

[54] **YARN MEASURING APPARATUS FOR
USE WITH WARP KNITTING
MACHINES**

[75] Inventor: **Rudolph G. Bassist**, Lancaster, Pa.

[73] Assignee: **Travis Mills Corp.**, New York, N.Y.
; a part interest

[22] Filed: Feb. 12, 1971

[21] Appl. No.: 114,874

[52] U.S. Cl.....235/92 PD, 235/92 CC, 235/92 R,
235/92 V, 235/92 DN, 66/86

[51] Int. Cl.G07c 3/10, G06m 3/08

[58] **Field of Search**.....235/92 PD, 92 V,
235/92 PE, 92 CC, 92 DN; 340/279

[56] **References Cited**

UNITED STATES PATENTS

3,539,782	11/1970	Upshur.....	235/92 PD
3,467,821	9/1969	Arp.....	235/92 PD
3,558,860	1/1971	Bauldreay et al.....	235/92 V
3,630,052	12/1971	Fertig.....	235/92 PD X

Primary Examiner—Thomas A. Robinson

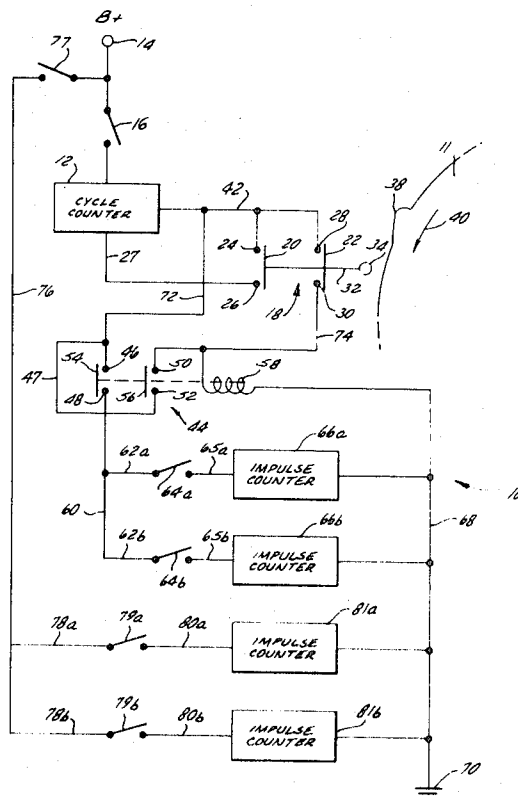
Assistant Examiner—Joseph M. Thesz, Jr.

Attorney—Breitenfeld & Levine

[57] **ABSTRACT**

An apparatus including a machine cycle counter and at least one impulse counter operable only concomitantly with the cycle counter. A yarn measuring device is responsive to rotation of the warp beam for providing pulses, the number of pulses being proportional to the linear amount of yarn drawn from the warp beam. Another impulse counter is operable independently of the cycle counter and also receives pulses from the yarn measuring apparatus. The yarn measuring apparatus may include a roller engaging and rotatable by the warp beam, the roller carrying at least one magnet. A magnetically operable switch adjacent to the circular path through which the magnet travels is operated each time the magnet passes it so as to produce a pulse. Alternatively, the roller may include a light source for energizing a light-sensitive detector each time the light source passes it, so as to produce a pulse.

