

[72] Inventor **Raymond M. Beers**
Johnson City, Tenn.
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 [73] Assignee **Great Lakes Carbon Corporation**
New York, N.Y.

[56]

References Cited

UNITED STATES PATENTS

3,148,814	9/1964	Studer	242/36 X
3,298,401	1/1967	Stutz	250/231 X
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Primary Examiner—James W. Lawrence

Assistant Examiner—T. N. Grigsby

Attorney—Carl F. Peters

[54] **FILAMENT BREAK DETECTOR UTILIZING PHOTOELECTRIC MEANS FOR DETECTING SPEED OF SUPPLY SPOOL**
 2 Claims, 2 Drawing Figs.

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 B65h 63/00, G01d 5/34
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 57; 250/231, 219 S, 206

ABSTRACT: A break detector useful for the determination of breaks in the winding or rewinding of a filament is disclosed. The detector is characterized by the fact that none of its components contact the filament during revolutions of the supply or takeup means. Filament breaks are sensed by interruption of a light-sensitive device responsive to variations in the revolution rate of the filament letoff or spool feed means.

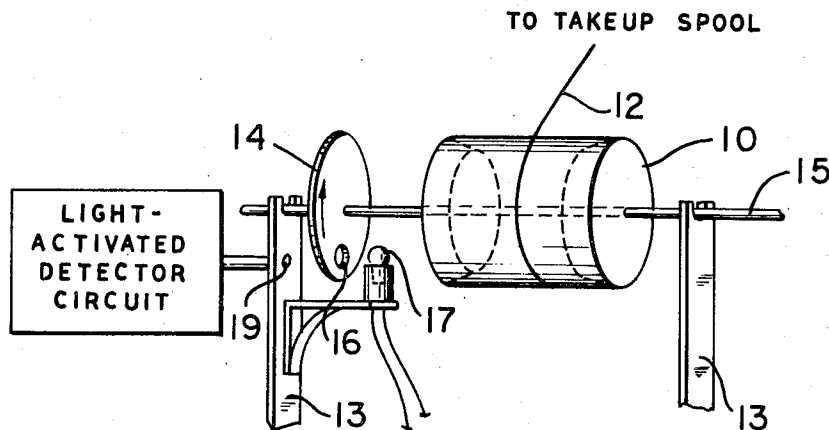


FIG. 1

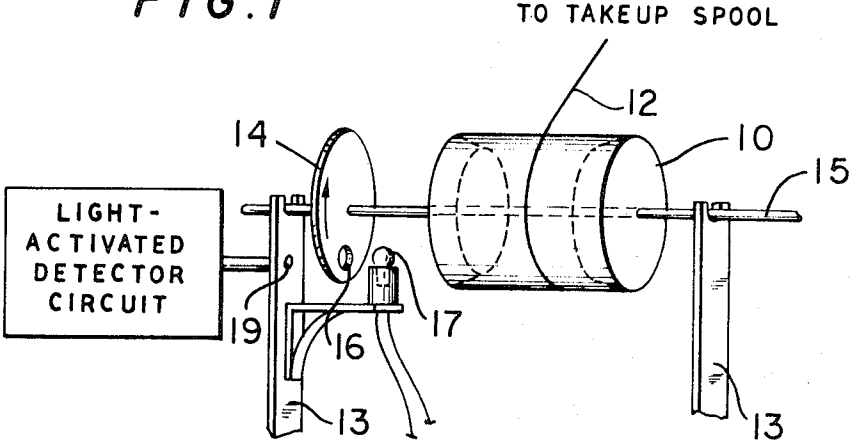
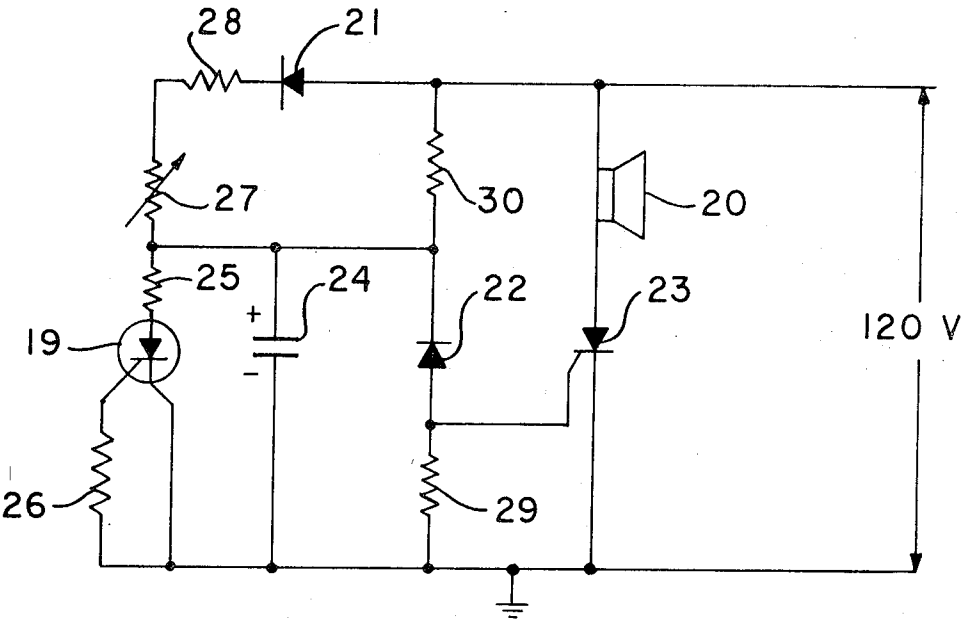


