United States Patent

Delair et al.

[15] **3,690,123**

[45] **Sept. 12, 1972**

[54] **DEVICE FOR THE AUTOMATIC MEASUREMENT OF THE LENGTH OF YARN CONSUMED IN KNITTING MACHINES**

[72] Inventors: **Jean-Paul Delair,** Saint Loubes; **Jean-pierre Raisin,** Troyes, Aube, both of France

[73] Assignee: **Institut Textile de France,** Boulogne, France

[22] Filed: **March 9, 1970**

[21] Appl. No.: **17,491**

[30] **Foreign Application Priority Data**

March 17, 1969 France 6907568

[52] **U.S. Cl.** .....**66/1 R,** 66/125 R, 66/126

[51] **Int. Cl.** **D04b 9/00,** D04b 15/38, D04b 11/00

[58] **Field of Search**.....66/125, 1, 154 A, 132, 126, 66/54

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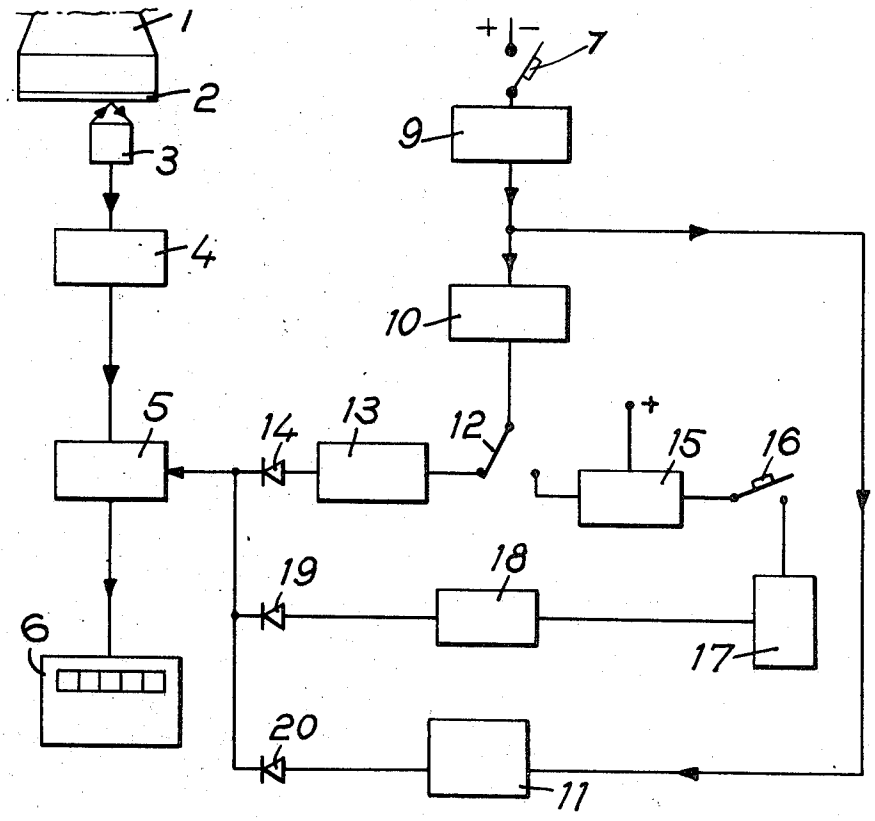
Primary Examiner—Wm. Carter Reynolds

Attorney—Marshall Yeasting

[57] **ABSTRACT**

The invention relates to a method of and device for displaying the length of yarn used in making a given number of stitches on a knitting machine. With regard to the dimensions of the device microswitches are set to be activated at an interval of time during which the machine knits a selected number of stitches different from said given number. Electrical pulses are generated as the yarn is fed and are counted during the interval between activation of the microswitches. The length of yarn used in making the given number of stitches is displayed on the counter.