9 Claims, 5 Drawing Figures



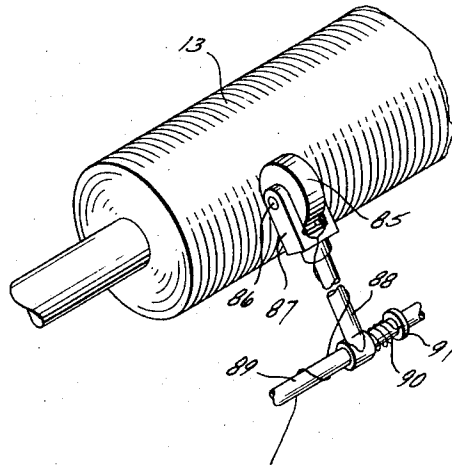


FIG. 1

FIG. 2

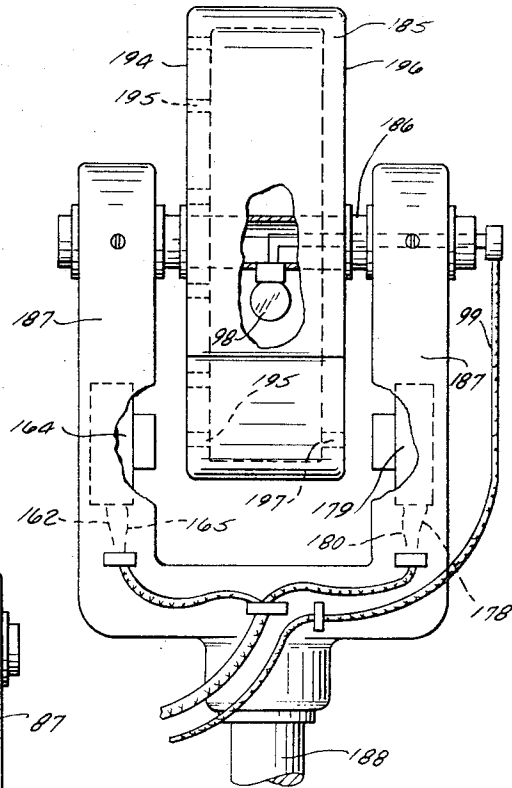
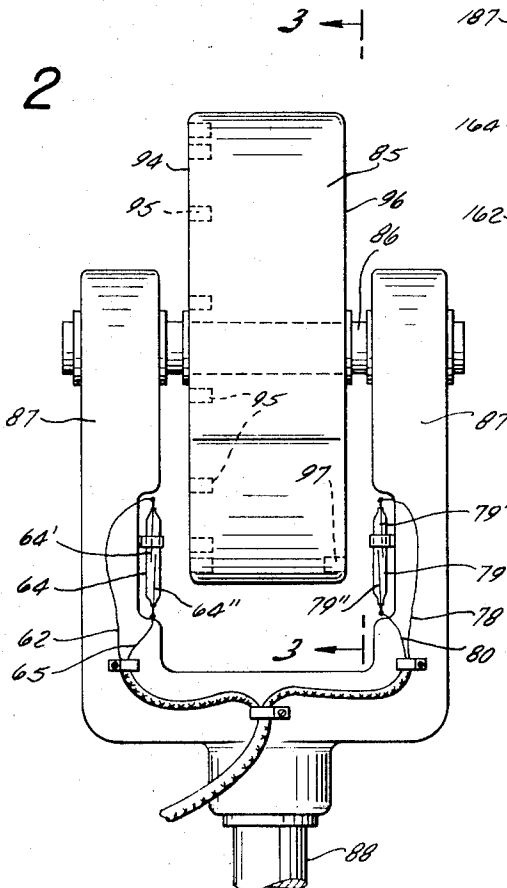


