51 and the partition 52 is a retrograde pawl 77 biased into engagement with the teeth of the driving ratchet wheel 54 by means of a spring 78 which extends between an anchor pin 79 secured to the casing 51 and a rock arm 80 secured on the rock shaft 76. The retrograde ratchet wheel 58 secured to the indicating wheel 55 similarly cooperates with a retrograde pawl 81 secured on a rock shaft 82 journaled between the casing 51 and the partition 52. A spring 83 extending between an anchor pin 84 on the casing and a rock arm 85 fast on the rock shaft 82 serves to bias the retrograde pawl 81 into engagement with the retrograde ratchet wheel 58.

Both the retrograde pawl 81 and the drive lug 64 45 when in engagement with the pin 65 serve to prevent the indicating wheel 55 partaking of retrograde movement as the indicating wheel is indexed by the driving ratchet wheel. The indicia on the indicating wheel are thus indexed past a window 90 formed in a cover plate 91 secured on the casing 51, a predetermined increment for each revolution of the knitting machine, or in other words, a given increment upon each completion of that number of courses made by the machine in each revolution.

Secured on the casing 51 is an electric solenoid 92 of 50 which the armature or plunger 93 is pivoted as at 94 to the rock arm 85 associated with the retrograde pawl 81. The solenoid 92 is connected electrically with the switch 40 and is arranged when activated by closure of the switch 40 to shift the slide bar 93 to the right as viewed in FIG. 3 to release the retrograde pawl 81. Since the switch 40 is closed only momentarily upon the measurement of each predetermined quantity of fabric, the solenoid will be activated only momentarily after which the retrograde pawl under the action of the spring 83 will be returned into engagement with the retrograde ratchet and the plunger 93 will be shifted to the left as viewed in FIG. 3.

A pin 95 protruding from the plunger 93 of the solenoid 92 slides beneath a link 96 pivoted at 97 on the retrograde pawl 77 which engages the driving ratchet wheel 54. The undersurface of the link 96 is formed with a notch 98 which falls into engagement with the pin 95 when the plunger is shifted to the right as viewed in FIG. 3 upon actuation of the solenoid 92. When the

spring 83 returns the plunger 93 to the left as viewed in FIG. 3, the pin 95 in engagement with the notch 98 will shift the retrograde pawl 77 out of engagement with the driving ratchet wheel 54 thus releasing the driving ratchet wheel to be returned at the at-rest position by the coil spring 60.

Since the retrograde pawl 81 will have re-engaged the retrograde ratchet wheel associated with the indicating wheel prior to release of the driving ratchet wheel, the indicating wheel will be maintained in the final position to which it has been indexed by the driving ratchet wheel and that indicium corresponding to such indexed position will be maintained opposite the window 90.

Upon the first actuation of the drive pawl 70 after each release of the driving ratchet wheel, a cam surface 100 formed beneath the drive pawl 70 will engage a pin 101 carried by a release lever 102 fulcrumed at 103 on the casing 51, and shift the release lever against the action of a light spring 104 upwardly beneath the link 96. The notch 98 in the link will thus be raised out of engagement with the pin 95 and the retrograde pawl 77 will be returned by the spring 78 into engagement with the driving ratchet wheel 54.

The cycle of operation above described will be repeated continually during the operation of the machine with a plurality of indexing pulses being imparted to the driving ratchet wheel until culminated by the alternate release of the retrograde motion pawls 81 and 77. If the fabric being manufactured by the machine is of uniform yield the number of courses produced during the measurement of any discrete quantity of fabric will remain the same and the drive lug 64 will be in engagement with the pin 65 whenever the retrograde pawl 81 is released. With uniform conditions, therefore, the same indicium will remain in view through the window 90.

If, however, the fabric should gradually become more dense, i.e., comprise a greater number of stitches per unit length of fabric, a greater number of indexing pulses will occur by way of the driving pawl 70 during each interval of fabric measurement. As a result, the lug 64 will engage and advance the pin 65 and, therefore, the indicating wheel 55 so as to change the indicia displayed through the window 90.

Should the fabric decrease in weight i.e., contain fewer courses per unit length, the lug 64 will be indexed short of engagement with the pin 65 and upon release of the retrograde pawl 81, the indicating wheel will be returned by the coil spring 66 until the pin 65 engages the lug 64 thus changing the indicium displayed through the window 90.

The indicia marked on the indicating wheel may be calibrated in many ways. It may be calibrated directly in terms of fabric weight per unit quantity or for more general application of the same computing unit from machine to machine it may be calibrated in terms of courses or stitches per inch of fabric.

With the present invention, indicia directly representative of the yield of the fabric as it is being manufactured is displayed continuously. The operator of a plurality of machines equipped with this invention can tell at a glance whether each is producing fabric uniformly and at specific predetermined yields. This invention not only indicates the occurrence of a change in the fabric yield but it indicates precisely what that change is so that corrective adjustments may be made immediately, often during operation of the machine and, moreover, with the results of any adjustment being indicated immediately.

The measurements which in this invention result in the display of indicia representative of fabric yield are derived from the fabric F as it is being knit and while the fabric is under the influence of a take-up device. This is advantageous, as pointed out above, in providing practically immediate indication of corrective adjustments. The yield of a fabric, however, many change when it passes

from the influence of the take-up device. Moreover, different yarns recover at different rates from the tensions applied during fabric manufacture. The difference between the condition of the fabric as it is being knit and its condition after it has reached an equilibrium is, for any given fabric substantially a constant, the value of which once determined either by measurement or by experience may be included in the calibration of the indicating wheel.

