Nov. 10, 1970 L. UPSHUR 3,539,782

APPARATUS FOR MEASURING THE LENGTH OF YARN OR THE LIKE CONSUMED IN A PREDETERMINED NUMBER OF CYCLES OF A CYCLICALLY OPERATED MACHINE SUCH AS A TRICOT KNITTING MACHINE

Filed Feb. 16, 1967 2 Sheets-Sheet 1

Fig. 2.

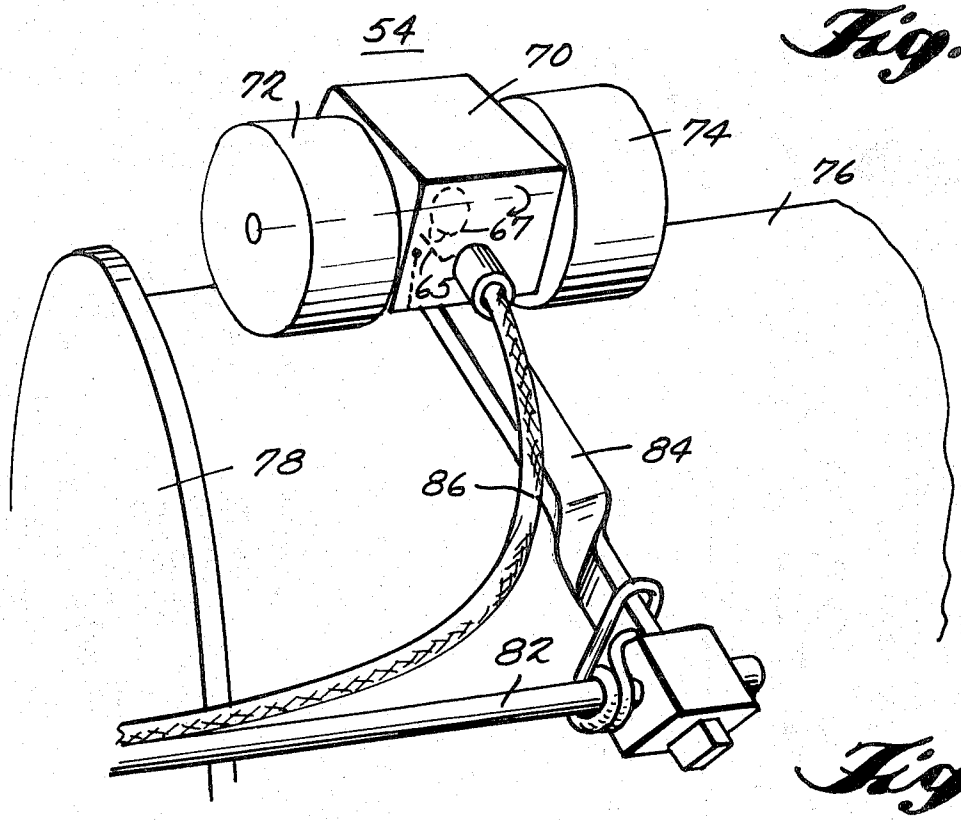
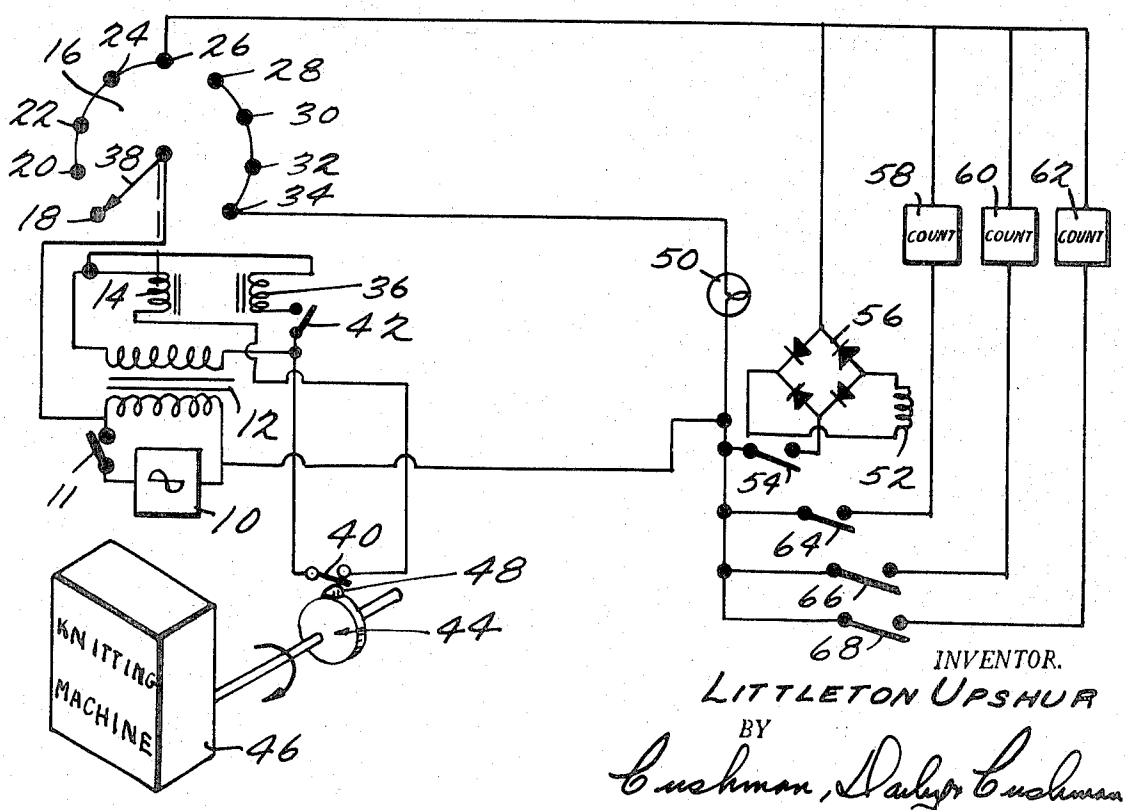