FIG. 5

INVENTOR:
RUDOLPH G. BASSIST
BY
Brentenfeld & Levine
ATTORNEYS

FIG. 3

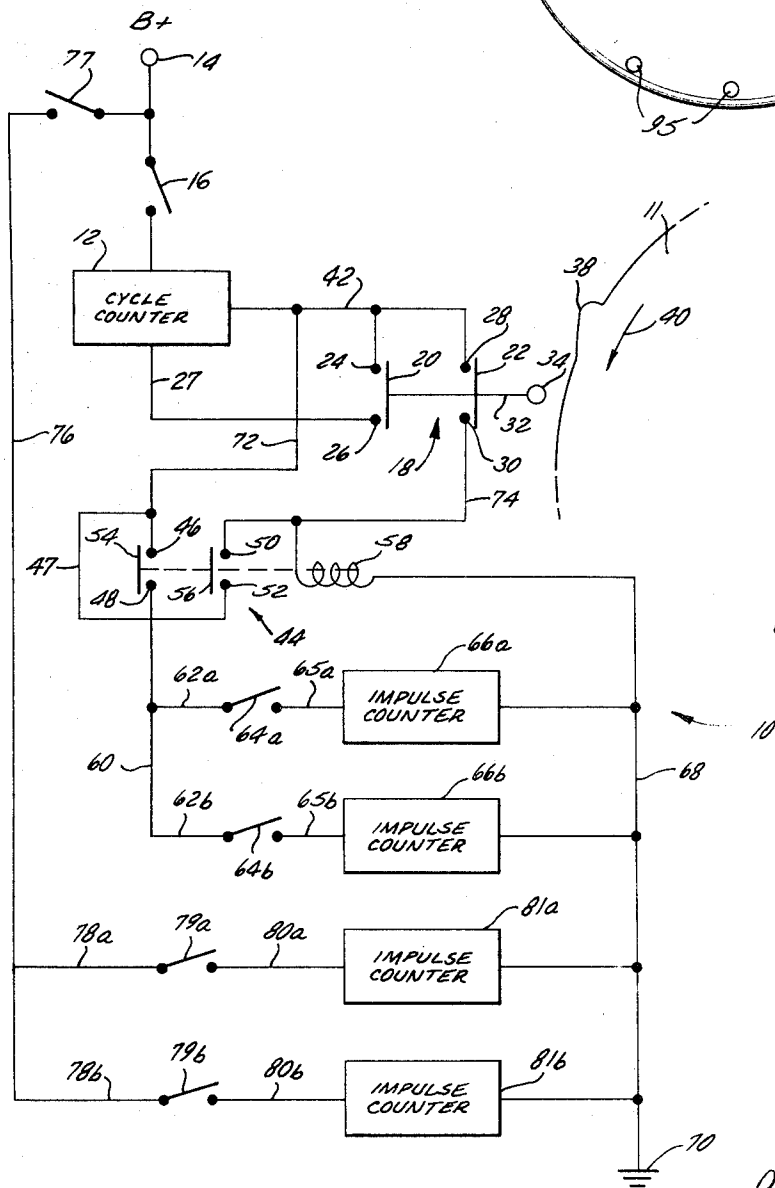
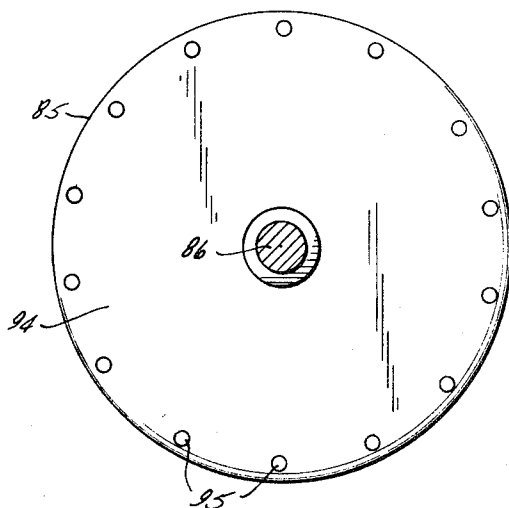


FIG. 4

INVENTOR
RUDOLPH G. BASSON
BY
Brentonfeld & Co.
ATTORNEYS

YARN MEASURING APPARATUS FOR USE WITH WARP KNITTING MACHINES

This invention relates to warp knitting machines, and more particularly to an apparatus for measuring the amount of yarn used to make a certain number of courses of a knitted fabric.

It is exceedingly important for purposes of quality control, when knitting textile fabrics with a knitting machine that the amount of yarn fed to the machine during its operation not be too much, so as to result in a loosely-knit fabric, nor be too little, so as to result in a fabric which is extremely tight woven.

It is therefore, the primary object of the present invention to provide apparatus for use in conjunction with warp knitting machines which is capable of measuring and recording the amount of yarn being employed by the machine to fabricate a particular textile fabric, thereby permitting quality control of the finished garments or fabrics.