As illustrated in FIG. 1, the casing 51 of the computing device of this invention may also include conventional counting devices for recording and displaying as at 110 the total machine revolution, or as indicated at 111, the total fabric yardage produced. These conventional counting devices may be operated by the solenoids 74 and 92 or by other means if desired, such counting devices being conventional in the art the operating means therefore are not illustrated in the accompanying drawings.

Having thus set forth the nature of this invention, what I claim herein is:

1. In a circular knitting machine having a plurality of circularly arranged needles, at least one needle actuating means operatively associated with said needles, yarn feeding means disposed so as to deliver a yarn to the needles being actuated by said needle actuating means for concatenation of said yarn by said needles into a course in a tubular fabric being knit by said machine, and means for imparting circular motion to said needles relatively to said needle actuating means, means for measuring the circular motion of said needles relatively to said needle actuating means during operation of said knitting machine, means for measuring the length of tubular fabric produced during the operation of said knitting machine, a computing device operated by said measuring means, and means operated by said computing device for providing a continuous visible indication representing the courses per unit length of said tubular fabric being produced during the operation of said knitting machine.

2. In a circular knitting machine having a plurality of circularly arranged needles, at least one needle actuating means operatively associated with said needles, yarn feeding means disposed so as to deliver a yarn to the needles being actuated by said needle actuating means for concatenation of said yarn by said needles into a course in a tubular fabric being knit by said machine, and means for imparting circular motion to said needles relatively to said needle actuating means, means operated by said circular motion imparting means for providing a first signal upon completion of each predetermined number of courses in a tubular fabric during the operation of said knitting machine, means for measuring the length of tubular fabric produced during operation of said knitting machine, means operated by said fabric measuring means for providing a second signal upon completion of each predetermined length of fabric produced during the operation of said knitting machine, and a computing device associated with said knitting machine and operated in response to both said first and second signals to provide a continuous visible indication representing the courses per unit length of said tubular fabric being produced during the operation of said knitting machine.

3. In a machine for concatenating fibers to produce a fabric having means for concatenating fibers into successive courses lengthwise of said fabric, and fabric take-up means for drawing said fabric under tension from said concatenating means, a first means for measuring the fiber courses being incorporated into said fabric during operation of the machine, a second means for measuring the quantity of fabric produced between said concatenating means and said take-up means during the operation of said machine, a computing device operated by said first and second measuring means, indicia associated with said computing device, and means operated by said computing device for displaying indicium representing the yield of the fabric produced during operation of the machine.

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4. In a machine for concatenating fibers to produce a fabric, a first means for measuring the fiber courses being incorporated into said fabric during operation of the machine, a second means for measuring the quantity of fabric produced during the operation of the machine, a computing device operated by said first and second measuring means, indicia associated with said computing device, and means operated by said computing device for displaying indicium representing the yield of the fabric being produced during the operation of the machine.

5. In a knitting machine having measuring means responsive to the formation of each predetermined number of courses of knitting by said machine, and measuring means responsive to the formation of each predetermined length of fabric knit by said machine, a computing device comprising a shiftable indexing member, means defining an at-rest position of said indexing member, means for imparting successive increments of movement to said indexing member in one direction from said at-rest position one increment upon each response of one of said measuring means, means effective upon response of the other of said measuring means for returning said indexing member to said at-rest position, fabric yield indicating means for producing visual representation of the position of said indexing member at each response of said other of said measuring means, and means for maintaining the visual representation provided by said yield indicating means between successive responses of said other measuring means.

6. In a knitting machine having measuring means responsive to the formation of each predetermined number of courses of knitting by said machine, and measuring means responsive to the formation of each predetermined length of fabric knit by said machine, a fabric yield computing device comprising a shiftable indexing member, means defining an at-rest position of said indexing member, means biasing said indexing member toward said at-rest position, a ratchet associated with said indexing member, pawl means cooperating with said ratchet for imparting successive increments of movement to said indexing member in one direction from said at-rest position one increment upon each response to one of said measuring means, a retrograde pawl cooperating with said ratchet, a fabric yield indicating member shiftable sup-

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ported adjacent to said indexing member for movement toward and away from the at-rest position of said indexing member, means biasing said indicating member toward said at-rest position, an abutment on said indexing member engageable with said indicating member in a predetermined relative position of said members and effective to shift said indicating member along with said indexing member in said one direction from said at-rest position, retrograde brake means associated with said indicating member, indicia provided on said indicating member, and means effective upon each response of said other measuring means for effecting in seriatim release of the retrograde brake means of said indicating member, reengagement of said retrograde brake means, and release of the retrograde pawl of said indexing member.

7. A device as set forth in claim 6 in which the fabric yield computing device includes a casing, a shaft carried in said casing, and in which said indexing and said indicating members comprise separate cylindrical members rotatably supported on said stud shaft and in which said indicia is provided peripherally on said indicating member and provides a visual representation of the fabric yield through an aperture formed in said casing.

8. A device as set forth in claim 6 in which said measuring means responsive to the formation of each predetermined number of courses of knitting comprises electrical switch means actuated momentarily upon completion of each predetermined sequence of knitting machine operation, in which said fabric measuring means comprises a fabric engaging wheel carried by said knitting machine and electrical switch means actuated momentarily upon completion of each predetermined segment of angular motion of said fabric engaging wheel, in which a first solenoid is operated in response to each momentary actuation of one of said electrical switches to operate said pawl means cooperating with the ratchet associated with said indexing member, and in which a second solenoid is operated in response to each momentary actuation of the other of said electrical switch means to effect in seriatim release of the retrograde brake means of said indicating member, reengagement of said retrograde brake means, and release of the retrograde pawl of said indexing member.

No references cited.