9 Claims, 3 Drawing Figures



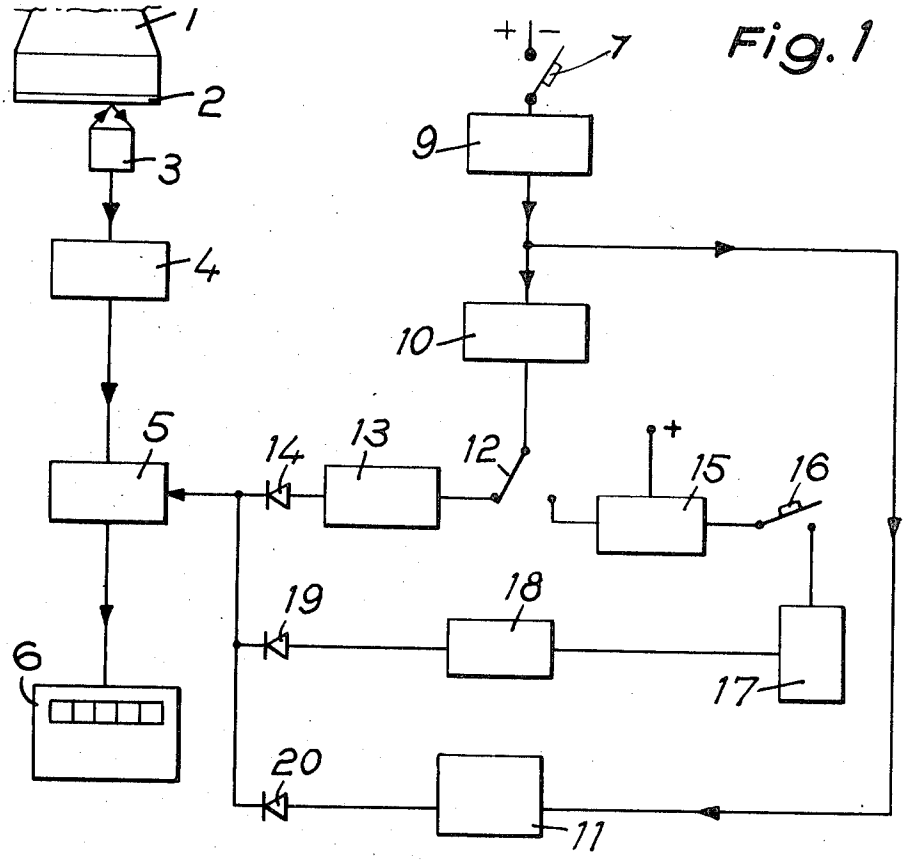


Fig. 1

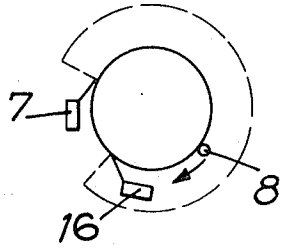


Fig. 2a

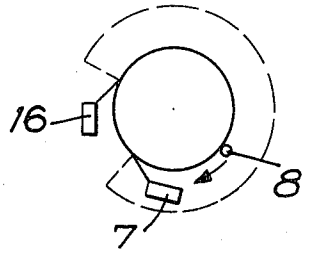


Fig. 2b

DEVICE FOR THE AUTOMATIC MEASUREMENT OF THE LENGTH OF YARN CONSUMED IN KNITTING MACHINES

The present invention relates to a method of and a device for the automatic measurement of the length of yarn consumed in knitting machines, particularly hosiery knitting machines.

The length of yarn used in knitting machines can be estimated by measuring yarn withdrawal velocity from the bobbin with a tachometer, or by measuring the yarn used by the machine during one or more revolutions of the machine.

The second method is more common, particularly when a positive feeder, that is a means supplying to the machine a length of yarn per revolution which is equal to its circumference, is used. The number of revolutions of the positive feeder is a measure of the consumption of yarn for a given number of machine revolutions.