Fig. 1.



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2 Sheets-Sheet 2

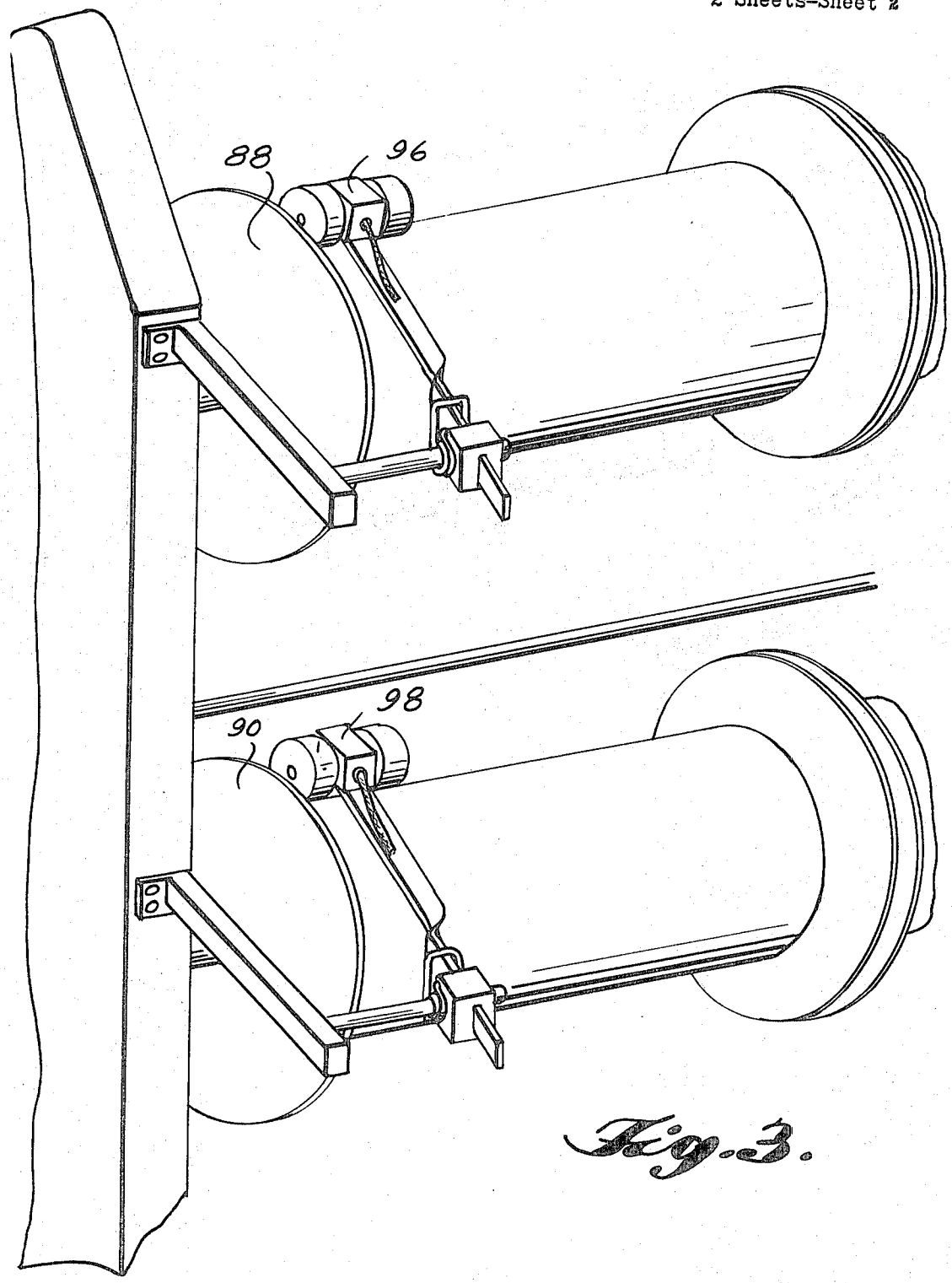


Fig. 3.

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13 Claims

ABSTRACT OF THE DISCLOSURE

An apparatus for measuring the length of yarn consumed in a predetermined number of operational cycles of a textile machine. For instance, if it is desired to measure the length of yarn consumed in knitting 960 courses of fabric on a tricot knitting machine and if 240 courses are knitted for each cycle of the machine, a stepping relay is provided in accordance with one aspect of the invention, whereby a counting device is connected to an appropriate source of electrical power by the stepping relay for four steps of the relay, the relay being stepped in response to each cycle of the machine. Thus, the counter will be connected to the electrical power source for a total of 960 courses. The length of yarn consumed in knitting 960 courses will be measured because of an impulser switch consisting of a pair of contact points which are closed by a cam driven by a pair of wheels of known diameter in friction contact with the yarn on the beam. The cam and wheel are arranged so that one contact closure occurs for each inch of linear movement of the periphery of the wheel. Since the impulser switch assembly is connected in circuit with the counter and since electrical power is supplied to the counter through the impulser switch assembly for a period of time corresponding to the amount of time required to knit 960 courses of fabric, the counter will register the total length of yarn consumed in knitting 960 courses.

This invention relates to improved apparatus for measuring the length of yarn consumed in a predetermined number of cyclic operations of a textile machine; and in particular, the invention relates to improved apparatus for determining the length of yarn supplied from each beam which is fed into a given number of courses of fabric on a textile machine such as a knitting machine.

It is thus a primary object of this invention to provide improved apparatus for measuring the length of yarn consumed in a predetermined number of cyclic number of operations of a textile machine.