FIG. 2



INVENTOR
RAYMOND M. BEERS

FILAMENT BREAK DETECTOR UTILIZING PHOTOELECTRIC MEANS FOR DETECTING SPEED OF SUPPLY SPOOL

BACKGROUND OF THE INVENTION

The detection and control of breaks during the winding and rewinding of monofilaments, fibers and yarns, particularly in the textile industry, has been the subject of considerable research. Break detection is most generally accomplished by means of an extended arm linked to an electrical switch or the like held in an open position by the tension of the filament. Upon breakage of the filament, either gravity or the relaxation of a tension spring on the feeler arm causes closure of the switch and cessation of the winding operation. In more rudimentary operations, an audible or visual alarm system will be actuated upon closure of the switch; in more sophisticated systems a retying operation is set in motion. This retying operation finds the loose ends of broken filament, ties them, restarts the winding operation, and resets the break detector.

The above-described detector is satisfactory for use with most commercial monofilaments and yarns. It is unsatisfactory, however, when winding and rewinding carbon or graphite fibers or monofilaments. These fibers have a limited flexibility and filament strength when compared to uncarbonized fibers. Passing these fibers through or over feeler arms causes abrasion and breakage of the fiber.

New and useful carbon fibers and monofilaments have been developed by spinning pitches derived from petroleum, coal tar, polyvinyl chloride, and like origin. These fibers, both before and after carbonization and graphitization are brittle and very abrasive. The abrasive characteristic of these fibers, when passing through or over the feeler arm of a commercial break detector, causes the transfer of metallic particles from the detector's feeler arm onto the fiber. These metallic particles are thereafter damaging to the fiber, causing breaks in the fiber due to reaction therewith during carbonization and graphitization.

Further, the carbon monofilament is useful as a base for the deposition of boron in the manufacture of boron fibers for the aerospace and related industries. Boron is deposited on the fiber as a result of the reaction of boron halides and hydrogen or a hydrocarbon up to about 1,500° C. This reaction temperature is conveniently maintained by resistance heating of the carbon fiber. Metallic impurities in or on the carbon fiber decrease the resistance of the fiber causing "hot spots" and resulting irregularities in the quality and quantity of boron deposition.

For these reasons, among others, a break detector which does not in any way touch the carbon fiber being wound or rewound has been needed.

Stephens et al., in U.S. Pat. No. 3,268,314, have disclosed a detector for monitoring the breakage of a monofilament during spinning from a melt. The Stephens et al. detector is responsive to variations in light intensity across the pathway traversed by a newly spun filament.

OBJECTS OF THE INVENTION

It is an object of this invention to provide a filament break detector for use in filament rewinding operations.

It is a further object of this invention to provide a filament break detector which does not contact the filament being wound or rewound.

It is a further object of this invention to provide a filament break detector which depends upon the revolution of the idler or supply spool to hold the detector switch in a normally open position.

Other objects of this invention will become apparent to those skilled in the art upon a further reading of this description.

SUMMARY OF THE INVENTION

The above objects are fulfilled by the break detector system of this invention which is characterized by being responsive to

a cessation of, or a change in the rate of rotation of the idler or supply drum or spool in the winding operation. Such a system includes: a disc or the like containing one or more apertures at or near the periphery thereof which serves to transmit light therethrough and which rotates concurrently with the rotation of the idler spool; a light source; and a light-activated detector and alarm system responsive to changes in the pulse rate of light from the light source passing through the aperture in the revolving disc. In operation, the alarm detector is an open switch while the disc is revolving. When the disc ceases to revolve, the alarm detector circuit closes, activating an audible and/or visual alarm device to notify an operator of the existence of a break in the filament being wound, and shuts off the takeup spool.

At no time does this break detector system come into contact with the fiber being wound nor is it dependent upon spring tension or gravity operations to activate the alarm system.

DETAILED DESCRIPTION OF THE DRAWINGS

In the drawings, which comprise a part of the instant description and are to be read in conjunction therewith, a simplified and preferred embodiment of the invention is shown and, in the various views, like numerals are employed to indicate the parts. It should be understood that the shown embodiment is susceptible of modification and change without departing from the spirit of the invention which is particularly pointed out in the appended claims.

Referring to the drawings:

FIG. 1 is a front view of the mechanical portion of the invention.

FIG. 2 is a schematic electrical diagram of the light-activated detector circuit used in the invention.

