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Pugh

[11] **3,840,869**

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[54] **YARN BALLOON DETECTOR FOR CONE OVER CONE LAZY TWIST**

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[73] Assignee: **Burlington Industries, Inc.,** Greensboro, N.C.

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[52] **U.S. Cl.** **340/259,** 57/81

[51] **Int. Cl.** **D01h 13/16,** G08b 21/00

[58] **Field of Search** 340/259; 57/19, 81

[56] **References Cited**

UNITED STATES PATENTS

3,158,852	11/1964	Schacher	340/259
3,562,734	2/1971	Hotchkiss	

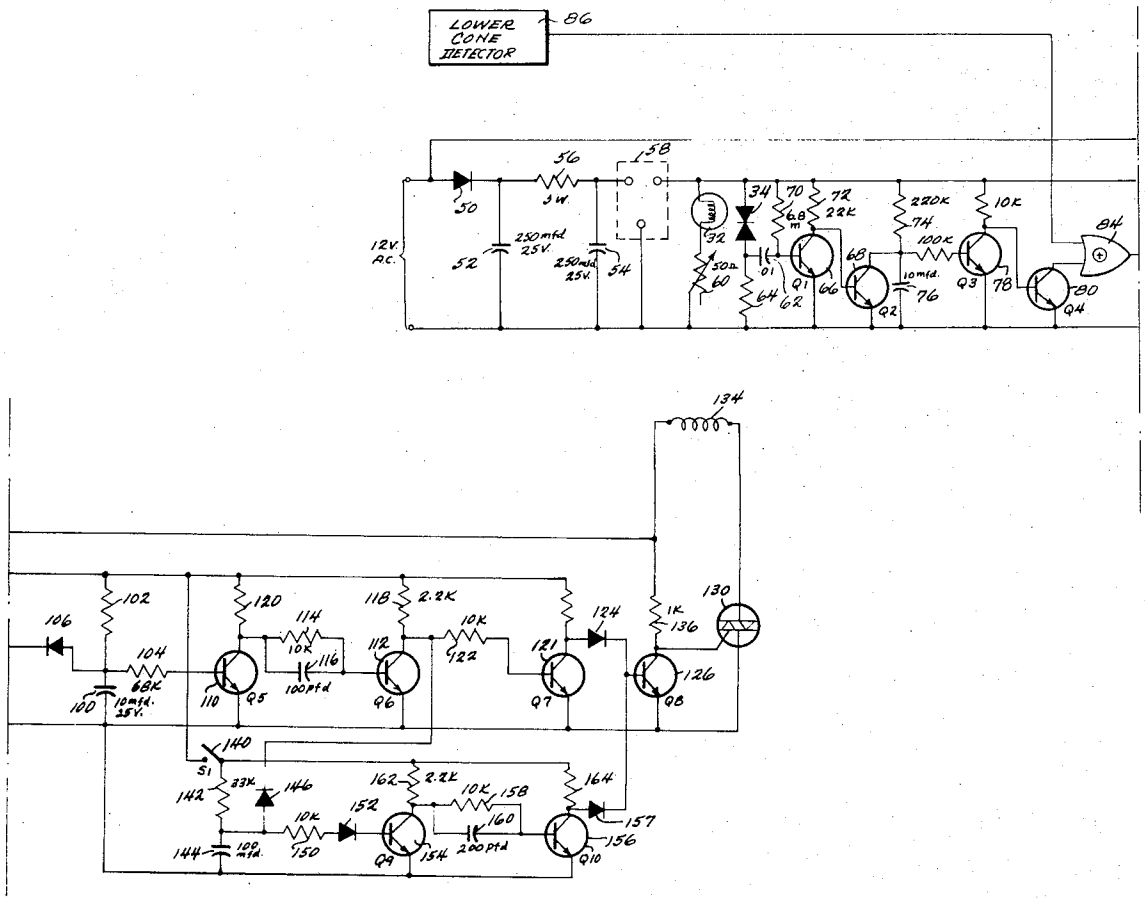
Primary Examiner—Glen R. Swann, III

Attorney, Agent, or Firm—Cushman, Darby & Cushman

[57] **ABSTRACT**

In an apparatus for producing uniformly twisted yarns and detecting the absence of one of the yarn strands being twisted, the two strands move through a passage with one of the strands ballooning and twisting about the other. A light source and photoresistive element are mounted in the passage with the ballooning yarn intermittently blocking the light path between the source and photoresistive element to produce a fluctuating voltage. This fluctuating voltage is applied to a circuit including a blocking capacitor, a pair of darlington connected transistors, a further capacitor connected to the transistor output and a further pair of darlington connected transistors which provide a first output when a fluctuating voltage is applied and a second output when a substantially constant voltage is applied. This output is in turn applied to an exclusive —OR circuit together with a detector signal for another strand. When the output of the exclusive —OR circuit shifts, indicating breakage of one of the twisting strands, an external device is activated to give an alarm or provide a control function. A mementary circuit, which is enabled by a manual switch, causes the external device to be activated for only a short time interval, for example, for looms having solenoids designed to be operated only momentarily. Alternately, the external device can be operated continuously.

