United States Patent [19]

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[11] **3,756,524**

[45] **Sept. 4, 1973**

[54] ELECTRONIC MONITORING APPARATUS AND MONITORING METHOD FOR TEXTILE MATERIALS

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[22] Filed: **Dec. 14, 1970**

[21] Appl. No.: **97,661**

[30] **Foreign Application Priority Data**

Mar. 24, 1970 Switzerland 4393/70

[52] **U.S. Cl.** .... **242/36,** 28/64, 73/170 R, 200/61.18, 323/68, 340/239 R, 340/259

[51] **Int. Cl.** **B65h 63/00**

[58] **Field of Search** .... 73/170 R, 295, 140; 323/68; 340/239, 259; 242/36; 200/61.18; 28/64

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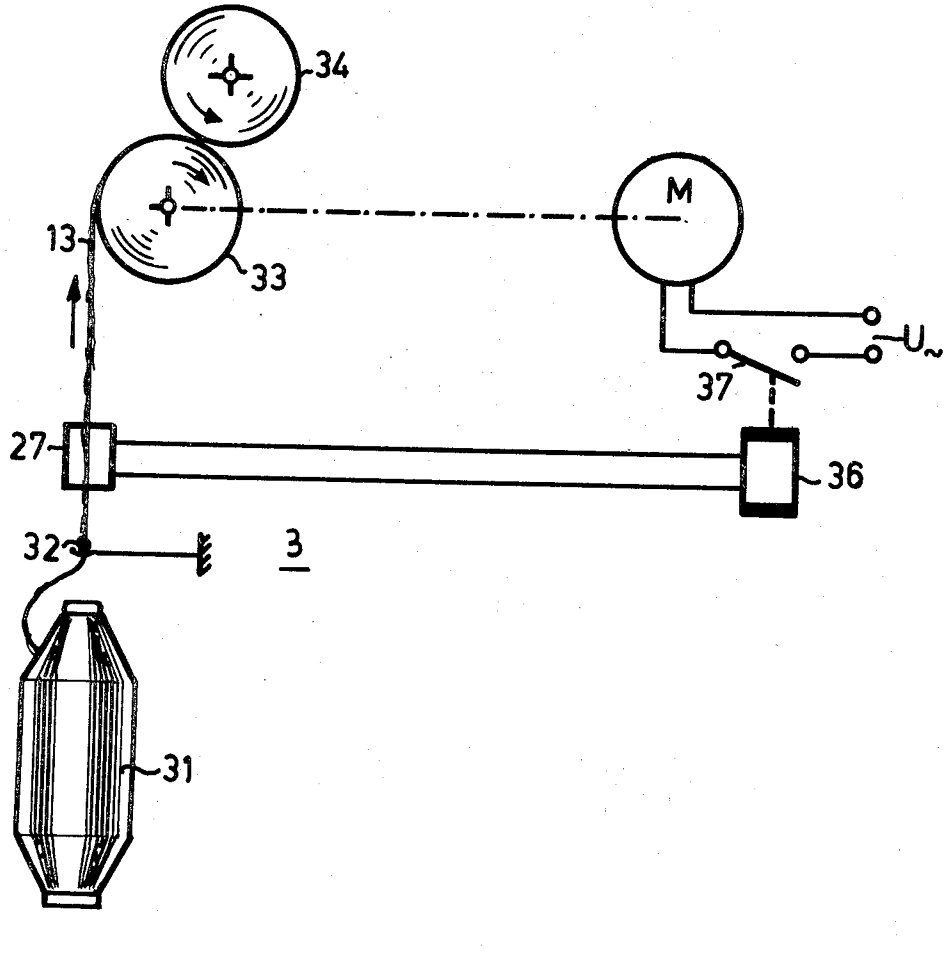
[57] **ABSTRACT**

An electronic monitoring system employing electrical circuitry for controlling the movement of textile materials, which circuitry embodies a temperature sensing device past which moves the textile material. The movement of the textile material past the temperature sensing device brings about changes in temperature of the temperature sensing device owing to the thus generated movement of the atmosphere surrounding the temperature sensing device and/or owing to contact of the textile material with the temperature sensing device. The changes in temperature of the temperature sensing device cause a change of the output signal of the circuitry which can be used to evaluate the presence or movement of the textile material. The method of the invention for monitoring the movement of textile material comprises moving a yarn past a temperature sensing device, bringing about changes in temperature of the temperature sensing device owing to such movement of the yarn, which changes in temperature cause a variation in the output signal of the electrical circuitry associated with the temperature sensing device which can then be used for evaluating the presence or movement of the textile material.

