

July 9, 1968

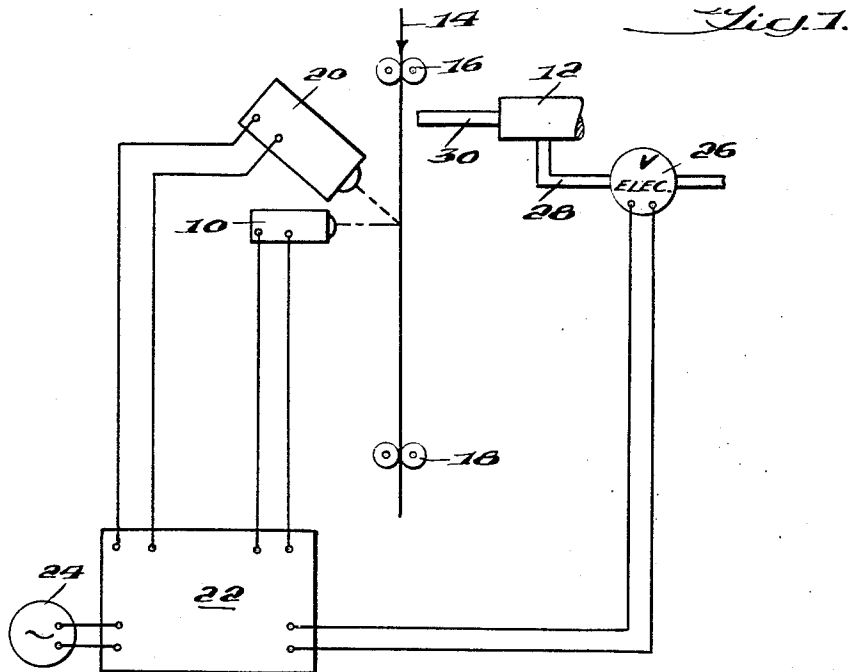
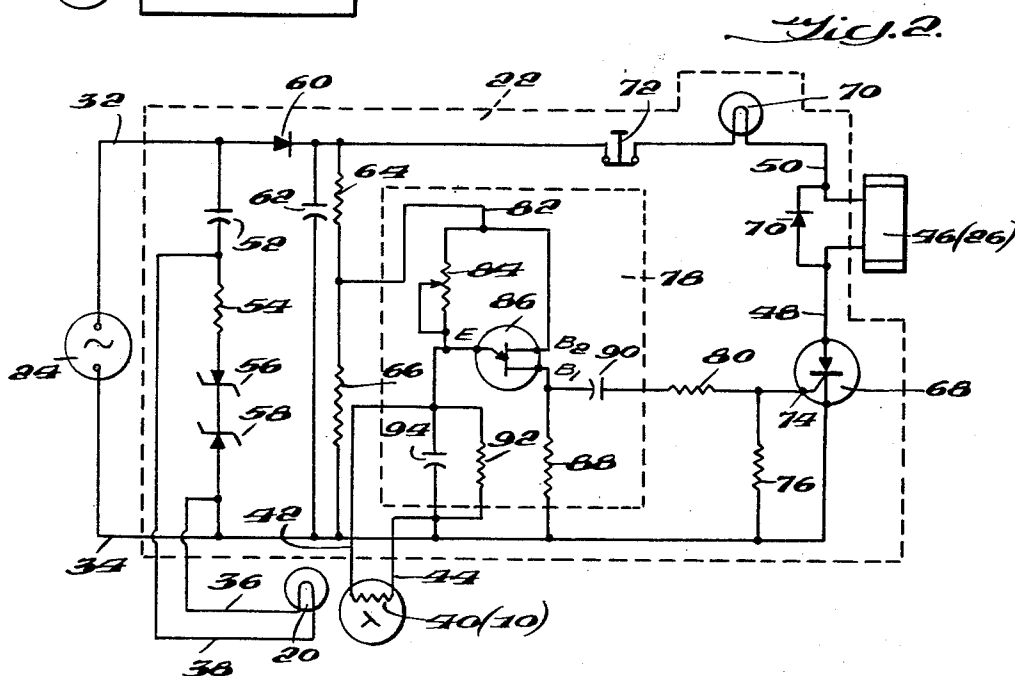
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3,391,840