In FIG. 1, reference 10 represents the idler or supply spool upon which is contained the yarn or monofilament 12. Frame 13 supports a shaft 15 upon which revolving disc 14 or equivalent member and the idler spool 10 are axially mounted. On opposing sides of the disc 14 are located a light source 17, held by bracket 18, and a light responsive element 19, preferably a light-activated silicon controlled rectifier. The latter feeds a signal to a detector circuit hereinafter described. In operation, the apparatus is energized by a switch connected to a 120-volt AC line and common to a motor (not shown) operating the takeup spool, the light source 17, and the light-activated detector circuit. When the idler spool 10 revolves, an aperture or lens 16 in the disc 14, when in alignment with the light source 17 and the light-responsive element 19, allows light to shine on the responsive element. Such light, when pulselike in character due to revolution of the disc 14, causes the light-activated detector circuit to be in a nominally open position. When the pulselike characteristics of light emanating from lamp 17 through aperture 16 ceases or varies greatly, as determined by the light-responsive element 19, the detector circuit closes thereby setting in operation a visual or audio alarm or the like.

The solid-state electronic circuit coupled to the light-responsive element 19 is schematically represented by FIG. 2. In the drawing, capacitor 24 is in a normally charging condition when the light responsive means 19 detects no light from lamp 17, and continues to charge toward peak AC line voltage through resistors 27 and 28 and diode 11. The charge is normally discharged intermittently through the light-activated silicon controlled rectifier 19 when light energy periodically strikes same from lamp 17 through aperture 16 as shown in FIG. 1 and described hereinabove. Thus, light emanating from lamp 17 striking the light-activated silicon controlled rectifier 19 causes a current flow through the rectifier 19 periodically discharging the voltage across capacitor 24 to zero. If the disc 14 stops turning because of a filament break, the capacitor 24 is not periodically discharged and its charge will build up and exceed the threshold level or "avalanche voltage" of a zener diode rectifier 22 causing capacitor discharge through the

zener rectifier. Current flow through the zener rectifier 22 establishes a bias on the gate of silicon controlled rectifier 23 allowing current to energize alarm 20 which may be a solid-state audible signal device. Resistor 25 limits the current through the light-activated silicon controlled rectifier 19. Resistor 29 is a gate-to-cathode resistor which establishes the gate bias for silicon controlled rectifier 23. The commutating current from the 60 c.p.s. AC line is supplied through resistor 30 which also establishes a maximum for this current. Resistor 26 is selected to prevent the light-activated silicon controlled rectifier from sensing ambient daylight or stray light; to prevent the device 19 from being triggered by leakage current; and to hold or maintain the sensitivity of the device 19 to "rate effect," the term "rate effect" meaning the number of "on-off" times per second that the device 19 can tolerate without overheating.

In operation, the total resistance established by variable resistor 27, and resistor 28 causes the charge rate of the capacitor 24 to be such that it will normally be discharged through the light-activated silicon controlled rectifier. The charge rate should not be such that the plate charge on the capacitor 24 exceeds the threshold level of the avalanche voltage of zener rectifier 22 in normal operation. When the idler spool slows beyond a predetermined speed the plate charge should then exceed the threshold level of the zener rectifier. Thus, wide variations in the rate of revolution of the idler spool can be tolerated by lowering the charge rate of the capacitor. This is particularly useful when winding filament from a thick package where the angular velocity of the idler spool is subject to wide variation.

The alarm device 20 can be an audio alarm, as for example a bell or buzzer, a visual alarm, as for example a light, gauge, or recording device, or any combination of the above instruments wired in parallel.

When a break has occurred resulting in a switch-on condition, repair of the break or removal of the takeup spool and replacement with a new takeup spool can be begun im-

mediately. Upon repair, the operator merely restarts the motor operating the takeup reel to reset the detector to the switch-off position. No additional operation is necessary so long as the idler spool is revolving.

On the chance that a filament break may occur when the disc stops in a position where the aperture is opposite the light source, it is advisable to have the disc slightly unbalanced.

What is claimed is:

1. Apparatus for detecting breaks in a filament winding operation comprising:
 - a. a filament supply spool axially mounted on a shaft,
 - b. a disc axially mounted on said shaft to rotate with said supply spool and having at least one aperture near the periphery of the disc,
 - c. a light source positioned on one side of said disc,
 - d. a light responsive element positioned on the other side of said disc in alignment with said aperture and said light source and responsive to changes in the light pulses received from said light source,
 - e. a light-activated electrical circuit and alarm system coupled to said light responsive element,
 - f. a filament takeup spool adapted to receive and wind the filament from said supply spool when the takeup spool is rotated, and
 - g. means for rotating said filament takeup spool, said means being coupled to said light-activated electrical circuit (e).
2. Apparatus according to claim 1 wherein the light activated electrical circuit (e) includes:
 - a. a capacitor which, when fully electrically charged, will discharge through a zener diode coupled to said capacitor, and
 - b. a gate coupled to said zener diode which, when biased from current received from said zener diode, will energize an alarm device, said capacitor being also coupled to the light-responsive element (d) which periodically discharges said capacitor when light from source (c) strikes said element.

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