18 Claims, 5 Drawing Figures



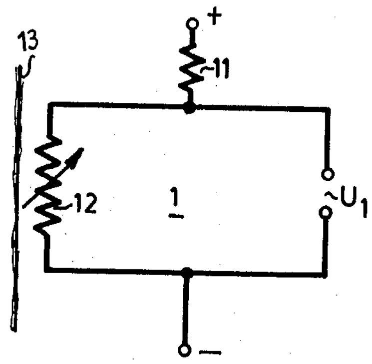


Fig.1

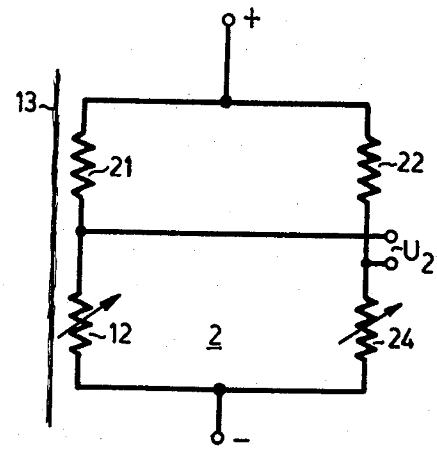


Fig.3

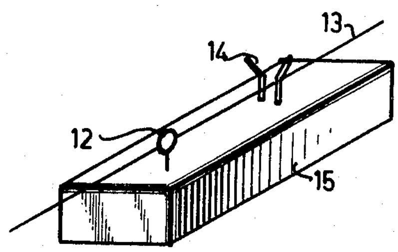


Fig. 2

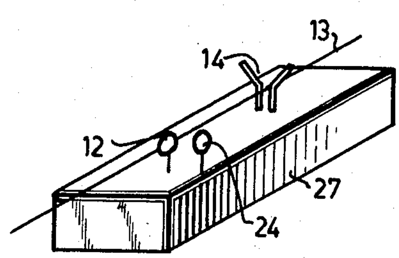


Fig. 4

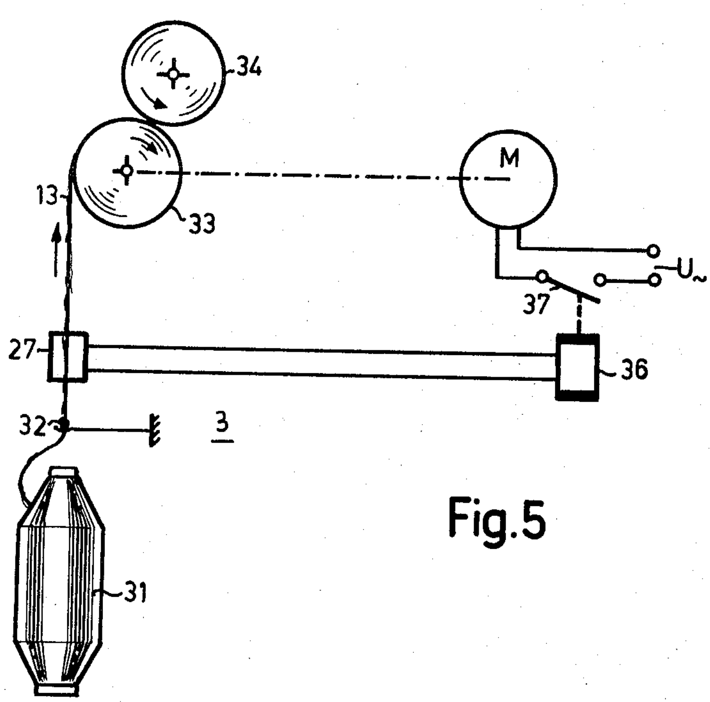


Fig.5

ELECTRONIC MONITORING APPARATUS AND MONITORING METHOD FOR TEXTILE MATERIALS

BACKGROUND OF THE INVENTION

The present invention broadly relates to textile monitoring equipment, and more specifically, is directed to a new and improved electronic monitoring device equipped with a circuit arrangement for controlling the movement of textile materials, especially yarns or threads formed of natural fibers or synthetic fibers, and additionally, the present invention also relates to a new and improved monitoring technique or method for textile materials. In the context of this disclosure the expression "textile materials" with which the monitoring device and techniques of the present invention are employed, is intended to encompass, by way of illustration and not limitation, yarns, ply yarns or threads, roving, slivers, and other similar types of filamentary materials, formed of natural fibers or synthetic materials.

Now the textile monitoring art is acquainted with electronic monitoring devices where the textile thread or yarn is supervised with the aid of a capacitive measuring element. Owing to the specific alternating current signal which is generated in a capacitor due to fluctuations in the cross-section of a moving textile yarn, it is possible to determine whether the yarn is moving or, in fact, is even present.

Apart from the capacitive type of yarn monitoring devices there have also become known to the art optical solutions for monitoring equipment. In these types of state-of-the-art equipment the yarn or thread is guided through an electro-optical measuring element which consists of a light source and a light sensitive cell. The yarn or thread passes between the light source and the light sensitive cell and by virtue of the spontaneously occurring fluctuations in the diameter of the yarn there is likewise generated during the movement of such yarn an alternating current signal characteristic for the movement of the yarn or thread.

A further type of monitoring equipment for textile materials has become known to the art which makes use of a mechanical yarn feeler; a rod member which can be placed into mechanical oscillation serves as the feeler element. The dampening of the mechanical oscillations which are brought about by the yarn is characteristic of the presence of the yarn.