YARN BREAK DETECTOR AND CONTROL CIRCUIT

Filed Oct. 25, 1965

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

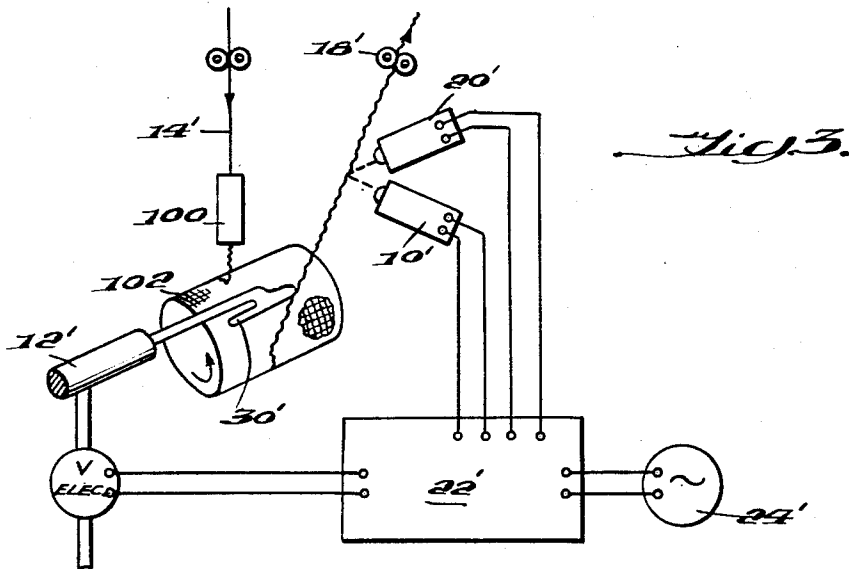
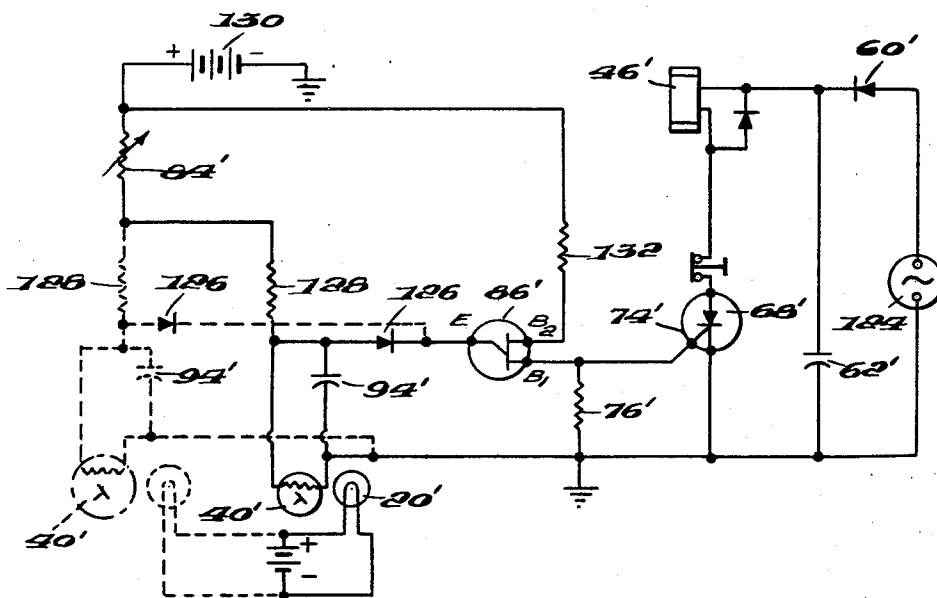


Fig. 4.



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YARN BREAK DETECTOR AND CONTROL CIRCUIT

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ABSTRACT OF THE DISCLOSURE

A yarn break detector coupled with an electropneumatic waste pickup device by a control circuit having time delay characteristics.

This invention relates generally to the high-speed, continuous production of filamentary structures and, more particularly, to the in-process monitoring of one or more running yarn lines for the purposes of detecting the occurrence of a broken line and actuating a pneumatic waste jet to pick up and withdraw the broken yarn until it can be strung-up to run in a normal fashion.

Numerous devices are known in the art for sensing the occurrence of a yarn break. Some employ spring-loaded mechanical sensors, other employ feeler gauges, and some use light sources and photocells as detectors. Although satisfactory for many applications, no known device is fully suitable for high-speed application because none couples a sensor with a waste jet and none has provision for avoiding false indication of a yarn break due to running yarn line vibration or jitter, while at the same time not contacting the running yarn line. Furthermore, no known device is fast-acting enough to prevent unacceptable yarn buildup at high yarn-processing speeds.