It is another object of the present invention to provide apparatus of the aforementioned type which employs means operatively associated with each of the warp beams of the machine to measure the amount of yarn fed to the machine by each of the warp beams.

It is a further object of the present invention to provide apparatus of the aforementioned type which employs read out means for providing a readily accessible visual presentation of the amount of yarn fed to the machine by each of the warp beams.

It is still another object of the present invention to provide apparatus of the aforementioned type employing a cycle counter which may be preset to measure the amount of yarn feed for a predetermined number of repetitive cycles of the knitting machine.

It is still a further object of the present invention to provide electrical impulse counters as the read out means showing the actual linear amount of yarn fed by each of the warp beams.

It is yet another object of the present invention to provide an electromechanical measuring means for converting the rotational movement of the warp beam into electrical impulses which are representative of the linear amount of yarn drawn from the warp beam.

It is a further object of the invention to provide a switch responsive to magnets carried by a roller engaging the warp beam for producing electrical pulses representative of the linear amount of yarn drawn from the warp beam.

It is an additional object of the invention to provide a device responsive to a light source carried by a roller engaging the warp beam for producing electrical pulses representative of the linear amount of yarn drawn from the warp beam.

It is another object of the invention to provide means associated with each warp beam to measure the total amount of yarn drawn therefrom so as to indicate how much yarn remains.

The foregoing and other objects, features and advantages of the present invention will become more apparent from the following detailed description when considered in conjunction with the accompanying drawings, wherein:

FIG. 1 is a perspective view of one embodiment of a yarn measuring device according to this invention;

FIG. 2 is an enlarged front elevational view of a portion of the yarn measuring device shown in FIG. 1;

FIG. 3 is a cross-sectional view taken on line 3—3 of FIG. 2;

FIG. 4 is an electrical schematic representation of the yarn measuring apparatus of the present invention with the measuring means being depicted as an electrical equivalent; and

FIG. 5 is a view similar to FIG. 2 of another embodiment of a yarn measuring device according to this invention.

FIG. 4 shows a schematic representation of the yarn measuring apparatus for use with warp knitting machines constructed in accordance with the principles of the present invention and denoted generally by the reference numeral 10.

It should be noted that the warp knitting machine (not shown) is of the usual type having a bank of knitting needles and pattern-controlling means, in the form of a rotating pattern wheel 11, all of which are actuated together by a common cam shaft. The machine also includes one or more warp beams, only one warp beam 13 being shown (FIG. 1), rotated about its longitudinal axis to feed yarn wound on the beam to the knitting needles.

The apparatus 10 comprises a cycle counter 12 for measuring the repetitive cycles of the knitting machine which is equivalent to the number of rotations of pattern wheel 11. Counter 12 is normally preset to count a predetermined number of cycles of the knitting machine. One type of counter which may be employed is the Sodeco predetermining counter distributed by Landis & Gyr, Inc. of New York, New York. The input of revolution counter 12 can be connected to a B+ potential terminal 14 by means of a switch 16. The apparatus 10 also includes a double pole switch, generally indicated by the reference numeral 18, including a first contact member 20 and a second contact member 22; the member 20 is adapted to contact terminals 24 and 26 while the member 22 is adapted to contact terminals 28 and 30. The contact members 20 and 22 are secured upon a rod 32 which is spring biased to the position shown in FIG. 1, with the members 20 and 22 out of engagement with the terminals 24, 26 and 28, 30, respectively. At the end of the rod 32 remote from the contact members 20 and 22 is a projection 34 whose purpose will be described hereinafter.

Secured to the pattern wheel 11 of the knitting machine is a cam 38. When the wheel 11 revolves in the direction indicated by the arrow 40, the cam 38 revolves and, once during each revolution of pattern wheel 11, engages the projection 34 which acts as a cam follower. Engagement of the cam 38 and projection 34 causes the rod 32 to move longitudinally, against its spring bias. The longitudinal movement of rod 32 causes the contact member 20 to connect terminals 24 and 26 and also contact member 22 to connect terminals 28 and 30, the purpose of which will be described hereinafter. Connected to the output of the revolution counter 12 is an output lead 42 which is, in turn, connected to the terminals 24 and 28 of the switch 18.