Although many different proposals for monitoring textile materials have been advanced in the art, still the various solutions known up to the present are not devoid of certain drawbacks. Hence, for instance, the prior art type of monitoring equipment is generally quite complicated in construction and not always reliable insofar as its monitoring function is concerned.

SUMMARY OF THE INVENTION

Therefore, a real need still exists in the art for monitoring equipment and techniques which are not associated with the prevailing drawbacks of the state-of-the-art equipment and monitoring techniques. Hence, a primary object of the present invention relates to the provision of an improved method of, and apparatus for, monitoring textile materials which is not associated with the aforementioned drawbacks of the prior art structures and techniques and which effectively and reliably fulfills the existing need.

Still another more specific object of the present invention relates to an improved electronic monitoring device for textile materials which is relatively simple in construction, inexpensive to manufacture, provides extreme reliability in performing its monitoring function, needs a minimum of maintenance and servicing, and is not readily subject to breakdown.

Yet a further significant object of the present invention relates to an improved monitoring technique for controlling textile materials wherein the movement of the textile material triggers changes in the temperature of a temperature sensing device which, in turn, brings about a change in an output signal indicative of the presence or movement of the textile material.

Now, in order to implement these and still further objects of the present invention, which will become more readily apparent as the description proceeds, the electronic monitoring device of the present invention is generally manifested by the features that the circuit arrangement for the monitoring device embodies a temperature sensing device or feeler which possesses a different temperature than the ambient or surrounding temperature when the textile material is not present or not moving. The textile material is moved past the temperature sensing device and the movement of the textile material at the temperature sensing device brings about changes in temperature of the temperature sensing device of the circuit arrangement owing to the movement of the atmosphere surrounding the temperature sensing device and/or the contact of the textile material with the temperature feeler. The aforementioned change in temperature of the temperature feeler at the circuit arrangement brings about a change of its output signal. It is particularly advantageous to use such electronic monitoring equipment as a yarn control device and/or a switching device for a textile machine, such as for instance a spinning machine or winding machine.