These and other difficulties have been avoided by coupling a break detection apparatus with an electropneumatic device for discharging a continuously advancing but broken yarn end to waste. The detection apparatus is comprised of a source of light directed at the normal path of advance for an unbroken yarn line, a photo-sensitive detector positioned to receive light from the source by reflection and an electronic control circuit having time delay characteristics, input leads connected to the detector and output leads connected to the electropneumatic device for its actuation.

Various details and advantages of the claimed improvements will be apparent from the following description taken in conjunction with the accompanying drawings in which:

FIGURE 1 is a schematic illustration of the yarn break detector, the relay-energizing circuit and waste jet in association with a continuously advancing yarn;

FIG. 2 is a schematic circuit diagram of the relay-energizing circuit showing the time delay components;

FIG. 3 is a partially isometric schematic representation of a preferred process installation in which the yarn break detector and waste jet are shown in association with a bulking drum; and

FIG. 4 is an alternate embodiment of the relay-energizing circuit particularly suitable for use with more than one yarn break detector.

The process installation chosen for illustration in FIG. 1 has a yarn break detector 10 and a waste jet 12 located adjacent a running yarn line 14 which is supplied continuously by feed rolls 16 and drawn off by rolls 18 when the process is in normal operation. To one side of the normal path of the yarn line, there is placed a focused light source 20 (e.g., Farmer Electric, TLS-1) which projects a narrow beam of light on one side of yarn line 14. Detector 10 is located on the same side of the yarn line as light source 20 and is arranged to view light re-

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flected from the illuminated spot on the yarn line. The detector is of the photo-resistive type (e.g., Farmer Electric, TPC-OL with Clairex CL-603AL), i.e., it includes a resistance which varies with changes in illumination. Power for light source 20 is supplied from a voltage-regulating section of an electronic control circuit 22 which in turn is supplied from a conventional 110-volt AC power supply 24. Control signals from the variable resistance in detector 10 are applied to circuit 22. The output of circuit 22 is connected to a solenoid in an electropneumatic valve 26 located in an air line 28. When open, valve 26 supplies compressed air to waste jet 12 which has a pickup nozzle 30 located adjacent yarn line 14.

Details of the circuit connections and components for electronic circuit 22 are shown in FIG. 2. Power from source 24 is furnished over lead wires 32, 34. Light source 20 is supplied over wires 36, 38. Control signals from resistance element 40 of detector 10 are applied to circuit 22 over wires 42, 44 and power to operate the solenoid 46 forming a part of valve 26 is furnished out over wires 48, 50. Within circuit 22, a first branch is shown to include capacitor 52, resistor 54 and two Zener diodes 56, 58 in series between wires 32, 34. Wires 36, 38 are connected across resistor 54 and the two Zener diodes 56, 58 which components function to regulate the voltage supplied to light source 20. Beyond the connection of capacitor 52 in wire 32, there is located a diode rectifier 60 after which a capacitor 62 is connected across the now rectified power supply. Next, a voltage divider branch including resistors 64, 66 is connected in parallel with capacitor 62. The latter functions to smoothen the rectified power. Still another parallel branch circuit contains solenoid 46, output wires 48, 50 and a silicon controlled rectifier or SCR 68. A diode 70 is connected across wires 48, 50. Solenoid 46 is series connected through wire 50 with a signal lamp 71 and a reset switch 72. The cathode of SCR 68 is connected to wire 34. The gate terminal 74 of SCR 68 is connected to wire 34 through a resistor 76 and to a time delay firing circuit 78 through a resistor 80.

Circuit 78 has a lead wire 82 connected at one end to the common terminal of resistors 64, 66 and at its other end through a variable resistor 84 in a biasing lead to the emitter E of a unijunction transistor 86. Base B₂ of transistor 86 is connected to wire 82 and base B₁ is connected through resistor 88 to wire 34. Base B₁ is also connected through capacitor 90 and resistor 90 to the gate terminal 74. Connected also to emitter E, there is a parallel circuit comprising a resistor 92, a capacitor 94 and the variable resistance element 40 of photo-detector 10. The other side of this parallel circuit is connected to wire 34, thus completing the electronic circuit.