Known devices for this method count the number of revolutions of the positive feeder which occur during a given number of revolutions of the machine in the case of a circular knitting machine for example, or on one row in two in the case of knitting machines of the Cotton type.

The main disadvantages of these devices is that the integrator does not directly give the length of yarn used per stitch.

According to one aspect of the present invention there is provided a method of measuring the length of yarn used in a given number of stitches on a knitting machine, said method including the steps of generating a number of electrical pulses said number being related to the length of yarn passed to the machine, and supplying said pulses to a counter while a preselected number of stitches are made by the machine, said preselected number being different from said given number, whereby said counter gives a direct reading of the length of yarn used in said given number of stitches.

According to a second aspect of the present invention there is provided a device for measuring the length of yarn used in a given number of stitches by a knitting machine including a feeder rotated in accordance with the movement of the fed yarn, a pulse generator for generating a number of electrical pulses in accordance with the length of yarn fed, a counter connected thereto via an output element, a first microswitch actuatable on operation of the machine to pass a pulse via a first circuit to the output element and a preselection counter and a second microswitch actuatable on operation of the machine and located in a second circuit between the preselection counter and the output element, whereby a pulse from the first circuit causes the output element to pass pulses to the counter and a pulse from the second circuit causes the output element to cease passing pulses to the counter.

In considering the invention it should be noted that for a given operation of measuring using as data the number of revolutions of a feeder and the number of stitches made, the following equation holds:

Length in mm. of yarn for 100 stitches, $L = (B \times n)/N \times 100$ 1

where:

B = circumference of the feeder in mm.;

n = number of revolutions effected by the feeder during counting;

N = number of stitches knitted during the measurement or metering operation.

Therefore, if the numerical ratio between the latter number and the circumference of the positive feeder is known the number of stitches made during a measuring operation can be controlled to give, on the counter, a figure corresponding to the length of yarn used in, for instance, 100 stitches.

Thus, if, for instance, the number N representing the stitches knitted during the measurement has a numerical value equal to 10 times that of the circumference of the positive feeder, equation (1) becomes:

$$L = 10\,n \qquad 2$$

If there are, for instance, ten pulses from the pick-up for each revolution of the feeder, then the number of pulses counted is the length of yarn used in 100 stitches.

In the case of circular knitting machines, the number of stitches knitted per revolution is not identical for each of the machines utilized. For each type of machine, the measurement will therefore have to be made on at least one single revolution plus or minus a part of a revolution, so that the number of stitches knitted during the measurement is equal to N.

In order that the invention may be more clearly understood, the following description is given, merely by way of example, with reference to the accompanying drawings in which:

FIG. **1** is a general diagrammatic view of a device according to the invention;

FIGS. **2***a* and **2***b* are diagrammatic views of the positions of the microswitches in the device relative to the knitting machine.

As illustrated in FIG. **1**, the device includes a yarn feeder **1** to the knitting machine, having a disc **2** attached thereto. The disc **2** has a given number of sectors which are alternately clear or reflective and dark or non-reflective. Non-reflective sectors are obtained by depositing, for example, matt black paint at the appropriate places. The disc **2** is illuminated by a small lamp (not shown) incorporated in a pick-up **3** which also contains a photoelectric cell to pick up light reflected from the disc **2**. When a non-reflective sector is illuminated little light is reflected compared to the case where a reflective area is illuminated, so that a succession of electrical pulses are issued by the photoelectric cell. The pulses from the pick-up **3** are amplified and shaped in the circuit **4** and are then directed to an integrator **6** via an output element **5**. The output element does not pass pulses when it is activated.

A microswitch **7** is closable by a means such as a dog **8** rotating on the knitting machine (FIGS. **2***a* and **2***b*), rotatable once with each circuit or row knitted. One of the contact studs of the microswitch is connected to a positive voltage source, and the switch is adapted to supply an electrical pulse each time the dog actuates it. The pulse is shaped in a circuit **9** and fed both to a preselection counter **10** and to an intermediate element **11** which deactivates the output element **5**.