As the temperature sensing device or temperature feeler there can be advantageously employed a component, an electrical parameter of which such as the electrical resistance of which varies with temperature. However, there are also available temperature sensing devices which generate a voltage which is dependent upon temperature, such as for instance thermoelements. A temperature sensing device or feeler possessing a temperature-dependent electrical resistance, such as for instance a negative temperature coefficient resistor, hereinafter conveniently referred to as a NTC-resistor, can be arranged for instance as a variable resistor in a voltage divider or in a measuring bridge. Apart from the use of a NTC-resistor, generally referred to in the art as a thermistor, there can also be used a resistor having a positive temperature coefficient, conveniently referred to hereinafter as a PTC-resistor, and typically referred to in the art as a sensitor.

It is advantageous if there is used a bridge circuit and in each arm or branch of the bridge there is arranged a respective similar temperature feeler or sensing device, whereby then only the temperature of one of both of these temperature sensing devices is changed by the movement of the yarn or the like. Within a certain range such a bridge circuit remains extensively independent of the ambient or surrounding temperature.

In addition to the aforementioned apparatus aspects of the invention there is also contemplated a new and improved technique or method for monitoring a textile material which, broadly speaking, contemplates moving the textile material past a temperature sensing device arranged in the circuit of the monitoring equipment, and causing a change in temperature of the temperature sensing device by means of the passing textile material. This change in temperature brings about a change in the output signal of the circuit arrangement of the monitoring equipment which is indicative of the presence or movement of such textile material.

BRIEF DESCRIPTION OF THE DRAWING

The invention will be better understood and objects other than those set forth above, will become apparent when consideration is given to the following detailed description thereof. Such description makes reference to the annexed drawing wherein:

FIG. 1 schematically illustrates a first embodiment of monitoring equipment employing a voltage divider-circuit arrangement utilizing a temperature feeler:

FIG. 2 schematically illustrates the construction of the monitoring device of the invention with a circuit arrangement of the type shown in FIG. 1;

FIG. 3 is a circuit diagram of a modified form of monitoring equipment employing a bridge circuit with resistors and temperature feelers or sensing devices;

FIG. 4 schematically illustrates the embodiment of textile monitoring device and circuitry according to the arrangement of FIG. 3; and

FIG. 5 schematically depicts the arrangement of monitoring equipment of the type shown in FIG. 4 at a winding machine by way of example.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Describing now the drawing, in FIG. 1 there is schematically illustrated the circuit arrangement of a textile monitoring device designed according to the teachings of the present invention and wherein such circuit arrangement comprises a voltage divider circuit 1 embodying the resistors 11 and 12. The NTC-resistor 12 constitutes the temperature feeler or temperature sensing device. By appropriately selecting the resistance value it is possible to achieve the result that the NTC-resistor 12 possesses an operating temperature which is considerably above the surrounding or ambient temperature. As soon as the textile strand 13 moves, preferably in its lengthwise direction, the atmosphere surrounding the temperature feeler or sensing device 12 is agitated or placed into motion, bringing about cooling of the NTC-resistor 12. Cooling of the NTC-resistor 12 causes a change in its resistance which, in turn, brings about a change in the voltage U_1 appearing across resistor 12. As long as the strand 13 is in motion the output signal U_1 assumes a predetermined value. Furthermore, when the strand or thread 13 is stationary or even no longer present, then the temperature of the NTC-resistor 12 again increases because the cooling effect previously existent by virtue of the atmosphere which was in motion is no longer present. Once again, the output signal U_1 changes. It will be readily apparent that the variations of this output signal U_1 are indicative of the presence or movement of the yarn.

FIG. 2 schematically illustrates one form of electronic monitoring equipment embodying a housing 15 within which there is arranged the circuitry shown in FIG. 1 for instance. The temperature feeler or temperature sensing device 12, which, as previously recalled, was assumed by way of example to comprise a NTC-resistor, is arranged in such a way that the textile strand 13 which moves through the guide element 14 travels in close proximity to the temperature feeler 12.