The apparatus also includes another double pole switch 44 having terminals 46, 48, 50 and 52 and contact members 54 and 56, the contact members 54 being adapted to connect terminals 46 and 48 while contact member 56 is adapted to connect terminals 50 and 52. The operation of switch 44 is controlled by an electri-

cal inductor coil 58. i.e., when there is no current flow through coil 58, the switch is inactive and when current flows through coil 58 the switch is activated and contact members 54 and 56 engage the terminals 46, 48, and 50, 52, respectively, the purpose of which will be discussed hereinafter.

A lead line 60 is connected to terminal 48, and connected to the lead line are one or more input leads 62a and 62b of one or more yarn measuring devices schematically illustrated as switches and denoted by the reference numerals 64a and 64b.

The number of switches or yarn measuring devices 64a and 64b, employed is equal to the number of warp beams associated with the knitting machine. If the machine has only one warp beam, only one yarn measuring device 64a will be furnished. The outputs of the switches 64a and 64b are connected via leads 65a and 65b, respectively, as the inputs to electrical impulse counters 66a and 66b, respectively. The circuits through the impulse counters are completed by connection to a lead line 68 which is, in turn, connected to a ground terminal 70. Each of the switches 64a, etc. and its respective impulse counter 66a, etc. are connected in parallel with every other switch and impulse counter, for simultaneous independent operation. The impulse counters employed may be any of the various electrical impulse counters presently available, one of which is the Sodeco impulse counters type TCe distributed by Landis & Gyr, Inc.

The coil 58 is also connected to the ground terminal 70 via lead line 68. A lead line 72 is connected between terminal 46 of switch 44 and the output lead 42 of revolution counter 12, while a lead 74 is connected between terminal 50 of switch 44 and terminal 30 of switch 18; the lead line 74 is also connected to coil 58.

A lead line 76 is connected to B+ potential terminal 14 via switch 77. Connected to lead line 76 are one or more input leads 78a and 78b of one or more yarn measuring devices schematically illustrated as switches and denoted by the reference numerals 79a and 79b. The number of switches or yarn measuring devices 79a and 79b employed is equal to the number of warp beams associated with the knitting machine. The outputs of switches 79a and 79b are connected via leads 80a and 80b, respectively, as inputs to electrical impulse counters 81a and 81b, respectively, which may be of the same type as counters 66a and 66b. The circuits through impulse counters 81a and 81b are completed by connection to lead line 68. Each of the switches 80a, etc. and its respective impulse counter 81a, etc. are connected in parallel with every other switch and impulse counter.

In the operation of the yarn measuring apparatus 10, the cycle counter 12 is initially set from zero to a predetermined number which will measure that number of cycles of the knitting machine and during which the yarn fed to the machine is to be measured. The switch 16 is then closed so that the counter is connected to the B+ source terminal 14 and is rendered operative by that connection. When the knitting machine pattern wheel 11 has rotated a sufficient distance, after the closure of switch 16, so as to bring cam 38 into engagement with the cam follower 34, the measuring operation commences. The initial engagement of cam 38 with follower 34 causes the rod 32 to

be shifted against its spring biasing, thereby causing the contact member 20 to connect terminal 24 to terminal 26, and simultaneously causing contact member 22 to connect terminal 28 to terminal 30. Connection of terminals 24 and 26 completes a circuit from terminal 14, through switch 16, counter 12, line 42, contact 20, and line 27, back to the counter 12. This circuit may best be termed a feedback circuit and the completion thereof serves to reduce the number set on the counter 12 by 1. It will be appreciated that the completion of this circuit is merely momentary, lasting only as long as the rod 32 is depressed by the action of the follower 34 and cam 38, thus there is a B+ pulse which is fed from the lead 42 to lead 27 and back to counter 12.