It is a further object of this invention for providing improved apparatus for sensing the length of yarn drawn from a rotating beam of yarn.

It is a further object of this invention to provide improved apparatus for determining the length of yarn consumed in a predetermined number of cyclic operations

of a textile machine and for indicating the completion of the measurement.

It is a further object of the invention to provide improved apparatus for measuring the length of yarn drawn from a plurality of beams associated with a cyclically operating textile machine.

Other objects and advantages of this invention will become apparent upon reading the appended claims in conjunction with the following detailed description and the attached drawings, in which:

FIG. 1 is a schematic diagram of the circuitry employed in one illustrative embodiment of the invention;

FIG. 2 is a pictorial representation of an impulser switch assembly employed in conjunction with a beam of yarn to sense the length of yarn drawn from the beam; and

FIG. 3 is a pictorial representation of a plurality of impulser switch assemblies when respectively employed with a plurality of beams.

Reference should now be made to FIG. 1 which schematically illustrates one embodiment of the invention, it being understood that the use of like reference numerals in the different figures of the drawing apply to like parts. A source of electrical power **10** is connected to the primary winding of transformer **12**. Typically, source **10** is the 24 volt AC power which is often available on a tricot knitting machine. The secondary winding of transformer **12** is connected across the stepping coil or stepping relay input **14** of stepping relay or multi-stable means **16** which has contacts or terminals **18**, **20**, **22**, **24**, **26**, **28**, **30**, **32** and **34** where contacts **20–26** and **28–34** are respectively electrically connected together as shown in the figure. Reset coil **36** is provided to cause armature **38** of the stepping relay **16** to return to the initial position **18**, the reset coil being energized upon the actuation of reset switch **42**.