FIG. 3 illustrates a modified form of monitoring circuitry embodying a bridge circuit 2 containing in each branch 12/21 and 24/22 of the bridge a respective temperature sensing device or feeler 12 and 24 respectively. This type of circuit arrangement renders the bridge extensively independent of fluctuations of the surrounding temperature. The current flowing in both branches of the bridge 2 is again selected in such a way that the temperature of the temperature sensing devices 12 and 24 is appreciably different from the surrounding temperature. When the textile strand 13 is stationary there is present a predetermined bridge voltage U_2. It is not necessary in any way that the bridge voltage U_2 be balanced to null. Now, if the textile strand 13 moves, then, the NTC-resistor 12 cools down in the same manner as already described in connection with the circuitry of FIG. 1. As a result, the bridge voltage U_2, the output signal, changes.

FIG. 4, which is somewhat analogous to the showing of FIG. 2, likewise depicts the electronic monitoring device utilizing circuitry of the type depicted in FIG. 3 embodying the temperature sensing devices 12, 24 arranged within the monitor housing 27. The textile strand 13 is guided by the guide arrangement 14 in close proximity past the NTC-resistor 12. The NTC-resistor 24 is subjected to the same surrounding conditions as the resistor 12.

Turning now to FIG. 5 there is schematically illustrated therein a winding machine or winder, generally designated by reference character 3, by means of which a textile strand or yarn 13 is wound from a cop 31 via the yarn brake 32 and the yarn drive-and guide roll 33 upon the cross-wound bobbin 34. The guide roller or drum 33 is driven by a suitable drive motor M which constitutes an element operated by or responsive to the output signal considered above. A monitoring device 42, for instance of the type heretofore discussed, and specifically, by way of example, illustrated in FIGS. 3 and 4, is arranged between the yarn brake 32 and the drive roll or drum 34. The output signal of this monitoring device 42, which can be amplified, is delivered to a relay 36, the switching contact 37 of which upon the presence of such output signal, which corresponds to a moving yarn 13, is closed. As soon as the yarn or strand 13 no longer is in motion or no longer is present, the relay 36 changes its switching state, the contact 37 opens, and the drive motor M is disconnected from the voltage source U.

While for convenience in discussing preferred illustrative examples of the invention it was remarked that the temperature feelers or sensing devices were NTC-resistors, it is again reiterated that the resistors 12 and 24 considered in conjunction with the circuitry of FIGS. 1 and 3 also could be PTC-resistors or other components, the resistance value of which changes as a function of temperature. They also can be constituted by components such as thermoelements which generate a voltage as a function of temperature. According to a modified version of electronic textile monitoring equipment according to this invention, the temperature of the temperature feeler 12 can also be maintained lower than the surrounding temperature. What is only of importance is that the temperature of the feeler or sensing element differs from the surrounding temperature. Moreover, with the discussion of the embodiments of the invention heretofore presented, it was indicated that the strand **13** did not directly contact the temperature sensing element or feeler **12**, rather merely passed in close proximity thereto, yet it would be equally possible for there to occur direct contact between the temperature feeler **12** and the textile strand **13** which brings about an additional cooling or heating of the temperature feeler. Hence, the term "close proximityy" as used hereinafter, or equivalent or similar expressions, are intended to embrace both possibilities and, therefore, should be construed in the broader sense.

If the monitoring equipment is used as a supervising- and/or switching element in a textile machine, then it is necessary that, for instance, upon start-up of the machine the effect of the output signal of the monitoring device be suppressed until the starting operation has been completed.

By way of completeness, it is here also mentioned that the movement of the strand need not necessarily be in its lengthwise direction. For instance, in the case of a ring winding machine the transverse movement of the yarn at the balloon can be used to generate the cooling air current. In the case of a spinning machine for synthetic yarns it is possible, for instance, that the temperature sensing device or feeler possesses a temperature approximating that of the room or surrounding conditions. In such case heating up of the temperature feeler is undertaken by the hot strand or yarn.