A two way switch **12** is connected to the output of the preselection counter **10**. In one of its positions the switch **12** connects the preselection counter **10** to an intermediate element **13**, for example a thyristor, which is connected to the input of the output element **5**

via a diode **14**. The purpose of the intermediate element is to activate or deactivate the output element **5**.

In its second position the two way switch **12** connects the preselection counter **10** to a further intermediate element **15** which is connected to a microswitch **16**. The microswitch **16** is also adapted to be actuated by the dog **8** on the knitting machine. The intermediate element **15** is also connected to the positive terminal of a voltage source. The microswitch **16**, when closed, transmits a pulse to a shaper circuit **17** connected in series to a control element **18**, for example a flip-flop, the output terminal of which is connected via a diode **19** to the output element **5**. The preselection counter **10** may be set to transmit the first or a subsequent pulse received from the shaper **9**. If it does not pass a pulse then no pulse flows from intermediate element **15**, which may be a thyristor, when switch **16** is closed. The counters **6** and **10** may be reset by hand at the end of each counting operation in accordance with conventional practice.

The device operates as follows with respect to circular knitting machines. In this description it is assumed that *B*, the circumference of the feeder **1**, is numerically equal to 132 units of length. If therefore *N*, the number of stitches measured is again 10 times this number, it is necessary to carry out a measurement of the yarn used in 1,320 stitches. This will give a value of the yarn used per 100 stitches (in terms of the same length units as *B* is measured in) of $10n$, where *n* is the number of revolutions of the feeder during measurement (equation 2). Clearly, therefore, if the disc **2** to the feeder has twenty sectors, half reflective and half not so, it will deliver ten pulses to the photoelectric cell per revolution. Since the circumference of the feeder **1** is 132 units of length, it follows that the length of yarn fed per pulse is 13.2 units. In order that the number of pulses passed during measurement may be a direct indication of the number of units of length of yarn used per 100 stitches, the measurement is carried out over a number of stitches equal to 100 times the number of units of length of yarn fed per pulse, i.e. 1,320 stitches. The number of pulses passed to the integrator **6** during the making of 1,320 stitches is, in these circumstances, equal to the length of yarn used in making 100 stitches. Under these conditions, if the knitting machine knits more than 1,320 stitches per revolution the arrangement of the microswitches **7**, **16** should be as shown in FIG. **2***a*.

In operation, a no-load of open circuit setting is first effected, i.e., the intermediate element **15**, the shaper circuit **17** and the control element **18** are put out of circuit, and the preselection counter **10** is connected to the intermediate element **13** by means of the switch **12**. It is the object of this first setting to enable the respective positions of the microswitches **7** and **16** to be set by hand, such that the machine knits 1,320 stitches between the time the dog **8** contacts the switch **7** and the time when it contacts the switch **16**. Such positions of the microswitches **7** and **16** having been established, the position of the two way switch **12** is reversed so that the preselection counter **10**, on which the numeral **1** is displayed, will pass the first pulse from shaper **9** to the intermediate element **15**.

Before the dog **8** energizes the microswitch **7**, the output element **5** is activated and the pick-up **3** pulses do not pass. When the dog **8** energizes the microswitch **7**, the pulse produced and converted in the shaper circuit **9** is fed simultaneously to the preselection counter **10** and the intermediate element **11** which deactivates the output element **5**, the consequence of this being to permit passage of the pulses derived from the pick-up **3**, which are counted at the integrating counter **6**.

When the dog **8** energizes the microswitch **16**, i.e., when the knitting machine has knitted exactly 1,320 stitches, the output element **5** is re-energized, and no further pulses from the amplifier and the shaper circuit **4** reach the counter **6**. The number displayed at the counter **6**, in this case, directly indicates the length of yarn consumed by 100 stitches.