Electrical power is applied to stepping coil **14** whenever switch **40** closes, this switch being under the control of a cam **44** on the tricot knitting machine **46**, the cam making one revolution per 240 courses, for example, knitted. The cam **44** is provided with a short lobe **48** which causes switch **40** to be closed for a short time each revolution. The closing of switch **40** energizes or applies switching signals to the stepping coil **14**, causing the armature **38** to step clockwise to the next contact of the stepping relay **16**. Thus, for each 240 courses knitted by the machine **46** the armature **38** is moved to the next contact point. Indicator lamp **50** signals the completion of the measurement when armature **38** is stepped to contact **28**.

Counter **52** is indicated by a coil and switch assembly **54** is representative of an impulser switch assembly which will be described in more detail hereinafter. Switch **54** closes every time a predetermined length, for example one inch, is drawn from the beam associated with counter **52** and switching assembly **54** and fed to the tricot knitting machine **46**. When armature **38** is connected to one of the contacts **20–26**, an electrical impulse is generated each time switch **54** closes, thereby pulsing counter **52**. The counters **52**, shown in FIG. 1, are made for DC operation and therefore the bridge rectifier circuit **56** is employed.

Whenever more than one beam is associated with the tricot knitting machine **46** a plurality of counters such as counters **58–62** must also be provided, each of the counters corresponding to one of the beams associated with the tricot knitting machine **46**. Thus, in FIG. 1 there are four beams associated with knitting machine **46** and thus the four counters **52**, **58**, **60** and **62** are respectively provided. Impulser switch assemblies **64–68** are respectively associated with counters **58–62**.

Reference should now be made to FIG. 2 where the relation of the impulser switch assembly **54** with respect to a beam of yarn is pictorially shown. The impulser switch assembly consists of a switch **65** diagramatically indicated in box **70**, the contacts being closed by a cam **67** also diagrammatically indicated in box **70**. The cam, in turn, is driven by one or both of the wheels **72** and **74** which are held in friction contact with the arm **76** on beam **78** by appropriate tension means or by the weight of impulser switch assembly. The impulser switch assembly is connected to the beam frame by rods **82** and **84** while the wire connection to the counter is shown at **86**. Of course, various means for maintaining the wheels **72** and **74** in friction contact with the yarn will be obvious to those having ordinary skill in the art.

The cam **67** and wheels **72** and **74** are arranged so that one contact closure of switch **65** occurs for each inch of linear movement of the periphery of the wheel **72** or **74**. The impulser assembly is positioned on the yarn beam with the wheel resting on the yarn so that the revolving of the beam causes the impulser wheel to rotate at the same surface speed as a point on the surface of the yarn of the beam. Since the revolving of the beam is caused by yarn being pulled into the machine, the impulser switch assembly produces one contact closure for each inch of yarn fed into the knitting machine. Of course, other lengths than the inch may be employed. Further, the impulser switch assembly described above is commercially available, this aspect of the invention consisting of the use of such a commercially available impulser switch unit with a beam of yarn to sense and cause electrical pulses to be transmitted for each inch or other predetermined length of material drawn from the beam **78**.

Reference should now be made to FIG. 3 which shows a plurality of beams **88** and **90**, both of which feed the tricot knitting machine **46**, shown in FIG. 1. As can be seen, impulser switch assemblies **96** and **98** are respectively associated with each of the beams **88** and **90**.

The operation of the apparatus in accordance with this invention as an operating knitting machine will now be described. After the impuser switch assembly is first positioned on the yarn beam with the wheels resting on the yarn, the impulser switches close every inch all of the time irregardless of whether or not the device of the present invention is in operation. With the knitting machine operating and when it is desired to make a check of the length of yarn fed into 960 courses, power switch **11** is closed and reset switch **42**, see FIG. 1, is also closed, thereby energizing reset coil **36** from the secondary winding of transformer **12**. This resets the armature **38** of stepping relay **16** to contact **18**. Not until lobe **48** momentarily contacts switch **40** is there any electrical power applied through stepping relay **16** to the counters **52**, **58**, **60** and **62**. The remainder of the description of the operation will be with respect to counter **52** since the operation of counters **58-62** and their associated impulser switch assemblies **64–68** is the same as that for counter **52** and its associated impulser switch assembly **54**.

Thus when lobe **48** of cam **44** contacts switch **40**, armature **38** is stepped to contact **20** of stepping relay **16**.