The connection of terminals 28 and 30 completes a circuit from lead 42 to lead 74, through coil 58, to lead line 68 and thence to ground at 70. This pulse produces current flow through the inductive coil 58 energizing the same and activating switch 44. The activation of switch 44 causes the contact member 54 to connect terminals 46 and 48 and thereby complete a circuit from lead line 42, through lead line 72, and terminal 46 and 48 to lead line 60, whereby when the switches 64a and 64b close, they pass impulses to their respective impulse counters 66a and 66b.

Activation of switch 44 also causes the contact member 56 to connect terminals 50 and 52 which completes a holding circuit for the coil 58, from lead 42, through leads 72, lead 47, which bypasses the terminals 46 and 48, through the connected terminals 52 and 50, to lead line 74, and then through coil 58 to lead line 68 and finally to ground terminal 70. As long as B+ remains on line 42, therefore, coil 58 remains energized. Thus, the pulse produced by the momentary closure of switch 18 produces a pulse to activate switch 44 which produces a continuous current flow through the coil 58 to maintain the switch 44 closed. Since switch 44 is closed, a B+ potential is maintained on lead line 60, whereby the switches 64a and 64b are operable to transmit pulses to their respective impulse counters 66a and 66b.

It is to be noted that the sequenced operation described above occurs only when switch 16 is closed and cycle counter 12 has been set to some number greater than zero. After switch 44 has been closed, the subsequent pulses produced by the operation of the knitting machine, and thus the engagement of cam 38 with follower 34, only serves to pulse the feedback path of counter 12 to reduce the preset number therein, thereby counting the number of revolutions of the knitting machine. Subsequent contact of member 22 with terminals 28 and 30 does not alter the operation of switch 44 since current is now continuously flowing through coil 58 and the momentary closure of switch 18 does not affect the current flow path from lead 72 to lead 47, through terminals 52 and 50, to lead 74 and thence through coil 58.

The impulse counters 66a and 66b, may be calibrated to give a readout which is merely the number of impulses supplied thereto or may be calibrated to give a direct readout of the amount of yarn fed by its associated warp beam to the knitting needles.

It is also to be noted herein that the counter 12 is provided with an internal switch, which is closed as long as the setting on counter 12 is other than zero, but

which opens after the completion of the predetermined number of cycles by the knitting machine, and the counter 12 has counted down to zero. Opening of the internal switch removes the B+ potential from lead 42 rendering the impulse counter 66a and 66b inoperative until the counter 12 has once more been reset.

Thus, at the conclusion of the predetermined number of revolutions as counted by the revolution counter 12, the current flow through coil 58 ceases, causing switch 44 to open, thereby rendering the impulse counters 66 inoperative. At this time there is present at the impulse counters a readout of the quantity of yarn fed to the knitting needles by each of the warp beams during the predetermined number of cycles of the machine. Thus, depending upon the reading of an individual impulse counter, the knitting machine can be adjusted to cause either more or less yarn to be fed to the needles. This permits controlling the quality of the fabric being knit by the machine.

Switch 77 is closed when a full warp beam is placed on the machine, and maintains B+ potential on line 76, whereby the switches 79a and 79b are operable to transmit pulses to their respective impulse counters 81a and 81b. It will be noted that pulses are transmitted to each of counters 81a and 81b throughout the rotation of the warp beam, regardless of the setting of cycle counter 12. Consequently, the reading on each counter 81a and 81b is an indication of total yarn drawn from its respective warp beam since the latter was full. Thus, the machine operator can tell instantly how much yarn remains on each warp beam.

FIGS. 1-3 show a yarn measuring device including switches 64 and 79 (FIG. 2) which correspond to like numbered switches in FIG. 4, and leads 62, 65, 78, and 80 which correspond to like numbered leads in FIG. 4. The device includes a roller 85 rotatable on a pin 86 extending between the arms 87 of a yoke. The yoke is carried by one end of a rod 88 rotatably mounted at its other end on a portion 89 of the machine frame. A coiled spring 90 surrounds frame portion 89, one end of the spring being secured within a hole in a collar 91 fixed to frame portion 89. The other end of spring 90 engages rod 88 and tends to rotate the rod in a direction which presses roller 85 against warp beam 13. As a result, roller 85 is rotated by the warp beam as the latter rotates. If desired, the edge of roller 85 engaging the warp beam may be suitably roughened to insure no slipping between the roller and warp beam.