18 Claims, 4 Drawing Figures



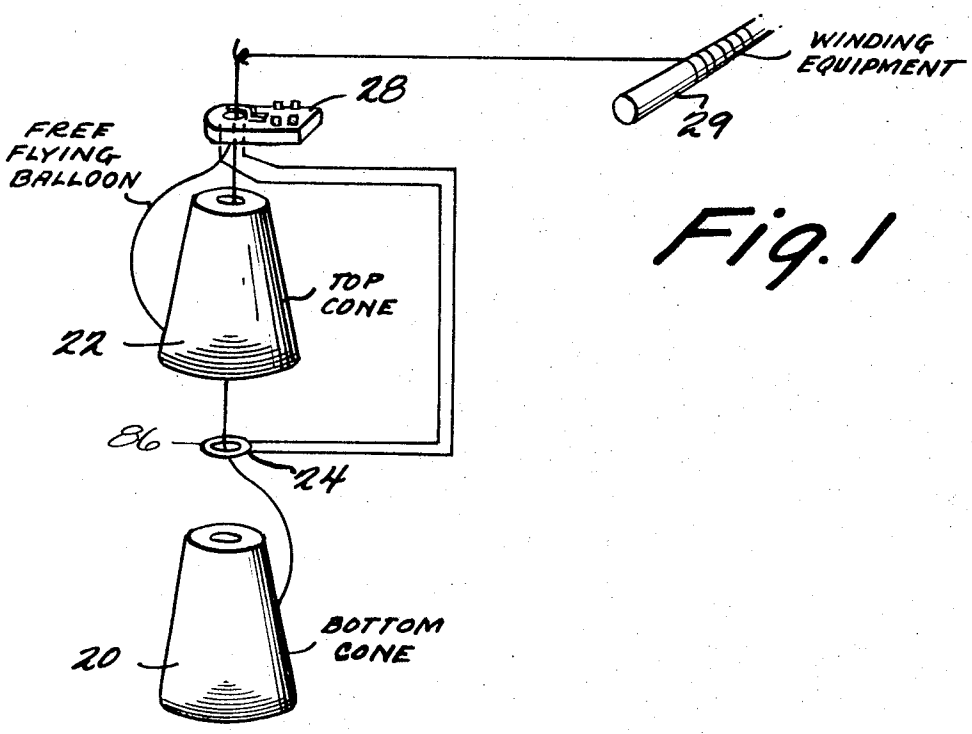

WINDING EQUIPMENT
29
28
FREE FLYING BALLOON
TOP CONE
22
26
24
BOTTOM CONE
20

Fig. 1

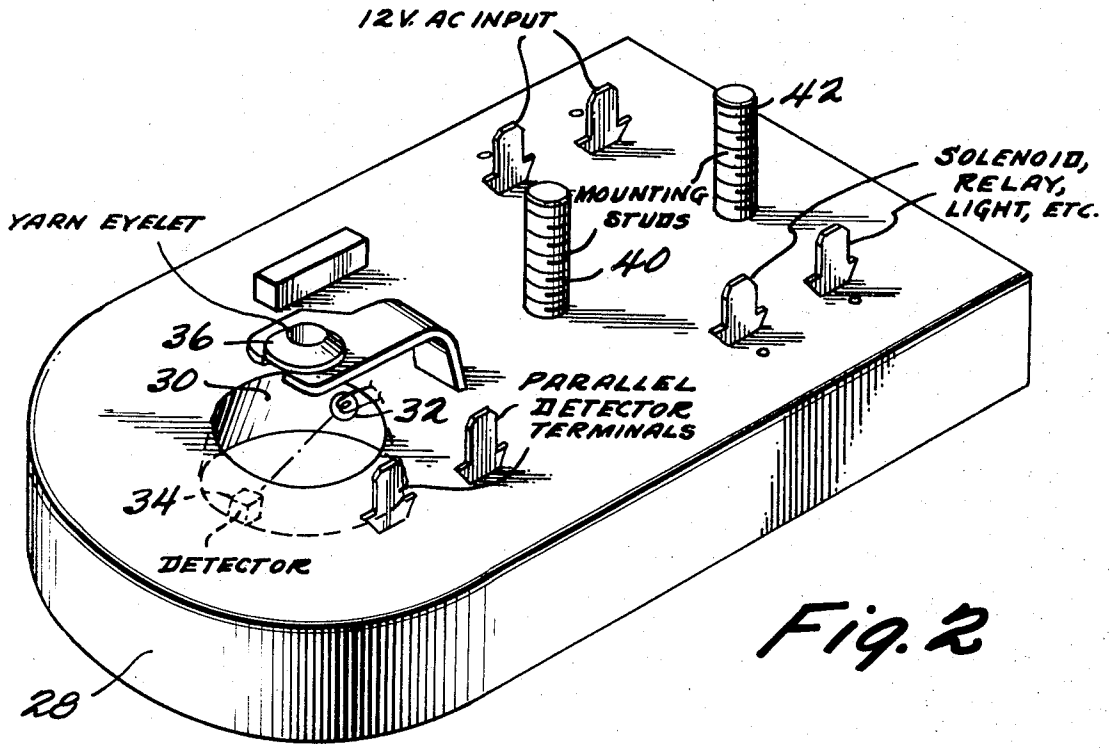

12V. AC INPUT
42
SOLENOID, RELAY, LIGHT, ETC.
MOUNTING STUDS
40
YARN EYELET
36
30
32
PARALLEL DETECTOR TERMINALS
34
DETECTOR
28