Since the impulser switch assembly **54** causes its contacts to momentarily close for every inch of yarn drawn from its associated beam, impulsive electrical power will

be applied to counter **52** from the primary transformer **12** through stepping relay contact **20** and switch assembly **54** when the first inch of yarn is drawn from the beam. Thus, a first count will be registered for counter **52** which, of course, corresponds to the fact that one inch of yarn has been drawn from its associated beam. The total number of counts registered by counter **52** will correspond to the number of inches drawn from the beam.

Assuming that 240 courses of fabric are knitted by machine **46** for each revolution of the cam **44**, the lobe **48** will cause the switch **40** to again momentarily close when 240 courses have been knitted thereby energizing stepping coil **14** from the secondary winding of transformer **12**. Hence, the armature **38** will move to contact **22**. Since contact **22** is also connected to the counter **52** through impulser switch assembly **54**, the measurement of the length of yarn drawn from the beam continues. Since contacts **24** and **26** are also connected to counter **52**, the counter continues to register the length of yarn drawn for two further revolutions of the cam or for a total of 960 courses of fabric knitted by machine **46**. When a further revolution of the cam causes the armature **38** to move to contact **28**, power is removed from the counter **52**. As this occurs precisely at the end of four complete revolutions of the cam, the counter ceases to count when 960 courses have been knitted. At the same time, power is applied to indicator light **50**, which indicates completion of the measuring operation. Unless the power switch is turned off, the armature continues to step to subsequent contacts with each rotation of the cam, until a mechanical stop is reached, said mechanical stop being a standard feature of the stepping relay. Indicator lamp continues to burn, since all contacts following contact **28** are connected to it.

This measurement or count remains displayed to be read at any subsequent time. Further, indicator lamp **50** shows that the measurement has been completed and is ready to be read, lamp **50** being energized through any one of the contacts **28–34** of stepping relay **16**, as shown in FIG. 1. Although in the operation described above, the circuitry is arranged to register the number of inches consumed in 960 courses of fabric, it will of course be obvious that a simple change in the connection of the contact points **20–34** of stepping relay **16** can be made to cause the circuit to count any multiple of 240 courses. Thus, if it were desired to measure the number of inches consumed, in knitting 1440 courses of fabric, contacts **20–30** would be electrically connected together and separated from contacts **32** and **34** which would also be connected together.

Transformer **12** is employed in the circuit of FIG. 1 because stepping relays are generally available for 115 volt AC operation and, thus, transformer **12** steps up the 24 volt AC power available on the tricot machine to the 115 volts required for stepping relay **16**. However, in some applications it may be feasible to supply the circuit in FIG. 1 with 115 volts power. In this situation, the transformer **12** would be eliminated. The counters **52**, **58**, **60** and **62** would, of course, also be suitably selected for 115 volt operation, thereby eliminating any need for two power sources.

The counters **52**, **58**, **60** and **62** run from DC power, as shown in FIG. 1. Where several counters are in parallel, as shown in FIG. 1, it is preferable to use a rectifier circuit for each counter as this permits the impulser switches to carry AC current, thereby eliminating arcing problems which may arise if these switches were operated with DC current.

As would be obvious to those having ordinary skill in this art, the circuits and apparatus described hereinbefore may be adapted to other types of cyclically operated machinery where it is desirable to measure the length of yarn or other material fed thereto for a predetermined number of cycles of operation of the machinery. It is only necessary to obtain a suitable arrangement for obtaining

a momentary closure of switch 40 each time one of the cycles of the machinery occurs.

Still numerous other modifications of the invention will become apparent to one of ordinary skill in the art upon reading the foregoing disclosure. During such a reading, it will be evident that this invention has provided a unique apparatus and circuitry for accomplishing the objects and advantages herein stated. Still other objects and advantages, and even further modifications will be apparent from this disclosure. It is to be understood, however, that the foregoing disclosure is to be considered exemplary and not limitative, the scope of the invention being defined by the following claims.

What is claimed is:

1. Apparatus for measuring the length of material consumed in a predetermined number of cycles of a cyclically operated machine such as a tricot knitting machine, said apparatus comprising,

multiple state means capable of existing in a multiple number of stable states, said multi-stable means being successively switched to each of its stable states in response to sequential switching signal being applied thereto, each of said stable states having associated therewith an output terminal and said multi-stable means having an input terminal,

means for generating one of said switching signals each time said machine executes one of said cycles,

counting means responsive to impulsive signals for registering a count corresponding to the measurement of the said length of material,

means for generating one of said impulsive signals each time a predetermined length of material is fed to said machine and for transmitting that impulsive signal to said counter when said multiple state means is in one of a plurality of said states less than all of said states, said plurality not including the first of said stable states,

indicating means responsive to at least one of said states which is not said first state and not in said plurality of states so that, when said multiple state means is switched to said the output terminal associated with said one state, said indicating means will signal the completion of said measurement, and

means for resetting said multiple state means to said first state after the completion of said measurement.