In operation, the apparatus of this invention serves to detect the occurrence of a yarn break and as a result to actuate the valve 26, thereby furnishing air to waste jet 12 so that the broken end of yarn is picked up by nozzle 30 and drawn away. When the yarn breaks, reflected light no longer enters detector 10. This causes an increase in value of resistance element 40 such that there is an increase in bias on emitter E, causing the unijunction transistor 86 to gate the SCR 68 and thereby allow power to pass through relay coil 46 for the actuation of air control valve 26. The time delay provision is accomplished by capacitor 94 in parallel with resistance element 40 such that short time length deviations of the yarn line from the focused light beam will not serve to operate unijunction transistor 86. However, when the yarn breaks, there is a loss of reflected illumination at detector 10 and capacitor 94 has time to charge up to a sufficient potential to allow current to flow between emitter E and base B₁, at which point capacitor 94 discharges through resistor 88 which in turn furnishes the necessary gating signal to SCR 68. Cur-

rent then flows through relay coil 46 which serves to turn on air supply valve 26 and actuate waste jet 12. Air is supplied to jet 12 until such time as SCR 68 is reset by opening switch 72. Diode 70 provides a path for current induced by collapse of the magnetic field in solenoid 46.

In the preferred process installation shown in FIG. 3, yarn 14' is supplied continuously to a bulking device 100 which deposits the yarn in a folded configuration on the screen surface of a rotatably driven drum 102. The yarn rides with drum 102 until drawn off by rolls 18'. It must be drawn off at very low tension to prevent loss of bulk. The folded nature of the yarn being drawn off results in excessive yarn jitter. Light source 20' and detector 10' are located adjacent yarn line 14' near the point of its departure from drum 102. Waste jet 12' is located adjacent drum 102 and has its pickup nozzle 30' placed near the drum surface, beyond the point at which yarn is drawn off by rolls 18'. In this embodiment, control circuit 22' is the same as the circuit 22 in FIGS. 1 and 2 except that appropriate values for capacitor 94 and resistance 40 are selected to insure a time delay short enough to provide for pickup of a broken end from the surface of drum 102 before the broken end reaches a location beneath bulking device 100. However, the time delay must also be long enough to prevent actuation of waste jet 12' due to yarn jitter. The noncontacting feature of the break detector is particularly advantageous since tension on the freshly bulked yarn must be held to a very low value.

In FIG. 4, an alternate relay coil-energizing circuit which is readily adaptable to use with multiple parallel ends has been illustrated. Here, as in the circuit of FIG. 2, an AC supply 124 is rectified by diode 60', smoothed by capacitor 62' and switched through coil 46' by means of SCR 68'. A gating signal for SCR 68' is furnished from the potential drop across resistor 76' which is connected between gate terminal 74' and the cathode of SCR 68'. The base B₁ of unijunction transistor 86' is also connected to gate terminal 74'. The emitter E of transistor 86' is connected through diode 126 to a time delay circuit which includes capacitor 94' and light sensitive resistor 40'. Diode 126 is connected through a fixed resistor 128 and variable resistor 84' to a conventional source 130 of 24 volt DC power. The base B₂ of transistor 86' is connected through a resistor 132 to DC source 130. The

waste jet can be actuated by signals from a duplicate light sensitive resistor 40', duplicate circuitry including another diode 126, resistor 128 and capacitor 94', as shown in phantom in FIG. 4. Such parallel circuits may be added for each of several parallel yarn lines which normally pass in close proximity to a single waste jet.

It is apparent that many changes and modifications may be made in the disclosed apparatus without departing from the spirit of the present invention which is accordingly intended to be limited only by the scope of the appended claims.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. In combination with an electropneumatic device for discharging a continuously advancing broken yarn end to waste, a break detection apparatus comprising: a focused source of light directed at the normal path of said yarn; a photosensitive detector positioned to receive said light by reflection; and an electronic control circuit including a transistor, a biasing lead connected to the transistor and a capacitor connected to said biasing lead, said photosensitive detector also being connected to said biasing lead, said circuit having output leads connected to said electropneumatic discharge device for its actuation.

2. The apparatus of claim 1 wherein said transistor is a unijunction transistor with an emitter terminal connected to the biasing lead, to the capacitor and to said detector, the latter being a light sensitive resistor connected in parallel with said capacitor.

3. The apparatus of claim 2 wherein said electropneumatic device includes a solenoid connected to said output leads and has a silicon controlled rectifier series connected therewith, said rectifier having a gate terminal coupled to said transistor.

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