Fig. 2

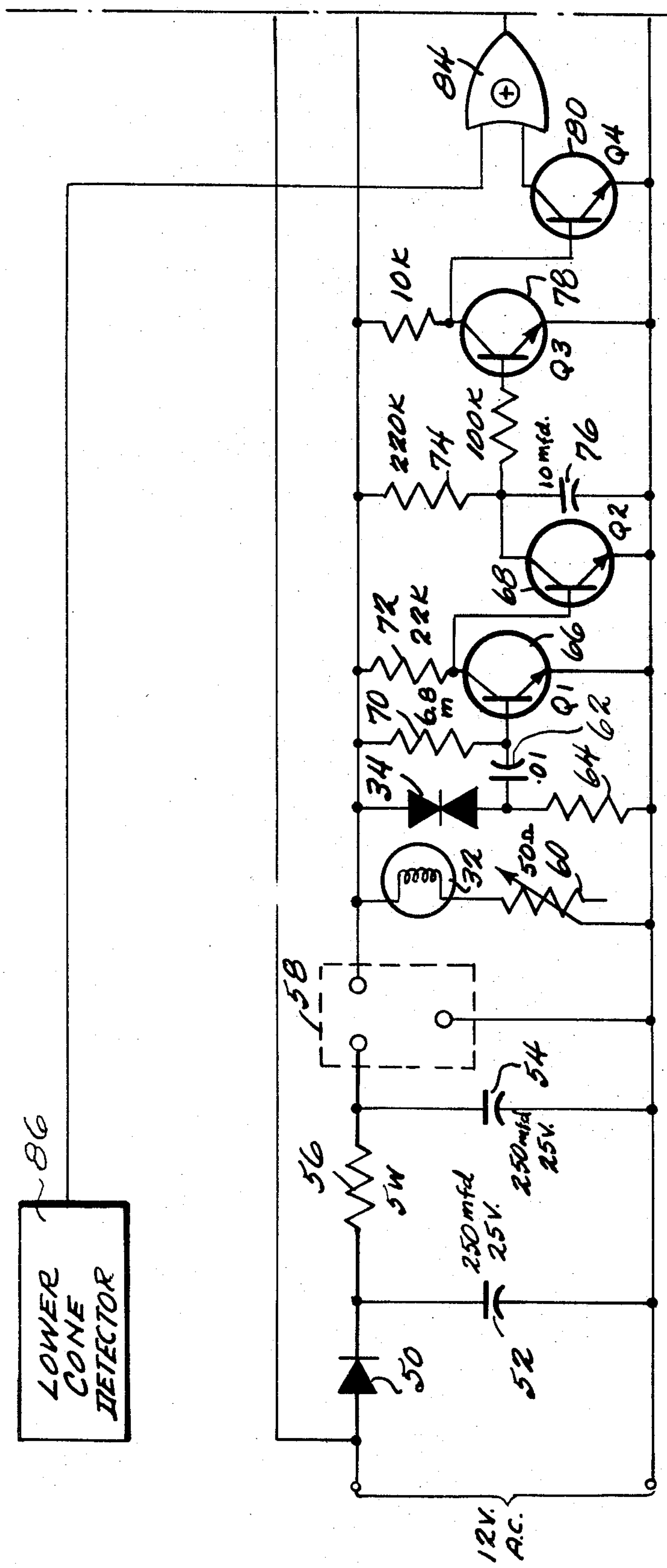

LOWER CONE DETECTOR
86
84
80
Q4
10K
78
Q3
220K
74
100K
10mfd.
76
Q2
68
72
22K
66
Q1
70
6.8 m
.01
64
62
34
32
50Ω
60
58
54
250mfd 25V.
56
5W
250mfd 25V.
50
52
12V. A.C.