2. Apparatus, as in claim 1, where said multistable means is a stepping relay.

3. Apparatus, as in claim 1, where said means for generating said switching signals includes an electrical power source and means for momentarily connecting said electrical power source to said multistable means each time said machine executes one of said cycles.

4. Apparatus, as in claim 3, where said means for momentarily connecting said electrical power source to said multistable means includes a switch and a cam driven by said machine, said cam having a short lob thereon so that said switch is closed each time said machine executes one of said cycles.

5. Apparatus, as in claim 4, where said means for generating said impulsive signals includes means for momentarily connecting said electrical power source to said counter means through at least one of the output terminals of said multistable means each time a predetermined length of said material is fed to said machine.

6. Apparatus, as in claim 4, where said means for momentarily connecting said electrical power source to said counter means each time a predetermined length of material is consumed by said machine includes at least one wheel in friction contact with the material on said beam whereby a point of said material moves at the same speed as a point on the wheel, so that a pair of electrical contacts between said electrical power source and said counting means are closed each time said predetermined length of material is drawn from the beam and consumed by the machine.

7. Apparatus for measuring the length of material consumed in a predetermined number of cycles of a cyclically operated machine such as a tricot knitting machine, said apparatus comprising,

a source of electrical power,

multiple state means capable of existing in a multiple number of stables states, said multi-stable means being successively switched to each of its stable states in response to sequential switching signals being applied thereto, each of said stable states having associated therewith an output terminal and said multi-stable means having an input responsive to said electrical power source,

means responsive to said machine for momentarily connecting said electrical power source to said multistable means input and thereby generating one of said switching signals each time said machine executes one of said cycles,

counting means connected in circuit with multi-stable means,

means for momentarily connecting said electrical power source to said counter means through at least one of the output terminals which is not the first of said stable states of said multiple state means each time a predetermined length of said yarn is fed to said machine, and

means for resetting said multiple state means to said first state after the completion of said measurement.

8. Apparatus, as in claim 7, where at least one of the output terminals of said multistable means is not connected in circuit with said counting means so that, when said multistable means is switched to the stable state corresponding to said last-mentioned one output terminal, the counting means will no longer register the said measurement of the yarn.

9. Apparatus, as in claim 8, including means responsive to said last-mentioned one output terminal for indicating the completion of said measurement of yarn.

10. Apparatus, as in claim 8, where said multistable means is a stepping relay and where the stepping coil therefor is connected in series circuit with said means for temporarily closing the connection between said electrical power source and said multistable means for each cycle of said machine.

11. Apparatus, as in claim 7, where said counting means includes a plurality of counters and a respective plurality of means for momentarily connecting the counter means to said electrical power source, said plurality of counters being connected in series with its associated means for momentarily connecting the counters to said electrical power source for each predetermined length of yarn consumed by the machine.

12. Apparatus, as in claim 7, where said means for momentarily connection said electrical power source to said counter means each time a predetermined length of yarn is consumed by said machine includes at least one wheel in friction contact with the material on said beam whereby a point of said material moves at the same speed as a point on the wheel, so that a pair of electrical contacts between said electrical power source and said counting means are closed each time said predetermined length of material is drawn from the beam and consumed by the machine.

13. A method of measuring the length of material consumed in a predetermined number of cycles of a cyclically operated machine such as a tricot knitting machine comprising the steps of,

generating a switching signal each time said machine executes one of said cycles,

applying said switching signal to multiple state means having a plurality of stable states each having associated therewith an output terminal so that said mul-

tiple state means is successively switched to each of said stable states,

generating an impulsive signal each time a predetermined length of material is fed to said machine and transmitting that impulsive signal to a counter when said multiple state means is in one of a plurality of said multiple states less than all of said states, said plurality not including the first of said states,

indicating when said multiple state means is in a state which is not said first state or in said plurality of states to signal the completion of said measurement, and

resetting said multiple state means to said first state after the completion of said measurement.

References Cited

UNITED STATES PATENTS

2,828,468	3/1958	Ball et al.	324—78
2,851,596	9/1958	Hilton	250—27
3,171,953	3/1965	Young	235—92

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