If, as opposed to the above situation the knitting machine knits less than 1,320 stitches per revolution, but more than 660, for example 700 stitches, a different arrangement of the switches must be used. More than one revolution of the machine must occur in the counting period. On the first revolution 700 stitches will be made, and the time for a further 620 stitches must be added to bring the total to 1,320. As shown in FIG. **2***b* the microswitches **7** and **16** are positioned so that the machine knits 620 stitches while the dog moves between the switches on the second revolution. Thus, on the first revolution the dog energizes switch **7** with the result that the output element **5** is deactivated and pulses from the pick-up **3** pass to the counter **6**. The dog does not cause the switch **16** to generate a pulse on the first revolution, but on the second revolution it energizes the microswitch **16** which stops the measurement. Thus, the counter **6** shows the length of yarn consumed for 100 stitches. The preselection counter **10** is in this case set to **2** in order that the second pulse from shaper **9** passes to element **15**, so that the counter can proceed for more than one revolution.

It will thus be clear that, with this method and device, it is possible to directly ascertain the length of yarn used up per stitch, whatever the type of feeder with which the knitting machine is equipped. If the knitting machine knits 400 stitches per revolution, the measurement should be effected on three revolutions plus 120 stitches.

The device may be fitted on a non-circular knitting machine of the Cotton type, wherein the feeder effects one linear travel per knitted row, the measurement then being effected either on $n/2$ successive rows or on *n* rows of the same direction (n being the number displayed on the preselection counter).

It is important to point out that the present apparatus may be used on knitting machines equipped with feeders of a type differing from that as shown, or on knitting machines not equipped with feeders. The pick-up means will then be by a small wheel or roller of known perimeter, entrained by the yarn, the rotation thereof being measured by the process described hereabove.

The number *N* of stitches on which the measurement is effected (in this case as described 1,320) is, as has been shown, linked with the perimeter of the feeder or of the metering wheel. If the said perimeter should vary, the number *N* will be required to vary accordingly.

We claim:

1. A device for measuring the length of yarn used in a given number of stitches by a knitting machine, said device comprising in combination:

a. a feeder rotated by said yarn

b. a pulse generator for generating pulses as said feeder rotates

c. an output element connected to said pulse generator

d. a counter connected to said output element

e. first and second microswitches actuatable on operation of the machine

f. a first circuit between said first microswitch and said output element

g. a preselection counter connected to said first microswitch, and adapted selectively to pass a selected pulse

h. a second circuit including said second microswitch connecting said preselection counter to said output element

whereby a pulse from said first circuit to said output element causes said output element to pass pulses from said pulse generator to said counter and a pulse from said second circuit to said output element causes said output element to cease to pass pulses from said pulse generator to said counter.

2. A device as claimed in claim 1 further comprising a disc attached to said feeder, and alternate reflective and non-reflective segments to said disc.

3. A device as claimed in claim 2 wherein said pulse generator comprises a light source and a photocell adjacent said disc to pick up light reflections from said reflective segments of said disc.

4. A device as claimed in claim 1 further comprising a member to said machine rotatable with said machine, and a dog on said member to actuate said microswitches.

5. A device as claimed in claim 4 wherein said microswitches are adjustable to be actuated by said dog at different intervals.

6. A device as claimed in claim 1 further comprising a third circuit including an intermediate element and a diode connected to said output element and a two way switch connected to said preselection counter and switchable to connect said preselection counter respectively

a. to said second circuit or

b. to said third circuit.

7. A device as claimed in claim 6 wherein said intermediate element is a thyristor.

8. A device as claimed in claim 1 further comprising a function selector and a diode in said first circuit.

9. A device as claimed in claim 1 wherein said second circuit additionally comprises an intermediate element energizable by a pulse from said preselection counter, and a control element and a diode.

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