Fig. 3

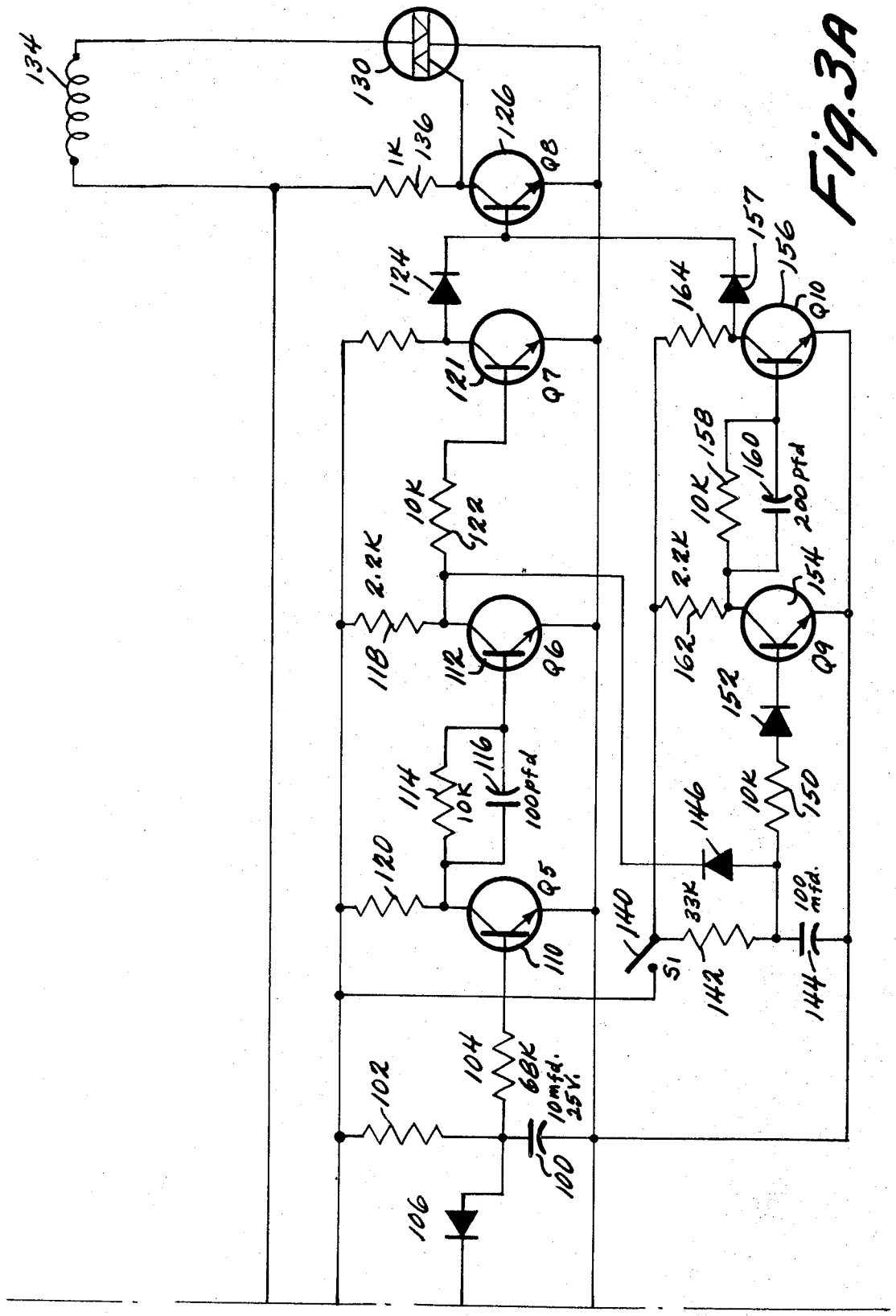

134
130
126
Q8
1K
136
124
121
Q7
10K
122
2.2K
118
112
Q6
114
10K
116
100pfd
120
Q5
110
102
104
68K
10mfd.
25V.
100
106
157
156
Q10
164
158
160
200pfd
10K
2.2K
162
154
Q9
152
146
10K
150
140
S1
33K
142
100
mfd.
144

Fig. 3A

YARN BALLOON DETECTOR FOR CONE OVER CONE LAZY TWIST

BRIEF DESCRIPTION OF THE PRIOR ART AND SUMMARY OF THE INVENTION

The invention relates to a detector and circuit for detecting the presence of a ballooning yarn strand moving through a passage and more particularly an apparatus for operating an exterior device such as an alarm, etc. When either of two strands of yarn, which are being twisted together, has broken.

Two ends of yarn which are plied together, for example, at one-half turn per inch or less, make a desirable filling yarn for various types of woven fabrics. This type of yarn can be produced by one of several different methods.

According to one method now in use, two cones of yarn are plied together on a bobbin on the twister. The bobbin, after it is full, must then be rewound back onto a cone so that the yarn can be woven on a loom. The cone plied yarn can be wound on quills to be run on a conventional box loom, or it can be run on a Unifil winder equipped loom. Operation on a Unifil winder loom is ordinarily more efficient than on a conventional box loom.

According to a second approach, two cones of yarn can be plied together by running one cone of yarn over the other such that the bottom yarn is fed through the hollow center of the top cone. The bottom yarn and the top yarn are then wound simultaneously onto a quill. These two yarns are plied together in a "lazy twist" fashion, since the balloon of the top yarn as it is pulled off the cone causes it to wrap around the bottom yarn which is being pulled to the center of the top cone. The quills containing the "lazy twist" yarn can then be run on a box-type loom. The U.S. Pat. No. 3,146,573 to Jones describes one such technique whereby the two strands pass through a guide ring.

According to a third method, two cones of yarn are also plied by running the bottom yarn through the center of the top cone and then permitting yarn from the top cone to balloon and twist about the yarn from the bottom cone in a "lazy twist" fashion. The two yarns from this "cone-over-cone" operation are then fed directly to a Unifil winder mounted on a loom, and the twisted yarn is directly woven in the fabric without additional and excessive handling. Unifil winders are well known in the textile art.