Each face of roller 85 is furnished with at least one permanent magnet. This may be done by drilling a hole in the face of the roller, perpendicular to the plane of the face, and securing as by cement a small cylindrical magnet in the hole. In the present example, one face 94 of roller 85 is provided with a plurality of magnets 95 all equidistantly spaced from the pin 86. In addition, each magnet 95 is equidistantly angularly spaced from the magnet immediately preceding and succeeding it. The other face 96 of roller 85 is furnished with a single magnet 97.

Adjacent to roller faces 94 and 96, yoke arms 87 carry magnetically operable switches 64 and 79, respectively. Switches 64 and 79 may be of the type commonly referred to as reed switches. Each switch is so spaced from pin 86 as to be adjacent to the circular path along which its respective magnet or magnets

travel. In the present example, each switch is normally open and is adapted to be closed by magnetic force. Thus, each time a magnet 95 passes switch 64, it attracts reed contact 64' into engagement with reed contact 64'' to close the switch and cause a pulse to reach its respective impulse counter 66. After that magnet 95 passes, switch 64 opens and is closed again by the next magnet 95 passing it. Similarly, each time magnet 97 passes switch 79, it attracts reed 97' into engagement with reed contact 97'' to close the switch and cause a pulse to reach its respective impulse counter 81.

The angular spacing between successive magnets 95 will have some known relationship to the linear distance measured along the surface of roller 85. For example, a spacing between each two successive magnets may be equivalent to a linear surface distance of 1 inch along the edge of the roller. Consequently, each pulse engendered by switch 64 will indicate one inch of surface travel of roller 85 and hence one inch of yarn drawn from warp beam 13. Thus, the reading on its respective impulse counter will indicate the number of inches of yarn drawn from the warp beam.

A similar proportionality exists for the movement of magnet 97. If one revolution of roller 85 is equivalent to a linear surface distance of one yard along the edge of roller 85, each pulse produced by switch 79, and hence each count on its respective impulse counter 81, will indicate one yard of yarn drawn from the warp beam.

As indicated above, a roller 85 and associated support means and switches is provided to engage each warp beam of the machine.

FIG. 5 shows another form of yarn measuring device wherein photoelectric means rather than magnetic means are used to produce the pulses. The device includes light-sensitive devices such as photoelectric cell means 164 and 179 which correspond to switches 64 and 79, respectively, in FIG. 4, and leads 162, 165, 178, and 180 which correspond to leads 62, 65, 78 and 80, respectively, in FIG. 4. (In FIG. 5, parts corresponding to parts in FIGS. 1-4 bear the same reference numeral preceded by a "1.").

The device includes a hollow roller 185 rotatable on a stationary hollow pin 186 extending between the arms 187 of a yoke, the latter being carried by one end of a rod 188. Roller 185 is rotated by the warp beam in the same way as roller 85. Mounted on pin 186, within roller 185, is a light source in the form of an electric lamp 98 supplied with power through a conductor 99.

Each face of roller 185 is furnished with at least one hole extending completely through that wall of the roller, each hole allowing light from lamp 98 to pass through and hence serving as a light source. In the example illustrated, one face 194 of roller 185 is provided with a plurality of through holes 195, and the other face 196 is furnished with a single through hole 197. The relative spacing of holes 195 may be the same as the relative spacing of magnets 95 in FIGS. 1-3.

Adjacent to roller faces 194 and 196, yoke arms 187 carry photoelectric cells and associated circuitry 164 and 179, respectively. Each cell is so spaced from pin 186 as to be adjacent to the circular path along which its respective hole or holes travel. Each time a hole 195 passes cell 164, light from lamp 98 passing through the hole energizes the cell and causes a pulse to reach its

respective impulse counter 66. Similarly, each time hole 197 passes cell 179, light from lamp 98 passing through the hole energizes the cell and causes a pulse to reach its respective impulse counter 81.