Electronic monitoring devices designed according to the concepts of the present invention are suitable for use in conjunction with many different types of textile machines, such as for instance doubling and twisting machines, looms, flyers, drawing frames, carding machines, warping machines, circular knitting machines, flat knitting machines, and raschel knitting machines, and so forth.

While there is shown and described present preferred embodiments of the invention, it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied and practiced within the scope of the following claims.

Accordingly, what is claimed is:

1. An electronic monitoring device for controlling the presence or movement of textile materials, especially yarns, ply yarns or threads, roving, slivers, formed of natural fibers or synthetic materials, comprising a circuit arrangement for generating an output signal and incorporating a temperature sensing device past which moves in close proximity thereto the textile material, movement of the textile material past the temperature sensing device placing the air surrounding the temperature sensing device into motion and thus bringing about a change in the temperature of such temperature sensing device, said circuit arrangement including means in circuit with said temperature sensing device, said temperature sensing device and said means in circuit therewith producing a change in the output signal of said circuit arrangement in response to the change in temperature of said temperature sensing device, said output signal being employed to act upon an element responsive to the output signal.

2. The electronic monitoring device as defined in claim **1**, wherein said textile material and temperature sensing device are arranged sufficiently close to one another that said textile material physically contacts said temperature sensing device.

3. The electronic monitoring device as defined in claim **1**, wherein said temperature sensing device comprises an electrical resistor element whose resistance value changes as a function of its temperature.

4. The electronic monitoring device as defined in claim **3**, wherein said means of said circuit arrangement comprises a voltage divider, said temperature sensing device being an element of said voltage divider and comprising a variable resistor, the resistance value of which is dependent upon temperature, and wherein the voltage across said temperature sensing device constitutes said output signal.

5. The electronic monitoring device as defined in claim **3**, wherein said means of said circuit arrangement defines a bridge circuit, said temperature sensing device being arranged in one branch of said bridge circuit, and the output voltage of said bridge defining said output signal of the circuit arrangement.

6. The electronic monitoring device as defined in claim **5**, wherein said bridge circuit includes a further branch which does not contain said temperature sensing device, said further branch being equipped with an electrical component possessing the same temperature-dependency of its resistance value as said temperature sensing device.

7. The electronic monitoring device as defined in claim **6**, wherein said electrical component likewise comprises a temperature sensing device.

8. The electronic monitoring device as defined in claim **3**, wherein said temperature sensing device comprises a NTC-resistor.

9. The electronic monitoring device as defined in claim **3**, wherein said temperature sensing device comprises a PTC-resistor.

10. The electronic monitoring device as defined in claim **1**, wherein said temperature sensing device generates a voltage as a function of its temperature.

11. The electronic monitoring device as defined in claim **1**, wherein said element responsive to the output signal is a motor.

12. A method for monitoring the presence or movement of textile materials, comprising the steps of: moving textile material in close proximity to and past a temperature sensing device arranged in an electrical circuit, agitating the air surrounding the temperature sensing device by means of the moving textile material in order to place the air surrounding the temperature sensing device into a state of motion to thus bring about a change in the temperature of the temperature sensing device due to the presence or movement of the textile material, the change in the temperature of the temperature sensing device altering an electrical parameter thereof, and utilizing such change in temperature of the temperature sensing device to bring about a variation in the output signal of the electrical circuit, which output signal is then indicative of the presence or movement of the textile material.

13. The method as defined in claim **12**, including the step of utilizing the output signal for supervising the textile material at a textile machine.

14. The method as defined in claim **12**, including the step of utilizing the output signal for controlling the operation of a textile machine.

15. The method as defined in claim 12, including the step of utilizing the output signal for supervising the textile material of a spinning machine.

16. The method as defined in claim 12, including the step of utilizing the output signal for supervising the textile material of a winding machine.

17. The method as defined in claim 12, wherein the step of moving the textile material past the temperature sensing device includes the step of moving the textile material in its lengthwise direction past the temperature sensing device.

18. The method as defined in claim 12, wherein the step of moving the textile material past the temperature sensing device includes the step of moving the textile material in a transverse direction with regard to its lengthwise axis.

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