One difficulty with each of the above three methods is in detecting the breakage of either of the plied yarns during twisting. Unless this breakage is promptly detected and remedied, the quality of these goods deteriorates and the quantity of rejected goods during inspection necessarily rises from the weaving of yarn which has only one rather than two strands. Several techniques have been used in the past to detect ballooning. The U.S. Pat. No. 3,158,852 to Schacher describes a detector which operates by detecting the periodic interruption of the light path between source and detector. A circuit then produces an appropriate signal when ballooning ceases. The U.S. Pat. Nos. to Maurmann 3,440,634, Guri 3,114,233, Stutz 3,298,401 and Hotchkiss 3,562,734 show other yarn detectors. Further, the first method described above, whereby two cones of yarn are simply plied together on a bobbin, has the additional disadvantage that the rewinding operation may not be in the same physical location as the raw yarn or loom, requiring additional handling and shipping which increase substantially the cost of the plied yarn. The second method in which the two yarns are applied by the "lazy twist" approach onto a quill which is then run on a box-type loom has the further disadvantages that box-type looms are in general less efficient than Unifil looms. Transporting the quills to the loom is a time-consuming and costly step. Further, plied yarn does not necessarily twist evenly due to the variable pattern of the natural balloons which is formed by the yarn being wound on the cone.

In general, the third method whereby the twisted yarn is fed to a Unifil mounted on a loom is the least expensive. However, in addition to resolving the variable ballooning which results in uneven twisting, this method is not practical unless the Unifil can be immediately stopped from winding a single end should either end on the top or bottom cone break. Since the yarn is plied and quilled directly on the loom, there is no chance for visual inspection for single ends before the cloth is woven. Weaving single ends, of course, results in cloth which must be rejected, resulting in a considerable and expensive waste.

This invention relates to a system which will prevent single ends from being woven into cloth when the ends are plied at the loom in any of the fashions described above. Further, the detector is provided with a conically converging passage in which the ballooning yarn twists about the yarn moving through that same passage in a fashion which will satisfactorily control ballooning to insure more uniform twist. While the invention can be used with any of the above mentioned approaches, it finds particular utility with the third method.

The balloon is controlled by the edge of the passage which the ballooning yarn first encounters. The uniformity varies as a function of the diameter of the opening which the yarn first encounters, and the distance between the device and the lower cone. According to a further aspect of the invention, a circuit is set forth which will produce a first output to operate an alarm, an external device to automatically cease operation of the loom, etc., whenever a constant input is received, and will permit operation or maintain the alarm inactive as long as an intermittent fluctuating voltage signal is applied as an input. Further, the circuit includes a manually operable switch for either operating the external device momentarily or maintaining that external device operative so long as the input signal remains at a constant value.

Many other objects and purposes of the invention will become clear from the following detailed description of the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates schematically the "lazy twist" method for producing twist yarn and the novel apparatus of this invention whereby the ballooning yarn on the top cone is uniformly twisted about the yarn moving through the center of the top cone and through a passage, and in addition breakages of either of the yarn strands results in a signal being produced which either sounds an alarm, automatically stops the loom or performs any other desired function.

FIG. 2 shows a detailed perspective of the device shown in FIG. 1 for controlling ballooning and producing the signal.

FIGS. 3 and 3A illustrate an electrical schematic of the novel detector circuit of this invention for producing a signal indicating detection of breakage of either of the yarn ends.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Reference is now made to FIG. **1** which illustrates a schematic of the novel apparatus of this invention for producing twisted yarn. As shown, a first cone of yarn **20** is disposed below a second cone of yarn **22** with which it is to be twisted, and the yarns can be held in any suitable fashion so that the yarn will be pulled off the two cones. The cones can be mounted on any suitable framework, including a frame having a rotatable member for receiving the cone with a passage through it for the yarn from the cone below. The yarn from bottom cone **20** is pulled through a ring **24** and balloons freely about that ring. Ring **24** preferably includes a detector for providing an output signal indicating the presence or absence of yarn moving through ring **24.** This detector can be the same type of detector which is described in detail below for detecting the ballooning yarn which moves through device **28.** Alternately, a switch or any other device which does not interfere with the proper movement can be employed.

The yarn passing through ring **24** moves through the hollow center of top cone **22** and through conically shaped passage **30** in device **28** which is described in detail with reference to FIG. **2.** The yarn from top cone **22** likewise passes through the passage **30** in device **28** and spins about the periphery of the lower opening thereof as it is pulled off cone **22** and balloons, twisting about the yarn from cone **20** to provide a uniform twisted yarn which is then wound directly on a device **29** such as a quill, or a Unifil mounted directly on a loom.

The ballooning yarn contacts the periphery of the lower edge which controls the balloons and ensures uniform twist. If desired a single ring of limited height could be substituted for device **28.** A diameter of one and one half inches with a distance of seven inches between the lower edge of passage **30** and the top of cone **22** has been found to produce satisfactory uniformity for most cone sizes and speeds. Too large a diameter or too small a diameter will not produce uniform twisting.

As discussed above, it is important that the twisting which results from the ballooning yarn from cone **22** be controlled and uniform. It is important that any breakage or absence of one or the other of the yarns from cone **20** or **22** be immediately detected, particularly if the yarn is being wound directly on a Unifil and thereafter directly woven into cloth. To insure uniform twisting, it is important that any detector which is used to sense the presence or absence of the ballooning yarn not in any way affect ballooning in any fashion which will result in an uneven twist.