The invention has been shown and described in preferred form only, and by way of example, and many variations may be made in the invention which will still be comprised within its spirit. It is understood, therefore, that the invention is not limited to any specific form or embodiment except insofar as such limitations are included in the appended claims.

What is claimed is:

1. A yarn measuring apparatus for use with a knitting machine having a warp beam, comprising:

- a. counting means for counting a predetermined number of repetitive cycles of said machine,
- b. at least two impulse counters,
- c. a yarn measuring device for providing at least two series of pulses to said counters, said device including roller means engaging and rotatable by the warp beam, and cooperable means carried by said roller means and located adjacent to said roller means for producing the two series of pulses in response to rotation of the warp beam, the number of pulses produced being proportional to the linear amount of yarn drawn from the warp beam,
- d. means for resiliently urging said roller means against the warp beam to insure continued engagement between the two as the yarn wound on the warp beam is depleted,
- e. means for conditioning one of the impulse counters to receive a series of said pulses concomitantly with the operation of said cycle counter means (a), said pulses being counted by said one of the impulse counters to indicate the linear amount of yarn fed from the warp beam during a predetermined number of machine cycles, and
- f. means for conditioning another of the impulse counters to receive another series of said pulses throughout the time during which the warp beam rotates, the pulses in said other series of pulses being counted by said other of the impulse counters to indicate the linear amount of yarn fed from the warp beam.

2. A yarn measuring apparatus as defined in claim 1, wherein said cooperable means comprise:

- at least one magnet carried by said roller means in a position radially spaced from the axis of rotation of said roller means, and
- a magnetically operable switch adjacent to the circular path through which said magnet travels, said switch being operated each time said magnet passes it so as to produce one of said pulses.

3. A yarn measuring apparatus as defined in claim 2

including a plurality of magnets carried by said roller means, all said magnets being equidistantly spaced from the roller axis of rotation, and each of said magnets being equidistantly angularly spaced from the magnets immediately preceding and succeeding it

4. A yarn measuring apparatus as defined in claim 1 wherein said cycle counter means (a) and said at least two impulse counters (b) are electrically operable, and including a source of potential and switch means controlled by said cycle counter means and connected between said source of potential and said one of the impulse counters, whereby said one of the impulse counters operates only during operation of said revolution counter.

5. A yarn measuring apparatus as defined in claim 1 wherein said yarn measuring device comprises roller means engaging and rotatable by the warp beam, at least two magnets carried by said roller means, and two magnetically operable switches, each of said switches being adjacent to the circular path through which one of said magnets travels and being operated each time its respective magnet passes it so as to produce one of said series of pulses, and each of said switches producing a separate series of pulses.

6. A yarn measuring apparatus as defined in claim 1, wherein said cooperable means comprise:

- at least one light source movable with said roller means and radially spaced from the axis of rotation of said roller means, and

a light-responsive device adjacent to the circular path through which said light source travels, said device being energized each time said light source passes it so as to produce one of said pulses.

7. A yarn measuring apparatus as defined in claim 6 including a plurality of light sources movable with said roller means, all said sources being equidistantly spaced from the roller axis of rotation, and each of said sources being equidistantly angularly spaced from the sources immediately preceding and succeeding it.

8. A yarn measuring apparatus as defined in claim 1 wherein said yarn measuring device comprises roller means engaging and rotatable by the warp beam, at least two light sources carried by said roller means, and two light-responsive devices, each of said devices being adjacent to the circular path through which one of said sources travels and being operated each time its respective source passes it so as to produce one of said series of pulses, and each of said devices producing a separate series of pulses.

9. A yarn measuring apparatus as defined in claim 1 wherein said other of the impulse counters receives a series of said pulses independently of said means (d) and hence independently of the operation of said cycle counter means (a).

* * * * *