To minimize stoppages for changing yarn, one or more additional cones can be mounted below cone **22** with their ends tied together. When one of the lower cones runs out, the twisting need not stop and the cone can be leisurely replaced with the end of the replacement being tied to the end of one of the others.

Accordingly, the detector which is used for detecting the presence of the ballooning yarn from cone **22** in the embodiment of this invention illustrated in the drawings, includes a light source **32** which is mounted preferably flush within the interior surface of passage **30** and providing a light beam which normally impinges upon a conventional photosensitive detector **34** likewise mounted in passage **30.** A solid state light source has been found to be quite satisfactory and holds up well to the vibrations inevitably present during twisting. Any suitable photosensitive device of the type which displays a resistance which varies as a function of the incident light can be used for the detector. The light beam passing across passage **30** in no way affects the ballooning yarn which is spinning about that passage and wrapping about the yarn from bottom cone **20.** As can be seen in FIG. **2,** the twisted yarns pass through an eyelet **26** before being wound on device **29.**

Device **28** is preferably comprised of an environment hard, molded material such as plastic, and the extent of passage **30** is preferably sufficient to produce satisfactory twisting of the yarn from cone **22** about the yarn from cone **20.** A plurality of contacts are preferably mounted as shown on device **28** for providing the electrical input signals to the detector and also for providing output signals as described in detail below which can then be used to provide an alarm should one of the yarn ends break, to automatically stop the loom or to provide any other control or informational function which is desired. Apparatus **28** can be mounted using mounting studs **40** and **42,** or in any other suitable fashion.

The yarn from cone **22** spinning about the interior of passage **30** periodically interrupts the light beam between source **32** and detector **34,** so that the resistance displayed by detector **34** fluctuates when yarn **22** is present. In the absence of yarn **22,** no substantial fluctuation of that resistance takes place; the resistance will be substantially constant at a value which depends on the extent the light path is blocked by the yarn from bottom cone **20** or will vary slowly about the constant value.

Reference is now made to FIG. **3** which illustrates one electrical circuit which has been found to be particularly advantageous for producing an output signal from the signals provided by detector **34.** An AC signal of roughly **12** volts is half-wave rectified by diode **50** and filtered by capacitances **52** and **54** and resistance **56.** The output of the filter is applied to a conventional power supply circuit **58** which provides a 5-volt DC output of at least one amp.

The output of circuit **58** is applied as shown to the serial connection of light source **32,** and a variable resistance **60** which can be varied to adjust the level of light incident upon the detector. A source furnishing infrared light around 900–950 nanometers in wavelength has been found to be satisfactory.

A photoresponsive device **34** is also serially connected with resistor **64** to the output of circuit **58,** and the resistance of device **34** varies directly as a function of the light from source **32** which is incident upon it. For visible light, a photodiode has been found satisfactory and for infrared light a phototransistor.

A pair of darlington connected transistors **66** and **68** are connected to the junction between detector **34** and resistance **64** by a DC blocking capacitor **62** with the base of transistor **66** also connected to one side of circuit **58** by resistor **70.** The collectors of transistor **66** and **68** are likewise connected to that same side of circuit **58** by resistances **72** and **74.** Whenever photore-

sponsive element **34** remains at a substantial constant resistance, capacitor **62** charges to a value sufficient to maintain transistor **66** in its conductive condition which in turn maintains transistor **68** non-conductive, so that capacitor **76,** which is connected between the collector and emitter of transistor **68,** charges to a level maintaining transistor **78** in its conductive condition which in turn keeps transistor **80** non-conductive and applies a high voltage as one input to a conventional exclusive OR circuit **84,** the functions of which are described in detail below.

When, however, the resistance of element **34** is fluctuating, for example, as the spinning yarn ballooning from cone **22** spins about the interior of passage **30** in FIGS. **1** and **2,** the negative pulses which are generated thusly are applied to transistor **66** via capacitor **62,** causing transistor **66** to intermittently shift from its conductive to its non-conductive state, in turn rendering transistor **68** intermittently conductive so that capacitor **76** discharges to a level sufficient to shift transistor **78** from its normally conductive to its non-conductive condition which in turn shifts transistor **80** into a conductive state applying a low input to exclusive OR circuit **84.** Thus, when a fluctuating signal is received, a first signal is applied to exclusive OR circuit **84,** and when a constant signal is received, be it high or low, a second signal is applied to OR circuit **84.**

The other input to exclusive OR circuit **84** is connected to a detector **86** which, as shown in FIG. **1,** detects the presence of the yarn from the lower cone **20.** Since free ballooning of the yarn from cone **20** is not essential, any type of detector, mechanical, electrical, etc. can be used for detecting the presence of the yarn passing through ring **24.** Detector **86** applies a low signal to exclusive OR circuit **84** whenever that detector detects the presence of the yarn from cone **20** passing through ring **24.**

The exclusive OR circuit produces a low output when both inputs are the same, i.e., when both inputs are high or both low. Thus, should one of the yarn ends break, exclusive OR circuit **84** shifts from a low to a high output condition. When the output of exclusive OR circuit **84** is low, the junction (FIG. 3A) of capacitor **100,** resistor **102,** and resistor **104** is held low by diode **106.** However, should exclusive OR circuit **84** shift to a high output, capacitor **100** begins to charge, raising the potential applied to the base of transistor **110** which together with transistor **112,** resistor **114,** capacitor **116,** resistor **118,** and resistor **120** forms a conventional Schmidt trigger circuit. The Schmidt trigger circuit then shifts its output at the collector of transistor **112** from a low output condition, which is applied to the base of transistor **121** via resistor **122,** to a high output condition and maintains this high output condition so long as the input to transistor **110** remains high.

When a high output is applied to the base of transistor **121,** that transistor shifts into its conductive state applying a low input signal to transistor **126** via diode **124.** Transistor **126** then shifts into its non-conductive state ceasing the application of a low signal to the gate input to triac **130** which is thus rendered conductive via resistor **136** to complete a current path through an external device **134.** External device **134** can be a relay for stopping the motion of the loom, a light, a buzzer, or other alarm for indicating breakage, or any other device for providing a control or informational function.

As mentioned briefly above, the novel circuitry which is shown in FIGS. **3** and **3A** includes a manual switch **140** which, when operated, causes the external device to be operated only momentarily each time the Exclusive OR goes from low to high. When switch **140** remains open, triac **130** remains conductive, activating the external device **134** until the output of exclusive OR circuit **84** shifts to a low condition indicating that both yarns are again being detected moving through their respective rings.

Closing switch **140** connects resistor **142** and capacitor **144** to one side of the output of circuit **58.** The junction of resistor **142** and capacitor **144** is connected by diode **146** to the collector of transistor **112** which normally is conductive so that the junction of resistor **142** and capacitor **144** is normally held at a low voltage which is applied via resistor **150** and diode **152** to transistor **154** which together with transistor **156,** resistor **158,** capacitor **160** and resistors **162** and **164** also forms a conventional Schmidt trigger circuit. Since transistor **154** is normally non-conductive, transistor **156** is normally conductive. A low input signal is not applied to the base of transistor **126,** since diode **124** applied a high signal maintaining transistor **126** conductive and triac **130** non-conductive.

When exclusive OR circuit **84** shifts to its high output condition upon detection of a breakage of one of the yarns, the collector of transistor **112** shifts to a high output, as transistor **112** becomes non-conductive and this causes capacitor **144** to charge and apply a voltage to transistor **154** which causes that transistor to shift into its conductive state and in turn shift transistor **156** to its non-conductive state, applying a high voltage to the base of transistor **126** via diode **157** which renders that transistor conductive which in turn shifts triac **130** to its non-conductive state and ends the current flow to the external device. Transistor **156** maintains transistor **126** conductive until OR circuit **84** shifts back to its low output condition, indicating detection of both strands. The time interval that the external device remains active depends on the time required for capacitor **144** to charge to a level sufficient to shift transistor **154** into its conductive state. Thus, the external device will be operated only momentarily when the switch **140** is manually closed.

Many changes and modifications in the above embodiment of the invention can, of course, be made without departing from the scope thereof. Particularly, any number of cones in a stack can be employed. For a three yarn twist, yarn from a bottom cone can be twisted with a yarn from a cone above it as shown in FIG. **1.** This twisted yarn could be then fed through the center of another yarn cone which is ballooned about it on a device such as shown in FIG. **2.** Any number of yarn strands can be successively twisted in this fashion. Accordingly, this scope is intended to be limited only by the scope of the appended claims.

What is claimed is:

1. Apparatus for producing a plurality of twisted yarn strands of substantially uniform twist comprising:

a first quantity of yarn,

a second quantity of yarn,

means defining a passage through which at least one strand from each of said first and second quantities of yarn moves with one of said strands ballooning

about another of said strands and at least intermittently contacting the periphery of said passage so that said one strand is uniformly twisted about the other strand,

means for pulling said strands through said passage,

means for detecting the ballooning of said one strand in said passage and means connected to said detecting means for producing a given signal when said detecting means detects that said one strand is not ballooning,

means for detecting said other strand and producing a predetermined signal when said other strand is not present.

2. Apparatus as in claim **1**, wherein said detecting means includes a light source disposed for providing a light beam across the region in which said one strand is twisting about said other strand so that said beam is periodically interrupted by the said ballooning strand,

a light detector disposed for receiving said light beam and producing a signal which varies as a function of incident light so that said signal fluctuates when said beam is being periodically interrupted, and wherein said producing means includes:

circuit means connected to said detector for receiving said varying signal and producing a first output signal when said signal from said detector indicates said beam is being periodically interrupted, and

a second output signal when said signal from said detector indicates said beam is not being periodically interrupted.

3. Apparatus as in claim **2**, wherein said circuit means includes:

an input DC blocking capacitor for receiving said signal from said light detector,

first electronic switch means with an input connected to said blocking capacitor for shifting from a first to second output condition when said blocking capacitor passes parts of a fluctuating signal which are changing in a given polarity direction,

a further capacitor connected to the output of said first electronic switch means for changing its charge toward a predetermined constant voltage when said first electronic switch means is in said second output condition, and

second electronic switch means connected to said further capacitor for producing said second output signal when said further capacitor changes its charge to a given voltage level and producing said first output signal when said further capacitor does not change its charge to at least said given voltage level.

4. An apparatus as in claim **3**, wherein said electronic switching means each includes first and second darlington connected transistors.

5. An apparatus as in claim **4**, further including means for producing a direct current voltage, means for connecting said light source to said direct current voltage circuit, means for connecting said light detector to said blocking capacitor and to said direct current voltage producing means for causing said detector to vary in resistance as a function of incident light so as to apply said input signal to said blocking capacitor.

6. Apparatus as in claim **3**, further including:

logic means connected to said second electronic switch means for providing an output voltage of first or second voltage levels,

a third capacitor connected to said logic means for changing its charge toward a given constant voltage when said logic means shifts from said first to second output voltage level,

third electronic switch means with an input connected to said third capacitor for shifting from a first to second output condition when said third capacitor changes its charge to a predetermined voltage level,

fourth electronic switch means connected to said third electronic switch means and to a device of the type which is operated by a change in the electric current flowing through it for causing said device to be operated when said third switch means shifts to said second condition,

a fourth capacitor connected to the said third electronic switch means for changing its charge toward a predetermined voltage when said third electronic switch means shifts from said first to said second output condition,

fifth electronic switch means connected to said fourth electronic switch means and to said fourth capacitor for shifting from a first to second output condition when said fourth capacitor changes its charge to a given voltage level and for causing said device to be deactivated when said fifth electronic means shifts to said second output condition.

7. An apparatus as in claim **6**, wherein said third and fifth electronic switching means each includes a Schmidt trigger circuit.

8. An apparatus as in claim **6**, wherein said logic means includes an exclusive OR circuit.

9. An apparatus as in claim **6**, wherein said fourth electronic switch means includes a first transistor, a second transistor, a diode connecting said first transistor to said second transistor, and a triac connected in series with a current carrying portion of said device and to said second transistor and wherein said fifth electronic switch means includes a diode connected to said second transistor.

10. An apparatus as in claim **9**, further including switch means for disabling said fifth electronic switch means.

11. A circuit for producing a first output signal when a substantially constant amplitude input signal is received and a second output signal when a fluctuating input signal is received comprising:

an input D.C. blocking capacitor for receiving said input signal,

first electronic switch means with an input connected to said blocking capacitor for shifting from a first to second output condition when said blocking capacitor passes parts of a fluctuating input signal which are changing in a given polarity direction,

a further capacitor connected to the output of said electronic switch means for changing its charge toward a predetermined constant voltage when said first electronic switch means is in said second output condition,

second electronic switch means connected to said further capacitor for producing said second output signal when said further capacitor changes its charge to a given voltage level and producing said first output signal when said further capacitor does

not change its charge to at least said given voltage level, and

means connected to said blocking capacitor for detecting a yarn strand and producing said fluctuating input signal when said strand is detected and said substantially constant input signal when said strand is not detected, means for detecting a further strand and producing a further signal indicating the detection of said further strand, logic means connected to said second electronic means and to said further strand detecting means for receiving said further signal and said first and second output signal and producing a first logic signal when said first output is received and said further signal indicates detection of said further strand and a second logic signal when said second output is received and said further signal does not indicate detection of said further strand.

12. A circuit as in claim **11,** wherein said electronic switch means each includes first and second darlington connected transistors.

13. A circuit as in claim **11,** wherein said means connected to said blocking capacitor includes means for producing a direct current voltage, a light source connected to said direct current voltage producing circuit, photoresponsive means connected to said blocking capacitor and to said direct current voltage producing means for varying in resistance as a function of incident light so as to apply said input signal to said blocking capacitor.

14. Apparatus for detecting yarn balloon comprising:

means defining a passage for a yarn strand so that said strand balloons through said passage,

a light source disposed for producing a light beam across and within said passage, so that said beam is periodically interrupted by the ballooning strand in said passage,

a light detector disposed in said passage for receiving said light beam, and producing a signal which varies as a function of incident light so that said signal fluctuates when said beam is being periodically interrupted, and

circuit means connected to said detector for receiving said varying signal and producing a first signal when said signal from said detector indicates said beam is being periodically interrupted and a second signal when said signal from said detector indicates said beam is not being periodically interrupted.

15. A method of producing a plurality of twisted yarn strands of substantially uniform twist comprising pulling strands from first and second yarn quantities through a passage, ballooning one of the yarn strands about another so that the ballooning strand at least intermittently contacts the periphery of the passage to insure uniform twist, detecting the ballooning strand within said passage and producing a given signal when said ballooning strand is not ballooning.

16. A method as in claim **15,** wherein said yarn quantities are on cones and said step of pulling strands includes the step of pulling at least said another strand through a central passage in the cone holding said one yarn strand.

17. A method as in claim **15,** including the step of detecting the presence of said another strand and producing a given signal when said another strand is not detected.

18. A method as in claim **15,** wherein said step of detecting includes the step of producing a beam of light which impinges upon photoresponsive means and which is periodically interrupted by the ballooning strand.

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